ELECTRICAL TRANSMISSION OF POWER.

By PROFESSOR OLIVER J. LODGE.

No. V.

PERHAPS the most interesting of the expressions we obtained last time are—first, that giving the highest possible efficiency which it is possible to obtain with a given wire resistance in the circuit, that is in the line wire and machines together, no matter at what speed you may run the machines; and, secondly, those giving the electromotive forces which the sending and receiving dynamos ought respectively to develope in order to give the above maximum efficiency, and at the same time to transmit a given power. See Problem 5, p. 179, vol. lv.

It will be worth while to throw these into the simplest values which they can attain in the case when the line is a stout and fairly insulated line, such as is likely to be employed in the greater number of cases. The solutions to the problems were last time expressed in their complete form, abbreviations indeed being used, but no approximations, since the accurate values of the abbreviations M_1, M_2 and D were given.

We will now insert the approximate values of these quantities, and will simplify the various expressions on the hypothesis that the insulation resistance of the line is great as compared with the conduction resistance of the circuit. The insulation resistance we called S; the conduction resistance of the whole circuit is $R + \rho_1 + \rho_2$, the line plus the two machines, and this being practically the same as the quantity we called D, we shall now use D to denote it.

The quantity we called M_1 is approximately $1 + \frac{\frac{1}{2}R + \rho_1}{S}$ and M_2 is $1 + \frac{\frac{1}{2}R + \rho_2}{S}$.

Hence if we refer to the value of D given in (γ), we see that

$$M_1 M_2 \text{ very nearly equals } 1 + \frac{D}{S}.$$

Now inserting this value into equations 41, 45, and 46, we get

the highest possible efficiency $\doteq 1 - 2\sqrt{\frac{D}{S}} + 2\frac{D}{S}$. (41[1])

the receiving electro-motive force necessary to transmit the useful power p;

$$\text{best } E_2 \doteq \sqrt{\frac{p}{M_1}} \cdot \sqrt[4]{(S D)}; \quad . \quad . \quad (46^1)$$

the sending electro-motive force corresponding;

$$\text{best } E_1 \doteq \sqrt{(p M_1)} \left\{ \sqrt[4]{(S D)} + \sqrt{D} \sqrt[4]{\frac{D}{S}} \right\} \quad (45^1)$$

$$= M_1 E_2 \left(1 + \sqrt{\frac{D}{S}}\right).$$

It is useless to attempt to get a higher efficiency than (41[1]) by turning either machine faster; the only way to increase it is to improve the insulation of the line.

Observe that the electro-motive force necessary to transmit a given power most efficiently increases with the square root of the power, and with the fourth root of the insulation and conduction resistances.

The strength of the current at the receiving end is

$$C_2 \doteq \frac{\sqrt{(p M_1)}}{\sqrt[4]{(S D)}}, \quad . \quad . \quad . \quad . \quad . \quad (30^1)$$

and a little more, of course, at the sending end.

Electro-motive force obtainable from a given machine at a given speed.—Having now determined the electro-motive force which the machines ought each to generate, we may next ask whether anything can be discovered about the speed at which they must run and what is the connection between this speed and the resistance of the wire which is wound on them. Referring back to article No. 1, equation (6) or (17), we find the electro-motive force expressed in terms of the resistance ρ and of the characteristic function ϕ of the machine as plotted in a curve from a series of experiments,

$$E = \tfrac{1}{2} K n \rho \phi (C),$$

where K is a constant expressing the size of the machine. Now, if V be the volume of the wire space of the armature and V^1 ditto of the field magnets; if L be the length of one mean turn of wire on the armature, and L^1 ditto on the field magnet, K varies with $L L^1 \sqrt{(V V^1)}$, as may easily be seen by thinking out the process of obtaining equation (6). This means that for a number of precisely similar machines, differing only in size and all running at the same speed, and wound with wire of the same total resistance, the electro-motive force developed in their respective armatures will be as the fourth power of their linear dimensions. Hence, to get a high electro-motive force economically, large machines must be used. The limit is not reached till the interest on first cost it greater than the electrical saving warrants.

The function ϕ, determined experimentally for any one speed and plotted, gives the relation which exists between the strength of the magnetic field in which the armature rotates and on the strength of current exciting the field magnets. The more iron there is in the field magnets the better, provided it can all be properly magnetised; and ϕ depends mainly on the quantity and quality of the iron. The curve having been plotted for any one speed, it can be drawn for any other speed simply by altering all the ordinates proportionately in the ratio of the two speeds, doubling them all, for instance, if the actual speed is double that when the observations were taken.

The speed is represented by n, and, since E is proportional to the speed, there is every advantage in running the machine fast. The limit is reached when more power is spent in churning the air than is compensated for by an increase in the electrical efficiency. It is difficult to express this relation accurately; but since the resistance of fluids at high speeds may be taken as roughly proportional to the square of the speed, it will be convenient to remember that the power spent in churning the air varies with the cube of the speed. This of itself explains why it is that extravagantly high speeds are impracticable and wasteful, even without the further consideration of wear and tear. Finally we come to ρ, the resistance of the wire with which the machine is wound, and here also a compromise is necessary. It is impossible to get a very high electro-motive force at any permissible speed without a fairly great value for ρ, because without plenty of wire on the field magnets they will not be properly excited, and without many turns of wire in the armature the electro-motive force will be low. At the same time remember that it is not resistance *per se* that is wanted, but great length, or rather a great number of coils of wire. Resistance itself is an evil, and to avoid it as far as possible the very best wire must be used, and that on the field magnets should be thick, a great quantity being used. The space of the armature is more constricted, and fairly thin wire may have to be used for it, but it must not be too thin.

To determine the connection between ρ and n, which will give the highest possible results; in other words, to determine the best speed at which to run a given machine, or the best wire with which to wind a given carcass running at its maximum speed, is determined by practical considerations: we have by (17) and (46[1])—

$$E_2 = \tfrac{1}{2} K_2 n_2 \rho_2 \phi_2 (C_2) \doteq \sqrt{p_2} \sqrt[4]{\left\{ S (R + \rho_1 + \rho_2) \right\}}$$

and by (6) and (45[1])

$$E_1 = \tfrac{1}{2} K_1 n_1 \rho_1 \phi_1 (C_1)$$

$$\doteq \sqrt{p_2} \left\{ \sqrt[4]{S (R + \rho_1 + \rho_2)} + \sqrt[4]{\frac{(R + \rho_1 + \rho_2)^3}{S}} \right\}$$

These two equations if solved will give the best values for n_1 and n_2, the sizes and characteristic curve of the machine having been already determined. Or they will determine ρ_1 and ρ_2, the resistance of the wire with which the machine had best be wound to transmit a specified power with the highest efficiency at given speeds. But to know the characteristic in this case it is necessary to have made preliminary experiments on the carcases of the machines when wound with some known wire or other. As a practical illustration of this let us take a Despretz kind of example, such as was discussed in Art. III. Let R=1000 and S=16,000 ohms; let the power to be transmitted be rather less than a horse-power, or p=685 Watts. Let the carcases of the sending and receiving machines be similar, and with the following data given about them, viz., that if either carcass be wound with such wire as will have a total resistance of 460 ohms, and if the speed be 2100 revolutions a minute, then the electro-motive force generated by a current of ·616 ampères is 2437 volts; while the electro-motive force generated by a current of ½ ampère round the field magnet, and with a speed of 1400 revolutions per minute, is 1370 volts. These are attempts at the actual Despretz data, as will be seen by referring to Art. III., and more especially to "case 2" in the third column. The imagined data show that approximately the function ϕ is in this case simple proportion, or that the electro-motive force generated simply varies with the current as well as with the speed; for $\frac{E_2}{E_1} = \frac{1370}{2437} \doteq \frac{1400 \times \cdot 5}{2100 \times \cdot 616}$. This will indeed usually be the case, because, since it is not economical to use strong currents, we may surmise that under the most favourable circumstances the magnets will not be saturated, and that therefore the function ϕ may be taken as approximately simple proportion; so we will write $\frac{1}{2} K \phi$ (C) as k C, and observe that the value of k in the present instance is about ·009.

$$\text{Then we have } k n \rho C = k n \rho \frac{\sqrt{p}}{\sqrt[4]{S D}} = \sqrt{p} \sqrt[4]{S D},$$

$$\text{or } k\, n_2 \rho_2 = \sqrt{(S D)} = \sqrt{S (R + \rho_1 + \rho_2)}$$

showing that the proper values of n and ρ are independent of the power p. A similar but longer expression gives the best relation between ρ_1 and n_1.

It was originally my intention, after having worked out the theory for a pair of series machines, to do the same for shunt machines. But there are objections to using shunt machines as motors to be driven by a current, and no apparent counterbalancing advantages. At full speed they do well enough, and are as efficient as the others, but at starting nearly all the current goes through the armature, heating it overmuch, and not exerting on it the full turning couple such as a series machine would give whose magnets and armature would be both very strongly excited. There are advantages in compound machines in the direction of steadiness, and we will discuss these, but I shall consider it unnecessary to examine the case of a shunt motor. For the generator, shunt winding is very satisfactory, and on the whole is likely to be more efficient as well as steadier than a series wound generator.

Meanwhile, there is one very important method which is likely to receive great attention, namely, the combination of accumulators with dynamo and motor, the power being received from the line by a set of secondary batteries, and the motor being driven from these instead of direct. Sir Wm. Thomson pointed out at York how this plan rendered very high potential in the line practicable, and also how it removed the danger of high potential in the immediate neighbourhood of the consumer. It is also obvious that a continuous power, such as a waterfall, may be thus intermittently utilised, and a great power obtained for a few hours instead of a moderate power all day long. The current is to be generated at the sending station by a large shunt dynamo, or set of shunt dynamos arranged in series, the middle of the set being put to earth; the terminals are to be connected to the direct and return line wire respectively, and at the receiving end the lines are connected to the poles of a large number of accumulators all in series. These cells will give the necessary back electro-motive force at the rate of about 2·3 volts per cell say, and the current can, by adjusting the number of cells, be kept at any small value desired. The smaller the current the greater the economy; while by the use of a sufficiently high electro-motive force any amount of power can be transmitted. The accumulators simply take the place of the receiving dynamo, and if we call their total opposition electro-motive force while being charged E_2, their true ohmic resistance ρ_2, and the electro-motive force between the extreme terminals e_2, all that has been said in Article II. about transmission along an imperfectly insulated line remains true without modification for the battery charged from a dynamo at a distance. Besides the advantage gained by being able to store up power for intermittent use, a battery is a more economical receiver than a dynamo for this reason, that it can give a high electro-motive force with far less internal resistance than a dynamo can—in other words it is like a low resistance dynamo running at a furiously high speed. Cells known as the horse-power-hour size need only have a resistance of about the five-hundredth of an ohm, with connections; consequently a back electro-motive force of say 2300 volts may be obtained from a battery with an internal resistance of about 2 ohms. Against this advantage, however, is to be set the fact that the electro-motive force during discharge is only 2 ohms per cell, instead of say 2·3, and that a rather less quantity of electricity is returned from the cells then was put in. Consequently, regarded from mere economy, the use of cells could hardly be advocated; their use depends on their great convenience and the ease with which a few can be coupled up direct to any piece of work. They are to be charged all in series; they will be discharged in batches; or they may be coupled up abreast if powerful currents are wanted—for electro-plating for instance. Accumulators, in fact, constitute a machine for transmuting high electro-motive force and small currents received from a distant station, into low safe electro-motive force and powerful currents such as may be wanted in actual use. They may also be used in locomotive appliances, such as boats and tramcars, to which the laying on of a wire is difficult. In former articles I have considered the charging and discharging of accumulators, so I have now only to consider how to obtain their power from them by a motor. Next week, therefore, we will discuss the case of a common series-wound dynamo, driven by the current from a storage or other battery, and through short thick leads of perfect conductivity and insulation.

VIENNA ELECTRICAL EXHIBITION.

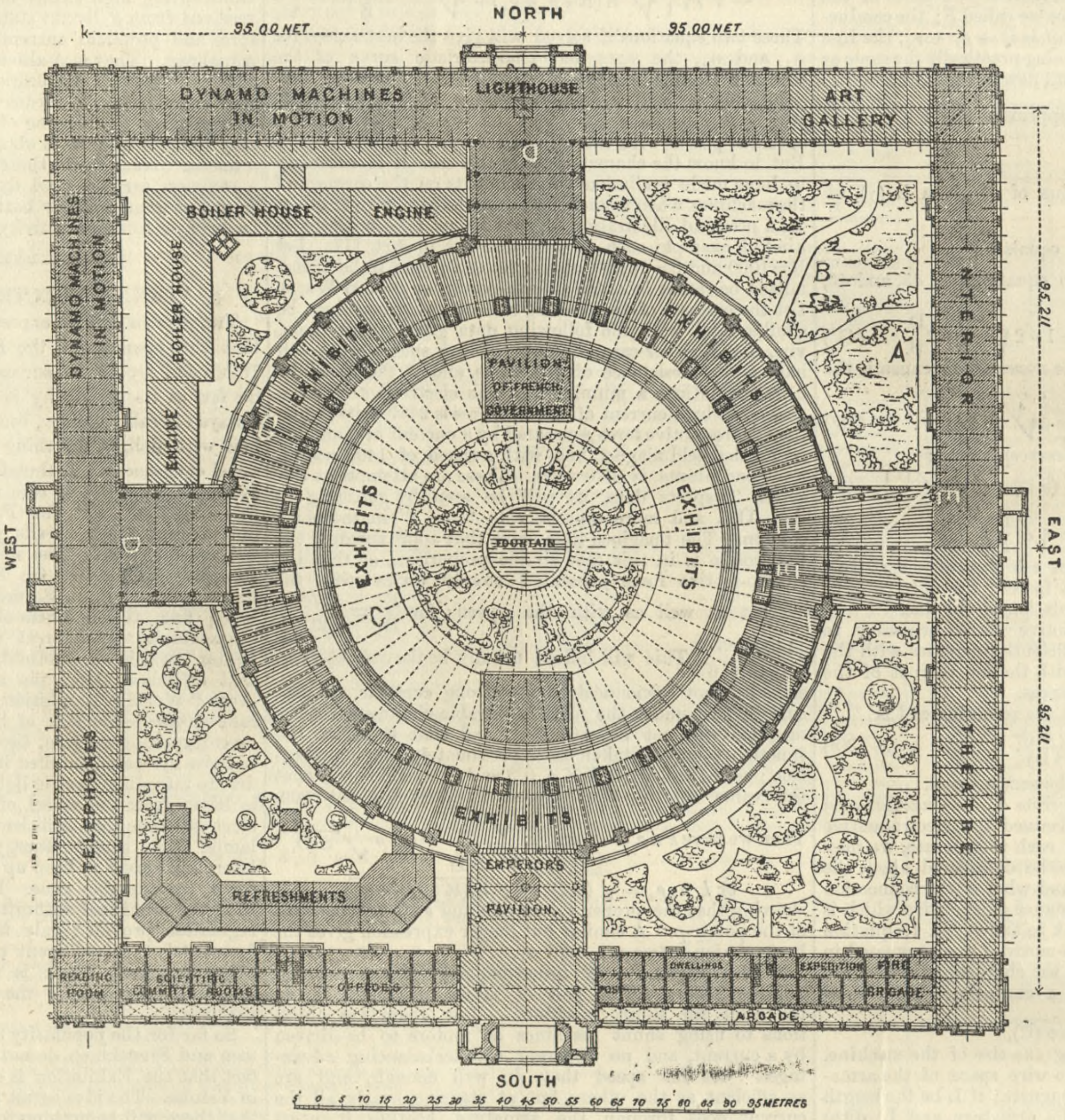
THE expectation we expressed in our last issue, namely, that the opening of the Exhibition on Thursday, the 16th inst., would be successful, has been fully realised. So far as its popularity is concerned, that was perhaps always tolerably certain, because the Viennese people ever hail with delight anything new that offers a prospect of novel excitement. A thunderstorm on Wednesday night, accompanied by heavy rain which lasted intermittently for two days, and left the Prater roads deep in mud, did not prevent great crowds proceeding to the Rotunda on the opening day. The number of 8d. tickets sold on Thursday was 4000. On Friday it fell a little short of that number, but on Saturday and Sunday, the weather being fine, the numbers of admissions paid for reached large totals. The great crowds streaming down the Prater towards the Rotunda remind one of the throngs that swarmed along the same roads in 1873 to the great "World's Exhibition." In the streets and in the caffées, one hears talk of little else than electricity; and an enterprising cabman, Leopold Frank, No. 737, deserves to have his name enrolled in scientific history as being the first to introduce electric lighting in cabs. A small dynamo is driven from the wheel of the cab, and furnishes sufficient or more than sufficient current for two incandescent lamps. The surplus energy is stored in a small accumulator, and serves to keep up the light while the cab stands for a considerable time. Frank had a difficulty at first with the municipal authorities, because their rules for cab regulation provided only for oil lamps and candles, but fortunately an intelligent chief director overruled these objections, and Frank is now allowed to drive before an admiring public in the full glory of electric illumination.

So far for the popularity of the undertaking. Englishmen and Frenchmen do not yet seem to have realised the fact that the Exhibition is open, because few of them are in Vienna. The idea seems to have gone abroad in England that there will be nothing to see for a month or so yet, and some even seem to deprecate the whole undertaking. This is a decided mistake. Although much remains unfinished even now after the formal opening, it is already easy to judge of the general character of the Exhibition, and it seems to be generally agreed not only that it will be very soon as nearly complete as an International Exhibition could be, but that it is of greatly higher scientific and industrial interest than was the Paris Exhibition. It is capable of teaching much more to the thorough-going practical engineer and user of scientific instruments. Thus the Crown Prince Rudolph, in his inaugural speech on Thursday, was not unreasonable in expressing a hope that this would prove to be the most important electrical Exhibition yet held.

Very unfortunately England is very poorly represented, and most of the English exhibitors are more behindhand in their preparations than any others. The only exhibitor that at all approaches the English in unpreparedness is a very well known French firm, and this forms a marked exception in the French department, which is generally already quite complete and excellently arranged, and is besides the largest of all the national sections with, perhaps, the exception of the Austro-Hungarian. It is a pity to observe that what will eventually be an interesting English exhibit is just now left entirely to the mercy of two labourers, who spend their days in slowly moving those machines that have already been unpacked about the floor in an erratic and apparently aimless manner, and, so far as can be discovered, utterly without any sort of supervision or direction. It is but fair to say that the Vienna Committee of Direction undertook to provide steam-power and shafting, and this offer having been accepted by the English firms in order to save expense of sending out boilers and engines, complaints are made by these latter that they have been unable to do anything because the committee has not completed, and proceeds slowly with, these promised provisions. But we are afraid that the Englishmen have gone too much on the extremely bad principle that one may safely leave work to be done by comparatively uninterested parties at a distance without sharp looking after and a good deal of pushing forward from the centre of self-interest.

On Thursday the Crown Prince arrived punctually at eleven o'clock. The formal opening occupied about ten minutes only, and the speeches were of no particular interest, except that the Crown Prince claimed for Vienna the honour of having first introduced successively lucifer matches, stearine candles, and street lighting by gas. We cannot say how far these claims can be substantiated. The Prince made up for the shortness of his speech by the length of his round of inspection. He spent fully three and a-half hours in walking about and examining with great minuteness a large number of the exhibits, interrogating the exhibitors in a very intelligent manner, and one that evinced a keen interest in what he was inspecting. He was accompanied by Baron von Erlanger, the president, and Graf Wilczek, the honorary president of the Exhibition, and by a large and distinguished company of invited guests, among whom were the Erzherzog Albrecht and the Crown Prince of Portugal.

In the remainder of the present article we intend to limit ourselves to a general description of the contents of the Exhibition.



The space occupied by England is bounded by the letters E E; Italy by letters I I; Germany by C H X I; Russia by G X; France nearly half circle G E; Austria southern half circle H I; at D are dynamo machines; B, repairing shops; A, accumulators.

On this page we give a plan, showing the general arrangement of the national sections, &c., on which are placed reference numbers indicating the different nationalities, as explained at the foot of the plan. This, for convenience of reference, we reproduce with some additions from p. 61.

Entering by the south gate, we find the south transept wholly occupied by Austrian exhibits, none of which in this place are of much interest. The Emperor's pavilion is richly and handsomely ornamented, but appears to be simply decorative and without useful purpose. This leads into the Rotunda, where we find nearly the whole of the southern part occupied by the Austrians. It is to be lighted up by a lustre of forty-eight incandescent lamps of Dr. Hollenbach's design, and by Swan lamps supplied by Ganz and Co., of Pesth, the current coming through accumulators of the Sellon-Volckmar system, supplied by the Electrical Power Storage Company, of London. They cover, roughly speaking, one-third of the ground in the Rotunda, the French covering another third diametrically opposite on the north side. Facing the centre of the Rotunda is a large and handsome open pavilion, put up by the Ministry of Commerce. Here is laid out for inspection a large collection of the different forms of telegraph apparatus at present in use in Austria, among which perhaps the most interesting is Hughes' type-printing telegraph instrument; telegraph apparatus that is now out of use, but which illustrates the history of telegraphic progress; plans and drawings of the electric and pneumatic telegraph system carried out in Vienna—where the pneumatic system is extensively and successfully used—and an interesting collection illustrating the process of decay of wooden telegraph posts.

In the south-east quadrantal gallery of the Rotunda, among the most interesting exhibits are those of A. W. Lamberg of type printing telegraphic machines and of telephones and microphones; Winiwarter's lead-covered cables for telephoning and electric lighting; a great number of electrical railway semaphore signalling apparatus of the different Austrian railways; F. Silas' chronophone; several electric clock designs, in one of which the clock goes for a couple of years without any help; a very beautiful collection of coloured figures on glass plates, produced by the passage of electricity in brushes, sparks and currents, by Professor Antolik, of Arad, in Hungary; the Southern Austrian Railway's new—and as yet untried—system of electrical carriage intercommunication from passengers to guard; and a carriage from the electrical railway from Mödling to Brühl, with the latest improvements for preventing sparking in stopping and starting.

The Italian section comes next, proceeding to the east transept, and it is chiefly remarkable for the very beautiful telegraphic apparatus shown. In one of the columns at the entrance to the east transept is A. Freissler's electrical hotel lift, which is already in working order, and forms one of the most interesting exhibits in the whole building. The sides of the east transept are occupied by the English section, which contains exhibits by the Telegraph Construction and Maintenance Company, and by Mr. Killingworth Hedges, as well as Thomson's syphon recorder, and a large collection of specimens of cables of the Eastern Telegraph Company. It must be confessed, however, that this English portion of the Rotunda is specially distinguished for its extreme minuteness. The space is filled up by a gorgeous pavilion, interior upholstered by J. Wiedmann in the richest and most romantic style, in which Japanese, Chinese, and Indian art are mixed up with an amount of incongruity impossible in any but a European drawing-room. This is lighted by Maxim incandescent lamps. A number of small portable electro-dynamos for household and dentists' purposes by a Philadelphia-London Company appears in this section, and attracts a good deal of attention from lady visitors. The catalogue locates a number of English exhibitors on this part of the floor who as yet show no signs of present or future appearance. Only about a fifth of the exhibits of the Society of Telegraph Engineers as stated in the catalogue can be found in place so far, but it is at least satisfactory to notice that a considerable extent of empty table belongs to this Society.

Passing onwards to the north-east of the Rotunda, we find Denmark making a very interesting show, among which are some Jüngensen dynamos, made by Professor E. Jünger, of Copenhagen. The Danish Marine Ministry, among other things, show the needle with which Oersted first discovered electro-magnetism, as being of historic interest.

We then pass into the French section, which, as already said, is in some respects the finest of the whole Exhibition. Gaston Planté, Paul Jablochkoff, Dr. Boudet, and Messrs. Brequet and Co. are among the exhibitors. The collections of microphones, phonographs, physiological cardiophones, arteriophones, and other instruments shown by Boudet has probably never been surpassed for ingenuity and scientific refinement. The exhibits of Brequet are equally interesting and excellent, and we hope to return to these exhibits to describe and illustrate them in some detail. We intend in our articles on the Exhibition to restrict ourselves to the description of objects of technical interest to engineers, but the above two collections have so much special scientific interest that we feel inclined to make an exception to our general rule in their favour. The French Ministry of Commerce also make a most interesting display, as also does the Northern Railway of France. L. Sautter, Lemonnier, and Co. show a collection of machines and projectors that will be examined with interest by all military and naval men. The same design of projectors as those that did such good work on our ships in Egypt last year is exhibited.

Russia occupies a somewhat small space in the north-west quadrant, but there are many things worth studying in it, among which Robertowitsch's phonophores deserve special mention. Next comes Germany, which covers a surprisingly small amount of ground in the Rotunda; but this is partially explained by her exhibits in the machine rooms being extensive. The south-western quadrant forms part of the very large Austrian section. Here is placed Siemens and Halske's exhibit, which stretches round through the east transept into the eastern machine gallery. In the southern end of this gallery is a library and reading-room. The library has been stocked by Hartleben, bookseller, of Vienna, and is supposed to contain the electrical literature of all nations. That this supposition is a very great mistake is evident from the fact that the books are contained on four shelves about 5ft. long, which are to a great extent loaded with the "Proceedings" of a Vienna Physical Society. As this library, if it were what it professes to be, would be of the greatest interest and usefulness to the scientific visitors, we trust that the original intention may still be carried out, and that the room may not be left, as it now is, a mere newspaper reading-room. In the same gallery are situated various dark rooms, in which the Commission will experiment on the lights, and telephone auditoriums, in which the public will have an opportunity of listening to the speeches and music made in far distant parts of the building. These and the library occupy nearly the whole of what is called the south-west gallery, or annexe, and the position is well chosen for these purposes, because it is quite shut off from the rest of the Exhibition; there is no traffic through it, and looking down the gallery from its end, nothing is to be seen but two rows of very bare and uninviting cupboards, so that this corner will probably remain a place of quiet refuge from the noisy crowds that tramp about the rest of the place.

The north-west gallery is a rectilinear continuation of the above, and it and the straight gallery running along the whole length of the north side of the Rotunda contain all the dynamos in action and the engines driving them. The boilers are in a gallery intermediate between these and the Rotunda. As we shall describe and illustrate the exhibits in these galleries in very full detail, we need say little of them now. The Schuckert machines are very numerous, and, so far as those which are as yet in action are concerned, they and the Schwerdt machines seem to take the lead. Crompton and Bürgin's machines will form an interesting portion of the Exhibition at some future date which it is at present impossible to calculate. The Weston machines are now ready, and are remarkable for their solid and workmanlike build. The Anglo-Austrian Brush Company would now have completed their preparations if the Vienna Committee had furnished them with steam power and shafting somewhat earlier than they did, and their exhibit will certainly not fall far behind any other in interest. Then comes the big Ganz machine already mentioned, 9ft. in external diameter, and built along with the vertical engine driving it, the engine shaft being in one piece with that of the dynamo. The other more interesting exhibits here are those of the Paris-Edison Company, with modified Edison machines driven by Siemens-Armington engines, and those of Brückner, Ross, and Consorten, of Vienna.

Most of these firms have series-wound, shunt-wound, and compound dynamos, but the separate exciter, although it has not altogether disappeared, appears very rarely in this Exhibition. Many firms also exhibit both continuous current and alternating machines. Brotherhood three-cylinder engines appear attached to a large number of the dynamos; sometimes, as in one exhibit of Sautter, Lemonnier and Co., assuming so diminutive a size as to seem almost comical. Langen and Wolf also show several Otto gas engines driving dynamos.

The north-east gallery is occupied firstly by a hall hung with pictures by modern Austrian artists, and containing some statuary. This is to be lighted by four arc lamps, but they have not been got in working order yet. Then comes a long series of "interiors," furnished in very elegant styles by Viennese upholsterers, and lighted by various kinds of incandescent lamps, the Edison supplying the most brilliant light. The theatre occupies the south-east gallery. It has a large stage, and a very small auditorium. It is lighted for the most part by incandescent lamps, the central lustre in the auditorium being by Hesse and Woolf, of Vienna, and the rest by Ganz and Co. Some arc lamps required for stage effects are furnished by Piette and Krizik, of Pilsen. Besides theatrical representations, an interesting series of scientific lectures will be given in this theatre. The first will be given next week by Sir W. Siemens, and later on Sir Wm. Thomson is expected to contribute one. The subjects are not yet known. Microscopical exhibitions will also be made in this theatre.

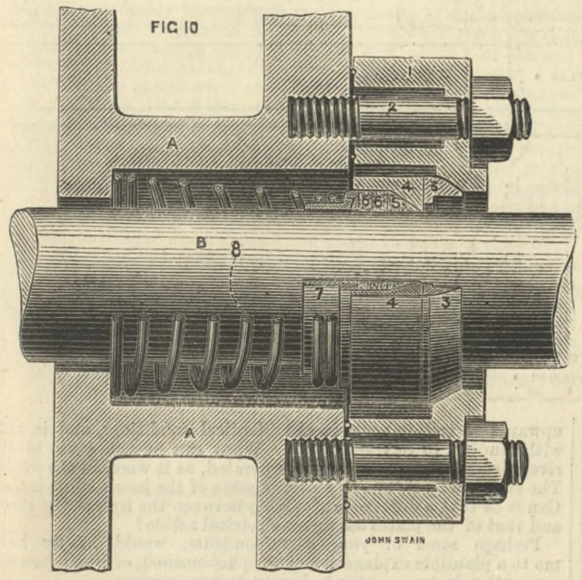
In our article on the exhibition last week, the big dynamo machine by Messrs. Ganz and Co. was referred to as 52ft. in diameter. This should have been printed 52in. radius, or 104in. in diameter.

THE CHICAGO RAILWAY EXPOSITION.

No. III.

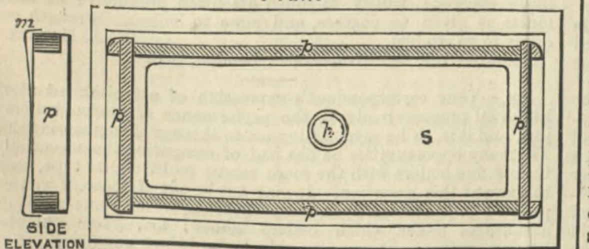
MUCH expense is caused and time lost by the constant repacking of piston and valve rod glands on locomotives, and though innumerable varieties of packing have been tried in this country, none of them appear to have achieved unqualified success or to show any marked superiority in durability, lessened friction, or decreased wear of piston-rod. Metallic packings, though often suggested here, never appear to have had a fair trial, which, judging from their success and general adoption in the States, is a matter of regret. A report, giving the experience of several locomotive superintendents who have used metallic packings, was recently communicated to the Association of Master Mechanics, and was, as we have previously mentioned, very favourable to their use. The metallic packing shown in our illustration was exhibited by the United States Metallic Packing Company, of Philadelphia, and appears to give excellent results. The method of application is very simple and easily understood. Three rings of Babbit's white metal are placed round the rod, and are held against a cone by the pressure of steam aided by a spiral spring.

FIG 10



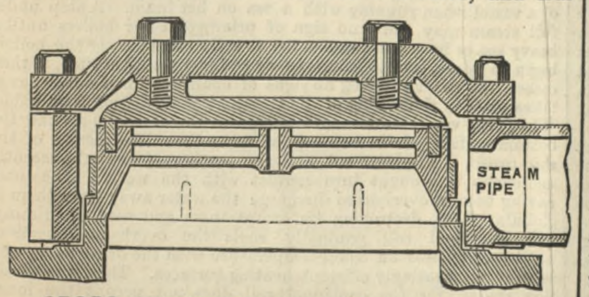
The cone bears against a ring which fits a spherical collar on the gland, the result of this arrangement being that the packing is free to move laterally inside the stuffing-box, and that the vibration of the piston-rod cannot cause any leakage or uneven wear. The driver cannot unduly tighten the packing, the pressure of the steam forcing the rings into the cone and taking up any wear, while the spiral spring retains the packing in place when the engine is running without steam. The wear of the rod is stated to be very slight and uniform, while the packing rings usually run without renewals between general repairs to the engine. The working friction of locomotives has also been diminished in the United States by the adoption of balanced slide valves, which, though extensively tried in this country have been generally abandoned, and are now only to be found on the Great North of Scotland, where Mr. Wm. Cowan seems to be able to make them answer, chiefly by the addition of an air inlet valve to the steam chest, acting when steam is shut off, and preventing that suction down the blast pipe of hot gases and cinders from the smoke-box into the cylinders, which sometimes takes place. Many balanced valves act very well as long as steam is on, but soon commence cutting when the regulator is shut.

FIG. II



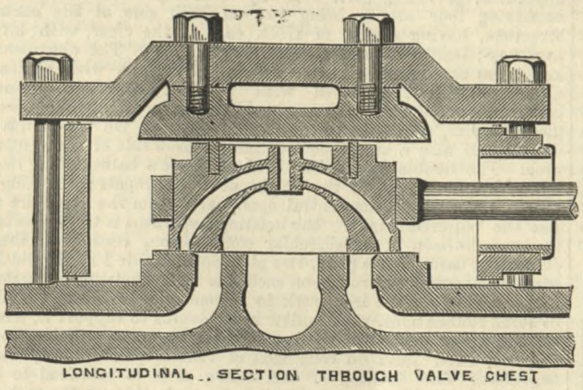
SIDE ELEVATION END BALANCING STRIPS — PLAN SHOWING BALANCING STRIPS

The valve we illustrate by the above Fig. 11, and two following, exhibited by Mr. W. F. Richardson, of Troy, N.Y., is extensively used in the United States, and is said to give satisfactory results. Four grooves are planed in the back of the valve, and four



CROSS SECTION THROUGH EXHAUST PORT

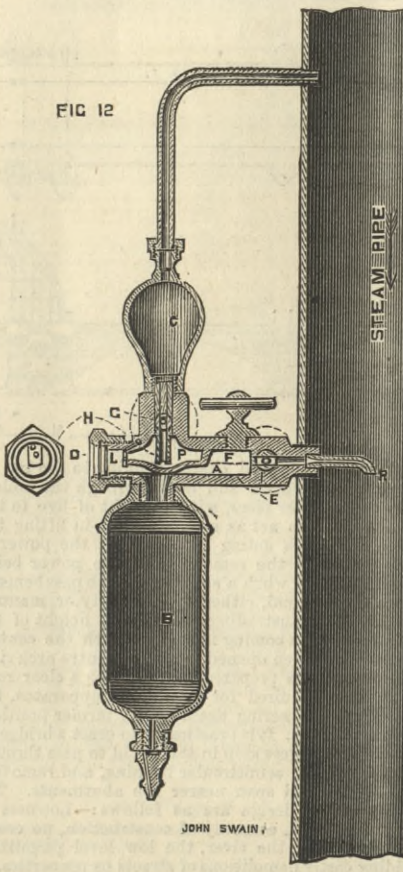
rectangular section strips being placed in these grooves are kept against a relief plate by light springs *m*, Fig. 11. The distance between the strips *p p* being greater than the travel of the valve, each strip wears its own path, and never crosses the ridges made by its neighbour, hence keeps tight. It will be noticed that the joint between the strips, at the corners of the rectangle freed from pressure, are in a line with the travel of the valve, and hence are

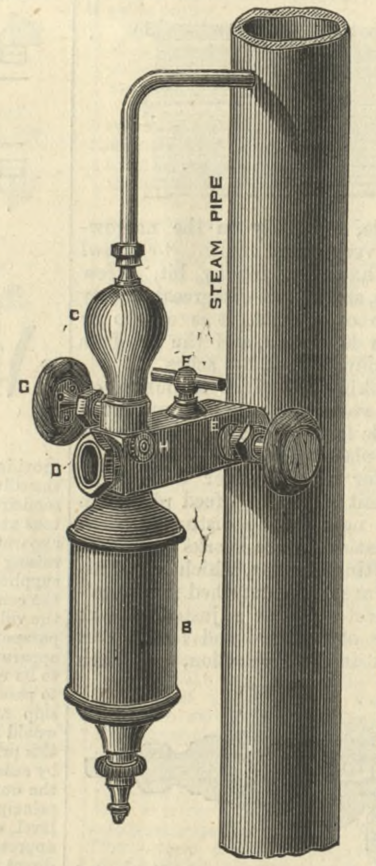


LONGITUDINAL SECTION THROUGH VALVE CHEST

always in contact with the ridge caused by this joint, and, therefore, keep tight. Any leakage is conveyed to the exhaust cavity by means of the passage shown through the crown of the valve.

FIG 12





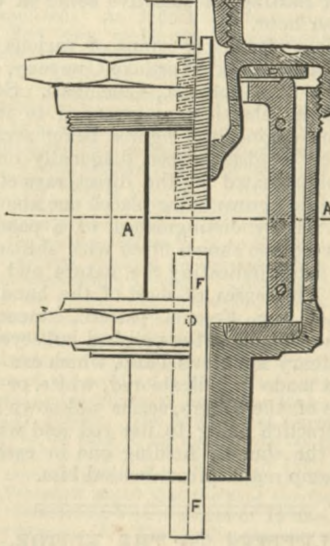
The Allen or Trick valve shown in our illustration has many obvious advantages, but owing to the internal passage diminishing the bearing surface on the valve face it is apt to wear very fast, unless relieved of the pressure on its back. However, this valve gives a sharp cut-off and admission, and when well made wears as well as an ordinary valve. Both the Allen and common D-valve, fitted with Mr. Richardson's balancing arrangement, are extensively used on the Boston and Albany, Old Colony, Fitchburg, and other roads, but have never, we believe, been tried in England.

The principle of the displacement lubricator is undoubtedly the best for lubricating the valves and pistons of locomotives where running with steam on, but its simplest application—Ramsbottom's patent—has been found to work very unequally, generally feeding with the greater part of the lubricant in the first half-hour of its working, and letting the engine run without oil during the remainder of the trip. Roscoe's lubricator, which provided a means of regulating the feed, was a distinct improvement upon Ramsbottom's, but as it afforded no positive indication of its working, the rate and regularity of the feed was a matter of guesswork. This evil has been found so great on marine engines that sight feeds have been extensively used at sea, a glass tube or window showing distinctly each drop of oil as it is displaced, and passes on its way to the steam pipe. American engineers seem to experience a difficulty little known in England, and sight-feed indicators adapted for locomotives were exhibited at Chicago, and though all of them were somewhat complicated in construction, the advantage of a regular supply of lubrication is so great, and effects such an economy in both wear and tear and quality of lubricant used, that it seems to the makers of these lubricators worth while to incur the disadvantages of a somewhat delicate apparatus if it can enable a driver to see at a glance each drop of oil supplied to his valves and pistons. Messrs. Fairbanks, Morse, and Co., of Chicago, the well-known weighing machine makers, exhibited two sight-feed lubricators, differing in detail. In one—Reid's patent—the oil falls, drop by drop, in a gauge glass, which at starting is filled with compressed air by a miniature hand pump attached to the lubricator, the object being to equalise the steam pressure, so that the latter has no tendency to blow the oil bodily through the lubricator, a very common defect in many lubricators, which are thus emptied in a few minutes. In the Thayer lubricator a horizontal glass tube is provided, having a bore of only ⅛in. diameter. By an ingenious mechanism oil and water in alternate quantities are fed along this tube to the steam pipe. Both these lubricators are somewhat complicated and expensive, the size holding one pint of oil costing £5 15s. The lubricator exhibited by A. W. Swift, Elmira, N.Y., is more compact, and, it is stated, can be modified to feed oil at the same rate, whether the engine is running with steam or without.

As shown, however, in our illustration—Fig. 12—it feeds oil only when the engine is running with steam; which, condensing in the chamber C, falls into a water trap P, and escapes through a small orifice L in a bright metal plate falling into the oil chamber B beneath, and consequently displacing a corresponding drop of oil, which passes into the steam pipe through a small bent nozzle R, which projecting into the centre of the current of steam, ensures a thorough mixture with the particles of oil. The drop of water falling on the surface of the oil can be seen through a glass plate, and it is obvious that every drop of condensed water falling on the surface of the oil A represents a drop of oil displaced, and forced down the pipe R. The flow of condensed water is regulated by the cock G, and the flow of water by the cock E. The oil vessel is filled at the plug F, and a small cock at H permits the escape of air while filling. The joints between the main body of the lubricator and the condensing chamber are sweated together, while the plug H and the emptying valve at the bottom of the oil chamber seat upon soft metal, in order to ensure tight joints. As long as the lubricator is working, the oil level A is always visible through the glass sight piece, and warning is given of the proximate exhaustion of the oil by the underlying condensed water becoming visible.

Messrs. J. E. Lonergan and Co., of Philadelphia, exhibited some oil cups, which were especially adapted for locomotives, and differ considerably in principle and arrangement from those in general use on English railways, though somewhat similar lubricators are extensively used in the United States and France. Fig. 13 represents an oil cup especially suited for coupling and connecting rods. The oil is contained in a cylindrical glass vessel, seated upon cork washers D, which make a tight joint against the brass cage A. The feed is given by the vertical movement of a pin F, its range of motion being limited by an adjusting screw by which the feed is regulated; the higher the feed spindle is allowed to lift, the larger the quantity of lubricant fed at each revolution. The whole lubricator is air tight, and feeds only when the engine is in motion. The feed can be regulated to a nicety, and instances have been known where connecting rods have run 5000 miles for one filling; the cup, when full, holding only 2½ oz. of oil. The absence of a wick, the ease and rapidity with which the rate of feed can be changed, and the readiness with which the driver can ascertain the condition of his oil supply, are the obvious advantages of this oil cup which, however, may be dropped on the road.

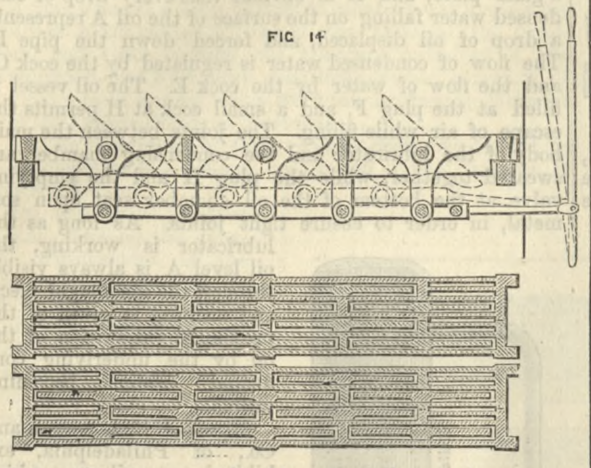
FIG. 13



Several forms of grate were exhibited for burning inferior or refuse coal. We illustrate in Fig. 14 one of these devices—the Howe grate, exhibited by Messrs. Howe and Co., Scranton, Pennsylvania. A set of cast iron grate-bars are used, through holes in which work tee-shaped rockers about 15in. long, pivotted as shown. These being coupled together, can be worked by a lever, and the clinker can be broken up and the fire cleaned without opening the fire-door. The rockers are not all placed in line, but break joint, so that their action does not leave the fire in ridges, but breaks up the whole surface. The coal found in the newer Western States of America is of very bad quality, and contains a large amount of ash and clinker, and therefore some special arrangement of grate is required to render the coal capable of raising steam.

Some of the locomotives exhibited were fitted with the patent ash-pan of W. H. G. Newth, of Detroit, Mich., by which the contents can be emptied without the fireman going underneath the engine, openings in the bottom of the ash-pan being worked by means of a lever on the foot-plate. The floor of the ash-pan is formed of a series of plates about 8in. wide, turning on pivots, which are worked by suitable arms coupled together by a rod, which is in turn connected to a hand lever on the foot-plate. The contents of the ash-pan fall on the ballast when these pivotted plates are turned to a vertical position, and when in their normal horizontal position the ashes are retained as usual. It may be doubted whether this method of construction is perfectly tight, and probably water could not be usefully used to cool the ashes. The advantages, however, of being able to empty the ashpan without going under

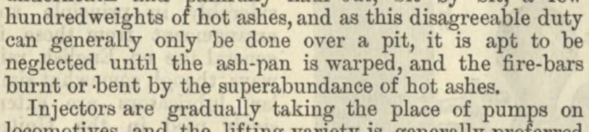
FIG 14



the engine are considerable, especially on the narrow-gauge, where it is often very inconvenient to crawl underneath and painfully haul out, bit by bit, a few hundredweights of hot ashes, and as this disagreeable duty can generally only be done over a pit, it is apt to be neglected until the ash-pan is warped, and the fire-bars burnt or bent by the superabundance of hot ashes.

Injectors are gradually taking the place of pumps on locomotives, and the lifting variety is generally preferred to the simpler non-adjustable forms used here, injectors in the States being generally placed alongside the fire-box above the level of the water in the tender tank. One advantage of this arrangement is that the feed pipes can be kept above the axles and need not be disturbed when the engine is lifted. The National Tube Works of Boston, Mass., exhibited a Mack's lifting injector, which we illustrate in Fig. 15. The parts are easily detached for examination or repair, and the injector can be adjusted to work well under great variations of pressure and feed. This injector was shown at work in the Exposition, and when

FIG 15



supplied with steam of 80 lb. pressure successfully fed against a boiler pressure of 170 lb., though the quantity of water thrown in was not large, and the escape at the overflow pipe was continual. The adjusting steam cone is pierced with a very small orifice which admits steam to the injector directly steam is turned on by slightly moving the steam cone which serves also as a stop valve seating on a face properly coned for the purpose. The water is lifted by the vacuum thus created, filling the injector, and running out at the waste opening, when the cone can be opened full and the overflow closed. The injector exhibited, a No. 8, was capable of feeding a locomotive boiler at the rate of 1800 gallons per hour.

Fine collections of railway lamps of various kinds were shown by the Adams and Westlake Company, of Chicago, and by Messrs. Post and Co., Cincinnati. Some of the engine head lamps shown were arranged to indicate the number of the engine, the figures being arranged in a vertical row on a glass placed diagonally on the front corners, and illuminated by the direct rays of the lamp. It is said that the figures being placed one above the other can be more readily distinguished on a passing engine. Head lamps were also shown fitted with shifting coloured glasses at the sides, indicating the nature and destination of the train. The lenses of most of the hand and signal lamps were of the Fresnel pattern, uncut, and presenting a great contrast to the polished bullseyes used here, while the ordinary shunter's lamp, which can be held by one hand, and made to indicate red, white, or green by a simple motion of the thumb, seems unknown in America, the general practice being to use red and white engine-room lamps, the shunter holding one in each hand and keeping the lamp not required behind him.

LETTERS TO THE EDITOR.

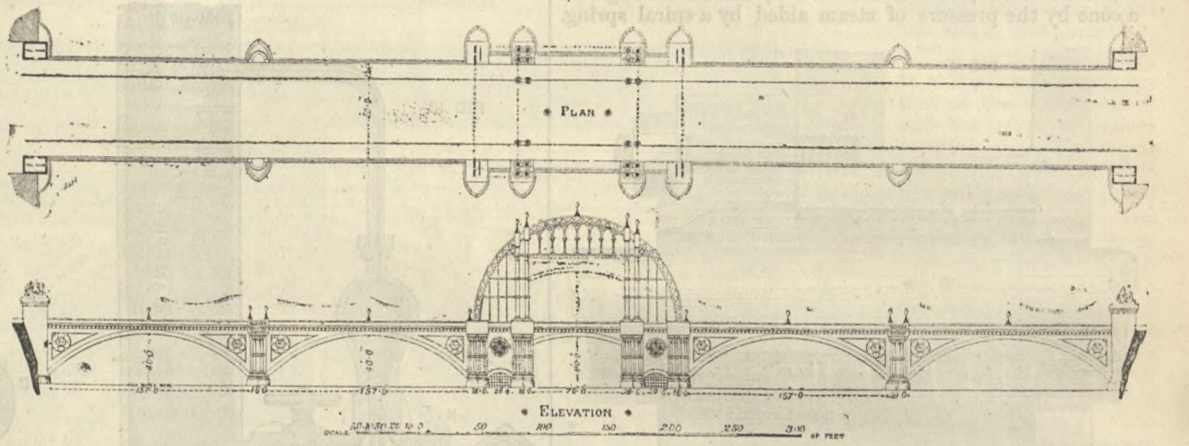
[*We do not hold ourselves responsible for the opinions of our correspondents.*]

PROPOSED BRIDGE OVER THE THAMES BELOW LONDON BRIDGE.

Sir,—Many are the schemes and suggestions for communication across the Thames below London Bridge submitted to public scrutiny that it is needless to remark at any great length that it is without doubt a complete necessity to erect a bridge, either a high or low level, in preference to any tunnel or subway between the two banks of the Thames.

It was the announcement of the London Chamber of Commerce that they were prepared to exhibit in its council-room any schemes or proposals for means of crossing the Thames below London Bridge that induced me to respond to their invitation. I prepared a scheme which I had carefully considered, and arriving at the conclusion that it would be an immense advantage to erect a low level bridge with a suitable structure in the centre to allow ships to pass through, which I have carried out generally in my scheme, and which has the advantage of avoiding any costly demolitions or the necessity of long approaches on either sides of the river, combined with simplicity in its construction. It will be seen from the illustration that the bridge is early English in style, with five spans, the centre span being 70ft. in the clear, with hoisting apparatus, providing 90ft. headway from high-water mark, the remaining four arches being two on each side of the centre structure, having a span of 175ft. each in the clear, with 40ft. headway; length of bridge, 880ft.; width, 74ft. The abutments and piers are intended to be erected of granite, with conical-shaped starlings, enriched with polished Aberdeen granite columns, curved caps and moulded bases, &c., with wrought iron girder arches, spandrils, cornices, parapets, &c. On the plan is a double and also a single dotted line on each side of the central arch. The double dotted line denotes where a balustrading rises by hydraulic power to the height of the parapets; the single dotted lines where the central span parts from the structure to rise the required height. The hoisting apparatus is to be erected in wrought iron of semicircular construction, resting on their respective bases of the piers, two piers on each side 16ft. in width, each with rooms constructed on each side for the hoisting apparatus to be regulated, the iron work to be embedded in the granite or stone foundations, with hollow iron columns to support it, fixed to the piers on each side, the semicircular framing springing from the two outer piers on each side of centre span securely tied together. The hoisting of the centre arch is intended to be done by hydraulic power, situated on each side of the arch in the rooms provided for that purpose, the water tubes being embedded in twelve of the columns, thus preventing exposure to view, the rooms being constructed over an arch with a waterway of 20ft. in the clear, and being 12ft. from high-water mark to the crown of the arch.

In eight of the iron hollow columns nearest the abutments are



provided with steel rivetted cranked chains running to the top of the columns and over pulley wheels and down through the hollow semicircular girders to the outer piers, with a weight of five to ten tons attached to each chain to act as a counterpoise in lifting the apparatus or centre arch, this acting as a part of the power of raising and lowering at will, the remainder of the power being supplied by hydraulic. Thus, when a ship requires to pass beneath the central arch at a given signal, either by electricity or manual, the valves are opened, the balustrading rises to the height of the parapets to prevent passengers coming in contact with the central apparatus; more valves are then opened, when the centre arch rises to its respective height. Thus prepared, the ship has a clear road to pass through; the time required for raising the apparatus, the ship to pass through, and lowering again to its former position, would not exceed four minutes. It is practicable to erect a bridge on this principle to allow the largest ship in the world to pass through by enlarging the radius of the semicircular framing, and removing the outer piers of the central span nearer the abutments. The principal advantages of the design are as follows:—Lowness of level, easy gradients for traffic, economy of construction, no costly approaches on either side of the river, the low level permitting direct access, avoiding costly demolitions of streets or properties, as little alterations are required, simplicity of construction for hoisting apparatus, occupation of the least possible interference with the navigation of the river. It is estimated that the cost of the bridge, including approaches, water towers on land, machinery, &c., would not exceed £400,000, which is about one-fourth the sum necessary for a high-level bridge.

J. Pitt Bayley.

18, Fulham-place, Paddington.

ENGLISH AND AMERICAN PATENTS.

Sir,—We notice in the issue of The Engineer dated June 22nd, a statement with reference to some patents recently taken out in this country on the application of Mr. Albert H. Emery, of New York, for testing machines, dynamometers, scales, &c. As these patents were issued to the Emery Scale Company, which is owned and operated by this company, we venture to offer some suggestions on the point of comparative expense of English and American patents, as it seems to us the conclusion you draw from our case is not altogether accurate.

In the first place, you correctly state the cost of nineteen patents in this country at £133 patent fees; but it should be remembered that a United States patent gives protection for seventeen years from its date, without any subsequent tax whatsoever.

Assuming for the moment that all the subject-matter of the nineteen United States patents could have been covered in one English application, which for three years would have cost £25, we find that, even at the same rate per year, to get protection for seventeen years would require an expenditure of about £141. But as matter of fact, in order to keep the British patent alive, it would be necessary to pay a tax of £50 before the expiration of three years, and £100 before the expiration of seven years. Having therefore paid in all £175, instead of £133 called for in the United States, the inventor is protected for only fourteen years, instead of for seventeen years as in the United States.

All the above is on the supposition that the subject-matter of nineteen patents could have been covered by one British patent. As matter of fact, however, all the subject-matter of these nineteen patents has not been covered by British patents, and on consultation with our solicitors we were advised that to obtain sure protection in Great Britain, it would be necessary for us to take out six patents, which has been done. Thus, on the basis assumed by you, to protect the same subject-matter in the United States we have paid £133 patent fees for seventeen years, while in Great Britain for three years the cost was £150 patent fees. It would seem, therefore, that as to the mere matter of cost the practice in this country is more favourable to inventors than that of Great Britain.

On the broader question of practice as to allowing different inventions relating to the same subject-matter to be included in one application, there is probably no doubt but what the English practice is more favourable to inventors, and on every account more desirable than the practice in this country.

For example, in the patent for the Emery testing machine, which machine embraces as necessary components pressure gauges and a scale, it was necessary in this country to show and claim the testing machine alone in one application, while separate applications were necessary for the gauge and the scale. This not only increases the expense, but in the case of litigation, or in the event of any one desiring to investigate a patented invention, tends greatly to confusion. This confusion arises because each application of course requires a separate specification; and in describing the testing machine by itself, the gauge by itself, and the scale by itself, a great deal of repetition is necessary, which could be avoided if all were included in one specification, and all were described as connected parts. For the information of your readers, we may add that the testing machine, scale, and gauge which are shown and described in the English patents, are the same machines which are in use by the United States Government at the Watertown Arsenal in Massachusetts. This testing machine is capable of testing a load up to a breaking strain of 800,000 lb., and can the next moment without any adjustment test a specimen with entire accuracy whose breaking strain is not over 1 lb. This machine has been in experimental and practical operation for seven years without repairs of any sort, and its delicacy is as great as when erected. We hope to give English engineers an opportunity in the near future of examining one of these machines in actual operation.

The Yale and Towne Manufacturing Compan
Schuyler Merritt, Secretary.

Stamford, Connecticut, July 11th.

A SINGULAR CASE OF BOILER CORROSION.

Sir,—I had recently the opportunity of examining a 20-horse Cornish boiler showing a curious instance of corrosion. The boiler had been at work only seven or eight months. Owing to pressure of business in that interval, it had been imperfectly scaled. At the end of that time it leaked so badly that work had to be stopped and the boiler examined. It was then found that a large proportion of the rivet heads of the flue tube inside the boiler had actually disappeared—become incorporated with the scale, and could hardly hold the plates together. I send you through the sample post one of the metamorphosed rivet heads. The plates were in good condition, and with the exception of a slight pitting in a spot or two, showed no signs of corrosion. There is nothing peculiar in the water used; in fact, a twin boiler has been at work upwards of twenty years in the identical conditions, and is, notwithstanding, in tolerable state. What can be the cause of the rivet heads having become incorporated, as it were, in the scale? The action is by no means uniform, some of the heads being intact. Can it be that a difference of quality between the iron of the rivets and that of the plates set up an electrical action?

Perhaps some of your correspondents, would kindly help me to a plausible explanation of the phenomenon, of which possibly some other instances may be known to your readers.

Palermo, July 28th. Robert Gill.

MARINE BOILERS.

Sir,—You were good enough to insert my remarks under this head in yours of the 27th July, and I now inclose the results of experiments made with an old flue boiler and the modern one now generally used for comparison, and as both boilers worked under the same conditions, this will serve to show the progress made, and as these boilers were used in the dockyards for testing purposes, considerable attention was paid to accuracy.

Lbs. of water evaporated per lb. of coal.		Cubic feet of water evaporated in an hour.	
Calculated at the actual temperature of the feed-water.	Calculated at the constant temperature. 100 deg.	Calculated at the actual temperature of the feed-water.	Calculated at the constant temperature. 100 deg.
Old, flued Boiler, Woolwich Dockyard, May 10th, 1845.			
9·02	9·43	47·88	50·05
New Multitubular Boiler, Portsmouth Dockyard, March 18th, 1874.			
7·56	7·90	49·23	51·46

Length of fire-bars in each boiler, 4ft. Same description of coals used in each trial.

The reason for selecting these two trials is that the coals were the same, size of furnaces, steam blown off at atmospheric pressure, and performing the same duty; and it may be asked where is the progress made in modern boiler-making, and is it creditable that 800 deg. to 1000 deg. of heat should escape up the funnel to waste? The temperature in the funnel of the old-flue boiler ran about 350 deg. to 400 deg. It is not my province to point out a remedy, it will be sufficient for me to point out that an evil exists and will likely continue whilst so much attention productive of refinements is given to engines, and none to boilers. Strength only seems to be studied.

W. A. Martin.

Pocock-street, Blackfriars-road, London, S.E.

Sir,—Your correspondent's expression of astonishment at the little real progress made in the performance of marine boilers is just, and it is, as he says, a disgrace to this age of engineering skill. The many opportunities he has had of comparing the execution of the old flue boilers with the more recent multitubular type, seems to warrant this assertion. It may not be out of place, if you will permit me, to remark upon the probable cause of some of the disadvantages under which boilers labour; *i.e.*, their imperfect heating surfaces. A common rule is to deduct one-fourth of the whole tube surface as inefficient. This may be largely increased; in fact, nearly one-half of the whole tube surface of multitubular boilers are useless, due to the presence of a thin film of steam, which covers the under side of the tubes, clothing them with a non-conducting medium, preventing the heat passing through the tubes from coming into contact with the water lying contiguous to them, except at those points above the centre line of tube—horizontally. This may be seen by the effect produced by the rolling of a vessel when running with a sea on her beam. A ship under full steam may show no sign of priming in her boilers until a heavy sea or long swell causes her to roll; immediately the boilers begin to prime, and continue to do so for some little time, it then ceases, the water showing no signs of ebullition until some change takes place in the rolling of the vessel. The deduction is palpable. Whilst the vessel is in smooth water the film of steam around the bottom surface of the tubes is at rest; the rolling action of the ship causes a displacement, and the portion of the tube recently inefficient is brought into contact with the water. The tubes having become overheated discharge the water away from them in globular form, destroying its compactness and causing priming. The continual roll gradually cools the overheated portions until they possess an equal temperature with the other parts, and become alternatingly efficient heating surfaces. Then it is ebullition ceases, for the continual roll does not permit the lower portions to become overheated. This leads us to the further consideration of the wearing away—in fact, the rapid decay of the under sides of tubes. The passage of soot and ashes is a small factor; but the real cause is the continued overheating, which destroys the nature of the metal, decomposition takes place, and the tubes are utterly destroyed.

Twelve years ago I suggested the above reasoning to Mr. Stewart, Blackwall; Mr. Penn, Greenwich; and to Messrs. Thompson and Boyd, Newcastle. They all agreed to the conclusions, but did not see how they might be remedied. I suggested an alteration in the form of tube, which, I believe, would effect a very great influence upon the evaporative capability of one pound of coal.

If these suggested ideas lead to a consideration of the whole subject of multitubular boiler construction it may lead to some practical good. J. B. PECKHAM.

[Has our correspondent ever seen what takes place inside a boiler when at work? He speaks with such confidence that we assume that he has. Our experience, however, with comparatively large models of marine boilers with glass ends does not at all substantiate Mr. Peckham's statements.—ED. E.]

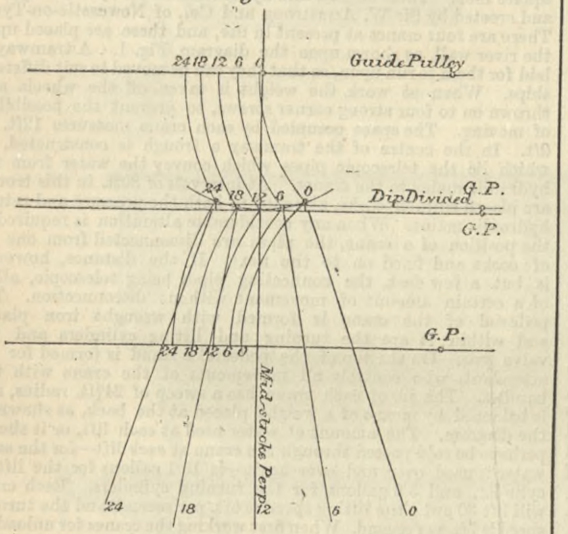
ABSTRACT OF A PAPER ON THE COMPARISON OF INDICATOR RIGS.*

By ROBERT GRIMSHAW.

CORRECT instruments may be applied and used in wrong ways, and give incorrect results. The steam engine indicator is frequently so applied and used; the devices employed to reduce the motion of the crosshead often causing great errors in the diagram. Among the methods we may consider—(1) Cord attachment from a pin in the end of the shaft or side of crank, direct to the paper barrel; (2) cord from a swinging lever slotted to receive a pin in the crosshead; (3) cord from a swinging lever connected with the crosshead by a vibrating link; (4) cord from a swinging lever attached to the crosshead, the pivot of this lever vibrating at the end of a swinging link; (5) the reducing wheel; (6) Pantograph; (7) "lazy tongs."

In devices 2 and 3, which are the most commonly used, the cord may be either (a) attached directly to the lever; (b) wrapped around a circular arc or sector centred in the pivot of the pendulum. No. 1 is irrevocably tainted with the angularity of the connecting-rod, compounded with that of the cord. It always gives less than a quarter the diagram length, for the first quarter of the outstroke of the piston; and gives longer cards on an indicator at the back end than at the crank end. The shorter the connecting-rod and cord, for a given stroke, the greater the errors. (2) The slotted lever gives absolutely correct results when at mid-stroke, it is perpendicular to the crosshead path, and the cord gets its motion from a pin which is driven by a radial slot centred in the pivot of the lever, and perpendicular to the cord at mid-stroke. (b) With long cord attached directly to the lever the results are practically correct, provided that the "dip" of the cord is divided, and the cord is led off so that at mid-stroke it makes a right angle with the radial line from its attachment to the pivot. (c) With a long cord wrapped around a circular arc, centered in the pivot, the results are practically correct, no matter how the cord is led off. This theoretical, but practically immeasurable error, gives equal cord lengths for both halves of the stroke, but the end quarters give somewhat longer card lengths than the central quarters. The error decreases with the total angles of lever and cord swing. (3)

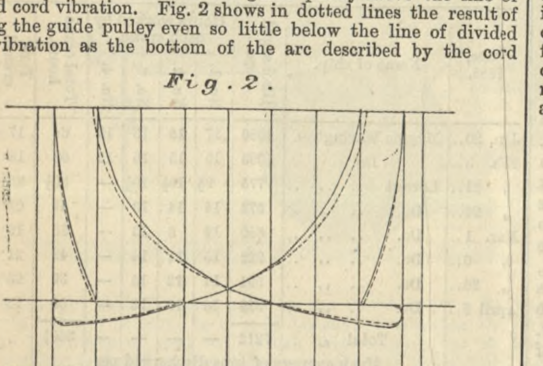
Fig. 1.



MOTION OF USUAL PENDULUM AND LINK.

The lever with fixed pivot, and linked to the crosshead, gives quite good results when properly applied, although not so accurate as a double-slotted lever of the same length. At mid-stroke it should be vertical, and the link sufficiently below the crosshead attachment to divide the dip. Remarks b and c concerning the cord attachment to the slotted lever apply to this rig. As in the latter rig also, the longer the lever, and the cord between lever and guide pulley, the more accurate the results. Fig. 1 is reduced from a carefully made plotting, full size, of the motion of a rig with levers 36in. and 24in. long. The vertical line represents the position of the pendulum at mid-stroke. The dip of the link was divided at this position. Four different cord angles gave as many varying results. When the angle of cord vibration was divided and the guide pulley placed at the point G P on the second horizontal line parallel to the crosshead path, the error in a 4in. card was hardly measurable. Circular arcs swept from the upper point G.P. from the points indicating successive positions of the point of cord attachment, show that with this position of guide pulley the first quarter of the forward piston stroke gives more, and the last quarter less, than a quarter of the card length, this being reversed on the back stroke. Carrying the guide pulley below the line of divided cord vibration, the errors of card length are exactly the opposite of those made with the guide pulley above the line of divided cord vibration. Fig. 2 shows in dotted lines the result of putting the guide pulley even so little below the line of divided cord vibration as the bottom of the arc described by the cord

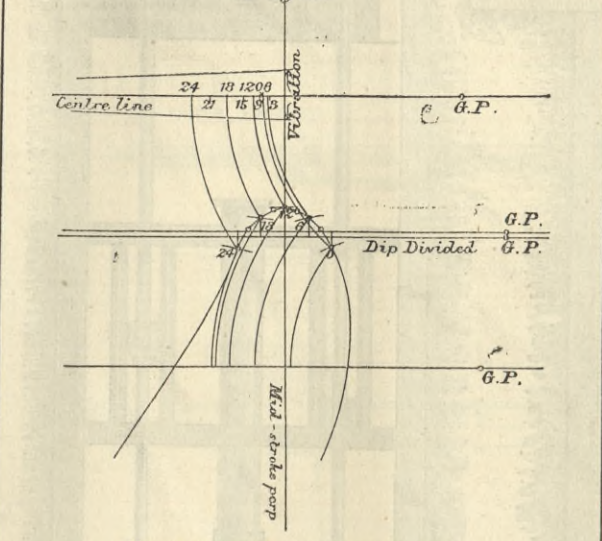
Fig. 2.



FALSE DIAGRAMS TAKEN BY USUAL PENDULUM AND LINK.

attachment. The correct cards for the plotted amount of clearance and points of cut-off and compression are in full lines. (4) The pendulum with swinging centre is probably the most erroneous used or proposed. Fortunately it is not a usual rig. It does not permit of the use of a circular sector for cord attachment, nor can the cord be attached, as in where the pendulum pivot is stationary, anywhere but in the line of centres of the long lever; thus losing one of the main advantages of fixed centre levers, the dispensing with a guide pulley. The point of cord attachment describes a mixed curve which is neither regular nor symmetrical, one limb being variably convex, and part of the other being decreasingly convex and then increasingly concave. With the lever plumb at mid-stroke, the "dip," or versed sine of the swing of both levers divided at mid-stroke, and the cord running off parallel to the crosshead path, the results, while not so correct as those from the other lever rigs, and not accurate enough to set valves by, will do to give a general idea of engine performance and an approximation as to horse-power. The greater the angular vibration of pendulum, link, and cord, and the greater the angle made by the cord with the path of the crosshead, particularly where the cord makes an acute angle with the radius between cord attachment and swinging centre, the greater the error. This tendency to error is so great, that some cord angles likely to be chosen by any one not thoroughly conversant with the errors of this rig, actually give a negative movement to the paper drum, during the first portions of the outstroke; so that for an engine with a lazy steam valve the admission line would appear as compression to initial pressure, and with cut-off at $\frac{1}{16}$ stroke, the diagram would commence with the expansion curve, and have two vacuum loops so large as to prove the engine to be driven by the main belt, and pumping into the boiler. Fig. 3 is a photo reduction from a plotting made with scrupulous care,

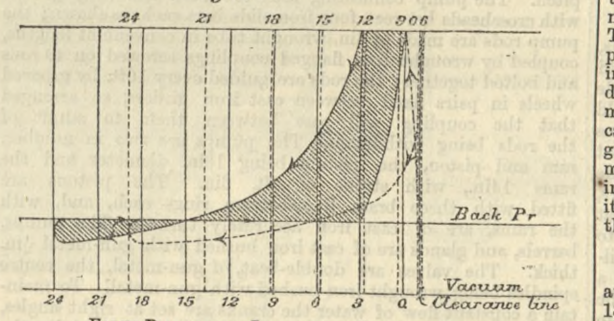
Fig. 3.



MOTION OF LEVER WITH VIBRATING PIVOT.

with a 36in. pendulum swinging on a 24in. link, the "dip" or versine of the latter being divided by the vertical line, which represents position at mid-stroke. The curved trace was made by inserting a pencil point in the hole for cord attachment; the line being the "reversed curve" referred to in a previous paragraph. The nine small circles on this curve show the successive positions of the cord attachment at equidistant portions of the piston stroke. With the angle of cord vibration divided, the error on a 4in. card is measurable, but not serious for rough calculations of horse-power, though sufficient to throw the cards out for plotting true theoretical expansion curves. The slightest variation from this height of guide pulley produces an error so great as to vitiate any cards with early cut off, even for horse-power calculation. With the guide pulley much above the line of divided card vibration, as shown in the diagram, there is produced the astounding result referred to in the preceding paragraph:—During the first eighth of

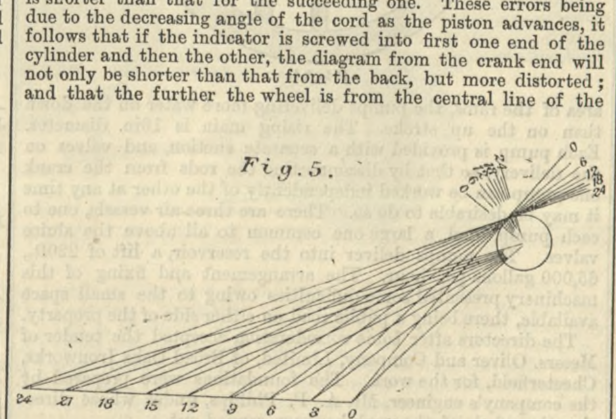
Fig. 4.



FALSE DIAGRAM BY LEVER WITH SWINGING PIVOT.

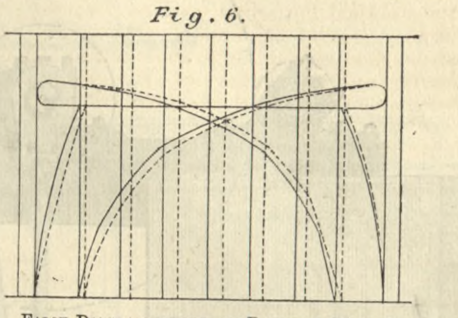
a forward stroke the cord slacks, and is not again tightened until the end of the third eighth of the stroke. The positions of the point of cord attachment at successive eighths of the forward stroke are shown in Fig. 3; while in Fig. 4 the dotted lines show the false card which would be produced with 60 lb. absolute initial pressure, and cut off at $\frac{1}{8}$ stroke—clearance and compression being as shown in the correct theoretical diagram hatched in full lines. The numbers 0, 3, 6, &c., on the lower line indicate correctly successive piston positions; the same numbers on the upper line showing where the piston would be represented to be, by the rig shown. (5) The reducing wheel gives absolutely correct results when properly applied, which is seldom the case. The cord should be led from an offset from the crosshead, so that it will, at all piston positions, be absolutely parallel to the piston-rod. When it makes an eagle with the rod, it gives a shorter card than is due to the stroke, but not only that, the card for any given fraction of the out-stroke is shorter than that for the succeeding one. These errors being due to the decreasing angle of the cord as the piston advances, it follows that if the indicator is screwed into first one end of the cylinder and then the other, the diagram from the crank end will not only be shorter than that from the back, but more distorted; and that the further the wheel is from the central line of the engine, and the nearer the crosshead attachment to that same axis, the greater the error. False cards by this rig always show the cut-off too early and horse-power too low on the out-stroke, and the reverse on the return. In Fig. 5 there are plotted eight equal successive portions of a 24in. forward piston stroke and a 4in. reducing wheel wrongly applied. The angles made by the tangents representing the successive positions of cord, are greatest for the earlier equal portions of the outward stroke; so that instead of correct diagrams like the full lines in Fig. 6, there are taken such as are shown by the dotted lines; the right-hand card being from the back end. (6) The pantagraph can be made to give perfect cards, the only danger being in oblique cord connections. (7) The same remarks apply to the lazy tongs; but in this there appear two special sources of error: lost motion in a multiplicity of joints and springing of the frame at high speeds, prolonging the card at the two ends, hence making cut-off appear too early and horse-power too low. In all cases, the cord should be light and non-

Fig. 5.



MOTION WITH WRONGLY APPLIED REDUCING WHEEL.

Fig. 6.



FALSE DIAGRAMS TAKEN BY REDUCING WHEEL.

stretchable. Braided corn is best, if cord is to be used; piano wire is better, and absolutely prevents the objectionable use of a guide pulley.

Since preparing this paper, Mr. B. F. Teal has submitted a model of a method of reducing the crosshead motion by differential pulleys carried on the crosshead, and giving the paper drum positive motion on each stroke.

The results of my investigations and tests are, that for accurate results at high speeds, the slotted lever is by far the best rig, from its simplicity, cheapness, ease of attachment while engine is running, lack of spring, direct cord connection, and adaptability to various lengths of stroke and position of indicator.

Before this abstract was in type, the appearance of a lengthy mathematical discussion of this question in a well-known magazine, by a gentleman who commenced a discussion of the paper itself at the meeting at which it was presented, renders it necessary for the writer to add to the abstract a memorandum of the manner in which the tests and measurements were made.

Hard wood pendulums and links were made, with the pivot centres accurately laid down, drilled squarely with a $\frac{1}{16}$th twist drill, and their distances carefully measured. Scribe lines were drawn and carefully drilled in the same manner to mark successive eighths of 24in. piston strokes. With a tested T square, the mid-stroke positions of the levers were laid down previous to drilling the centres for piston position holes. The levers were then accurately centred, and the point of cord attachment drilled for a metal marking point which should not only make a trace of the entire motion curve of the point of cord attachment, but would prick the positions of that point at each piston position. The distances from guide pulleys were transferred by stiff trammels, and the card lengths measured to hundredths of an inch as well as graphically recorded. In addition to the graphical test and proofs made by the levers themselves, full-sized diagrams were made with a hard pencil, and these were measured to check the graphical records.

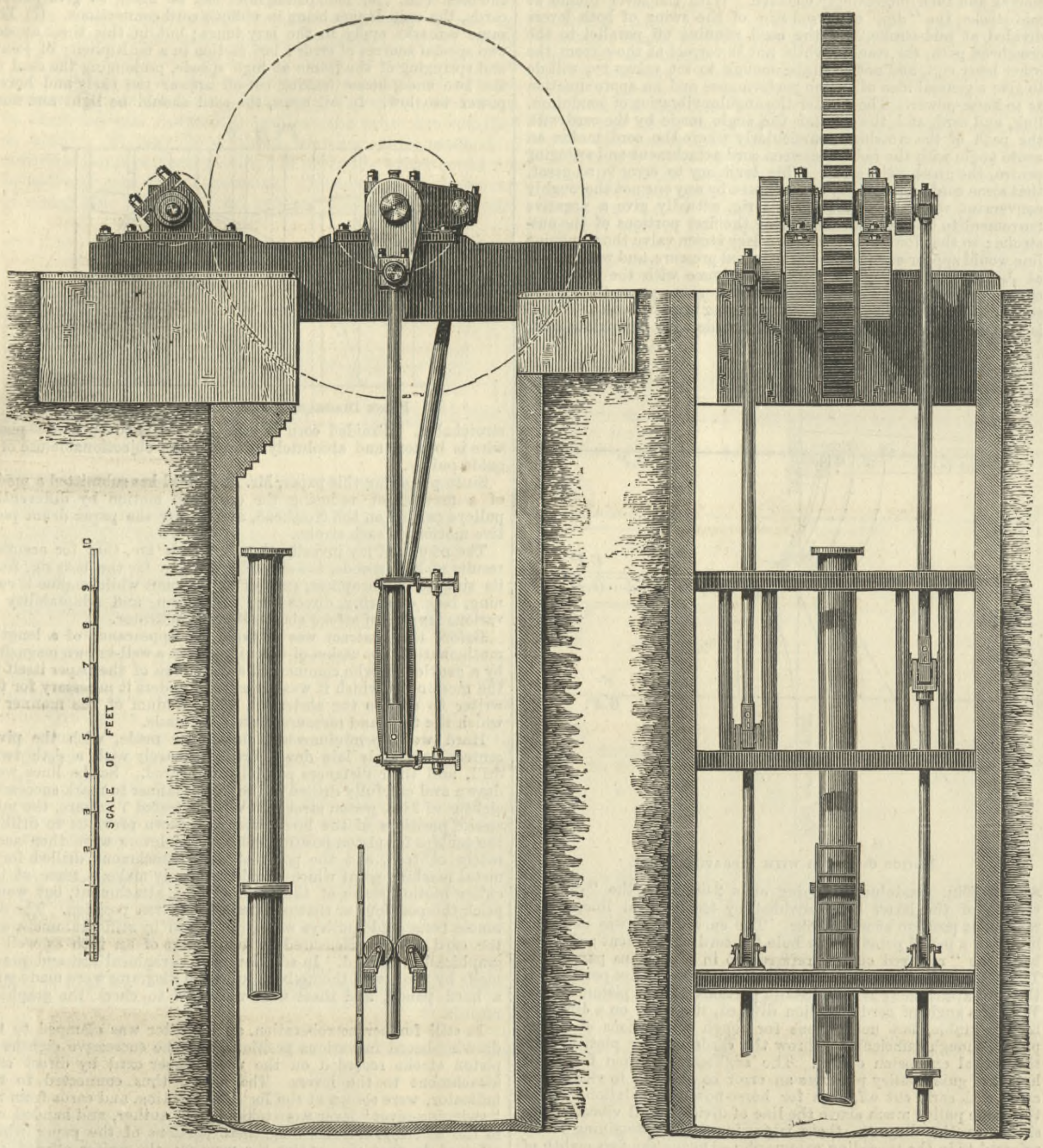
In still further corroboration, an indicator was clamped to the drawing-board in various positions, and the successive eighths of piston stroke recorded on the usual paper card by direct cord attachment to the levers. The levers, thus connected to the indicator, were shown at the Institute meeting, and cards from the "swinging-pivot" lever were taken by the author, and handed out at the meeting, corroborating those portions of the paper which referred to that rig. After the meeting, the writer offered the indicator to the member who upheld that rig, if he would either take a correct card with that rig, or disprove the methods and measurements there offered. The author still owns the indicator. The writer's measurements, particularly those of the swinging-pivot lever rig, were checked by skilled engineers and draughtsmen in various parts of the country, and the levers and board are on deposit at the Franklin Institute, for the convenience of those who may wish to test for themselves. The inference is clear: Where carefully made measurements by distant and disinterested parties give different results from those obtained by calculation, there must be a leak in the mathematics. In this connection, while not in the least wishing to disparage mathematical investigation and its results, the author begs to offer the following: Given, $a = b$; then, $a^2 - b^2 = ab - b^2$; $(a + b)(a - b) = b(a - b)$; $a + b = b$; $2 = 1$.

* Read before the Franklin Institute, May 18th, 1883.

THE IRON AND STEEL INSTITUTE.—The arrangement for the autumn meeting of the Iron and Steel Institute, to be held on the 18th, 19th, and 20th of September, at Middlesbrough, are now almost completed. An influential local committee has been formed in that town, under the chairmanship of Mr. Bolckow, and has organised a series of excursions and entertainments in honour of the Institute. The New Basic Steel Works of the North-Eastern Steel Company, and the new and very extensive works of Bolckow, Vaughan, and Company, at Eston, will be the chief places to be visited, and as they are the first works that have been established in this country for carrying on the manufacture of steel by the basic process, it is likely that they will be examined specially by the various members. Another interesting excursion will be made to the South Durham coal district, where a new system of manufacturing coke, admitting of very considerable economy in the yield as well as in the collection and utilisation of all the bye-products obtained by the distillation of coal, has been for some time successfully at work. A very good list of papers has been formed for reading and discussion, and a fund of several thousand pounds has been raised to cover the expenses for entertaining the members of the Institute.

THE ACCIDENT AT WHEAL AGAR MINE.—The inquiry into the circumstances of the accident at Wheal Agar Mine last week has been conducted and concluded at Pool, near Redruth, by Mr. Grenfell, the county coroner. The evidence of Captain Daniell, who was in charge at the time of the accident to the men, showed that in consequence of the failure of the whim rope during the night the capstan rope was attached to the cage to draw up the men. The pitman Pentecost stated that the rope was used on the Saturday prior to the accident with a weight of 10 tons, and it had been used to lower 20 tons. Mr. Frecheville, the Government inspector of mines, said to use the rope for 20 tons was improper. It was not provided for in the Mines Act, but managers and agents of mines should know that it was improper that such a rope should be used for drawing up men. If the manager knew that the rope was strained it would be his duty to see that it was not used to raise men. He had no doubt that a twist occurred in the rope, and so augmented the danger. About two months ago it was found that some of the wires were broken. The faulty part was at once cut and new shackles were put in. He was not aware that a strain of 20 tons had been put upon the rope. In the case of such a weight blocks would be used. The pitman Pentecost said that he put the 20 tons on the rope on his own responsibility. He was obliged to do it to get the pumps down to prevent the water gaining. Captain Trevena said that had he known that the capstan rope had been used for such a strain he would not have allowed it to be used for the men. The change of ropes was made during his absence. Captain Daniell also said he never heard of such a strain having been put upon the rope. The jury returned a verdict of "Accidental death," adding as a rider that catches should be fixed to the cage to prevent it from falling down the mine should the rope break.

PUMP GEAR, ST. ALBANS WATERWORKS.

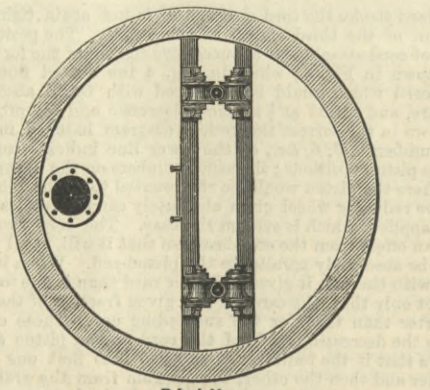


WATER SUPPLY OF SMALL TOWNS.

No. IX.—ST. ALBANS WATERWORKS.

The original water supply works of the city of St. Albans, date back many years. In the excavation of the roads old wooden water conduits have been discovered. A well was made and an engine-house with a tank over it erected on leasehold ground on Bernards Heath about the year 1836, from which mains were laid, and the town—as it then was—received an intermittent supply for many years. As the place remained stationary for some time after coaching ceased with the introduction of railways, this was ample. On the London and North-Western and Great Northern Railways introducing their lines the town began to revive, and more recently, since the main line of the Midland Railway passed through, bringing it in connection with London in a little over half an hour, the town has taken great strides. The extensive repairs of the Abbey, and the creation of the town into a city with a Bishop, has had a beneficial effect. To meet the requirements of the increasing population and in view of the old works being leasehold, in 1865 the directors obtained an Act of Incorporation and purchased a piece of ground at Snatchcups End, which, though somewhat inconvenient, was the only land then obtainable, and erected new works with a 25-horse power high-pressure horizontal engine working a pair of 8in. pumps, the water being raised from a deep well sunk in the chalk 190ft., and continued with borings. The greater part of St. Albans standing on the highest ground of the neighbourhood, the reservoir was constructed of cast iron, above ground, and contains 190,000 gallons.

In 1874, Mr. A. F. Phillips, M. Inst. C.E., having become engineer of the works, a compound condensing beam engine, with three 8in. pumps was put down, and a second reservoir containing 600,000 gallons constructed. In 1879, owing to the continued rapid development of the city and the demands likely to be made upon the works from the complete system of sewerage to be carried out, the company applied for a Provisional Order empowering them to raise additional capital. A second well, 200ft. deep, 7ft. 6in. diameter, with a 12in. boring, continued 150ft. beyond, with adits 230ft. long, was made, in which has been fixed the pumps illustrated this week at page 152, with the engine for working them. The normal level of the water from the surface is 160ft., and of course comes entirely from the chalk formation; it is of excellent quality, and not so hard as some of the chalk waters. A double set of mains have been laid through the district, affording both a constant and intermittent supply, the old customers being changed to the former on making the necessary alterations in their fittings. The engine is compound, cylinders being placed tandem, and fitted with a surface condenser. The high-pressure cylinder is 16in. diameter and the low-pressure 28in. diameter, stroke 32in.; both cylinders are steam jacketted, the jackets being cast on. The high-pressure cylinder is fitted with an expansion valve adjustable while the engine is running. The crank shaft is 9in. diameter, of best scrap iron, and the fly wheel 16ft. 6in. diameter, weighing three and a-half tons. The air pump is worked with a crank connected to the crosshead. The condenser is 8ft. long by 2ft. 6in. diameter, fitted with brass seamless tubes, the water passing through the tubes, the steam outside. The pump shaft, which is 10in. diameter with wrought iron crank at each end, is driven with spur wheels, the pinion being 2ft. diameter on engine shaft, and the wheel 10ft. diameter, the teeth 10in. wide, with a 3in. pitch. The pump connecting rods are 12ft. 3in. long guided with crossheads between four iron slide bars each, as shown; the pump rods are made of 4in. wrought tube in convenient lengths, coupled by wrought iron flanged couplings screwed on to rods and bolted together; the rods are guided every 10ft. by grooved wheels in pairs fixed between cast iron girders, so arranged that the coupling will pass between them to admit of the rods being withdrawn. The pumps are two in number, ram and piston, the pistons being 18in. diameter and the rams 14in., with stroke of 3ft. 6in. The pistons are fitted with three brass Ramsbottom rings each, and, with the rams, are of cast iron accurately turned. The pumps, barrels, and glands are of cast iron bushed with gun-metal ½in. thick. The valves are double-beat, of gun-metal, the centre spindles being wrought iron bushed with gun-metal. To maintain a constant flow of water the cranks are set at right angles, the weight of the rods and the cranks being balanced by the


PLAN

area of the rams, the pumps delivering more water on the down than on the up stroke. The rising main is 10in. diameter. Each pump is provided with a separate suction, and valves on the delivery, so that by disconnecting the rods from the crank one pump can be worked independently of the other at any time it may be desirable to do so. There are three air vessels, one to each pump, and a large one common to all above the sluice valves. The pumps deliver into the reservoir, a lift of 220ft., 65,000 gallons per hour. The arrangement and fixing of this machinery presented some difficulties owing to the small space available, there being a public road on either side of the property.

The directors after some consideration accepted the tender of Messrs. Oliver and Company, Limited, of Broad Oaks Ironworks, Chesterfield, for the work. The foundations were prepared by the company's engineer, Mr. A. F. Phillips, under whose direction the whole of the work has been carried out.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—John Miller, chief engineer, to the Lord Warden, vice Brown; Alfred Palmer, engineer, to the Indus, additional, for service in the Prince Albert, vice Baker; and Wm. C. Barnett, assistant engineer, to the Jumna, vice Fidder.

RECEIVING AND STORING LOCOMOTIVE COAL FOR THE GREAT SOUTHERN AND WESTERN RAILWAY, WITH A DESCRIPTION OF A NEW FORM OF WAGON.*

By J. A. F. Aspinall, Member, Vice-President.

In bringing the subject of the following paper before this Institution, the author cannot help feeling that it is one which will only be of interest to a small proportion of the members, and, therefore, his excuse for so doing must be that there are some points of novelty in the details, though the question of dealing with much larger quantities of coal has been the subject of many papers before the London Institution. It will be found, however, that these papers chiefly relate to the carriage of coal from the pits to the various shipping ports, and to the several methods of discharging it into ships. In the present case it is proposed to describe the reverse process of discharging the coal from ships, carrying it a certain distance in railway wagons, and then storing it for future use. The English railways have the advantage of being within comparatively easy communication with the coal districts, and, though very large consumers of coal can, in case of a strike, turn, without much difficulty, from one district to another for their supply, they do not, therefore, require to keep a very large stock of coal on hand in one place in proportion to their consumption. With Irish railways, however, it is somewhat different. The Channel intervenes between them and the coal districts, and any sudden stoppage of work in the coal mines affects these railways much more rapidly than it does those in England, as the points from which coal can be drawn are limited. It therefore becomes necessary to provide for these contingencies in proportion to the wants of the railways. For many years the coal used upon the northern division of the Great Southern and Western Railway had been delivered into lighters at the Ringsend Dock, then carried up the canal to a point about one-fourth of a mile from the yard at Inchicore, in which it was stored. From the canal boats it was loaded into tip wagons, which ran down a tramway to the stacking ground, where the wagons were tipped, and then hauled back to the canal by horses. This was an expensive system for reasons we need not enter into here, and the coal was much broken up and damaged by repeated handling. The opening of the railway to the North Wall enabled this system to be improved upon, with the additional advantage to the railway company of doing nearly all the work upon their own line. The coal is taken out of the ships with hydraulic cranes, and then loaded into drop-bottom wagons, which are shunted in and out of position by hydraulic power. When a train load is made up the wagons are taken over the North Wall Extension line to Inchicore, and there discharged, by means of the drop-bottom doors, into a coal yard 500ft. in length by 62ft. in breadth, over which run two high-level sidings placed 20ft. from centre to centre. The cranes and coal buckets will be first described, then the details of the wagons, and lastly, the high-level road. The power for working the cranes is supplied by a pair of horizontal 75-horse power engines, which work the other cranes, traversers, and capstans in and about the goods warehouse. These engines pump the water into the accumulator at a pressure of 700 lb. per square inch. These engines and hydraulic machinery were supplied and erected by Sir W. Armstrong and Co., of Newcastle-on-Tyne. There are four cranes at present in use, and these are placed upon the river wall, as shown upon the diagram, Fig. 1. A tramway is laid for them to run upon, so that they can be moved to suit different ships. When at work the weight is taken off the wheels and thrown on to four strong corner screws, to prevent the possibility of moving. The space occupied by each crane measures 12ft. by 9ft. In the centre of the tramway a trough is constructed, in which lie the telescopic pipes which convey the water from the hydraulic mains to the cranes. At intervals of 30ft. in this trough are placed suitable cocks, attached to both the pressure and return hydraulic mains. When any considerable alteration is required in the position of a crane, the pipes are disconnected from one set of cocks and fixed on to the next. If the distance, however, is but a few feet, the connecting pipes being telescopic, allow of a certain amount of movement without disconnection. The pedestal of the crane is formed with wrought iron plates, and within it are the turning and lifting cylinders and the valve gear. On the top of the pedestal a stand is formed for the attendant, who controls all movements of the crane with two handles. The jib of each crane has a sweep of 24¾ft. radius, and is balanced by means of a weight placed at the back, as shown in the diagram. The amount of water used at each lift, or it should perhaps be said passed through the crane at each lift—for the same water is used over and over again—is 18·1 gallons for the lifting cylinder, and 3·6 gallons for the turning cylinders. Each crane will lift 30 cwt., the lifting speed is 6ft. per second, and the turning speed is 7ft. per second. When first working the cranes for unloading coal, buckets carrying 10 cwt. each were used, the gross weight of the bucket and load being 18 cwt. Later, however, these were changed to a larger size, carrying 20 cwt., and weighing 10 cwt. when empty. The weight lifted each time was thus 30 cwt., being just within the capacity of the cranes. As the same amount of water is used in each case, this doubled the work done by the cranes without increasing the expense. There is nothing new in the form of the coal buckets, which are shown on diagram, Fig. 4; but it may be mentioned that for this class of work the cylindrical form seems to be the best, as they are subjected to such rough usage, and the absence of sharp corners prevents their catching in the hatchways. It is also of importance to have no projections of any sort that can be avoided on the outside of the bucket, as these are sure to be sheared off or damaged. It is found convenient to allow the tipping catches to fall into a recess in the rim of the bucket, and thus take nearly all strain off the hinge pins. In practice it is found that each crane makes one lift in three minutes. This allows for delays in placing wagons, tipping the buckets, and getting them into position in the hold. When three cranes, which is the usual number, can work at one ship, using the large coal buckets, one ton per minute is discharged. There is no difficulty in getting out 60 tons per hour under these conditions.

Particulars of Coal Tonnage Discharged by Great Southern and Western Railway Hydraulic Cranes at North Wall Quay.

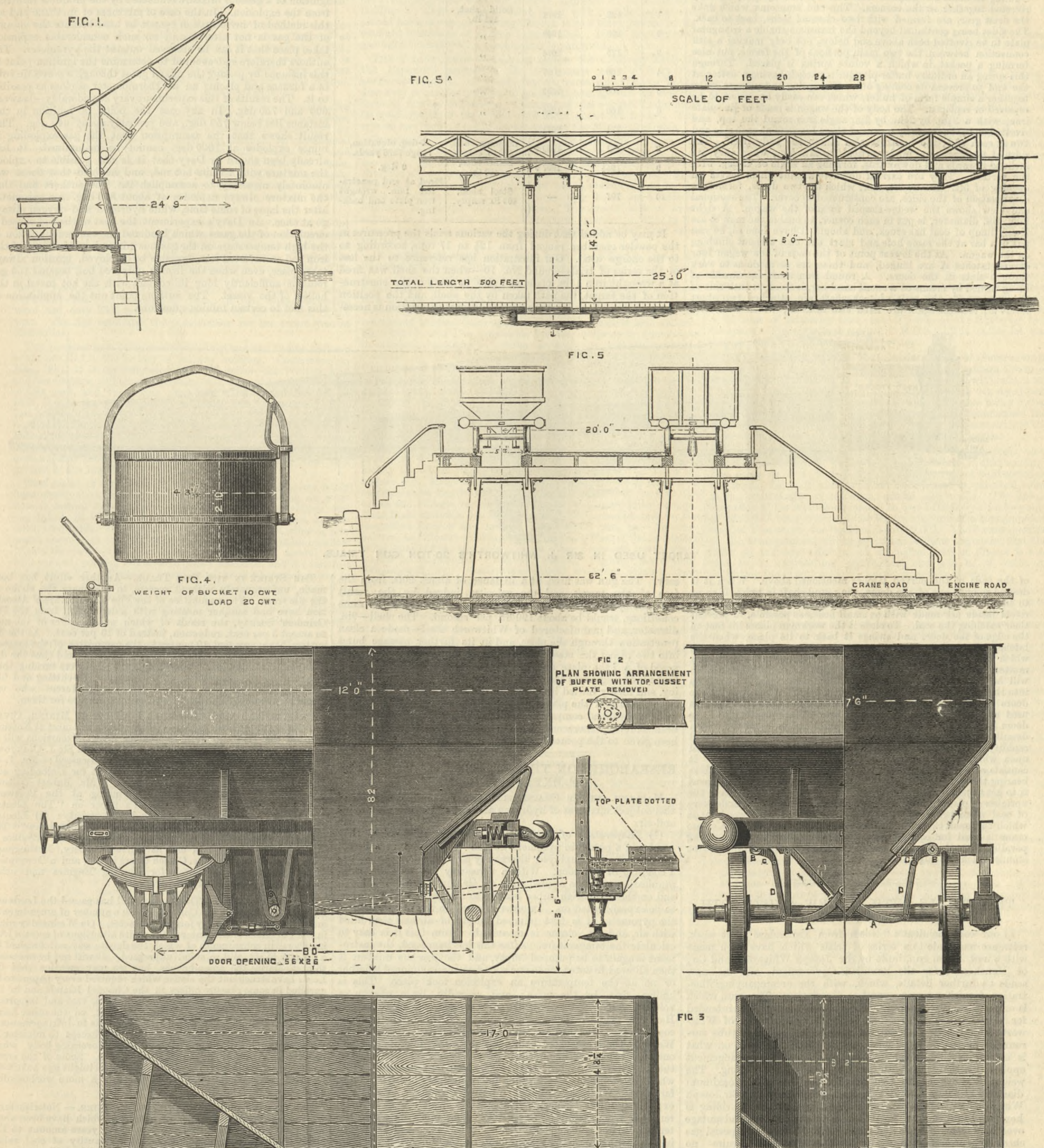
Date, 1883.	Name of ship.	Discharged tons.	Hours worked by each crane.				Total crane hours.	Tons craned per hour.	No. cranes used.
			No. 1.	No. 2.	No. 3.	No. 4.			
Jan. 20..	Maggie Warington.	1086	17	15	15	15	64	17·0	4
Feb. 5..	Do.	1093	15	15	15	15	60	18·2	4
„ 21..	Levant	775	9½	10½	10½	—	30½	25·4	3
„ 26..	Do.	873	14	14	13	—	41	21·2	3
Mar. 1..	Do.	650	12	8	13	—	33	19·7	3
„ 6..	Do.	922	15	14	14	—	43	21·4	3
„ 26..	Do.	894	14	12	13	—	39	23·0	3
April 6..	Do.	919	16	16	18	—	50	18·4	3
	Total	7212	—	—	—	—	360½		
	Mean average of tons discharged per crane per hour = 20 3.								

The wagons into which the coal is loaded have been specially constructed for the purpose of carrying coal and discharging it rapidly. Two classes of wagon have been made—one entirely of iron, to be used exclusively for carrying coal, and the other of wood, to be used both for coals and goods. Before any number of iron wagons were constructed, the designs of wooden drop-bottom wagons in use on other railways were carefully looked into, and it

* Read before the Institution of Civil Engineers of Ireland.

PLANT FOR RECEIVING AND STORING LOCOMOTIVE COAL.

(*For description see page* 148.)



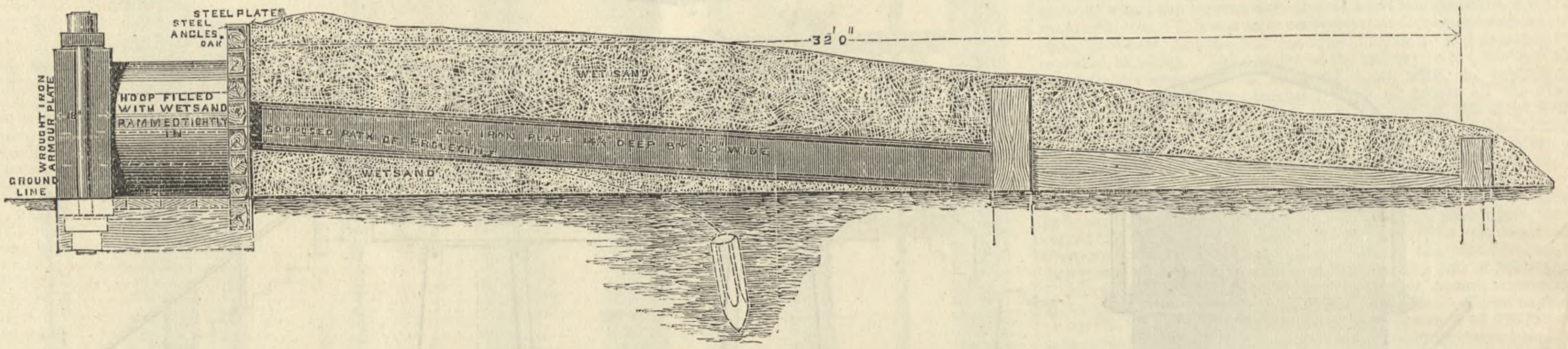
was thought that the one used by the North-Eastern Railway would probably be found to be well designed, considering the very large quantities of coal with which this company has to deal. This wagon is shown on Fig. 3, but was not found satisfactory. A wagon was wanted which would carry ten tons, that would discharge itself rapidly without a man having to get inside it, that should have doors through which the largest lumps of coal would pass, that these doors should be readily opened by one man, and as easily closed, and that when closed they should be efficiently yet simply locked, so as to prevent the possibility of their opening in transit. An able paper on the subject of drop-bottom wagons was read by Mr. Charles Wood, before the Cleveland Institution of Engineers, in April, 1875. He therein pointed out the serious defects of many of the existing forms of hopper wagons, also gave the outlines of the wagon in which he proposed to get over these difficulties. Advantage was taken of the information, and proposals made in this paper when designing the truck shown in Fig. 2. He proposed a truck with an iron body and wooden frame, whereas this is wholly of iron. One iron truck, Fig. 2, and what may be called a North-Eastern truck, Fig. 3, were first of all built to test their respective merits. Both carried ten tons, and both were constructed in hopper form, so as to empty themselves without a man entering them; should a man do so when the door were open he would run a risk of being shot out with the coals, with very little chance of saving himself. The timber under framing of the wooden wagon prevented large doors being used. There are two doors at each side which fall open easily when the safety-pin has been taken out and the catch pulled back. These doors measure 2ft. 7in. by 1ft. 11in. If small coal only is carried it will run out quickly enough, but it was found that the very large lumps of South Wales steam coal jambed in the openings. When this happened much time was lost in unloading. Under the most favourable conditions the time occupied in unfastening the doors, dropping the coal, and shutting the doors again, amounted to four minutes with two men. The weight of the truck alone was 6 tons 8 cwt. The construction of the iron truck, Fig. 2, enabled two large doors to be put in the centre, of such a size that few lumps of coal would not pass through. A large proportion of the body being below the framing the truck was thus made shorter, occupying less siding room, and enabling a shorter wheel-base to be used—a matter of considerable importance considering some of the sharp curves round which these trucks had to pass. The time occupied in unloading was about one minute with two men, including unfastening and closing the doors. The ten tons of coal ran out in from ten to fifteen seconds. The weight of the truck itself was five tons. The advantages of the iron truck having been shown it was decided to build more of the same pattern, with such modification in details as experience had suggested. The result of the work done with these trucks has proved that the decision was a wise one. They have already carried very large quantities of coal, discharging it with great rapidity, and being thus ready to return almost at once for another load. This saving of time reduces the number of wagons required to a minimum. The general construction of the wagon is shown in the diagram, Fig. 2. The framing is made of channel iron 8in. by 4in. by ½in., securely rivetted together at the corners. The end transoms, which take the draw gear, are formed with two channel irons, back to back. The sides being continued beyond the transoms enable a triangular plate to be rivetted both above and below, not only making a stiff connection between the two main portions of the frame, but also forming a pocket, in which a volute spring is placed. Through this spring an ordinary buffer-plunger is passed, having a cotter at the end to prevent its coming out. The spring and plunger make together a simple form of buffer, which can easily be got at to be repaired or replaced. The body of the wagon is made of ⅜in.-plate iron, with a 2½in. by 2½in. by ⅜in. angle iron round the top, and rivetted on to the frame by means of three brackets at each side and two at each end; the brackets also stiffen the body itself. The sides of the wagon are made vertical for 2ft. 5in., when they are inclined inwards and downwards, forming an angle of 43 deg. with the vertical. They are carried down to a point which leaves an opening of 5ft. 6in. by 2ft. 6in., which the two doors, forming a continuation of the sides, are constructed to cover. The sectional end view shows the wedge-shaped form of the wagon. A sight hole, 1in. diameter, is put in each corner, to enable the man to see if any lump of coal has stuck, and should it have done so, he can put in a bar at the same hole and start the coal without climbing on the wagon. At the lowest point of the ends of the wagon four curved latches A are hinged, and these are so made as to work through slots in the doors. A round iron shaft B, capable of being turned by means of a small hand-bar, is fixed on each side of the wagon. To the ends of each shaft are attached two short levers C; to these again are fixed two links D, which take hold of the ends of the curved latches mentioned above. When it is desired to open one of the doors, the round shaft is twisted, so as to lift the latches, and the door at once swings open. All the rivets inside are made with as small heads as possible, to prevent their catching the coal. To close it the workman places his foot on the edge of the door, and swings it back to its place, when the latches fall in their slots and retain it. The small angle through which the doors have to be swung makes the closing a very easy matter. Above each of these curved latches a small hinged catch will be noticed. This has a projecting tongue upon it which fits into the slot in which the curved latch works. When opening the doors the first operation is to knock these catches out. This is used as a locking arrangement to prevent the possibility of the doors opening in transit. The three chief points about the wagon described are—rapidity of opening, quick discharge of its load, and rapidity of closing. The diagram No. 5 shows the overhead road upon which these wagons run in order to discharge the coal. It consists of a series of trestles upon which the longitudinal timbers bearing the rails are bolted. The general idea of the arrangement is to get as much clear space as possible for coal, and to have the uprights so placed as not to interfere in any way with the delivery of coal when being used. The yard is paved with wood, upon which the small skips for coaling the engines run freely. A steam crane is used for coaling the engine, which runs upon the siding parallel with the coal stage and the line upon which the engine stands which is being coaled.

TEST TRIALS WITH A NEW WHITWORTH 20-TON GUN.

In our correspondent's "Notes from Lancashire" last week, reference was made to a series of trials which have been made with a new 20-ton gun, built by Sir Joseph Whitworth and Co., of Manchester, for the Brazilian Government, and he now sends us further details, which, with the accompanying illustration, furnish a more complete description. The gun, which is one of a number ordered by the above Government, is intended for the Brazilian man-of-war Richuelo; it is made of Whitworth's fluid pressed steel, and consists of an inner tube surrounded by two series of hoops. The breech action is on what is known as the French system, with a special arrangement applied by the manufacturers for opening and closing. The weight of the gun is 20 tons, and it has a bore with a maximum diameter of 9·05in. and 29 calibres in length, rifled on Sir Joseph Whitworth's well-known system. This system of rifling is hexagonal in form, and for it it is now claimed as an advantage over other forms because that with the introduction of a special gas check the projectiles are now used as cast and require no tooling. The hexagonal form of projectile, it may be added, does not depend on the gas check for rotation, and there is no danger of its stripping as is sometimes the case with projectiles that have to depend for their rotation solely upon the gas check. It is also well known that a gas check does not in all cases entirely prevent the escape of gas past the projectile, and when this is the case erosion must inevitably commence, which ultimately will tend to destroy the fine lines of any polygroove system of rifling. The special advantages claimed for the hexagonal bore, it may be stated, are that with its well-rounded corners it is stronger in form and much less liable to fracture and damage, or to deterioration from corrosion when neglected, and that with its positive rotation a quicker pitch of rifling may be employed, whilst it enables a longer projectile to be used or fired, which is a point of considerable importance when the shot or shell is required for the piercing of armour plates. With regard to loading, any difficulty which might arise with the hexagonal form of projectile is overcome by the use of guides, and as all breech-loading guns have now enlarged powder chambers, a guide to carry the projectile through the chamber is necessary. If, therefore, the guide is made of the right form, the hexagonal projectile can be loaded as easily as one of cylindrical shape. It is not necessary to refer at any greater length to the special construction of the gun, and passing on to the results obtained as shown by the series of trials it has undergone, they may be said to have been of a highly satisfactory character throughout. The trials have been carried out at Blackley, near Sir Joseph Whitworth and Co.'s works, and on the Birkdale Sands at Southport, and the results of each trial are given in tabulated form as under:—

Round.	Powder charge. lbs.	Velocity. Feet per second.	Projectile.	Result.
1	122	1872	Solid shot, 321 lb.	
2	150	1982	"	
3	175	2096	"	
4	160	2027	"	
5	160	2003	"	
6	160	1988	"	
7	171	2074	"	
8	181	1989·9	Common shell, 300 lb. empty.	10 deg. elevation, range 7876 yards.
9	194½	1897·9	Solid shot, 400 lb.	0 deg.
10	197	—	Steel shell, 403 lb. empty.	Fired at and penetrated 18in. wrought iron plate and backing.

It may be added that during the various trials the pressures in the powder chamber ranged from 12½ to 17 tons, according to to the charge used. Our illustration has reference to the last of the series of trials—round No. 10—when the shell was fired at a wrought iron 18in. plate, and give in section the construction of the target, the path taken by the shell, and the position in which it was found. Very little additional description is necessary. The gun was fired at a distance of about 90ft. from the face of the target, and the velocity, judged by the result obtained by the previous shot fired under practically the same conditions, would be about 1900ft. per second. The shell—9in. diameter, and manufactured of Whitworth steel—made a clean penetration through the plate, and in its further passage burst into two pieces the steel hoop, passed through the backing composed of a 1½in. plate and oak planks bolted on with T-iron, broke into fragments the cast iron bed-plate supporting the backing, and finally buried itself in the sand at a distance of 17ft. 6in. from the face of the plate. The shell when dug out was found to have sustained comparatively little injury, except that it had been somewhat shortened at the extremity and a slight twist had been given to the pointed end.



TARGET USED IN SIR J. WHITWORTH'S 20-TON GUN TRIALS.

RESEARCHES ON THE IGNITION OF MIXTURES OF EXPLOSIVE GASES.

Mallard and Le Chatelier chose for the investigation of this subject mixtures of hydrogen and air, and of carbonic oxide and air.

(1) *Temperature of ignition.*—To measure this point, they employed a porcelain pyrometer, which was heated in a Perrot furnace; it was employed alternately as a thermometer and as a chamber of explosion. With a three-way tap of glass, communication could be opened with an air pump on the one hand, and on the other with tubes leading to the air or with the gases to be experimented on. In order to measure the temperature of the pyrometer it is first pumped empty of air and then filled with air, and its volume is measured. From this it is easy to calculate the temperature. After this has happened, the instrument is again to be pumped empty, and the gaseous mixture is then allowed to enter, when one soon becomes convinced whether or no at the temperature an explosion took place. This is known, first, by the noise; and, secondly, by a change of volume, which most gaseous mixtures undergo during explosion. Here it is assumed that the temperature of the furnace remains constant for a certain time, which, indeed, is hard to arrive at. We must therefore make two determinations of temperature—one before the experiment, the other after—and take the mean of them. The results can only be regarded as sufficiently exact when the two temperatures, thus determined, are not exceedingly far apart. With each gaseous mixture a number of series of experiments were made at temperatures which were as little removed from each other as possible. One must lie above the temperature of ignition, the other below it. The results obtained in this manner were very accordant, as the following numbers obtained for the explosion of mixtures of hydrogen and oxygen will show:—First series, 540 to 555 deg.; second series, 552 to 577 deg.; third series, 550 to 560 deg.; fourth series, 557 to 562 deg.; fifth series, 539 to 552 deg.; sixth series, 552 to 557 deg.; seventh series, 552 to 559 deg. The temperature of ignition, therefore, of this mixture lay at 552 deg. In other experiments the authors have gone much further, and the work was much increased. The following determinations were made:—

	Hydrogen.	
(1) Hydrogen and oxygen.	(0·15 O, 0·85 H) ..	560 to 570 deg.
" " ..	(0·30 O, 0·70 H) ..	552 " 569 "
" " ..	(0·66 O, 0·33 H) ..	530 " 532 "
(2) Hydrogen and air ..	(0·70 air, 0·30 H) ..	552 " 553 "
" " ..	(0·30 air, 0·70 H) ..	530 " 570 "
(3) Hydrogen, oxygen, and carbonic acid	($0·15 O, 0·35 H, 0·50 CO_2$) ..	562 " 592 "
Hydrogen, oxygen, and carbonic acid	($0.21 O, 0·49 H, 0·30 CO_2$) ..	560 " 595 "
	Carbonic oxide.	
(1) Carbonic oxide and oxygen	(0·15 O, 0·85 CO) ..	630 " 650 "
Carbonic oxide and oxygen	(0·30 O, 0·70 CO) ..	645 " 650 "
Carbonic oxide and oxygen	(0·70 O, 0·30 CO) ..	650 " 680 "
(2) Carbonic oxide and air	(0·70 air, 0·30 CO) ..	650 " 657 "
(3) Carbonic oxide & oxygen and carbonic acid	($0·15 O, 0·35 CO, 0·50 CO_2$) ..	695 " 715 "
(4) Carbonic oxide, air, and carbonic acid	($0·35 air, 0·15 O, 0·50 CO_2$) ..	715 " 725 "
	Methane.	
Methane and oxygen ..	($0·70 O, 0·30 C_2 H_4$) ..	600 " 650 "
" " ..	($0·30 O, 0·70 C_2 H_4$) ..	640 " 660 "

The most remarkable result of these experiments is that the temperature of ignition of the gaseous mixture is little affected by the admixture of strange gases. The greatest variation occurs by the addition of carbonic acid to the carbonic oxide mixture; in the case of the hydrogen mixture the influence is less. From this we are driven to the assumption that the temperature of ignition of a gaseous mixture is affected by the products resulting from the explosion. In the case of mixtures of methane and air this method of investigation cannot be used because the volume of the gas is not altered, and no such considerable explosion takes place that it can be observed outside the pyrometer. The authors therefore endeavoured to determine the ignition point in this instance by passing the mixed gases through a porcelain tube in a furnace and placing an air thermometer as close as possible to it. The results of this experiment vary considerably—between 600 and 750 deg. In any case the point of ignition in this instance lies below 750 deg., and probably about 640 deg. This result shows that the assumption that the gas exploding in mines explodes at 1000 deg. cannot be maintained. It had already been shown by Davy that it is not possible to explode the mixture with a white-hot rod, and he held that flame was absolutely necessary to accomplish it. The authors find that the mixture always explodes at about 800 deg. in a pyrometer after the lapse of some time, while hydrogen and oxygen always go at once. In Davy's experiment the heat of the rod caused a circulation of the gases which hindered the continuous action of the high temperature on the gaseous mixture. If in place of the iron rod an inverted iron crucible be employed, ignition always takes place, even when the iron is only red hot, because the gas remains sufficiently long in contact with the hot metal in the hollow of the vessel. The authors point out the application of this fact to certain mining questions.

The Strike in the File Trade.—Another effort has been made, unfortunately without success, to terminate the strike in the file trade. The committee of the File Manufacturers' Association have had another meeting with a deputation from the File Grinders' Society, the result of which was the offer of the men to accept 5 per cent. reduction, instead of 10 per cent. As the file cutters have accepted 10 per cent., the committee of the masters refuse to submit this offer to the general body, and thus the dispute remains unsettled. It has led to the employers turning their attention to the adaptation of machinery to file-cutting and file-grinding, and at this moment the manufacturers who use machinery are helping others by grinding their files for them.

Chesterfield and Derbyshire Institute of Mining, Civil, and Mechanical Engineers.—This Institute will meet at Nottingham on the 11th and 12th September next. Excursions will be made to the Woollaton and Clifton collieries and Sir J. Oldknow's lace factories. The following papers will be discussed:—Mr. T. G. Lees' paper on "A Self-acting Arrangement for Unloading and Loading Colliery Cages—Fisher's Patent." Mr. Robert Wilson's paper on "The Koepe System of Winding at the Bestwood Collieries." Mr. Sydney F. Walker's paper on "The Electric Light and Transmission of Power by Electricity: (*a*) Electric Lamps; (*b*) Dynamo-electric Machines; (*c*) Accumulators." The following paper will be read or taken as read, "On a System of Endless Rope Haulage in use at Clifton Colliery, Nottingham, with Remarks on various Clutch Gears in use, and a Description of a New Frictional Clutch for Hauling Engines and other Machinery," by Mr. Henry Fisher.

The Patents Bill.—The Patents Bill has passed the Lords and has been sent back to the Commons with a number of amendments, mostly, however, of purely formal character. On Wednesday night in the Commons it encountered the polite attentions of certain Irish members, in consequence of which the debate was not finished by a quarter to six, and so stood adjourned. It will not be necessary to particularise the amendments, but we may mention that the Lords have struck out the clause which required every patent to be enrolled in some obscure offices in the Channel Islands and in the Isle of Man before it could have force in those vast and important territories of her Majesty's dominions. But, on the other hand, there are a number of minute provisions as to infringements in those islets which can be of no earthly use, except to minister to the vanity of the House of Keys, and to the governing body, whatever its name may be, of the Channel Islands. Some of the errors and inconsistencies which we pointed out a fortnight ago have been removed, and generally the Bill presents a more workmanlike appearance.

The Closing of Collieries in Yorkshire. — Notwithstanding the fact that the number of collieries which have been abandoned in Yorkshire during the last eight years amount to 137, there has been a great increase in the quantity of coal raised during the past ten years. According to Mr. Wardell's report, the production of mineral has advanced from 14½ millions of tons to 19 millions of tons, and that the number of persons employed has increased by more than 10,000. The output of coal in 1882 was 18,525,406 tons, being an increase of 238,265 tons. The number of mines in 1882 was 452. In order to show the extraordinary fluctuation of the trade, it may be stated that in the year 1873 the inspector received notice of 30 collieries which had been opened out, whilst notices were served on Mr. Wardell in the same year of 97 pits which were about to be commenced. So that up to May, 1874, over 100 new collieries had been projected. The decay of the trade is vividly seen from the return of abandoned mines in the inspector's reports. In 1874 only 4 collieries were abandoned; but in 1875 15 were closed. This was followed by more being abandoned. In 1876 22 were closed, 30 in 1877, 20 in 1878, 10 in 1879, 13 in 1880, 13 in 1881, and 14 in 1882. In the last report for 1882, 2 were abandoned in the Barnsley district, 2 in the Halifax district, 1 in the Rotherham district, 18 in Leeds district, 6 in Huddersfield, 3 in Sheffield district, 2 in Bradford district, 3 in Wakefield, 2 in Dewsbury, and 1 in Mirfield district. Many of the pits closed or abandoned were only small, so that the output was not materially affected. Indeed, at the present time scarcely any of the pits are worked to their full capacity. According to the return, there were 15 collieries in 1882 in the course of sinking; but these for the most part are only prosecuted in search for thin seams. The South Kirkly Colliery, which is in the Pontefract district, is amongst the number, and is now opened out, coal being reached and won in both shafts. The colliery, which will rank amongst the largest in the South Yorkshire coal-field, will soon be developed, and will raise, if necessary, something like 1200 tons of coal per day.

RAILWAY MATTERS.

A NEW tramway route, giving direct communication between North-street, Wandsworth, and the Borough, has been opened by the South London Tramways Company. The distance is about six miles, and the maximum fare 4d.

THE report of the directors of the North London Railway gives the total cost of the locomotive power as £41,094; that of maintenance of way, works and stations, as £15,353; and the train-mileage of the company's engines, 981,147.

COLONEL YOLLAND has reported to the Board of Trade concerning a collision on the London and South-Western Railway at Bishopstoke station, on July 21st, between two passenger trains, when about twenty-eight persons were injured, and says:—"It is fortunate that the collision was not attended with more serious results. Neither of the trains was fitted with continuous brakes. Had either been, the collision might have been avoided."

DURING the past session there have been thirty applications for provisional orders for the construction of 137 miles of tramways, at a cost of £834,584. Twenty-two of these were sanctioned by Parliament. There were also seven applications for provisional orders for gas, seven in respect of water, and two for water and gas combined. All sixteen were granted by the Board of Trade, and confirmed by Parliament. The fees amounted in the aggregate to £1600, or £35 for each application—not a very considerable item of the expenditure generally included under the head of "parliamentary expenses" in half-yearly reports.

THE *Railway Age* publishes statistics of railway building in the United States for the first half of the current year These show a construction of 2509 miles of main track, not including switches or sidings, on 114 lines, in 35 States and Territories. During the corresponding period last year 4900 miles were constructed. This difference is accounted for on the ground that last year was unusually favourable for the early commencement of the work, while the reverse has been the case this year. In 1881, when 9300 miles were laid, only 2300 miles were built during the first half of the year. The *Age* estimates the construction for the entire year at 8000 miles.

THE progress now being made with the Canadian Pacific Railway is unexampled in the history of railway building. Commenced in May, 1881, it is contemplated that 925 miles—the Western End and the Ontario and Quebec section—will be completed by the end of this year, and the whole line—2906 miles—before the end of 1885, though the charter grants till 1891. During the first half of last July as many as 800 labourers were sent by the employment bureau at Winnipeg to the end of the track, and the line is being laid at the rate of three to four miles per day. The *Times* says: Five thousand men are now employed on the Rocky Mountain division, and these will be retained during the winter, that this portion of the line may be pushed on vigorously.

THE island of Ometepee, in the lake of Nicaragua, has lately been utterly devastated by a volcanic outbreak, causing an overflow of several lava streams, which filled up several valleys, and engulphed in its fiery current farmsteads, cattle, and all the cultivated fields. The eruption began on June 19th, when a new crater opened. A continuous earth-tremour resulted in an overflow of lava directed towards Las Pilas. Two days later several other hills opened, pouring out lava in every direction, and the terrified inhabitants fled. Boats were sent from the neighbouring towns to save them. Unfortunately, some persons took refuge on a hill, which was soon completely insulated by the surrounding lava. It was impossible to devise any way of saving them, and they perished miserably. The whole island is described to be at present a heaving mass of molten lava.

IN a report on the accident that occurred on the 12th ult. at the Manchester end of Bacup Station, on the Lancashire and Yorkshire Railway, when the engine and four leading carriages of the 3.22 p.m. train from Manchester got off the rails, just after passing the junction signal-box at the south-west end of the station yard, Colonel Rich says:—"The points and stock rails at the place where the accident happened are now about $\frac{1}{4}$in. tight to gauge, and considering the sharp curves at the place in question, I think it would be safer and better if they were about $\frac{1}{4}$in. wide to gauge. I would recommend that a better and stronger description of tie-bars should be adopted, and that the speed of all trains should not exceed five or six miles an hour when passing the Bacup signal-cabin, particularly as any failure of the Fay's or other continuous brakes would probably lead to a collision with the stop-buffers at the end of the platform."

THE Railway Accommodation Committee of the Hove Commissioners have had an interview with a deputation from the promoters of the proposed new line between London and Brighton, who submitted the plans. They showed that it was intended to communicate with the lines to the north of London at Ludgate-hill and Kensington, that the proposed route was west of the existing main line, coming direct from Reigate to a point near Devil's Dyke, passing immediately to the east of Hangleton Church, some distance south of which it branches off to Shoreham on the east, crossing the existing railway to Portsmouth at Hove, and thence by a tunnel to Marlborough-place, close to the Royal Pavilion, Brighton. After consideration the committee generally approved of the scheme, deferring a definite conclusion until an opportunity had been afforded of more closely considering the details. Their report was adopted at a meeting of the Commissioners.

THE New York *Journal of Commerce* gives the following statistical information relating to the railway companies of the States:—The Union Pacific Railway Company is the largest company in America. It has 4269 miles of rails; capital, £18,000,000. The Pennsylvania operates 1173 miles; capital, £17,000,000. New York Central, 993 miles; £18,000,000 capital. Wabash, 3348 miles; £10,000,000 capital. Missouri Pacific controls 5533 miles; capital, £6,000,000. Louisville and Nashville, 2028 miles; capital, £5,000,000. Lake Shore, 1277 miles; capital, £10,000,000. Illinois Central, 1892 miles; capital, £6,000,000. Chicago and North-Western, 3278 miles; capital, £7,500,000. Chicago, Milwaukee, and St. Paul, 4353 miles; capital, £7,000,000. Chicago, Burlington, and Quincy, 3136 miles; capital, £14,000,000. Central Pacific, 2995 miles; capital, £12,000,000. Baltimore and Ohio, 1553 miles; capital, £4,000,000. Northern Pacific, 2091 miles; capital, £18,000,000. Erie, 1020 miles; capital, £17,000,000.

THE sums of money paid by the railway companies for compensation during the past half-year are very heavy. The official accounts show that the London and North-Western Railway Company paid £27,296 for compensation for personal injury and loss of and damage to goods. Large as is this amount, it is less than that paid in the first half of last year. The Great Western Railway paid £23,153—an amount rather above that of the corresponding period of the past year; and the Great Northern Railway paid £30,468 for the same period this year. The Lancashire and Yorkshire Railway has in the past year reduced its expenditure for compensation by one-half; and the Midland Railway has also a similar reduction; but the sums paid by the Manchester, Sheffield, and Lincolnshire and the North-Eastern Railways show increases. The Metropolitan Railway, which carries by far the largest number of passengers, pays the least for compensation, the total payments both for personal injury and loss of or damage to goods for the past half-year being £146 only. Generally, the sums paid for compensation are much less than they were eight or nine years ago; but they show in several instances an increase on the sums paid in the past few years, and that to a rather heavy amount. The *Times* says that it had been hoped that there would by this time have been a large reduction owing to the general adoption of the block system and to the more efficient brake power, but we may point out that the amount of compensation money paid by the different companies bears a striking relation to the character of the brakes employed.

NOTES AND MEMORANDA.

MR. T. S. HUMPIDGE, of University College, Aberystwith, has made recent experiments on H, the horizontal component of the earth's magnetism, by a method described by Mr. Andrew Gray. He found the mean to be $0·17736 \pm 0·00048$.

Les Mondes says M. Meyer, of Zurich, has devised the following experiment: He encloses by parallel panes of glass a tube 7·5 metres (39·37ft.) long and with an interior diameter of 4 centimetres (1·575in.). This apparatus, being filled with distilled water and placed horizontally, on looking through it at a black ground in the sunlight it appears of a deep intense blue. If, on the contrary, gas light is employed, a green colour is perceived.

THE *Jekaterinoslav Nedelja* announces the discovery lately, in the Uspenskij portion of the Ural range some of very rich auriferous deposits. It is said that the remarkable feature in this discovery is not the quantity of gold forthcoming, but the singular form of the crystallisation. Thus one of the nuggets had among its gold crystals a pyramidal octahedron about $\frac{1}{4}$in. in size. This crystal has been placed in the museum of the Mining Institute.

PROFESSOR THURSTON states that the co-efficients of friction of lubricated surfaces under pressure, as given in text books, are much too high; instead of 4 to 7 per cent., as stated therein, he has obtained as low as one-fourth of 1 per cent. with sperm oil. This, he says, is the best he ever found for heavy pressures, and he has made experiments all the way from very light up to fifteen hundred pounds per inch of surface. The crank pins of beam engines on steamboats, where a thousand pounds pressure to the square inch is not uncommon, run as low as one-half of 1 per cent. for the friction.

IN extracting sugar from beet roots by diffusion, gases are liberated which sometimes take fire and burn with a bluish flame. M. L. Chevron has analysed the escaping gases, and describes his experiments in the *Bulletin de l'Academie de Belgique*, and finds that they consist at first only of carbonic acid and nitrogen. After awhile hydrogen begins to appear, which seems to be due to an acid reaction of the beet juice upon the iron with which it is in contact. He thinks it would be impossible for the hydrogen to accumulate in sufficient quantities to produce an explosion, but the inevitable corrosion of the diffusives by the acid juice is an inconvenience which should be guarded against.

THE general census of Japan, taken on the first day of the present year, gives the total population of the country at 36,700,110, made up of 18,598,998 males, and 18,101,112 females. The population of the larger towns is given as follows:—Osaka, 1,772,333; Hiogo, 1,418,521; Nagasaki, 1,204,629; Tokio, 987,887; Kioto, 835,215. To avoid erroneous conclusions, it may be well to state that the figures here given are not the populations of the towns and cities mentioned, but of the administrative districts, locally known as *fu* or *ken*, bearing these names. In some instances, *e.g.*, Hiogo and Nagasaki, these districts are as large as a medium-sized English county, and in all cases they include the towns and villages for several—from ten to thirty—miles around. Thus these statistics can by no means be accepted as data for the respective sizes of the towns. These would run, we—*Nature*—believe, as follows:—Tokio, Osaka, Nagasaki, Hiogo; the two latter being smaller than probably a dozen other Japanese towns which might be mentioned—Nagoya, Sendai, Niigata, Kagoshima, Shimonoseki, &c. Statisticians should therefore receive these figures with the explanation here given.

DURING 1881, the date of latest report, the mineral products of the Austro-Hungarian Empire amounted to 8,961,498 tons of lignite, valued at 40,048,707f., and averaging $4\frac{1}{2}$f. per ton; and of coal, 6,343,315 tons, of the value of 5,841,077f., and averaging $8\frac{1}{4}$f. per ton. The portion of the Empire most productive in mineral fuel is Bohemia, which yielded 6,450,996 tons of lignite—nearly three-quarters of the whole—and 3,417,632 tons, or more than half of the coal supply. Styria contributed 1,640,154 tons of lignite, and Silesia, 1,749,598 tons of coal. The extraction of lignite employed 29,083 miners, working in 352 pits, while that of coal employed 37,113 hands in 365 collieries. The production of iron ore was 618,963 tons, of the value of 4,470,505f., which was worked as follows:—Styria, 420,974; Corinthia, 88,041; Bohemia, 70,206; Moravia, 11,401; other provinces, 28,341. There are 241 iron mines, though only 77 actually at work, giving employment to 4510 workmen. Throughout the empire there are 175 blast furnaces for iron smelting, out of this number only 79 were in activity during 1881, the yield of iron being 379,639 tons, of which 337,843 were refined pig. Each furnace, on an average, was in blast for forty-three weeks during the year, and the number of hands employed was 8105.

THE following method of estimating dextrin, sugar, and other constituents in malt extract, has been suggested by Carl Jungk; it was intended for testing the quality of the different medicinal extracts of malt, but the *Brewers' Guardian* says it is equally applicable to the brewer's requirements. Weigh from two to five grains of extract of malt, or, in the case of worts, measure a quantity containing about two grains of solid extract; mix with twenty grammes of dry sand which has been previously washed with hydrochloric acid and water, and dry this mixture in an air-bath at 100 deg. C., until it ceases to lose weight. Transfer the mixture into a small glass percolator, supported by a wire stand of such size that the entire apparatus may be weighed on an analytical balance. Dry thoroughly in an air-bath and weigh. Now percolate with strong ether, evaporate the percolate, and dry the residue; its weight indicates the resin of hops. The apparatus is also dried in the air-bath and weighed; the loss in weight shows likewise the resin of hops. Then percolate with a mixture of two volumes of absolute alcohol, and three volumes concentrated ether, until a drop of the percolate heated on a platinum foil will not char. The loss of weight after drying in air-bath represents glycerin. A mixture of chloroform and alcohol cannot be used as a solvent for glycerin, as the malt sugar is somewhat soluble therein. Exhaust the residue completely with stronger alcohol, dry and weigh. The loss of weight gives amount of sugar. The balance, after subtracting the weight of sand, is dextrin and albumin. The dextrin may also be extracted with hot water, and determined from the loss of weight. After igniting the sand, its weight must be the same as in the beginning.

IN the office of the French Minister of Public Works, charts and plans are prepared by a process of photo-zincography. The *Bulletin de la Societé d'Encouragement* thus describes it: A plate of commercial zinc is chosen which is free from defects. In order to cleanse it thoroughly it is rubbed with a stiff hair brush, which is dipped into a mixture of one-third sulphuric acid and two-thirds water. After this cleansing, which removes every trace of oxidation and grease, the plate becomes very brilliant, and it is rubbed for some minutes with a cork dipped in powdered pumice stone. It is then washed and plunged, for ten or fifteen minutes, into a bath acidulated with 3 per cent. of nitric acid. The plate then has a dull look and shows a slight roughness under the microscope. After having carefully dried it, it is covered by a preparation composed of 10 litres of water and 500 grammes of crushed nutgalls. After boiling this preparation until it is reduced about one-third, it is cooled and filtered through linen; then are added 100 grammes of common nitric acid and 6 grammes of pure chlorhydric acid. After the preparation has been left in contact with the plate for some time it is washed and dried, and then coated with bitumen in the ordinary manner, and exposed to the light under the drawing which is to be copied. When the exposure is over, the plate is warmed slightly and developed with the addition of a liquid containing 5 per cent. of acetic acid. To facilitate the inking, it is well to apply to the lines some oil, which destroys their brilliancy and turns them gray. Then, after a careful drying, the bitumen is dissolved by benzine, and the plate is again dried. It can then be delivered to the printer, who submits it, without any precautions, to the customary operations of lithography for inking and printing.

MISCELLANEA.

AMERICAN definition of a steam hammer: An earthquake on stilts.

A REPORT on the utilisation of the Rhone for lighting the whole of the city of Geneva has been drawn up, and it is expected that the city will be so lighted.

IN Newcastle and Gateshead the proposal to construct another high-level bridge over the Tyne, at a cost of from £150,000 to £200,000, is being well supported.

IN the manufacture of fans in Japan about 100,000 persons are said to be engaged out of a population of 1,500,000 in the three fan districts of Osaka, Kiota, and Nagoya.

THE Science and Art Department, in concert with the Foreign Office, have appointed the Astronomer-Royal and Colonel A. R. Clarke, C.B., R.E., F.R.S., to represent this country in the coming International Geodetic Conference, and they have consented to act.

THE damage caused at Boosbeck-in-Cleveland through great subsidence of land has increased to an alarming extent. Families have had to remain in the streets all night, and some compelled to clear out of their houses during the night, owing to the subsidence spreading. It is stated that over 100 houses are affected more or less by the subsidence.

THE Corporation of Tiverton have instructed Mr. E. Pritchard, C.E., to report upon the competition schemes sent in for the disposal of the river Lawman drainage. The schemes, seven in number, are somewhat similar in design; and intermittent filtration upon a small area of land in conjunction with deposition tanks is the method of purification proposed.

AN interesting sale of iron took place in Sheffield on Tuesday. The Butterley Iron Company is relinguishing the retail iron trade in Sheffield, and has recently been offering its stock at somewhat tempting prices. 112 tons, chiefly in bar, sheet, and angle, remained, and this was offered to public competition. It consisted of 62 tons of Butterley iron, and 50 tons of the Butterley Iron Company's Silverdale iron marked "B.C.S." The entire lot was sold at prices averaging about £4 per ton.

THE foundations of the south-eastern pier of Peterborough Cathedral, which supported the now demolished Lantern Tower of Peterborough Cathedral, the work in connection with which we illustrated and described in our impression for the 6th April last, have been unearthed and found in a crumbling state many inches below the original level. The condition of the foundations has thus proved them to be built in the manner so characteristic of the 14th century Norman work when not near stone quarries.

A SURVEY of France is, according to the foreign press, now being organised by the Minister of Public Works in that country. The object in view is not only to obtain an exact delineation of the levels, &c., but also to collect information of practical value in the construction of railways, canals, and roads. The actual execution of the work is estimated to cost £760,000; a further sum of £120,000 being reserved for the production of a topographical map of France on the scale of 1 to 50,000. The former portion of the arrangements will be entrusted to State engineers, and the latter to military officials. A geological chart of France is also said to be approaching completion, and will be of value as indicating the exact position of coal deposits in France.

THE Sanitary Institute of Great Britain holds its autumn congress at Glasgow, from 25th to the 29th September. A reception room will be opened at the St. Andrew's Halls, Granville-street, on Monday, September 24th, at 1 p.m., and on the following days at 9 a.m., for the issue of congress tickets, which may also be obtained previous to the meeting, on application to the secretary of the Institute, or to the honorary local secretaries, 11, Bothwell-street, Glasgow. The lectures to the congress, the sectional meetings, and the general meetings will be held in the St. Andrew's Halls. The conversazione will be given in the Corporation Galleries, Sauchiehall-street. The Exhibition will be held in the Burnbank Drill Hall, Great Western-road, and will remain open until October 20th.

COMMODORE SIMPSON and a number of naval officers from the United States—forming the members of a newly-appointed Board to inquire into the condition of armour plate and ordnance manufacture, with a view to the construction of new war ships for America—are now on a visit to Europe. They were at the Atlas and Cyclops Works last Friday and Saturday and witnessed the production of compound (steel-faced) plates on the "Ellis" and "Wilson" patents. They also saw the production of heavy guns for ships. This week they proceeded to Middlesbrough, and the North, and will afterwards return to London, where they will inspect such arsenals and dockyards as are opened to them. It is their intention then to proceed to France and Germany to witness—at Creuzot—the manufacture of Schneider's all-steel plates, and—at Essen—the production of Herr Krupp's heavy guns. On the result of their visits will depend the kind of armour to be adopted, as well as the ordnance to be mounted on the new ships Secretary Chandler intends to add to the United States fleet.

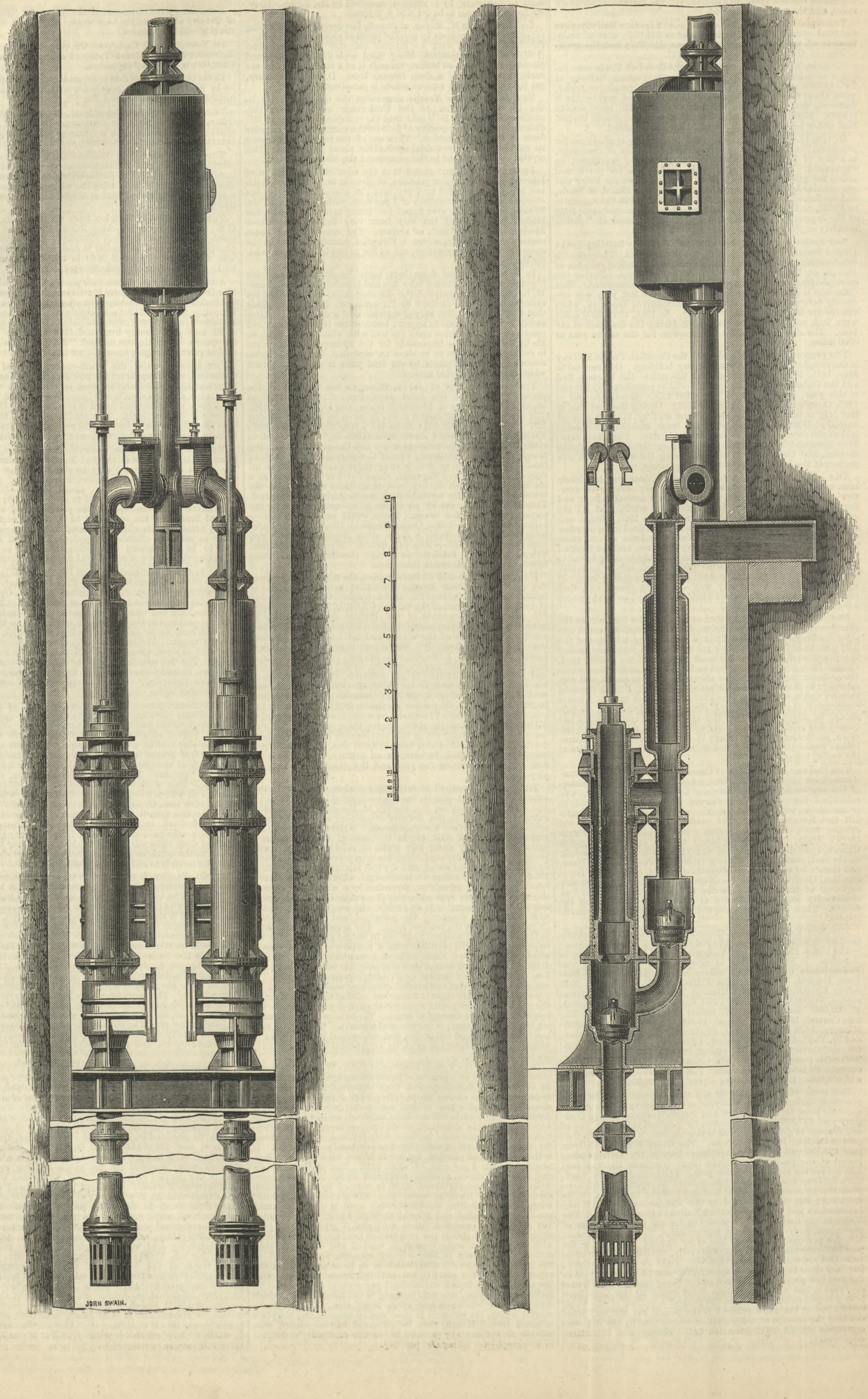
MESSRS. TASKER, SONS, AND CO., telephone engineers, Sheffield, have just completed telephonic communications for her Majesty at Balmoral. The wires radiate from the Castle at Balmoral to the Albert Memorial Hall at Ballater, to Abergeldie—the residence of the Prince of Wales—and to the house of Dr. Profeit, her Majesty's Commissioner, at Craig Gowan. Ballater is the nearest telegraph station to Balmoral, and messages for Windsor, Osborne, and other places will be telephoned to the Albert Memorial Hall, and thence handed to the Ballater Post-office for transmission by telegraph; while telegrams received at Ballater for Balmoral, Abergeldie, or Dr. Profeit will be telephoned to their destination after being handed from the telegraph officials to the telephone operator for that purpose. The operations have been very rapidly completed, under the direction of Mr. Johnson, engineer and electrician to Messrs. Tasker, Sons, and Co., and are now in readiness for her Majesty on her arrival at Balmoral to-morrow—Saturday. Special messages notifying the completion of the works have been despatched by the new system from Balmoral to her Majesty at Osborne.

ATTENTION is being again drawn to the price at which gas is sold. We have previously given statistics as to the cost of production and the price of gas in a northern town where the corporation owns the works, and it may be interesting to quote those of a neighbouring town where the works are owned by a company. West Hartlepool is supplied with gas by the Hartlepool Gas and Water Company. In the financial year just closed, the quantity of coal carbonised was 13,750 tons, and with the usual average yield, there would be produced over 138,000,000 cubic feet of gas therefrom. Over 103 million cubic feet are accounted for as sold, in addition to that supplied under contract and for public lighting purposes. The price of the gas sold varies from 3s. 2d. to 4s. 1d., but from these rates there are discounts on prompt payments, and these amount in the total to about 15 per cent., so that the price may be said to range from about 2s. 9d. to 3s. 6d.; which must be considered high prices when the extent of the production is borne in mind. The coal carbonised yielded about 8656 tons of coke; the tar yield was 146,368 gallons, and the ammoniacal liquor, 432,072 gallons. The receipts for coke were £1984, but a portion was used at the works; for tar, £1690; and for ammoniacal liquor, £1610. The broad result of the working of the gas department of the company's operations for the year was that the total receipts for gas, residual products, &c., was £23,730, and the total expenditure £11,138. More than one-half of the gross receipts therefore were profits, and this branch is by far the most profitable of the company's operations. It is attained, it is true, by a range of prices for gas that is above that of the towns that are neighbours, to which we have referred previously, and it is possible that lower rates will have to be resorted to.

PUMPS AT ST. ALBAN'S WATERWORKS.

MR. A. F. PHILLIPS, M.I.C.E., ST. ALBANS, ENGINEER.

(*For description see page 148.*)



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.*

W. J. B.—*The Dutch built vessel shown in your first sketch would possess no quality that a steamship ought to have save stability. Your second sketch is an exaggeration.*

Water.—*We have had no personal experience in the use of asbestos in the way you suggest, nor do we suppose that any one else has. But we see no reason to doubt that it will answer perfectly.*

G. W. R.—(1) *Practice varies so much among engineers that no precise rule can be laid down, or ever has been laid down. It has been found, for example, that the shortest wheel-base that can be given to any particular type of engine is not necessarily that which runs best round sharp curves.* (2) *There is no rule for the greatest safe load which a rail will carry, because the load is always much less than would suffice to break a good rail. As to what a given track will carry, that is almost entirely a question of condition. With a first-rate steel rail and sound road bed and sleepers, you may put 3½ tons on a 35 lb. rail at any speed you are likely to get on a narrow gauge line.*

RICE MACHINERY.

(*To the Editor of The Engineer.*)

Sir,—I shall be glad if any of your correspondents will send me particulars and prices of rice hulling and dressing machinery for doing 10 tons per day fit for market. Also name and address of Hercules bone crusher. Rice.

NOISE OF GEARING.

(*To the Editor of The Engineer.*)

Sir,—Can any of your numerous readers suggest a remedy which will enable me to deaden the noise caused by the gearing of a pair of horizontal compound engines, the principal dimensions of which are:—Spur wheel, 14ft. 8in. diameter, 145 teeth; revolutions per minute, 46; width of teeth, 9in.; pitch, 3¾in; this wheel is internally geared with a wheel 5ft. diameter, 47 teeth. Spur wheel is fastened to fly-wheel, and the weight of spur and fly-wheel is 20 tons. Both wheels are iron. The engines drive a flour mill, and power is taken from second motion shaft to stones by belts. Average load on engines, 280-I H.P. Alpha.

Birmingham, August 21st.

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THE ENGINEER.

AUGUST 24, 1883.

THE METROPOLITAN AND SUBURBAN WATER SUPPLY.

In discussing the subject of the metropolitan water supply a few weeks ago, we gave prominence to the fact that the jurisdiction of the London Water Companies extended considerably outside the area set forth in the Metropolis Local Management Act of 1855 and recognised in the Metropolis Water Act of 1871. We showed that the outlying districts comprehended a population of nearly a million, supplied with water by the London Companies through a thousand miles of mains. A novel feature in the water controversy presented itself last Tuesday, when a deputation from certain of these extra-metropolitan districts waited upon the Home Secretary with a complaint that, although they were able to supply themselves with water, they were not allowed to do so, owing to the 52nd section of the Public Health Act of 1875, which provided that it should not be lawful for the local authority to construct any waterworks within the statutory limits of a water company, so long as the company was "able and willing to supply water proper and sufficient for all reasonable purposes." The deputation complained that this law had come upon them unawares, and they asked that general legislation should remove the restriction which had thus been placed upon the freedom of local action. The appeal thus made was presented on behalf of nine suburban local boards and sanitary authorities connected with districts having an aggregate of 150,000 inhabitants. Among the localities thus concerned were Ealing, Chiswick, Twickenham, Edmonton, Brentford, Wimbledon, Isleworth, Finchley, Bexley, and Keston. The Home Secretary heard the complaint and told the deputations that he considered their case one of hardship. But he was "not responsible for the legislation of 1875," and he was quite at a loss to understand why such a prohibition was laid upon the local authorities. From this point Sir William Harcourt was able to go a step further and argue on the general question of the metropolitan water supply. Purchase and competition were the two leading topics. Should the companies be bought up, and, if so, at what price, or should there be a competing supply, threatened or actual, so as to bring the companies to a surrender? As for the special complaint made by the deputation, Sir William could only promise that he would "take every pains to consider if there is any, and, if so, what remedy for it."

The gentlemen who thus waited upon the Home Secretary were of opinion that the companies charged too much for the water which they supplied, and that in some cases the liquid was not sufficiently pure for domestic consumption, besides being insufficient in quantity. It is argued that while the authorities of provincial towns at a distance from London are able to buy up the local water companies, it is quite out of the power of the suburban authorities contiguous to the metropolis to purchase the enormous properties of the London water companies. Hence the Public Health Act, they conceive, bears upon them with exceptional severity. But we should like to ask whether it is likely that a number of isolated water companies, encircling the metropolis, would be able to supply the million of people to whom we have referred so effectually or so economically as the great corporate bodies which furnish the metropolis with its unfailing flow of the prime necessary of life. A striking example is before us just now of what the local authorities may possibly do for themselves. The vestry of Richmond have been trying to make themselves independent of the Southwark and Vauxhall Water Company, with the result that having expended nearly £60,000 in seeking for water from a subterranean source, they have managed to leave the town almost without any water at all. The inhabitants are in a ferment, and live in dread of fire or pestilence. No doubt they would be thankful just now for water at almost any price. The idea exists that things would be very much better if the vestry were abolished and a Corporation substituted. But a blunder in sinking an artesian well may be committed by a Town Council as readily as by a vestry. No doubt deep wells in the chalk furnish a very pure supply, as in the district of the Kent Company; but the Richmond authorities have carried their boring down through the chalk and find themselves in the old red sandstone, after the manner of some other adventurers in and about the metropolis. Water companies are said to manage things for their own benefit. Certainly if they were to fling away £60,000 in search of water which they could not find the shareholders would be likely to oust the directors. But it is not so easy to oust a vestry, and "the remedy," to use Sir W. Harcourt's phrase, is not altogether obvious when local authorities go astray. Of course it is possible for companies to err as well as vestries, of which we see an instance at Northampton, where there has been a serious lack of water, and where the people have held an indignation meeting on the subject in the market place.

However much the fact may be regretted, we can see no chance of any actual competition with the London Water Companies. It may be threatened, but the companies are well aware that there are practical difficulties of almost an insuperable nature in the way of any such scheme. London is tormented more than enough already by the tearing up of the streets in order to get at the pipes beneath, or to repair the roadway. It often happens that the former process necessitates the latter, and for one reason or the other the streets of London seem to be in a perpetual state of upheaval. The inevitable disturbance of roads and footways was one of the objections to the dual supply proposed some few years ago by the Metropolitan Board. If every leading thoroughfare had its subway, perhaps London would seriously entertain the idea of competition in the water supply. But consideration must also be given to the question of finance, and there is something exceedingly extravagant in the notion of ignoring the outlay incurred by the companies, and introducing a second supply at a further cost. As the subject ripens in the public mind, it will probably be seen that the better course is to control and modify the present system, rather than attempt any violent change. Extreme ideas respecting the impurity of the London water supply are likely to do much harm, by inducing a neglect of that which is practicable, and inciting a pursuit of that which is only visionary. If in the first place the local authorities would see to the introduction of the constant supply, enormous benefit would result to the poor of London, as well as to many who are not poor. As the companies are under statutory obligation to give a wholesome supply, it should be seen that they have proper filter beds and subsidence reservoirs. They should also be induced to mingle as much as possible of a subterranean supply with their river water. There is really nothing to be got by scolding, but much may be gained by management. London is favoured, after all, in having a supply which never fails. The only exception to this is the choking up of a filter bed which took place some years ago. The law, as it exists, ought to be enforced, so as to prevent such an occurrence, or if the law be defective, it could be amended. Amalgamation among the London Water Companies might also be promoted to a good purpose, as it would then be practicable to distribute the supply more economically and with a generally higher pressure. But modest means of improvement seem to be overlooked in favour of some grand scheme which may never come to pass, and which is certain to be very remote.

PETROLEUM AS FUEL.

Since the discovery of the oil springs in America, various efforts have from time to time been made to introduce petroleum as a fuel for steam boilers and general heating purposes, but notwithstanding that the subject has been taken in hand by both British and Foreign Governments, as well as by private individuals of considerable influence and ability, it is a fact that not only has no practical progress been made in the use of liquid fuel, but that in those cases where it has been tried, and experiments carried out with the best results as regards evaporative efficiency, the installation has been abandoned, and a return made to our old and much abused friend coal. The reason for this is not far to seek, and consists in the fact that the cost of evaporating a given quantity of water by means of heat produced by the combustion of petroleum so far exceeds that when coal is used, as to much counterbalance any advantages that may be gained; always excepting those few countries where from scarcity of coal and wood, and abundance of petroleum, the latter fuel is found to be the cheapest.

One of the earliest investigators into the merits of liquid fuel was Sainte Claire Deville, who carried out a series of very extensive experiments with a couple of locomotives on the Paris and Strasbourg Railway, which were specially fitted up, under his direction, with appliances for burning the oil. The results of these experiments were published in the Journal of the French Academy of Sciences for 1868 and 1869; the average evaporation being given as about 11 lb. of water per pound of fuel. In the United States, commissioners were appointed to specially consider the value of petroleum as fuel on board steamers; a sum of 5000 dols. being appropriated for making the necessary tests; but after long and careful trials, the Secretary of the Navy finally reported against its use, on the grounds that convenience, comfort, health, and safety were against it, the only advantage shown being a not very important reduction in bulk and weight of fuel carried. As far as our own country is concerned, the whole subject was brought before the Institution of Civil Engineers in 1878 by Mr. Harrison Aydon, in a comprehensive paper dealing with the matter historically, and in which the results of a great number of experiments made with different forms of boilers under various conditions, and with several kinds of burners, were given. In this paper the use of liquid fuel was strongly advocated, and it was shown that with burners on Mr. Aydon's system, in which superheated steam was used for evaporating the oil previous to combustion, and in which a jet of steam was associated with the burning fuel, perfect combustion without smoke was obtained, with an evaporation almost identical with the full calorific power of the oil. Other burners, on somewhat different plans, but all employing the use of steam in combustion, gave almost similar and equally satisfactory results. In view of this it is somewhat surprising to read in a pamphlet recently published in order to puff up the value of "water gas," produced by the process of Dr. C. Holland, to which our attention has been directed, that "how to use petroleum or mineral oil in a direct manner as fuel with good economy and effect has never been discovered." Further, "that if such a direct way to burn petroleum had been discovered, we should have been much later in learning, if at all, how to make the most effective and economical fuel ever known, by using petroleum as a resolvent of water, and thus reproducing the enormous heat which the constituents of water, oxygen and hydrogen, create in re-uniting. The effective power of the combustion of oxygen with hydrogen has been shown by the experiments of various standard authorities to be 50 per cent. greater than that of the combustion of the same quantity of oxygen with the equivalent of carbon required for its separation from the hydrogen of the water." This, as is afterwards stated, has been learnt and applied by Dr. C. Holland, whose process is thus described:—"Not a particle of oil or of oil vapour is burned in this process after its operation is fairly started. The oil is entirely combined with the oxygen of the water—steam—within the retorts, without a single atom of atmospheric oxygen. The constant temperature of the fire chamber keeps the retorts hot enough for the disengagement of the oxygen of the steam in the presence of the carbon of the oil. The chemical affinity of these two elements at such temperature causes them to unite, and so releases the hydrogen of the steam, which issues at the burners in the most powerful combustion, producing instead of smoke, only the purest aqueous vapour."

These modest statements practically amount to a claim for producing perpetual motion; for it is proposed to acquire heat energy by continually separating water into its constituents, oxygen and hydrogen, and by again combining these two gases, their separation, it is alleged, absorbing less heat than is given out in their combination, so that there is a surplus which may be utilised for raising steam or for any other purpose. The absurdity of such a claim will, of course, be apparent to any engineer who gives the matter a moment's serious consideration; but as there are doubtless many to whom the whole subject is strange, we propose to briefly consider the circumstances attending the combustion of mineral oil, and to make a concise comparison between its calorific power and other properties and those of coal.

A pound of petroleum may be taken as consisting of 0·85 lb. of carbon and 0·15 lb. of hydrogen, which, if burnt direct to carbonic anhydride and water with the exact equivalent of atmospheric air, would produce 22,700 heat units, with an elevation of temperature of 5484 deg. Fah., always supposing that combination could take place at this temperature, which is doubtful. This supposes a thermal value of 17,000 units per pound of carbon, and 55,000 units per pound of hydrogen, the former being somewhat higher than is generally allowed for carbon in the solid state, and the latter a little lower than is taken for gaseous hydrogen. Assuming now that instead of being burnt directly with air, the petroleum is first heated in a chamber in contact with steam, to such a degree that partial combustion takes place, the oxygen of the steam combining with the carbon of the oil to form carbonic oxide, while the hydrogen of the steam, as well as of the oil, is set free. In this case the 0·85 lb. of carbon will combine with 1·13 lb. of oxygen from 1·27 lb. of steam, giving out 5950 heat units, and setting free the 0·15 lb. of hydrogen in the oil as well as 0·14 lb. with which the oxygen was associated in the form of steam. The separation of this steam into its constituent gases is only effected by the expenditure of heat, as much heat being absorbed as is given out in its formation, so that to supply the 1·13 lb. of oxygen, 8680 units must be communicated from the outside. After this partial combustion there remains 1·98 lb. of carbonic oxide and 0·29 lb. of hydrogen, which, on issuing from the retorts through suitable nozzles and meeting a proper supply of air would be burnt to carbonic anhydride and water, producing 25,430 heat units. Adding to this the 5950 units from the formation of carbonic oxide, and deducting the 8680 units required for the dissociation of the 1·28 lb. of steam, there is left a net total of 22,700 units as the result of the complete combustion of 1 lb. of petroleum, which is precisely the same value as was found in the case of direct combustion with air. It will thus be seen that no advantage as regards increase in heating power is obtained by the use of steam. In practice, however, there seems to be an advantage of another kind, inasmuch as the steam is found to promote combustion by bringing about a proper intermixture of combining particles, so preventing the formation of the smoke which nearly always accompanies combustion with air alone, and which is the cause of considerable loss from waste of carbon and reduction in the efficiency of the heating surfaces. Steam also promotes the draught, and so permits of a lower temperature of escaping products than when the draught is entirely dependent on the chimney. Taking this temperature at 300 deg. Fah., and assuming the temperature before combustion at 60 deg. Fah., each pound of petroleum will give 21,460 available units of heat, which is equivalent to an evaporation of 22·21 lb. of water from and at 212 deg. Fah.

Turning now to coal—which we may take as being composed of 83 per cent. of carbon and 5 per cent. of hydrogen, the remainder being chiefly ash, with a little oxygen and nitrogen—and taking thermal values of 14,500 and 50,000 units respectively for 1 lb. of solid carbon and hydrogen in the condition in which it exists in coal, we find that the combustion of 1 lb. to carbonic anhydride and water will give 14,535 units, while, if only the exact proportion of air be admitted, the rise in temperature would be 4845 deg. Fah. Allowing an initial temperature of 60 deg. Fah., and a temperature of 500 deg. Fah. for the escaping products, this represents an evaporation of 13·5 lb. of water from and at 212 deg. Fah. The evaporative efficiency of 1 lb. of coal to 1 lb. of petroleum is, therefore, as 1 to 1·64 under the conditions taken; but as with petroleum the admission of air to the combustion chamber can be controlled with much greater exactness than with coal, there is less loss from the cooling effect produced by more air entering than is really necessary to support combustion, and allowing for this, we are disposed to place the possible actual efficiencies as 1 to 2. With this as a basis it is easy to arrive at the relative cost of the two fuels. Taking coal at 15s. a ton, the value of 100 lb. weight will be 8$\frac{1}{28}$ pence. Crude petroleum is at present worth 6d. a gallon, but is not fit to be used as a fuel without distillation. We will, however, take it at 6d., and as the specific gravity is ·800, water being 1·0, 100 lb. weight will occupy 12½ gallons, and will cost 75 pence. The relative costs of coal and petroleum, weight for weight, are, therefore, as 1 to 9·3; but as we have admitted the evaporation efficiencies to be as 1 to 2, it makes the actual cost of evaporating a given quantity of water with petroleum to be 4·63 times as much as it is with coal.

One of the chief advantages alleged in favour of petroleum is that it would occupy much less space than coal, and that ships could therefore take away a much greater supply of fuel than at present, which would enable them to remain longer at sea, and obviate the necessity for coaling depôts. This advantage has been very much overrated, for with petroleum of specific gravity 0·8 equal spaces would be occupied by equal weights of coal and oil. This allows 50 lb. weight to the cubic foot, which is about correct for north-country semi-bituminous coal when heaped, Welsh and Scotch being heavier, and therefore making the comparison less favourable to petroleum. It would appear, then, that taking into account the calorific power of the two fuels, a given amount of storage room would be just twice as efficient if petroleum was used as in the case of coal. In addition to this there must be reckoned the reduction in the number of stokers, which is no doubt a very important feature, especially at sea. Against this, however, the highly inflammable nature of the oil must always be considered a source of great danger, as well as the difficulty in storing it in vessels sufficiently away from atmospheric action. There is also the difficulty which may arise from the clogging-up of the apparatus, and its destruction from the intense heat. The high furnace temperature is also exceedingly apt to produce priming, though this could be guarded against to some extent; but we believe it is entirely owing to excessive priming that such absurd reports have been made as to the evaporative power of petroleum, some experimenters having recorded as much as 35 lb. of water per pound of fuel, whereas we have seen that 22·21 lb. is the maximum amount attainable, even when only the exact supply of air required for combustion is admitted.

That petroleum can under some circumstances become an efficient and economical fuel is a proposition we are not disposed to dispute; for instance, in THE ENGINEER of March 23rd we published an illustrated description of a system adopted in Russia, where, from the scarcity of wood and other fuel, mineral oil has been very advantageously used. What we do contend is, that excepting under such special conditions as are not likely to obtain in England and other principal countries in Europe, or even in the United States, which is comparatively close to the oil wells, petroleum is a much more expensive fuel than coal. It is well for us also to state again, that there is no difficulty in burning mineral oils, notwithstanding what may be said to the contrary by anxious inventors. It is too late in the day to claim any very special advantage in the use of superheated steam. This has been done over and over again, and though we do not pretend that one form of burner may not give somewhat better results than another, there is certainly little prospect of any startling discovery being made which is at all likely to enable petroleum to compete commercially with coal as a general fuel for raising steam. What is really wanted is a reduction in the price of the oil, but we think that not even the prospective new sources of supply, when made available, will effect much in this direction.

ASEISMIC BUILDING AND THE ISCHIA EARTHQUAKE.

IT is not our purpose to dwell upon the scenes of horror resulting from the recent earthquake of Cassamiciola, but it is impossible to let such a catastrophe pass without some reference to the lessons it should teach the dwellers in countries known to be subject to great seismic disturbance. If it were not known to be otherwise, it would seem that the occurrence of such fearful death-spreading natural convulsions should be sufficient to cause human beings to desert the country affected by them. No such warning, however, is sufficient. People are everywhere more or less the creatures of circumstances, and after the occurrence of a great earthquake those who are left, especially of the poorer classes, are usually more than ever bound to the country which has been the scene of the ruin of all they possessed. They have little indeed left them, and that little will not help them to leave their own for other and safer countries. Even in their ruins the long-dwelt-in places have their strong attractions, and it happens that by far the larger part of the earthquake-threatened and devastated countries are amongst the most luxuriant in vegetation, and the most prolific in the production of man's natural requirements. The climates of some are beautiful, and in them men can probably live with less of toil than in most other parts of the earth. Ischia will no doubt soon be covered with new dwellings or wild vegetation, and in a dozen years the terrible catastrophe of 1883 will to most of its dwellers be a something very terrible which happened a long time ago. It is, therefore, not unreasonable to think that house builders will again be busy in the now unhappy Cassamiciola and other places near, and even if they be not there busy, there are other countries wherein earthquakes are frequent, and where the subject of building is and will be occupying attention.

If buildings to a great extent proof against ordinarily severe earthquake shocks are not practicable, then at least one master in the observation of and in the art of deciphering natural phenomena laboured much in vain. Robert Mallet, the founder of the science of seismology, worked much to make the application of physics and mechanics to geology subservient to mankind. To be able to build so that an earthquake may not easily destroy, it is necessary first to have some idea of what an earthquake is. To have had some experience of the effects of an earthquake, or to have felt earth tremours such as those which occasionally are felt in England, and very frequently in parts of Scotland, is not to have any notion of what earthquakes are, in the sense that such experiences afford no assistance in the problem of building so as to minimise their effects, or rather those of the rather severe earth shakings which are unknown in this country. We say unknown in this country, and of course mean within historic periods, for although shocks more than sufficient to excite alarm have occasionally visited us, such as that which frightened many thousands in October, 1863, we have not experienced anything that would in the least discompose the inhabitants of some parts of Italy, of Chili, or Japan. Experience, therefore, warrants our building without reference to this most terrible of all natural phenomena. This, however, is not the case everywhere, and it would be discreditable if the knowledge we now possess of the nature of an earthquake were not utilised for the benefit of those who live in lands less fortunate in respect of visits of this kind than are we.

What, then, is an earthquake? To quote from one of Mallet's numerous works on the subject, an earthquake is "The transit of a wave or waves of elastic compression in any direction, from vertically upwards to horizontally in any azimuth, through the substance and surface of the earth, from any centre of impulse, or from more than one; and which may be attended with sound and tidal waves, dependent upon the impulse and upon circumstances of position as to sea and land." In the first place, then, it is necessary to understand the sense in which the word wave is used in this definition. When a blow or pressure of any sort is suddenly given, or when a previously applied steady or slowly variable force is suddenly increased upon or relaxed from any material substance, a pulse or wave originated by such an impulse is transmitted through the material acted upon in all directions from the origin or centre of impulse. The transfer through the material, or the transit of such an elastic wave, is merely the continuous forward movement of the original change in the relative positions of the particles of part of the elastic mass produced by the extraneous force or blow—a relative displacement and replacement of those particles within a determinate range. The shaking of the ground by a heavy train at speed affords an example of such waves in solids. The velocity of transit of such waves varies in different materials, and depends, for any given substance, upon its elastic modulus. In air it is about 1140ft. per second; in water, about 4700ft. per second; in homogeneous crystalline rocks, such as porphyry or granite, it is from 5000ft. to 10,000ft. per second; and in iron and steel it reaches from 11,000ft. to 12,000ft. per second. As they occur in nature, however, rocks of any kind are seldom homogeneous through any considerable distance, and Mallet found by laborious experiment over distances extending from several hundred yards to over a mile, that the mean rate of wave-propagation through solid granite was about 1664ft. per second; in similar but much shattered granite, 1306ft. per second; in contorted and stratified quartz and slate, 1088ft. per second; and through wet sand, 825ft. per second. The centre of impulse of an earthquake shock is, however, always at a great distance below the surface, and the velocity of transit is always very slow compared with the velocities thus obtained experimentally. The velocity at the earth's surface has probably seldom reached a dozen feet per second. But no ordinary buildings are constructed to withstand a fourth of this, and even this velocity of wave transit is much greater than that at which motion may be safely imposed on any structure, though standing upon the most heterogeneous materials. It is, then, the inertia of any ordinary structure or building which brings about its overthrow or destruction; though this, at the same time, saves many strong, heavy structures, the earth upon which it stands moving without conveying the movement to it, or only doing so to a small extent—just as a coin may be knocked from the centre of a pile of coins if hit at a high velocity. When this relative movement cannot take place, then the structure to which the movement is conveyed must either be of materials of sufficient strength to receive and transmit through itself motion of high velocity, or it will be overthrown or shattered by its own inertia of rest, and the fall will take place in a direction opposite to that in which the ground has moved under it. With masonry walls, the lower course or courses have often been found to have been unaffected by their movement during an earthquake shock, but the upper courses—to which movement, if communicated at all, must have been transmitted through the mortar joints—have moved through greater or less range on the lower courses, or, more correctly, their inertia has been sufficient to destroy the bond of the mortar, and has prevented their receiving the movement which has been imparted to the lowest course. Many illustrations of this are to be found in the South of Europe and elsewhere, where upper parts of walls and columns remain in the new positions acquired during the earthquake wave transit, and in some cases columns and spires are twisted partly round or have received a vorticose motion. It will be seen that if a stone rest upon a base to which motion is suddenly communicated, the impelling force available for moving the upper stone consists only in the friction of the stone upon its base or the adhesion of any cement between them. If now the inertia of the upper stone be greater than that friction or adhesion, the base which is suddenly put into motion must move without the upper stone or only convey part of its motion. If the friction or adhesion be greatest at some part of the base not directly under the centre of gravity of the stone, then its inertia will cause it to turn through a greater or less arc on the base in proportion to the relation between the adhesion and inertia. A good example of this is, or was, to be seen in the two obelisks in front of the convent of St. Bruno at Stephano del Bosco. If the wave impulse be of sufficient amplitude, and the height of the stone compared with the width of its base great, the stone will be overthrown. Thus, the velocity necessary to overthrow a parallelopiped or rectangular prism may be obtained from the following equation:—

$$V^2 = \frac{4}{3} g \sqrt{a^2 + b^2} \times \left(\frac{1 - \cos. \theta}{\cos.^2 \theta}\right),$$

a being the height of the prism, b its diameter of base, θ the angle formed by the side and a line drawn through the centre of gravity to the extremity of the base. $V^2_1 = 2\,g\,h$ with the usual signification. The inferences, then, are several. When stone is used every piece should be well fastened to every other, but any stone structure will be subject to destruction under wave impulse of considerable amplitude or high velocity of wave particle. Whenever possible in countries much visited by earthquakes, either framed wood houses should be used as having less inertia and great strength, or framed ironwork houses may be used, as, although their inertia would be great, their strength might be also very great. As showing that stone structures of considerable altitude when firmly connected, or as nearly monolithic as possible, may withstand the effects of earthquake shocks or earthwave transit of rather high velocity, the three marble shafts of the columns of the Temple of Serapis at Pozzuoli, which are 41½ft. in height and 4ft. 10in. diameter, and have been standing uncovered since 1750, may be referred to. Earthquake shocks, however, which have failed to overturn these have caused widespread disaster in the badly built towns of some parts of Italy, though a velocity of wave transit which would overturn them, a velocity probably not one-fourth of that which destroyed Cassamiciola, would not throw down a well-built house. It is necessary, however, to be prepared against the great shocks, and it is questionable whether stone buildings of the best workmanship but usual method of construction would withstand a velocity of wave transit of more than from 6ft. to 10ft. per second. Amongst the few buildings constructed under the guidance of Mallet's researches, are the Japanese lighthouses, built under the direction of Messrs. D. and T. Stevenson, engineers to the Commissioners of Northern Lights. The light apparatus of the houses is mounted so that no motion is directly transmitted to it, even though the base may be subjected to wave transit of high velocity.

There is no reason why the science of seismology should not be brought to bear in the construction of buildings of all kinds, and it may be hoped that the Ischia disaster may draw attention to the knowledge available on the subject.

CORNELIUS WHITEHOUSE.

THOSE who remember the great patent case of Russell *v.* Ledsam, which for many years dragged its slow length through the various courts up to the House of Lords, where it was finally decided in the year 1848, will regret to learn that Mr. Cornelius Whitehouse, one of the inventors whose patent was in dispute, died on the 7th inst. in the eighty-ninth year of his age. The invention was of the greatest importance, and may be said to have laid the foundation of the welded tube trade. Whitehouse was originally a workman in the employ of James Russell, tube manufacturer, of Wednesbury. As far back as the year 1825 he took out a patent for making tubes, according to which the skelp, previously bent up, was heated in a furnace, and was welded by being drawn, without a mandril, through a pair of semicircular dies; or through pincers, each jaw of which had a semicircular groove or aperture. It created quite a revolution in the trade, the price of tubes being reduced to one-half and for some sorts to two-thirds, and much longer lengths could be made. The tubes were of greater uniformity, both internally and externally, and the trade came very soon almost entirely into the hands of Russell, to whom the patent had been assigned, the inventor receiving an annuity sum of £300, together with a house and certain other advantages. Ledsam, the defendant in the action, was the assignee of a patent taken out by the late Richard Prosser, of Birmingham, according to which tubes were welded by drawing them through grooved rollers. This was decided by the court to be an infringement of Whitehouse's patent, the grooved rollers being regarded as the mechanical equivalent of Whitehouse's die, but the litigation which was commenced in 1830 was not finally set at rest until 1848, long after the patent and its extension had expired. It was extended for six years in 1839, on condition that an annuity of £500 should be secured to the inventor. The defendants contended that the Crown had no power to insert such a proviso, and they further alleged that the application for extension had not been made in time, and that the annuity had not been duly paid. Amongst the testimony to the great value of the invention given before the Privy Council was that of Perkins, the patentee of a well-known system of warming buildings, who stated that no other tubes would have enabled him to carry out his invention. They would bear bending cold, and would stand a pressure of 5000 lb. on the inch. Francis Bramah, son of the great inventor, also stated that the introduction of the improved pipe enabled him to dispense with the very expensive copper tubing formerly used in connection with hydraulic presses, which cost 10s. per foot, whilst Russell's pipe could be obtained of sufficient strength at 1s. 3d. per foot. Mr. Whitehouse commenced business on his own account at the Globe Tube Works, Wednesbury, in 1845, which, however, he relinquished to Mr. John Spencer last year, as we reported at the time. He also took out several other patents in connection with the manufacture of lap-welded tubes, but none of such importance as his original invention. No one will be surprised, though it is much to be regretted, that in common with many other patentees, the benefits Mr. Whitehouse conferred upon all countries through his invention did not leave his latter days with such substantial means as the importance of the industry he created ought to have afforded him.

LITERATURE.

A Physical Treatise on Electricity and Magnetism. By J. E. H. GORDON, B.A., Camb. Second edition. Revised, re-arranged, and enlarged. Two vols. London: Sampson Low, Marston, Searle, and Rivington. 1883.

THIS work is altogether unique in the list of books on electrical subjects, and if any attempt was made to classify such books, we imagine this would occupy a class by itself. Experimental research in electrical matters is being carried on in various directions, but the ordinary reader knows little of the results obtained, nor are these results incorporated in the text-books for many years after the investigations have been made. Mr. Gordon's book deals mainly with recent investigations and their influence upon electrical theories. The instruments used in these experiments are carefully described and illustrated; in fact, the illustrations in this work are far better than those usually seen in English scientific books. The cuts have been looked upon as of equal importance with the letterpress, the result being that they are the best of their kind. The descriptions of instruments are to be found interspersed with the other matter in the book, and not collected into one chapter. It seems that the author's idea has been to describe the instruments used in certain experiments just before he refers to the experiments and the results obtained by these experiments.

In the preface to the new edition Mr. Gordon mentions the great importance of electric lighting, and promises a special book upon this subject; hence very brief reference will be found in the book to this most recent development of electricity.

The work itself is divided into four parts, respectively treating of electro-statics, magnetism, electro-kinetics, and electro-optics. A brief discussion of the elementary principles involved is given as an introduction to each part, so that the reader may understand the true bearing of the experimental work described. In the part devoted to electro-statics, the preliminary chapters lead up to the discussion of "specific induction capacity." The text before the author in writing this portion of the work is evidently given in the first paragraph of the chapter on specific induction capacity, which reads as follows:—"If electric induction were a 'direct action at a distance,' we should expect that it would be transmitted equally through all insulators. One of the strongest arguments for supposing it to be a strain of the particles of the insulator, is found in the fact that different insulators transmit it with very different strengths." This text is due to Maxwell, of whom Gordon was an apt pupil. As a further proof of the text, we read—page 66—after a reference to one of Hopkinson's papers:—"Thus a complete analogy is established between the twisting of a glass fibre and the phenomena of residual charge, and we can have no doubt that the electrical effects are due to mechanical strains of the insulator." This part of the subject is, as might be expected, rather exhaustively treated, Mr. Gordon having himself carried out elaborate series of experiments, is therefore well able to point out the bearing of the results obtained by Cavendish, Gibson and Barclay, Boltzmann, and others.

The part on magnetism receives comparatively cursory treatment, whilst that on electro-kinetics forms about one-half of the entire work. This latter part commences with a discussion of various kinds of voltaic batteries, dealing then somewhat fully with the contact theory and the investigations of Faraday, Thomson, Muller, De la Rue, Ayrton, and Perry upon this theory. Further chapters deal with the methods and apparatus of measurement; the units in use, the action of magnets on currents and currents on magnets, bringing us to the second volume. Here the commencing subject is that of electrolysis. It is in this part of the work that the most extensive additions have been made. Among these additions we find a be[illegible]tifully illustrated chapter describing Tribe's experiments on the distribution of the electricity in electrolytes traversed by a current. Then after discussing Adams' work on equipotential curves, we have another addition, giving a well-illustrated description of the experiments of Bjerkness, Stroh, and others, "showing that it is possible to imitate most of the well-known actions between currents and magnets by means of bodies pulsating and vibrating in water and other fluids." As is well known, the experiments of Bjerkness were carried on with water as the medium; Stroh extending these experiments to air, &c. The author remarks upon the work of Bjerkness, "By these admirable researches of Professor Bjerkness we see opened a possibility of explaining some of the mysterious mechanism of electric and magnetic attractions, without the necessity of supposing any force to be at work other than those with which common experience makes us familiar, for we see them all reproduced by vibrations of material fluids, which differ from our supposed ether only in the superior elasticity and smaller density of the latter, that is, they differ only in degree and not in kind."

In this part of the work we have also a full discussion of the vacuum discharge, and discharge generally, giving the experiments of Crookes, Spottiswoode, De la Rue, and others.

The fourth part of the work deals, as we have said, with electro-optics—principally with the researches of Faraday, Verdet, Kerr, Röntgen, and Gordon—concluding with Maxwell's electro-magnetic theory of light.

We have thus briefly described, rather than expressed any opinion upon, the contents of Mr. Gordon's work. We feel, indeed, that so large a portion of the work being almost in the words of the original investigation, criticism should be directed more to the question whether the compiler has selected judiciously rather than anything else, and in our opinion his judgment has not been at fault in the selections he has made. As for the experiments described, they are matters of fact, admitting of little or no dispute. Many, if not most, have been corroborated by other experimentalists, and are accepted as tried data upon which the science of electricity is being gradually built. We have said that the author in one particular part of the work had a text—we might say this text seems to have been continually before him—and that the main idea of the work is to show the great probability of the correctness of Maxwell's theory, or rather theories. These theories cannot be better put than in the words given in p. 305: "Electro-magnetic induction is propagated through space by strains or vibrations of the same ether which conveys the light vibrations; or, in other words, light itself is an electro-magnetic disturbance." Here are, it will be seen, two theories—one relating to electro-magnetic induction, the other to light. When we notice that by far the greater part of the experimental work referred to in this treatise is of British origin, we may well be proud to think that if Germany is ahead of us in chemical research, we still more than hold our own in electrical research. Just a few words as to the work of the publisher. He must be congratulated in having produced one of the best printed, and by far the best illustrated, work on electricity that exists.

THE FISHERIES EXHIBITION.

ON Wednesday evening Mr. Paxman, of the firm of Davey, Paxman and Co., Colchester, gave a dinner to the leading authorities of the Fisheries Exhibition, certain members of the press, and others. About twenty-five sat down to table in the Prince of Wales' Pavilion, which he had courteously placed at Mr. Paxman's disposal. Among those present were Mr. Birkbeck, the president, Mr. Trendle, Lieut.-Col. Festing, R.E., Mr. W. D. Gooch, C.E., the Mayor of Colchester, &c. &c. The dinner was in every respect a success. When it was over the party adjourned to the main building and the electric light shed. The whole of the power required for the illumination of the building, amounting to about 1000-I.H.P., has been supplied by Messrs. Davey, Paxman, and Co., and is given off by six engines. The largest is a coupled engine—or pair of engines—with two 18½in. cylinders, 32in. stroke, making sixty-eight revolutions, with a pressure of 90 lb., and indicating about 300-H.P. This pair has been purchased by the Government for supplying the electric light at South Kensington. The second engine is compound, with cylinders 15in. and 22½in. diameter and 24in. stroke, making 103 revolutions per minute, with a pressure of 120 lb., and indicating about 250-H.P. There are also three double-cylinder semi-portable engines, with 12in. cylinders and 14in. stroke. Two of these make 135 revolutions, and one 140 revolutions per minute, and working with 75 lb. steam, they indicate about 100-H.P. The sixth engine is also semi-portable, with two 10½in. cylinders, 14in. stroke, making 140 revolutions, and with 90 lb. pressure, this engine will indicate about 110-H.P. The total power provided is about 1135 horse, of which about 1000 on the average are required. Various changes are, however, being made from time to time in the numbers and dimensions of the dynamos employed, a good deal of experimental work being done, and much more than 1000-H.P. has been exerted. The first two engines and the last are fitted with Mr. Paxman's automatic expansion gear, and all are fitted with a new and excellent governor made by the firm.

This is the largest display of steam engines ever publicly exhibited at work by one firm, the total power exerted being about as much as that expended by a 3000-ton Atlantic steamer, making 10 knots an hour. An approximate idea may be formed of the magnitude of the performance when we say that not less than 40 tons of coal are required per week, and this notwithstanding the fact that all the engines employed are of exceptionally economical types, and specially designed to get the largest possible amount of power from the smallest possible quantity of coal. Those who are familiar with the performance of steam engines, will see that this is equivalent to a consumption of less than 3 lb. of coal per horse-power per hour, and it must not be forgotten that the engines are worked under unfavourable circumstances, steam having to be got up every night, while the engines are run, at present, not more than three or four hours at a time; as the days grow shorter, and the engines are run for a longer period, the consumption of coal per horse-power per hour will be reduced.

It is further to be noted that all these engines run with remarkable steadiness; uniform velocity of rotation of the driving power being essential to successful electric lighting, and this has been secured in an eminent degree by the "Paxman" automatic expansion valve and governor referred to above, and this not in one but in all the engines fitted. This is the more noteworthy that several changes have, as we have said, been made in the dynamos, and in the way in which power is distributed in compliance with the desires of the electricians. Thus under varying conditions the velocities of the engines have remained unaltered.

There are in all forty dynamos of various types at work, and it may be safely said that the electric light shed at the Fisheries Exhibition contains one of the most interesting displays of electrical plant ever got together; indeed, it is certain that nothing so complete, so efficient, or of equal magnitude and value has ever been shown under one roof in Great Britain.

THE EXPORT OF IRON TO FOREIGN COUNTRIES AND BRITISH COLONIES.

IN the absence of the CustomHouse returns, which are usually distributed during the summer months, there is professedly great anxiety expressed to obtain details of the results of last year's operations in so far as exports are concerned, and we endeavour to give in the following the outlines so far as possible. The export of railroad iron, as will be seen from the table below, shows an increase of some importance; the totals have risen from 693,000 tons of railway iron in 1880 to 826,000 and 933,000 tons in 1881 and 1882 respectively. British North America took (leaving out 000's) 85, 100, and 95, during the three years, viz., 1880-82. The shipments to British India have been, in 1880, 128,000 tons, 94,000 tons in 1881, and 135,000 tons in 1882. The increase to Australasia is demonstrated as follows: Shipments in 1880, 86,000 tons; in 1881, 97,000 tons; and in 1882 91,000 tons.

There is, again, a large increase of pig iron, the largest portion of which is shipped to European ports, while 500 to 600,000 tons go annually to British North America and the United States of America. Nearly all other descriptions show an increase so far as it affects quantity, but the percentage in values presents but little if any changes. The tonnage under the head of sheets, plates, has advanced from 283,000 in 1880 to 304,000 and to 343,000 tons, respectively, for 1881 and 1882. On the other hand, the exports to the European group show no remarkable activity. There is an increase in regard to the tonnage shipped and the exports to the lowlands, which goes in transit, more or less, to Germany and other countries; there is a corresponding expense summing up to a total increase of about 10,000 tons. The same remarks refer so far as it affects the European countries. With the exception of Italy, Spain, and, in a minor way, the Scandinavian countries have been comparatively faithful customers. The only increase, likewise on a Liliputian scale, appertains to France and Portugal. With the exception of the Brazilian Empire and the Mexican Republic, who have steadily advanced in iron shipments from this country, there is no apparent sign that progress is on foot with the view of recouping the heavy losses which the South American Continent has inflicted on the British iron industry. The shortcoming in tonnage during the period 1876 to 1880 may roughly be estimated as exceeding one million tons of iron, wrought and unwrought. Where little, or comparatively less decrease is appearable, it must be borne in mind that in many cases finished iron has, within the last seven years, taken a lower place in the rate of percentage when compared with increase of pig iron. However that may be, so far as it regards the tonnage, the British iron industry has lost no ground. The falling-off in shipments on the one side has received a check. The healthy trade with our Colonies has now reached a development which fully compensates for prior losses in the decline of the countries nearer home who have, for nearly a century, been faithful customers. The European States took in the aggregate, roughly estimated, 45 to 50 per cent. of the proportion of total iron shipments from Great Britain during twenty-five years, 1856 to 1880. During that period 26 millions of best iron, all descriptions, were shipped to European States out of a total of 54,100,000. The United States shared in this respect, subject to fluctuations to a rate varying from 15 to 25 per cent., thus leaving 25 to 30 per cent. as the proportion falling to the share taken by all other countries, including shipments to British colonies. The proportion per cent. held by British Colonies has now assumed a percentage exceeding 30 per cent., and this takes the place of others, who have retired, more or less, as stated above, during the past seven years.

Statement showing the Exports of Iron and Steel in the Year 1882, *compared with the Year* 1881, *and the Results of the Average Shipments during the Quinquennial Period* 1876 *to* 1880, *distinguishing the Increase between* 1882 *and the Average of previous Five Years.*

QUANTITIES—NUMBER OF TONS.

	Average of five years, 1876—1880.	Total of 1881.	Total of 1882.	Increase of 1882 over the average of 1876–1880.
Bars, bolts, &c.	247,049	294,361	313,645	66,596
Railroad iron	501,975	820,800	933,123	431,148
Cast and wrought ..	257,142	291,844	329,399	72,257
Hoops, plates, &c. ..	212,171	364.925	343,287	131,116
Steel unwrought ..	34,863	167,423	171,653	136,790
Steel wrought	11,729	16,373	17,938	6,209
Wire	47,183	75,129	86,686	39,483
Tin-plates	171,158	243,381	265,021	93,863
Tons	1,483,216	2,214,236	2,460,752	977,462
Pig and puddled scrap and old iron	1,225,683	1,606,077	1,889,545	658,912
Total	2,708,841	3,820,313	4,350,297	1,636,374

VALUES, IN £ STERLING.

	Average of five years, 1876—1880.	Total of 1881.	Total of 1882.	Increase of 1882 over the average of 1876—1880.
Bars, bolts, &c.	1,878,455	2,013,133	2,299,627	421,172
Railroad iron	3,761,712	5,666,446	6,376,034	2,614,322
Cast and wrought ..	3,684,963	3,964,268	4,552,994	868,026
Hoops, plates, &c. ..	2,721,481	3,404,790	3,948,005	1,226,624
Steel unwrought ..	986,624	1,871,161	2,044,722	1,058,098
Steel manufactured ..	745,103	919,311	926,345	181,342
Wire	687,810	1,000,844	1,322,537	634,717
Tin-plates	3,324,612	4,663,132	4,642,184	1,317,572
	17,790,766	22,998,085	26,112,448	8,321,873
Pig and puddled scrap and old iron	3,699,682	4,592,823	5,466,943	1,753,261
Gross total	21,410,449	27,590,908	31,579,411	10,775,034

TENDERS.

SEWER, &c., FOR THE ABINGDON BOARD OF GUARDIANS.

MR. GEORGE WINSHIP, A.M.I.C.E., engineer, Abingdon and Westminster.

	£	s.	d.
H. Norman, Fulham	630	10	0
G. Thatcher, Abingdon	622	10	0
Messrs. Buckle and Wheeler, Abingdon	615	0	0
H. Potter, London—accepted	610	0	0

THE DAPHNE DISASTER.

THE very able report by Sir Edward Reed, M.P., the late Chief Constructor of the Navy, on the Daphne disaster, is now published, and will be welcomed alike by shipbuilders and shipowners at home and abroad as a valuable addition to the science of naval architecture. That there are both novel and startling disclosures, relating to the stability of ships, embodied therein, must be universally acknowledged, and emanating from such an authority they will, it is to be hoped, carry with them sufficient weight to render their consideration a matter of necessity in the future, both before launching a ship or sending her to sea. He says that—

It is now manifest that ships of modern type are sometimes characterised when floating light by a very abnormal deficiency of stability in inclined positions. I will explain the matter as it became developed during this inquiry. The accident was so distressing to Messrs. Stephen, and cast upon them so many novel labours and anxieties, that they secured the services of Mr. Francis Elgar, member of Council of the Institution of Naval Architects, for the investigation of the causes of the accident, and for furnishing me with such information from their firm as I desired. In the course of his evidence Mr. Elgar, on the 11th July, gave the results of certain preliminary estimates and calculations which he had made for the Daphne, and which showed that the ship appeared tc have a metacentric height of nearly 8in. He went on to state that with this amount of stability, and with the usual height of side out of water, it had been most difficult to account—up to the date of his evidence—for the capsizing of the Daphne. He further represented that it had been everywhere understood down to the present time that a ship having some actual stability in the upright position, and a high side must of necessity be incapable of capsizing under all ordinary circumstances. So general was this belief that it had never, he said, occurred to any one, so far as he was aware, "to calculate the actual curve of stability of a ship at her launching draught." The only exception to this known to him was the curve of the Hammonia, which was, less than a year ago, upon the Clyde, nearly or quite capsized in launching. "The builders of that ship appear," said Mr. Elgar, "to have been as much astonished as Messrs. Stephen were in the case of the Daphne at the ship having capsized, so they had the whole matter looked into, and they have had the actual

FIG. 1

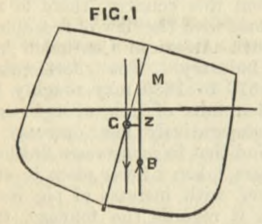


FIG. 2

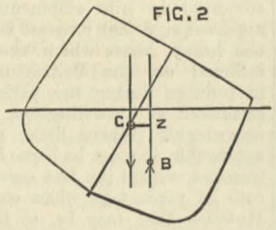


FIG. 3

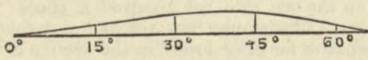
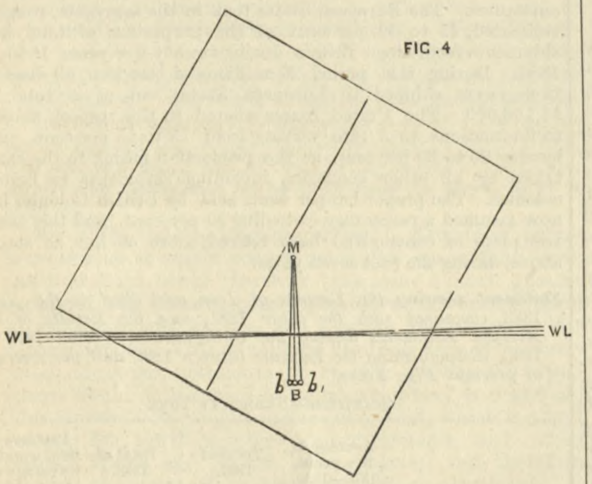


FIG. 4



curve of stability of that ship calculated." And the belief of the witness was that this curve disclosed a deficiency of stability which had hitherto been wholly unexpected in such ships, and which it was quite impossible—the details of the Hammonia case being unknown to them—for the builders of the Daphne to have foreseen.

This evidence of Mr. Elgar was substantially repeated by Mr. J. H. Biles, naval architect to Messrs. J. and G. Thomson, of Clydebank. Mr. Biles produced the Hammonia's curve of stability, which he had himself calculated, and which disclosed the fact that although the ship had some stability in the upright position, it, nevertheless, reached a maximum at about 33 deg., vanished at about 50 deg., and became again positive at about 90 deg. Mr. Biles shared Mr. Elgar's belief that no previous curve of stability had ever been constructed for a mercantile ship at her launching draught. "I know of no calculation," he said, "for a complete curve of stability having been made, or even of the necessity of the thing having been suggested." Before proceeding further, I would explain that the "curve of stability" to which reference has been made is nothing more than a graphic representation of the successive leverages with which the buoyancy of the ship tends to force her either back into the upright position, or further from it when she has been by force inclined from that position. This leverage is measured by the distance between the two vertical lines through which the weight of the ship acts downward and her buoyancy acts upward respectively. As a given ship is more or less inclined, this distance or leverage usually alters, because the centre of buoyancy alters, while the centre of gravity does not. These stability leverages, being calculated for various angles of inclination, are set up as ordinates along a base line—at distances corresponding to the number of degrees in the respective angles—and a curve drawn through the ends of these ordinates becomes the "curve of stability." It is constructed, therefore, just as curves are being continually constructed, to represent changes of temperature, changes of barometric pressure, growths of population, and a thousand other like varying quantities.

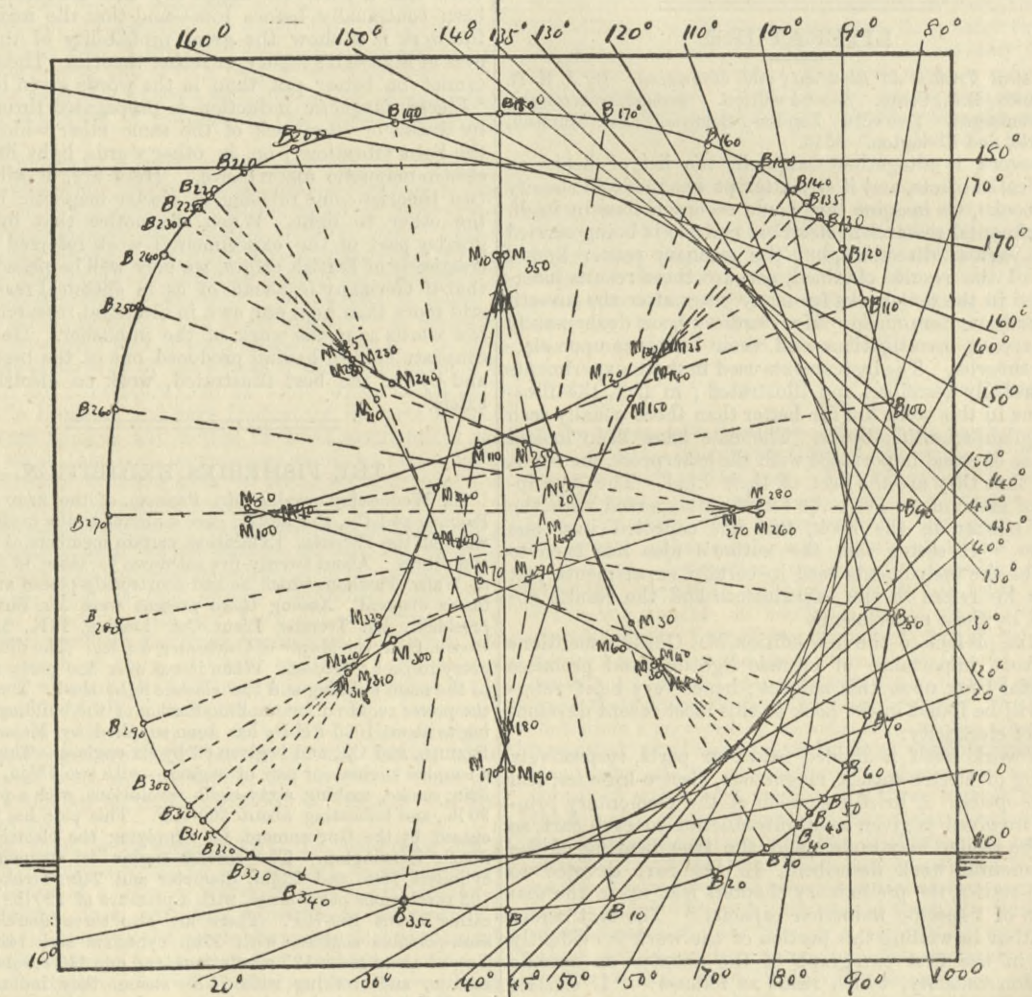
As no curve of stability has ever before been made public for a mercantile steamer at launching draught, and as I can find no trace of one having been made even in those shipbuilding establishments which are most advanced in scientific practice, it may be proper to explain this deficiency by reminding you that the "curve of stability" is itself of quite recent construction. In 1867, on certain designs being submitted to the Admiralty, which appeared to me manifestly deficient in stability at large angles of inclination, I had the stability calculated at several successive equal angles, and the results were brought to me in the graphic form of a curve. Mr. N. Barnaby, C.B., the present Director of Naval Construction at the Admiralty, was the officer who conducted, and Mr. John, now the manager of the shipbuilding works at Barrow, was the officer who actually made the calculations, and produced the first "curve of stability" which has ever been constructed. Its construction was first publicly described, and the curve itself published, in a paper read by me at the Institution of Naval Architects in 1868. Since that time it has been universally employed for graphically illustrating both the statical and the dynamical stability of completed ships, but until the Hammonia case occurred it had not been produced apparently for any mercantile vessel in the launching condition, for the reason which I have quoted from the evidence of Mr. Elgar and Mr. Biles—viz., the general assumption that if a ship has initial stability and is high-sided she can be launched with safety.

That this view has widely prevailed is quite certain. It has been taken very generally for granted that a high-sided ship with initial stability goes on gathering additional stability up to large angles, and that although it reaches a maximum and then diminishes, it may be relied upon as existing in some degree for even very large angles of inclination. Sufficient initial stability has been regarded in ordinary ships as a guarantee of sufficient stability at all angles for launching purposes. No firm upon the Clyde, or indeed anywhere else, have taken more pains, in my opinion, to apply scientific calculation to their work than Messrs. Denny Brothers, of Dumbarton, who have greatly distinguished themselves by organising at their establishment a costly scientific department and staff, and giving the profession the benefit of many of their investigations. Yet Mr. Peter Denny, the senior member of the firm, says that curves of launching stability have not been made by him. This view has also taken another form in the literature of naval architecture, where it has been laid down that if a ship has initial stability and has some stability also at very large angles of inclination, say 90 deg., then it is quite certain that she will possess stability at all intermediate angles of inclination. This principle was laid down quite clearly in an able paper "On the Calculation of the Stability of Ships and some Matters of Interest connected therewith," read at the Institution of Naval Architects in 1871, and has been repeated in Mr. W. H. White's "Manual of Naval Architecture." The Hammonia's case has clearly shown, however, that the stability at the large angle of inclination, instead of being a continuation of the positive stability of the upright position, may be a reappearance of positive stability occurring after an interval of instability, and consequently that the existence of positive stability both at the upright position and at extreme angles of inclination is no guarantee whatever of safety, at least in certain cases. Nor can it at all be assumed hereafter that because a high-sided vessel has initial stability she can be relied upon not to capsize under ordinary launching conditions.

It is not easy to see how the doctrines which I am here calling in question come to be widely accepted by the profession. They will not for a single moment stand the test of scientific investigation. As soon as they are carefully considered they are seen to be wrong. They are at the best but specious generalisations from a limited class of familiar facts, and though they may find many seeming corroborations under the ordinary conditions of ships, they may also be disproved by abundant examples. It is needless even to draw such examples from ships, for the most elementary forms of floating bodies furnish ready illustrations. In the 1871 paper on the calculation of the stability of ships, to which I have just adverted, floating bodies of square sections and parallel throughout their length are employed as illustrations of certain scientific principles. Now a floating body of this simple description serves perfectly to illustrate the unsoundness of the doctrine in question. I have ascertained the stability of such a body of square section immersed at various depths, and have constructed for it curves of stability corresponding to different positions of the centre of gravity, and have thus obtained numerous confutations of the principle. A single case will here suffice. When this body is immersed three-twenty-fifths of its depth, and has its centre of gravity 2ft. below its centre of form, it has abundant stability, both in the upright position and inclined at 90 deg., but none at all when inclined at 66 deg. When the centre of gravity is raised a foot it still has large stability upright, and good stability at 90 deg., but it loses all stability at the intermediate inclination of 53 deg., and only begins to regain it at 82 deg. The Hammonia example shows that the doctrine is no more true for ships than for prismatic forms, and it consequently follows that professional men must forthwith abandon a doctrine which they have to a very large extent at least accepted without question, but which is now seen to involve public danger.

Now, although in the Daphne case there is no recovery of stability at 90 deg. as in the Hammonia, a condition which may or may not be associated with the other characteristics of ship stability at very light draught, and which much depends on the form of the upper portion of the ship, and although the actual metacentric height of the Daphne as launched was less than Mr. Elgar estimated it approximately at the early stage of the inquiry, it is manifest that the present disaster was much influenced in its character, and the complete capsizing brought about by the unexpectedly slow growth of the stability already adverted to. I have had the ship's curve of stability at the launching draught carefully calculated, and it appears that as she inclined she gathered stability so slowly that at an angle of inclination of 10 deg. her lever of stability was only about $\frac{3}{4}$in. in length, giving a righting moment of only about $32\frac{1}{2}$ foot-tons; at an angle of 20 deg. the lever was $2\frac{1}{16}$in. long and the righting moment 89 foot-tons; at 30 deg. the lever was $4\frac{3}{16}$in. and the righting moment 182 foot-tons. These increases of stability are so small that, when first brought to light by the calculations made after my experiments upon the ship on July 28th, they seemed open to doubt, notwithstanding the fact that curves previously calculated in London, the evidence of Mr. Elgar, and the case of the Hammonia, had all made a specially low curve of stability seem probable. Mr. Peter Denny, of Dumbarton, in whose establishment all appliances for shipbuilding calculations exist, as I have previously intimated, having kindly placed them at my disposal, I had the curve of stability for the launching condition of the ship calculated there, and as the results conformed closely to other and independently constructed curves, there appears to be no reason to doubt the accuracy of the work upon which the above figures are based, notwithstanding their very unusual character. I will complete the figures by saying that, presuming all openings to have been effectually closed during the inclination of the ship, and the whole ship watertight up to the top deck, also that no weights shifted, the lever of stability at 40 deg. of inclination would have been $7\frac{1}{4}$in., and the moment of stability 315 foot-tons. At 50 deg. the lever would be nearly 1ft. in length, and the righting moment 500 foot-tons. At $50\frac{1}{2}$ deg. the whole side would be immersed, and all stability would be gone. It must be perfectly obvious to everyone, however, that long before the ship could reach this inclination, the men, and much of the loose material, must have begun to slip down the decks, and have introduced altogether new conditions.

Fig. 5.



It is unnecessary to enter here into minor particulars, because it will be obvious that with so little increase of stability as she inclined, the capsizing of the vessel is clearly accounted for. Before passing on, however, it may be well to exhibit the contrast between the Daphne and other vessels of small initial stability, and for this purpose I have taken almost at random, and as ordinary examples, two other mercantile steamers, which I will call A and B, and of which the curves of stability are known, and reducing them, as well as the Daphne, to one standard by bringing the metacentric height of all to zero, I obtain the following lengths of stability levers at different angles, observing that on this comparison I assume that the bulwarks above the main deck and the poop are not water-tight, and that the stability ceases with the gradual immersion of the main deck:—

Ship.	At 10° In.	At 20° In.	At 30° In.	At 40° In.	At 50° In.	At 60° In.
Daphne	$\frac{1}{16}$	$\frac{3}{4}$	$2\frac{1}{4}$	$1\frac{15}{16}$	$-1\frac{15}{16}$	-7
Ship A	$\frac{1}{8}$	$1\frac{7}{16}$	$6\frac{1}{8}$	$11\frac{1}{16}$	$13\frac{7}{16}$	12
Ship B	$\frac{1}{4}$	$2\frac{1}{16}$	$5\frac{7}{16}$	$10\frac{9}{16}$	$12\frac{1}{8}$	$11\frac{3}{16}$

Were I to regard the Clyde disaster in the abstract, or to make my own sense of what is right and safe at ship launches my only standard, I should certainly say that before launching the Daphne with so many men and so much loose materials as she had on board the builders should, even without any suggestions as to a slow and small increase of stability as the vessel inclined, have calculated the initial stability of the vessel, and finding it as small as it was, as they would have done, they should have naturally altered the conditions of the launch. But I cannot, with due regard to what is just, fail to qualify this statement by pointing out the relations of this case to the general practice of shipbuilders and shipowners, and to the grave defect in the assumed theory of the stability at light draught which, as we have seen, this disaster has been the means of disclosing. That there has been a great disclosure, and one which, during the three weeks this inquiry lasted, already began to have effect is manifest. When such shipbuilders as Mr. Pearce, Messrs. R. Napier and Sons, and Messrs. Denny, without hesitation or delay, proposed to act upon a novel development of professional science, its importance cannot be doubted, nor its adoption long be neglected by others. The general belief that a high-sided ship having some initial stability will as she inclines gather large additional stability and will retain some even at very large angles has exercised a widespread influence on modern mercantile shipbuilding, and has greatly encouraged people to be satisfied with very small initial stability, in some cases with none at all, and even less than none. Many steamships of large tonnage have been built of late years for influential steam companies and other owners, which ships are totally incapable of floating upright without the aid of ballast or of cargo, and which cannot be unloaded in dock without being held upright with hawsers attached to the shore. Such ships, even when capable of floating unballasted without capsizing, can only do so by lolling over at large angles of inclination, and there finding a position of stable equilibrium. When carefully watched over and stowed with suitable cargoes these ships can usually be made safe at sea, and sometimes even safer than ships with larger initial stability but less range—a circumstance to which undue prominence has perhaps been given, and which has diverted many from the grave elements of danger which more often are associated with small initial stability. There is not the least doubt, however, that a very small initial stability given to many modern mercantile steamships—given in the belief that much more is sure to be gained as the ship inclines (within large limits)—has resulted in the capsizing of many ships at sea and in grave danger to many that are still afloat, not in the same manner, because not in the same condition as to lightness as the Hammonia and Daphne, but from other not less real deficiencies.

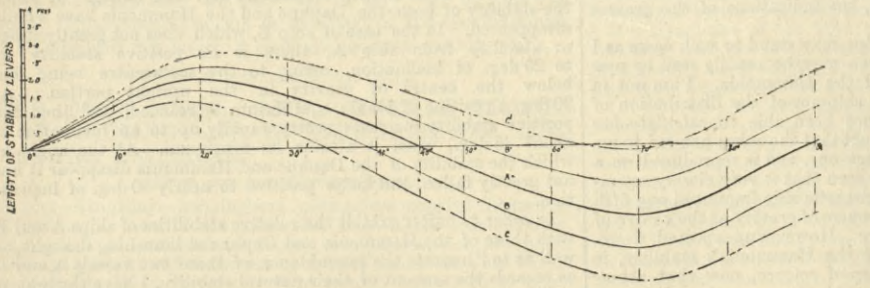


FIG. 6.—CURVES OF STABILITY OF PRISMATIC BODY OF SQUARE SECTION.

Draught of water $\frac{3}{10}$ths of depth: A, with centre of gravity at centre of form; B, with centre of gravity, 1ft. above centre of form; C, with centre of gravity, 2ft. above centre of form; B[1], with centre of gravity, 1ft. below centre of form; C[1], with centre of gravity, 2ft. below centre of form.

FIG. 7.—CURVES OF STABILITY OF PRISMATIC BODY OF SQUARE SECTION.

Draught of water $\frac{1}{8}$th of depth: A, with centre of gravity at centre of form; B, with centre of gravity, 1ft. above centre of form; C, with centre of gravity, 2ft. above centre of form; B[1], with centre of gravity, 1ft, below centre of form; C[1], with centre of gravity, 2ft. below centre of form.

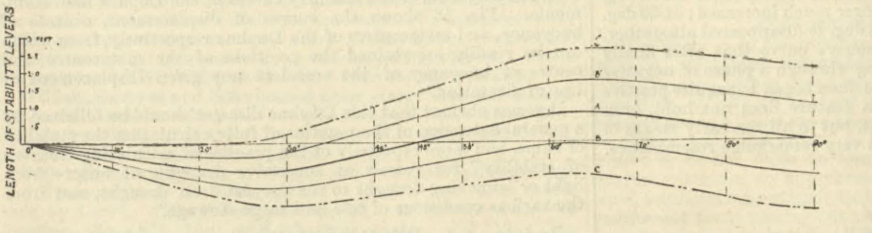


FIG. 8.—CURVES OF STABILITY OF PRISMATIC BODY OF SQUARE SECTION.

Draught of water $\frac{5}{8}$ths of depth: A, with centre of gravity at centre of form; B, with centre of gravity, 1ft. above centre of form; C, with centre of gravity, 2ft. above centre of form; B[1], with centre of gravity, 1ft. below centre of form; C[1], with centre of gravity, 2ft. below centre of form.

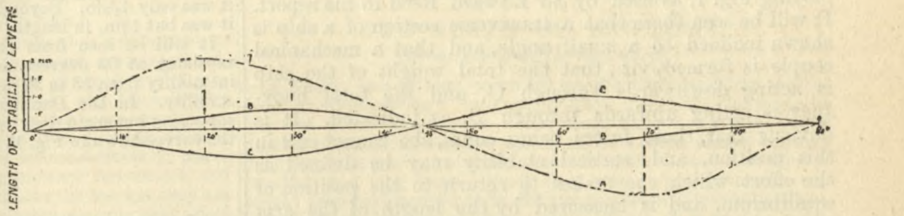


FIG. 9.—CURVES OF STABILITY OF PRISMATIC BODY OF SQUARE SECTION.

With centre of gravity at centre of form: A, with draught of water $\frac{3}{10}$ths of depth; B, with draught of water $\frac{1}{8}$th of depth; C, with draught of water $\frac{5}{8}$ths of depth.

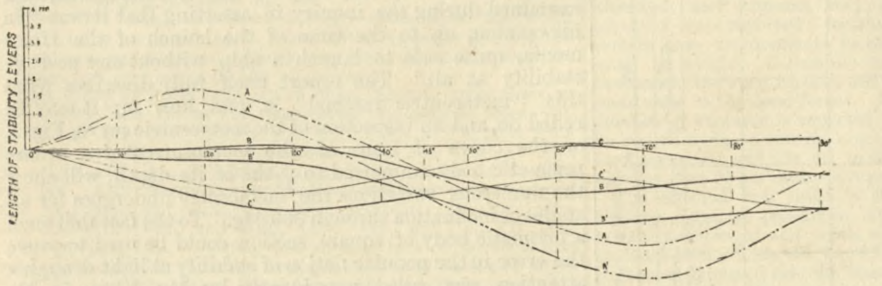


FIG. 10.—CURVES OF STABILITY OF PRISMATIC BODY OF SQUARE SECTION.

Draught of water $\frac{3}{10}$ths of depth: A, with centre of gravity, 1ft. above centre of form; A[1], with centre of gravity, 2ft. above centre of form. Draught of water $\frac{1}{8}$th of depth: B, with centre of gravity, 1ft. above centre of form; B[1], with centre of gravity, 2ft. above centre of form. Draught of water $\frac{5}{8}$ths of depth: C, with centre of gravity, 1ft. above centre of form; C[1], with centre of gravity, 2ft. above centre of form.

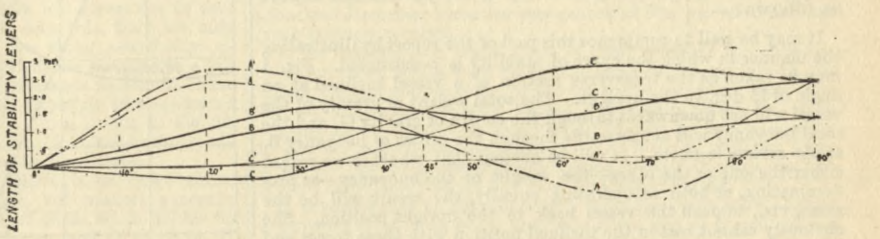


FIG. 11.—CURVES OF STABILITY OF PRISMATIC BODY OF SQUARE SECTION.

Draught of water $\frac{3}{10}$ths of depth: A, with centre of gravity, 1ft. below centre of form; A[1], with centre of gravity, 2ft. below centre of form. Draught of water $\frac{1}{8}$th of depth: B, with centre of gravity, 1ft. below centre of form; B[1], with centre of gravity, 2ft. below centre of form. Draught of water $\frac{5}{8}$ths of depth: C, with centre of gravity, 1ft. below centre of form; C[1], with centre of gravity, 2ft. below centre of form.

FIG. 12.

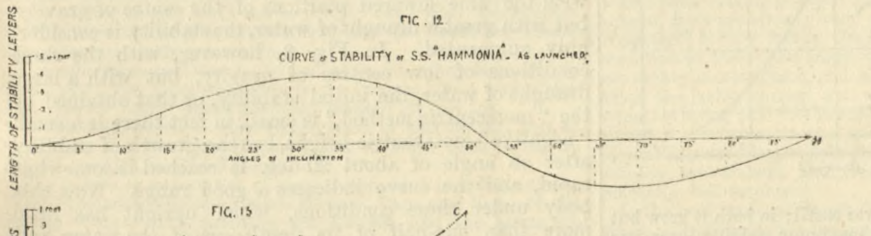


FIG. 15

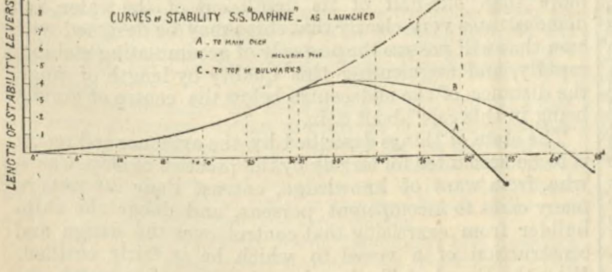


FIG. 13.

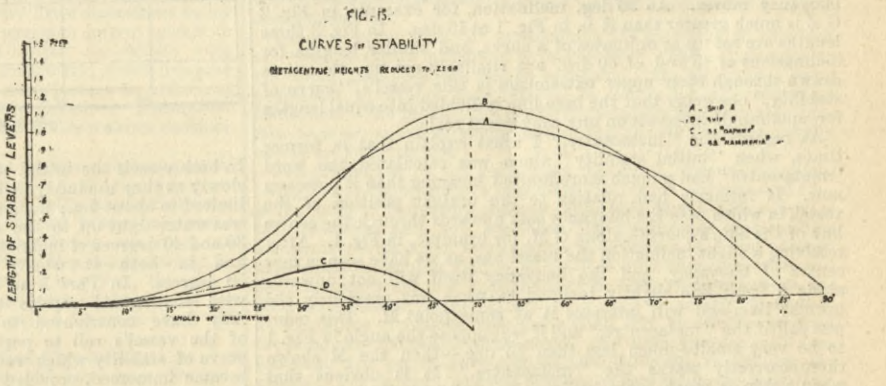
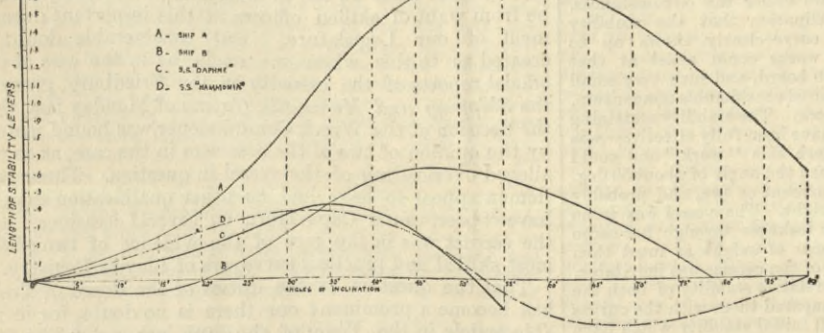


FIG. 14.



The Commissioner then proceeds to deal at length and in great detail with the various fittings of the Daphne, and shows the effect they had on the stability, and says:—

Before proceeding to Part II. of this report, it may be proper to express—as I understand I am expected by you to do—the view I take of the responsibilities involved in this disaster, and I would say—

First—I am thoroughly convinced that neither the builders nor the owners of this ship, nor any persons in their service, were in the least degree conscious that any exceptional risk was being incurred by the Daphne's launch, nor in the least degree negligent of any precaution which they know or believed to be essential to its success and safety. Apart from the question of the vessel's stability, everything that experience could suggest to secure a safe launch was attended to, and all the arrangements were carried out satisfactorily. The manner in which both builders and owners have assisted in giving fulness and completeness to the official inquiry is most honourable to them, and suggests complete unconsciousness of any intentional or known negligence on their part.

Secondly—I am equally convinced that the system which was pursued at the origin of this vessel, under which owners define so many dimensions and particulars of a ship as to leave the designer but extremely little scope for the determination of the elements which compose or regulate a vessel's stability, and under which system builders conform to these requirements of owners, and undertake to carry them out without a full investigation of that subject, is essentially a bad and dangerous one, bringing about a division and confusion of responsibility and opening avenues to accidents which neither party foresees. I am also of opinion that the system, which likewise has been pursued in this case, of entrusting the overseeing of ships throughout their construction and equipment exclusively to persons who are unable to judge of the effects which enforcement of their requirements may produce upon stability and other vital qualities, is, although in a less degree, an essentially bad and dangerous one; but both of these systems are so widely practised and receive the sanction of so many eminent owners and builders, that I should regard it as a harsh and more or less unjust use of the Daphne disaster to visit its owners and builders with the consequences, even if no unforeseen and exceptional condition of the ship, as regards stability, had been developed.

Thirdly—It would have been well, doubtless, as the event has proved, for the builders of the Daphne to have made an exception of this vessel by calculating, before the launch, not only the height of her metacentre, which is often done, but also as approximately as was possible the height of the centre of gravity, which is much less often done before launching. I am of opinion, however, that no such calculations as would usually be made, either at Linthouse or at many scores of other private shipbuilding establishments, would have been likely to develope the real state of the ship—First, because much of the excess weight in the upper parts and equipments of the ship would probably have escaped detection in any merely approximate calculations conducted by those who had no suspicion of risk or danger; in the second place, because very small initial stability had come to be widely regarded as sufficient for practical purposes; and in the third place, because there lay behind the question of metacentric height the undisclosed question of very small angular stability, which in this case proved so fatally deficient. I regard the two successive elements of initial and subsequent stability as inseparably connected in this case, which has proved even more exceptional than that of the Hammonia, yet in the Hammonia case Mr. Biles stated in his evidence that he had very carefully calculated the metacentric height of the Hammonia, and "on the face of it there did not appear to be any reason why the ship should turn over." He also said—"Until we had that experience we should certainly have said that the ship was quite safe to launch with any positive stability at all."

The Daphne had some positive stability, and the same conclusion might have been drawn in her case by those who knew nothing of the fatal smallness of the stability to be developed during inclination, as was subsequently shown by my calculations.

It has been correctly laid down, in all recognised works on naval architecture, that a floating vessel must not only displace a volume of water equal to her own weight, and whatever may be in her at the time, but that the centre of gravity of the ship and its contents should be in the same vertical line with the centre of buoyancy of the volume displaced. Two forces are thus at work upon the ship, viz., that of gravity acting downwards, and that of buoyancy acting upwards, and when these two forces are in the latter named condition, and are subject to no other disturbing force or forces, the ship will remain at perfect rest, or, in other words, occupy a position of equilibrium. The centre of gravity, however, of a ship, is a fixed point, the actual position of which may be ascertained either by calculation or by experiment. The centre of buoyancy, on the contrary, may vary, as the vessel becomes inclined by any disturbing force, owing to the difference of the shape, the immersed and emerged parts of the vessel, when inclined, but its position may be found by the proper treatment of the immersed and emerged portions, or "wedges," as they are termed in the profession.

We cannot illustrate this principle better than by employing Fig. 1, as used by Sir Edward Reed in his report. It will be seen there that a transverse section of a ship is shown inclined to a small angle, and that a mechanical couple is formed, viz., that the total weight of the ship is acting downwards through G, and the total buoyancy is acting upwards through B, as indicated. It is obvious that, these forces being equal, she cannot rest in this position, and statical stability may be defined as the effort which she makes to return to the position of equilibrium, and is measured by the length of the arm G1, multiplied by the displacement of the ship in tons. By continuing this process for several angles of inclination, a curve of stability may be constructed, as described in the report, by which a correct estimate of the ship's capabilities, or powers to return to the upright, may be measured at any desired angle of inclination.

The Commissioner begins the second part of his report as follows:—

It may be well to commence this part of the report by illustrating the manner in which the curve of stability is constructed. Fig. 1 may be taken as the transverse section of a vessel inclined at an angle of 15 deg. to the upright. The total weight or gravity of the vessel will act downwards through the centre of gravity G, and the total buoyancy will act upwards through the centre of buoyancy B, as the arrows indicate. It will be obvious that whether we regard either the one or the other—the weight or the buoyancy—as predominating, or both as operating equally, the result will be the same, viz., to push the vessel back to the upright position. She obviously cannot rest in the inclined position with these forces and no other operating upon her, she must revolve until gravity and buoyancy act in the same vertical line, but in opposite directions. If she oscillates back and passes the upright position, there will at once be an excess of buoyancy on the opposite side. The centre of buoyancy will move out, and she will be pushed back again to the upright. It is also obvious that the further she is inclined the more will the ship be immersed on one side and emersed on the other, and therefore the further out will the centre of buoyancy move. Now, as neither the gravity nor the buoyancy need be altered in amount by mere inclination, and as they are equal and operating equally, it follows that whatever the inclination, the force acting will always be the same, but the leverage marked G Z will vary as the centre of buoyancy moves. At 30 deg. inclination, for example, in Fig. 2 G Z is much greater than it is in Fig. 1 at 15 deg. In Fig. 3 these lengths are set up as ordinates of a curve, and similar lengths for inclinations of 45 and of 60 deg. are similarly set up, the curve drawn through their upper extremities is this vessel's "curve of stability," observing that the base line is divided into equal lengths for equal angle intervals on any convenient scale.

As regards the "metacentre," I must explain that in former times, when "initial stability" alone was calculated, the word "metacentre" had a much more limited meaning than it possesses now. It formerly had relation to the upright position of the vessel, in which case the buoyancy acts upwards through the centre line of the ship's course—along G M, for example, in Fig. 1. After receiving a slight inclination the vessel has, as we have seen, a new centre of buoyancy, and the buoyancy itself will act upwards along a fresh line slightly inclined to what was previously the upright line, and will intersect it at some point M. This point was called the "metacentre," and if we suppose the angle in Fig. 1 to be very small—much less than 15 deg.—then the M shown there correctly marks the "metacentre." It is obvious that when a ship is much more inclined the point at which two consecutive lines of the buoyancy's upward action will intersect, may not be and often will not be in the middle line of the ship at all; but this point is, nevertheless, called the "metacentre," and the use of the word in this extended sense has recently become general. In Fig. 4 is shown a floating body of square section, inclined in the water at an angle of about 30 deg. W.L. is its water line or line of floatation. B is its centre of buoyancy. By giving it a "slight" inclination from the position, it will, of course, have a new centre of buoyancy given to it. If we incline it one way b will show this, if we incline it the other way b^1 will show it, and for each of these positions there will be a new line of action or buoyancy. But these lines of action together with that through B, will all meet or intersect in one point, and this point M will be the metacentre at 30 deg. of inclination. In Fig. 5 I have represented the water-lines, centres of buoyancy, and metacentres for a large number of angles of inclination, and in order to illustrate the change of position which the metacentre undergoes, even in the case of so simple a form as a prismatic body of square section partly immersed, I have completed the metacentric curve, or curve of loci of the metacentres, for all angles of inclination through 360 deg. at intervals of 10 deg. It may be said, in passing, that this figure is of itself sufficient to illustrate the very great and complicated changes which even this simple form of ship would undergo with varying positions of the centre of gravity. In Fig. 6 I have shown curves of stability for this prismatic body, with the centre of gravity in the centre of form, and also with that centre in some cases raised above, and in others placed below the centre of form. In this figure the draught of water is taken at three twenty-fifths of the total depth of the prism. In Fig. 7 are shown similar curves of stability for the same figure, and under the same conditions, excepting only the draught of water, which in this is one-fifth of the total depth.

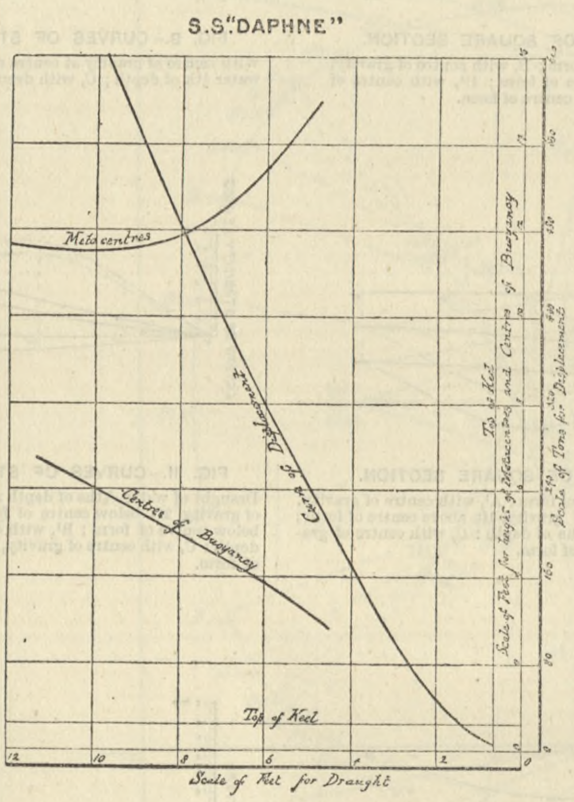
In Fig. 8 are shown similar curves under like conditions, but with a draught of 2-5 in depth. In Fig. 9 I have selected from the above curves those in which the centre of gravity and the centre of form have been taken as coincident, but at their respective draughts of water. In Figs. 10 and 11 I have again taken cases in which the draughts of water differ as before, but in which the centre of gravity is in the one set of cases—Fig. 10—taken 1ft. and 2ft. respectively above the centre of form, and in the other cases —Fig. 11—like distances below it. These figures serve to illustrate very clearly the error involved in the assumption that with stability at the upright position and stability at 90 deg.—or but little in stability at the latter, which is what some authors have instructed the profession to be content with—there need be no apprehension of any deficiency of stability at intermediate angles of inclination. They show that with square sections and prismatic forms there may be various dispositions of centre of gravity and draughts of water, with which stability in the upright position, and again at 90 deg., are not proofs of safety, but indications of the gravest danger.

The relation in which actual ships may stand to such cases as I have for simplicity sake given above may be readily seen by now proceeding to consider the curve of the Hammonia. I am not in possession of the drawings of this ship nor of the distribution of her weights, and have therefore not been able to calculate her curve of stability; but I have no doubt that the curve handed to me in evidence by Mr. Biles is a correct one, and is reproduced on a smaller scale in Fig. 12. It will be seen that it very closely resembles the curve of stability of the prismatic ship immersed one-fifth of her total depth, and having the centre of gravity at the centre of form—slightly below the metacentre. However unexpected, therefore, may have been the state of the Hammonia's stability, it clearly lies within the view and grasp of science, now that attention has been drawn to the subject. At the same time I do not think that either Mr. Elgar or Mr. Biles in any way exaggerated the risks which must have been run at launches since the introduction of modern vessels with small metacentric height at launching draughts. The Hammonia, instead of rapidly acquiring stability as she inclined—as it was thought and taught that high-sided ships would certainly do—in point of fact gained stability so slowly that although she had some substantial metacentric height —$6\frac{7}{8}$in.—at 20 deg. she had a righting lever of only $3\frac{1}{4}$in. At 30 deg. it was only $4\frac{9}{10}$in. Beyond this it never much increased; at 50 deg. it was but $1\frac{1}{4}$in. in length, and at 53 deg. it disappeared altogether.

It will be seen from the Hammonia's curve that after finally capsizing at 53 degrees, and passing through a phase of negative instability from 53 to 90 degrees, she then began to acquire positive stability. In the Daphne case this feature does not hold, even supposing her main deck water-tight, but in all the early stages of the curve shown in Fig. 13 there is a very remarkable resemblance.

FIG. 16.

S.S. "DAPHNE"



In both vessels the initial stability was small; in both it grew but slowly as they inclined; in both the maximum stability lever was limited to about 5in.; in both this maximum—provided the vessel was water-tight up to the main deck only—was reached between 30 and 40 degrees of inclination. In both it then rapidly declined, and in both it wholly disappeared at little more than 50 degrees. In Part I. of this report I have assumed in dealing with the actual capsize that the side above the main deck may have contributed to stability during the brief period of the vessel's roll to port, and in Fig. 13 I have shown the curve of stability which would have held good until the gunwale became immersed, provided the side was perfectly watertight up to the top deck. I have also shown the modification the curves undergo on the assumption of the poop being watertight, and of this alone above the main deck being so. It does not appear to me at all necessary to discuss at length the actual conditions or value of these upper structures in the present case, because, as I show in Part I., there was even on the most favourable suppositions, insufficient stability to keep the ship safe under the circumstances. It was at the early angle of inclination that the stability failed to come into play, as the curve clearly shows up to 31 deg. neither poop nor upper works could assist at that angle, with so much shifting weight on board, and such very small growth of stability, she must have acquired considerable momentum, and have accumulated considerable work. The stability remaining —even assuming the upper works to have been fully effective—was very little more than sufficient to absorb this "work," and could only have done so when she had reached the angle of about 50 deg. where she was apparently held for a moment or two, and probably carried slightly back towards the upright. The vessel was in no condition, however, to withstand such leakages through her cargo ports, &c., and such further movements of weight as must then have taken place, and the completion of the capsize was inevitable.

In order to further illustrate the relative stability of both the Daphne and the Hammonia, I have compared them with the curves of stability of two actual ships of small initial stability which have been carefully calculated, and which I will call ship A and ship B. The ship A has a positive metacentric height of eight-tenths of a foot, but ship B has a *negative* metacentric height of five-tenths of a foot. In the latter case the vessel would roll over to about an angle of 20 deg. before she began to acquire positive stability. I have shown these curves on Fig. 14, from which it will be seen that both the Daphne and the Hammonia are at launching draught greatly deficient in stability alike in amount and in range. The slowness with which they acquired additional stability is alike remarkable as compared with the growth of stability in vessels A and B. I may add that ship A is a spar-decked vessel, 245ft. long, 32ft. 3in. broad, and 24ft. deep, with a freeboard of 8ft. to the spar deck, and with full cargo of coals or grain. Her curve is extracted from a valuable paper read before the Institution of Naval Architects by Mr. Benjamin Martell, entitled, "On Causes of the Seaworthiness in Merchant Steamers." Ship B I have taken from Mr. W. H. White's "Manual of Naval Architecture," published in 1882, and her particulars are as follows:—Passenger steamer, with miscellaneous cargo, laden so as to be initially unstable; 312ft. 6in. long, 33ft. 4in. broad, and 16ft. 3in. mean draught, and with about 9ft. 8in. freeboard. On inspecting the curves in Fig. 14 it will be seen that in the case of ship A, although her metacentric height is only eight-tenths of a foot, and the early growth of stability is not rapid, it increases quickly and largely after an inclination of 20 deg. is reached, and has scarcely reached its maximum at an angle—between 50 deg. and 55 deg.—at which the stability of both the Daphne and the Hammonia have wholly disappeared. In the case of ship B, which does not greatly differ in stability from ship A, there is no positive stability up to 20 deg. of inclination, owing to the metacentre being 6in. below the centre of gravity in the upright portion. At 20 deg. a position of stable equilibrium is reached, and then the positive stability increases pretty rapidly up to an inclination of about 45 deg., when it attains its maximum. At the angle at which the stability of the Daphne and Hammonia disappear it has not greatly fallen, and keeps positive to nearly 80 deg. of inclination.

In order to better exhibit the relative stabilities of ships A and B with those of the Hammonia and Daphne at launching draught, as well as to illustrate the resemblance of these two vessels A and B as regards the amount of their natural stability, I have thought it well to eliminate the initial metacentric heights by assuming that they are so shown as to bring the centre of gravity and metacentre together in each case respectively. For the sake of extending the comparison between these ships and the Daphne and Hammonia I have also modified their curves of stability to suit the condition of coincident centres of gravity and metacentres. Fig. 15 accordingly shows these four curves of stability with the metacentric height reduced to zero. This figure well illustrates the comparative lowness and shortness of the stability curves of the Daphne and Hammonia. Fig. 16 shows the curves of displacement, centres of buoyancy, and metacentres of the Daphne respectively, from which can be readily ascertained the positions of the metacentre and centre of buoyancy of the vessel at any given displacement or line of floatation.

It seems obvious that this Daphne disaster should be followed by a general extension of the practice of fully calculating the stability of ships, and more especially of the practice of calculating "curves of stability" for vessels at successive draughts of water—from light or launching draught to the deepest load draught, and from the various conditions of coal and cargo stowage.

Judging from Sir Edward Reed's report, however, too much reliance appears to be given to what is known as the "metacentric method" of estimating a ship's stability in the light condition, and more especially in the launching condition, and this belief has actually already gone so far as to justify one of the scientific witnesses examined during the inquiry in asserting that it was "in his opinion, up to the time of the launch of the Hammonia, quite safe to launch a ship without any positive stability at all." The report itself fully describes what this "metacentric method" is, and how far it may be relied on, and an inspection of the metacentric curve, Fig. 5, or the curve of locus of the metacentres of a square prismatic body immersed to $\frac{3}{25}$ths of its depth, will show the numerous variations the metacentre undergoes for all angles of inclination through 360 deg. To the fact that such a prismatic body of square section could be used to prove the error in the popular notion of stability at light draughts attention was called prominently by Mr. Elgar in his evidence.

By continuing the investigation thus suggested still further, with the same prismatic body, and varying the draughts of water, and the position of the centres of gravity, it will be seen in Fig. 6 that as the centre of gravity is lowered, that greater stability is given to the body both in amount and in range, and in Fig. 7, that with the same lowered positions of the centre of gravity, but with greater draught of water, the stability is considerably augmented. In Fig. 8, however, with the same conditions of low centres of gravity, but with a large draught of water, the initial stability, or that obtained by the "metacentric method," is small, in fact there is a small "negative" metacentric height, but the growth of stability after an angle of about 20 deg. is reached is somewhat rapid, and the curve indicates a good range. Now this body under these conditions, when upright has little more than one-half of its depth out of the water, and demonstrates very clearly that ships may be designed with care that will possess the property of accumulating stability rapidly, and augmenting this quality by length of range, the distance of the metacentre below the centre of gravity being in this case about $2\frac{1}{2}$in.

The state of things described by the evidence and report is to be accounted for largely by the practice of shipowners, who, from want of knowledge, entrust their interests in many cases to incompetent persons, and debar the shipbuilder from exercising that control over the design and construction of a vessel to which he is fairly entitled. Why the Board of Trade, who are supposed to watch our merchant shipping interests in such matters, do not interfere in these cases we fail to understand. It surely cannot be from want of skilled officers in this important department of our Legislature. But considerable doubt is created as to this when one reads, as in the case of the official reports of the casualty to the Friedburg, given in the *Shipping and Mercantile Gazette* of Monday last, that the decision of the Wreck Commissioner was bound mainly by the opinion of two of the assessors in the case, as to the alleged overloading of the vessel in question. These gentlemen appear to have had no other qualification than to have "been round Cape Horn on several occasions," and the verdict was in the face of the evidence of two of the most skilled and practical surveyors of Lloyd's Registry.

That the question of the duties of the Board of Trade has become a prominent one there is no doubt, for in an able article in the *Times* of the 20th inst., on "The Stability of Ships," it is adverted to by the remark "That it is impossible for the Board of Trade to remain much longer open to a reproach of this most serious nature; it is high time that something were done to bring that department of the Government to something like the level of the Admiralty in respect of naval science. It is not to be doubted that immeasurable good would result from a vigorous handling of this subject at the Board of Trade, under sound scientific guidance, and taking effect rather in the way of collecting, collating, and publishing the abundant evidence, which the mercantile marine affords, than in the way of prescribing minutely the thousand-and-one details which enter into the construction of the modern vessel."

It is gratifying to learn that the Daphne disaster, and the facts disclosed during the inquiry regarding the stability of ships, are already exercising a beneficial effect, by inducing some at least of the Clyde shipbuilding firms to issue standing rules throughout their works, that this matter is for the future to receive greater attention and fuller investigation. If this can in any way be followed up by departmental action on the part of the Government, it will indeed commence a new era in naval architecture.

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

(*From our own Correspondent.*)

TO-DAY—Thursday—Birmingham ironmasters reported themselves fairly busy in most of the mills that have lately been running. The extent of new business is not considerable, nor are prices tending upwards, and the orders upon offer here to-day, nor indeed yesterday in Wolverhampton, were scarcely calculated to much improve the position.

The week's mails from Australia and New Zealand were pronounced by merchants to be of little value, and to be devoid of any speculative tendency. Yet there continues to be a steady business doing with London, on account alike of export and of home requirements, and if the prices which customers offer could be accepted, the volume of business now in hand would be sensibly augmented from that market.

Home orders for boiler plates, no less than for general merchant bars and for certain classes of sheets, are lessened by the uncertainty which agricultural engineers and other similar customers intimate still overhangs the outcome of the now ingathering harvest. Prices for ordinary quality boiler plates range from £8 10s. upwards.

William Barrows and Sons quoted their plate "list" as: B.B.H. Bloomfield, not exceeding 4 cwt. each, £9; best boiler ditto, £10; double best ditto, £11; treble best ditto, £12; extra treble best, £15; and best charcoal ditto, £19 5s.

Boiler plates made by E. T. Wright and Son were to-day quoted:—"Monmoor best," to 5 cwt. each, £9; double best, £10; treble best, to 4 cwt., £12; "Monmoor special," to 3 cwt. each—for flanging, &c.—£15 10s.; and charcoal plates, £17 10s. The "Wright" brand of the firm was 10s. per ton lower than these quotations. Plates rolled by W. Millington and Co. were:—Plates to 4 cwt. each, 4ft. wide, and 15ft. long, S.H., £9; best boiler plates, of similar dimensions and weight, £9 10s.; double best, £10s. 10s.; treble best, for hemispherical forms and flanging outwardly, £12 10s.; and treble best, L.M. ditto, for fire-boxes, strong work, and flanging inwardly, £15 10s.

Sheets for rough uses were a shade easier upon the week, doubles being procurable at, in a few instances, under £8 10s.; but for galvanising purposes makers required all that money for doubles, and they asked £9 10s. for trebles.

Bars rolled by John Bagnall and Sons, Limited, were quoted as here:—Flat bars, 1in. to 6in., and rounds and squares from $\frac{7}{16}$in. to 3in., £7 10s.; flat, 6½in. to 9in., and rounds and squares from 3⅛in. to 4in., £8; rounds and squares, 4⅛in. and 4¼in., £8 10s.; ditto 4⅜in. and 4½in., £9; ditto 4⅝in. and 4¾in., £9 10s.; ditto 4⅞in. and 5in., £10. Rounds only of 5⅛in. and 5¼in. were quoted £10 10s.; 5⅜in. and 5½in., £11; 5⅝in. and 5¾in., £11 10s.; 5⅞in. and 6in., £12; 6¼in. and 6½in., £13; 6¾in. and 7in., £14; and 7⅛in. to 7¼in., £15. Turning and shoeing bars of the same firm were quoted £7 10s.; plating bars, guttered shoe bars, and angle bars, £8; best rivet iron, £9; and double best rivet iron, £10; hoops from 14 w.g. to 19 w.g. are £8.

Common bars were plentifully offered, and where the competition from other districts, which the ironworkers' strike made practicable, was felt, prices showed a decline in some cases of 2s. 6d. per ton, making the minimum prices less than £6; but the makers of a good common bar sought to secure £6 5s., and declined to accept some offers from customers of £6 2s. 6d.

Quietude characterised pigs. "Willingsworth," and similar medium Staffordshire qualities, were quoted at 45s.; and all-mines of the leading brands could not be bought under 65s. Derbyshires at 48s. were out of the market, and the 60s. asked for Blaina hematites was rarely procurable.

Common forge coal was to be had at 6s. 6d. upwards into boats at the pits; new mine sorts were 8s. for furnace kinds, while thick coal, also for blast furnace purposes, realised 10s. per ton.

Welsh coke, which is most largely used in this district, sold at from 15s. and 16s. for minimum and medium qualities up to 17s. 6d. and 18s. for No. 3 Rhondda.

The failure is announced of one of the chief iron firms of the West Bromwich district—Messrs. Edward Page and Sons, of the Roway Works. The liabilities are £30,000, and the assets are estimated at about £23,000, including the freeholds, which are valued at £17,000. The bulk of the debts are owing to South and North Staffordshire firms, chiefly for raw materials, pig iron, and coal supplied, but a considerable proportion of the total liabilities are secured.

In North Staffordshire the finished iron trade is still quiet both as to home and export. Orders are arriving but tardily, and consumers show no disposition to contract for forward delivery. Prices are low, crown bars being quoted on the basis of £6 10s. as a minimum. Pig iron and ironstone are in limited demand. Satisfaction is expressed at signs of the breaking up of the coal strike, which has lasted now over three months.

The miners now on strike in North Staffordshire held a meeting on Tuesday, and having been addressed by the two miners' agents of the district, passed a resolution asking the employers to meet them at an early date with a view to work being resumed at the old rate of wages.

The efforts at organisation among the South Staffordshire ironworkers which began at the termination of the late strike are being continued, with the view of a combination being effected between the South Staffordshire district and the Lancashire division of what is known as the National Amalgamated Association of Iron, Steel, and Blast Furnace Workers. The organisers state that upwards of 1000 men in the Smethwick district have joined the new union, about the same number in North Staffordshire, and some 500 in East Worcestershire; whilst lodges are being organised throughout the West Bromwich district.

Although work has been resumed, yet grumbling continues. In Scotland, say the discontented, the ironworker's lowest price is 8s. 9d. per ton, which is for "nobbling," whilst for "doubling" he is paid 9s. 3d. per ton, with 1s. extra for best iron. In South and North Staffordshire and in East Worcestershire the ironworker gets 7s. 6d. per ton, the pay being raised to 8s. 6d. in the case of best iron.

The secretary to the employers' section of the Mill and Forge Wages Board has sent to all the Staffordshire works a broadsheet copy of the rules of the Wages Board, to be fixed up where it shall be accessible to the men, who, it will be remembered, complained during the strike that they were ignorant of the rules. A wise step has also been taken in that more than a month beforehand the date has been published on which the accountants to the Board will issue their certificate as to the selling price of bars in the Staffordshire district during the preceding quarter. The date arranged is Saturday, the 22nd of September.

At a meeting of the operative section of the board at the beginning of the week at Wednesbury a resolution was proposed by the Sheffield delegate, seconded by the delegate for Dudley Port, and carried, to the effect that the secretary be instructed to give the requisite notice at the end of the present month to discontinue the operation of the existing sliding scale, with a view to a revision in the wages basis that shall include all classes of iron, and also of shortening the period during which the new sliding scale shall be in operation.

The preparations for instituting for the South Staffordshire coal trade a board on the model of that which obtains in the finished iron trade are being continued, though not with the smoothness that has hitherto marked them. On Tuesday a large meeting of miners at Cradley Heath discussed the draft rules. Most of them were agreed to, whilst others met with much opposition. Objection was taken to the rule which provides that "the board shall continue to exist for twelve months certain, and then may be determined by three months' notice on either side."

It is significant of the hold of the market which soft steel is obtaining that part of the Patent Shaft and Axle-tree Company's premises are being adapted for the manufacture of this material. And those adaptations are another source of yet unreturned outlay.

On Thursday morning the new Coal Trade Wages Board met in Birmingham to confirm the draft rules. Mr. Haden Corser, barrister, Wolverhampton, was elected president. All the draft rules were confirmed and the subscriptions were fixed quarterly at 3d. per man and 1½d. per boy. The employers to pay a sum equal to the aggregate sum paid by the workmen in and about the mines, and the men's money to be collected by themselves in any way they like. Twelve men and twelve masters constitute the Board, and six members, irrespective of either section, form a quorum, and the Board will have an assured twelve months' existence, terminably by three months' notice; an amendment that the existence should be six months with one month's notice being lost. The Board is to be elected annually every September, the next election to be in 1884. Mr. Dudley was appointed employers' secretary and Mr. Barnes men's secretary, each at £50 yearly; each member will be paid 10s. for every day's attendance.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—In the iron trade of this district business continues without animation, but steady so far as prices are concerned. There is still plenty of activity both in the production and consumption of iron on account of old contracts, and these for the present are to a large extent keeping makers and consumers going, but there is no disposition on the one hand to give out further orders or on the other to force business by concessions in price. Buyers entertain no apprehension of any upward movement, and until requirements compel them to come into the market they are indifferent about placing out orders. Producers consider that prices are already low enough to induce business if there were any to be done; in fact, they are so low that they leave very little margin for profit, and they are content to work on with their contracts and what little new business they are able to secure without showing any anxiety for orders which would tend in any way to weaken values.

The Manchester market on Tuesday was only moderately attended, and business very quiet. For pig iron very few inquiries were reported; occasional orders are given out as consumers have requirements to cover, but, as a rule, they are only small in weight. Lancashire makers are doing practically no business in the open market, and transactions are confined to a few small sales to the local forges. In district brands an almost entire absence of business is reported. Prices, although scarcely tested by actual business, remain nominally very firm at 45s. to 45s. 6d. for Lancashire, and 45s. 4d. to 45s. 10d. for Lincolnshire forge and foundry, less 2½ per cent. delivered equal to Manchester.

The finished iron trade is steady; there is no large actual business doing at present in the market, but makers generally are fully employed and prices are from at £6 2s. 6d. to £6 5s. for ordinary bars, £6 12s. 6d. to £6 15s. for hoops, and £8 to £8 7s. 6d. for sheets delivered into the Manchester district.

For shipment there has been rather more inquiry. There are apparently moderately large requirements for sheets for Russia and the Continent. Egypt is in the market for packing hoops, and in tee and angle iron and in railway material there is a poor export trade doing.

The only noticeable feature involving any very material change in the condition of the engineering trade is in connection with the machine-making branch of industry. In this department there is a general, and, in fact, a serious quieting down, which indicates a discouraging prospect for the future. Lancashire machinists in most cases are already very quiet, and the weight of new work in prospect is very small. In fact, in the present unsatisfactory condition of the cotton trade, there is very little disposition to lay out money in new plant, and although constant improvements in detail are being carried out, which, of course, necessitate some attention being paid to the replacing of machinery, it would require almost a revolution in the method of manufacture to induce at present any very large expenditure in this direction. Locomotive builders, tool-makers, and marine engine boiler-makers continue generally well employed.

In the coal trade, although there is not as yet any actual general pressure, the demand is becoming more active as the summer wears on. Pits are now in most cases working pretty nearly full time, with very little coal going into stock. Quoted prices for present sales are without change, but there is a hardening tendency, and although it can scarcely be said that there is a demand which of itself would justify an upward movement in prices, there is a generally strong feeling in favour of an advance at the close of the month, when it is tolerably certain that prices for round coal will be put up 6d. to 1s. per ton.

Barrow.—The sanguine expectations that were indulged in of a better trade in the hematite pig iron market have been doomed. The demand is quiet, quieter perhaps than a few weeks ago, and prices have gone down 1s. per ton. The activity on the part of buyers during the two previous weeks was taken by some as an indication of a revival in the hematite pig iron market. The idea was not very generally held, and it was regarded by some as an unhealthy sign. It was not expected, however, that prices, which last week had a slight stiffening tendency, would be lower by 1s. per ton so soon, and even those who had not much hope from the activity displayed, scarcely thought of lower quotations. As mentioned in my last notes, Continent and America were expected to furnish the main-spring of a revived market; but the expectations of business from these quarters have not been realised, and the demand has fallen away to less than it was before the spurt, especially on American account. No. 1 Bessemer is quoted at 50s.; No. 2, 49s.; and No. 3, 48s. per ton net at maker's works. The demand for steel rails is also quieter, but prices are maintained, present quotations being £4 10s. to £5 per ton. Iron shipbuilders are likewise quiet, but orders are expected, as inquiries are being made which are likely to result in business. Iron ore is slow at late rates. I hear it reported that smelters near the Clyde, North Lancashire, and Cumberland ports have entered into a contract for about half a-million tons of Spanish ore, to be delivered before the expiration of the year. Shipping is rather quieter.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE house coal pits in the Barnsley district have been making twenty-four to twenty-six days a month, which is unusually good at this season of the year. A large quantity is sent by rail to the metropolis, and this weight would be increased were it not for the heavy tonnage rates imposed by the railway companies. Stocking, which was rather early commenced in London, has now extended to the country districts, the Lincolnshire merchants, who are heavy consumers, now taking quantities for the whole season. The steam coal trade is still fairly sustained, a good tonnage going to Goole and Grimsby both by rail and water. Some of the newly-developed collieries, including Carlton Wood and Mitchell Main, have greatly increased their tonnage, whilst others are considerably lighter. A fair increase is reported on the Hull trade with the Yorkshire collieries. Gas and locomotive coal is supplied by contract, and is, therefore, not subject to the fluctuations of the market; these qualities are in average demand; engine slack and small coal generally are in very poor demand.

The coke trade is getting into a better state, the output, though large, failing to keep the stocks high. A large quantity, fully up to the average, is sent away to North Lincolnshire, Northamptonshire, &c.

In the iron trade affairs remain very much as they were—several local ironworks being fairly employed, while generally business is not animated. No great improvement is expected this season.

A fortnight of really warm summer weather has caused the farmers to be more hopeful, and though the rains have greatly damaged the wheat crops on heavy lands, there is at present every prospect of a fair harvest. This is having a favourable aspect on trade, though the latter is dull for this time of the year. Makers of implements and agricultural machinery generally report that they have had a pretty good season with the goods required before autumn, and they are now turning their attention to root pulpers and other articles in which certain interesting novelties have been brought out by various firms this year, and exhibited at the "Royal" and other shows with favourable results accruing in the form of orders.

At Messrs. S. Fox and Co.'s annual meeting last Thursday the chairman stated that the Bessemer steel trade was in a state which admitted of improvement. This is a very mild way of putting it. Not only the Bessemer, but the crucible steel trade is in a very languid condition indeed. This is chiefly owing to the falling-off in the American market, where we are not sending more than one-tenth of what we were doing in the corresponding periods of 1882 and 1881.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A QUIET, steady tone prevailed at the Cleveland iron market held at Middlesbrough on Tuesday last. For quick delivery, the price of No. 3 pig iron was, if anything, somewhat stiffer than a week before. The demand which existed came almost entirely from exporters, who naturally desire to make the most of the fine weather and long days. Forge iron was in poor demand, and might have been bought at 1s. 6d. per ton below foundry qualities. For forward delivery all kinds were offered at from 3d. to 6d. per ton below current prices. No. 3 was sold at 39s. per ton f.o.b., and forge was offered at 37s. 6d., for delivery, say, over the next two months.

Shipments have been, so far, below the average; but increased activity has been apparent during the last few days, and it is not unlikely that, after all, they may prove to be quite satisfactory by the end of the month. Warrants were offered freely at the same price as makers' iron, but met with little favour from buyers. Cleveland Bessemer hematite was quoted at 52s. per ton; but not much business resulted.

In the finished iron trade there is great pressure for delivery. Stockton races, which were made the occasion for closing all the Middlesbrough and Stockton works for the whole of last week, have thrown deliveries seriously behind. For ship plates for quick delivery £6 5s. can now be freely obtained, and for bars and angles £5 17s. 6d. and £5 10s. respectively. For forward delivery there is as yet but little buying, but having plenty of work for the present manufacturers are not inconvenienced thereby.

It is stated that an outside firm of manufacturers have decided to suspend operations, being unable to avoid loss at present prices.

The steel rail trade continues in a depressed condition. The best price obtainable for large and desirable specifications is at present not more than £4 12s. 6d. to £4 15s. per ton. The North-Eastern Steel Company has now raised its rate of output to 750 tons per week, and is gradually surmounting the little difficulties which always beset the path of new starters. It is fortunate in having an order-book which will serve it for the remainder of the present year, and at prices higher than are now obtainable.

A report has been in circulation for some weeks to the effect that Messrs. R. Dixon and Co., iron shipbuilders, of Middlesbrough, intend shortly to migrate to Hull or to Barrow. Their shipyard is held partly or entirely on lease from the Middlesbrough owners, and it is understood that it will shortly require renewal. Under these circumstances it is not thought that the firm really desire to remove.

The guarantee fund for entertaining the members of the Iron and Steel Institute in September is now over £2000. Inasmuch as not more than 300 are likely to attend, this allowance, being equivalent to £7 per head, should be ample for all reasonable festivities. The programme is nearly complete, and seems to promise as much as can be assimilated in the time by the mind or body of any ordinary mortal.

The subsidence of the surface at Borsbeck, near Guisbrough, owing to mining operations by Messrs. Stevenson, Jaques, and Co., is becoming of increasing interest and importance. The land is still creeping, and not less than 150 houses are more or less damaged. With one or two exceptions all the houses—ninety-seven in number—in Fenton, Gerrie, and Albion-streets are deserted, and the inhabitants are now hastily removing their furniture from the forty-six houses in Carney-street. Warning is usually first given by the falling of plaster from the ceiling and by the breaking of the windows without obvious cause. No lives have as yet been lost, but the police have considerable difficulty in keeping the people out of danger. A great number of persons arrive daily from all parts to inspect the scene of the catastrophe.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow warrant market has been very quiet all the week, with scarcely any speculative business doing. Prices of warrants have varied only a few pence per ton, and altogether the condition of the market is very languid. At the same time there is an extensive legitimate business in pig iron. The shipments are well maintained, amounting for the past week to 14,884 tons, as compared with 14,054 in the preceding week, and 14,085 in the corresponding week of last year. Inquiries from the United States are slow, but there are some good orders on behalf of Canada, and the German demand keeps well up. The arrivals from Middlesbrough are good, and the home consumption continues large. Stocks in the warrant stores have increased about 400 tons in the course of the week.

Business was done in the warrant market on Friday morning at 47s. 1d. to 47s. 0½d. cash, and 47s. 3d. one month; the afternoon quotations being the same for cash as in the morning, and 47s. 3½d. to 47s. 3d. one month. On Monday the market was flat in the forenoon at 47s. 1d. to 46s. 11½d. cash, and in the afternoon, 46s. 11d. to 47s. cash, and 47s. 2d. one month. On Tuesday business took place at between 46s. 11d. and 47s. cash, and at 47s. 1½d. one month. Business was done on Wednesday at from 47s. 1½d. to 47s. cash and 47s. 4d. to 47s. 1½d. one month. To-day—Thursday—transactions took place at 46s. 11d. to 47s. cash and 47s. 2d. one month; very quiet.

The values of makers' iron are somewhat easier, as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 56s. 6d.; No. 3, 52s. 6d.; Coltness, 60s. and 52s. 9d.; Langloan, 59s. and 53s.; Summerlee, 57s. and 51s.; Chapelhall, 57s. and 54s.; Calder, 57s. 6d. and 50s. 6d.; Carnbroe, 55s. and 49s.; Clyde, 50s. 6d. and 48s. 6d.; Monkland, 48s. 3d. and 46s.; Quarter, 47s. 6d. and 45s. 6d.;

Govan, at Broomielaw, 48s. 3d. and 46s.; Shotts, at Leith, 59s. 6d. and 54s. 6d.; Carron, at Grangemouth, 48s. 6d. (specially selected, 54s. 6d.) and 47s.; Kinneil, at Bo'ness, 49s. and 47s. 6d.; Glengarnock, at Ardrossan, 55s. and 47s. 6d.; Eglinton, 48s. 9d. and 45s. 6d.; Dalmellington, 49s. 3d. and 48s. 3d.

The manufactured iron and steel works have orders in hand that will keep them busy for a considerable time. It is reported that negotiations are in progress for the starting of an additional malleable ironworks in Lanarkshire. But although there is a good supply of orders, the competition is so keen that makers have not yet been able to obtain any advance in prices.

In most districts the coal trade is fully employed, but the coalmasters have not as yet been able to obtain the full advance that they desired on the prices of all descriptions of coal. This observation applies more particularly to Lanarkshire. In Fifeshire a slight advance on last week's prices is being got for shipping qualities. The accumulations of coal at the pits are now reduced to very small bulk. Inquiries increase in number and importance. The average weekly shipment of coals from Burntisland is at present fully 16,000 tons. The past week's shipments at Leith were about 4000 tons, while 8727 tons were despatched from Grangemouth.

The wages agitation proceeds in the different mining centres. At Hamilton it was intended to hold a great wages meeting a few days ago, but only about a hundred men put in an appearance. They agreed to hold one idle day per week until the increase of 6d. a day should be obtained, and they counselled that this resolution should be generally adopted throughout the country. At a meeting of the Executive Board of the Fife and Clackmannan Miners' Association, Mr. Weir, the secretary, reported that he had received no reply from the masters in response to the request for an increase of pay. The meeting passed a resolution expressing dissatisfaction at the attitude of the employers, and instructing the men in various districts to send deputations to their employers urging their claim previous to the adoption of measures for enforcing the same.

The Mining Institute of Scotland held their summer meeting at Hamilton on Saturday, when there was a large gathering of members, colliery owners, and others. The company visited the Cadzow Colliery, distant about a mile and a-half from the town, where they were received by the managing partner, Mr. Austine, and the manager, Mr. H. Smith. Here they spent a couple of hours examining the nature of the works, which have been in operation since 1876, with a daily output of from 1000 to 1500 tons, the mineral field, leased from the Duke of Hamilton, being 500 acres in extent, and containing coal of superior quality. The party next visited Mr. John Watson's colliery at Earnock, which is lighted by the electric light, and has hauling and ventilating machinery of first-rate description. Returning to the town in the evening, the members dined in the Commercial Hotel, and before the close of the meeting a number of interesting papers were read and considered. The meeting altogether was of a pleasing and instructive nature.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is a falling off here in steamboat enterprise, and I am not surprised. For a long time scarcely a week has passed without seeing a "Steamship Company" floated, and in the nature of things this could not be expected to last. Speculators are now looking rather shyly at new ventures, and this, too, while the coal trade maintains its vigour.

I note no falling off in any one particular, and from Pembrokeshire to the Cardiff Docks the utmost animation prevails. In a recent run throughout the whole district I was especially struck with this, and the export figures, showing that 200,000 tons had been sent away during the week to foreign destinations, showed that the appearance of things was not illusory. In addition to this, over 50,000 tons of coal went coastwise, and the transmission by rail continues as excessive as ever.

At Llanelly, Swansea, and Neath there is an improvement in general industry, though there is not much good news to be recorded as to iron and steel. The steel rail orders in hand keep the majority of the works tolerably active, but there is no spurt observable, and the works generally could do more than they are doing. The principal trade done last week was for Naples and America, and the whole of the iron and steel consignments from Newport and Cardiff amounted to 6000 tons.

In tin-plate the last movement has been maintained, and American business is imparting a healthier character to it. At Swansea there are one or two heavy "loadings" going on, the Coriga taking out 1600 tons tin-plate to New York, and two large steamers are in port waiting their turn for the same destination.

Prices vary for ordinary coke plates up to 16s., at which figure some have been fortunate enough to book. But it may be added that the buyers are equally fortunate, as they ensure a good brand. American customers are beginning to find out that there is a limit to the wisdom of driving prices down. A maker may, *in extremis*, be compelled to accept a low price; but his rejoinder not unusually is an inferior article.

No stronger proof of the care shown in opening out collieries and the skill indicated in managing can be given than the freedom we have so long enjoyed from colliery disasters. This week there was an exceptional event, an explosion at Gellihouse Colliery, Rhondda Valley, the property of Messrs. Thomas and Griffiths—Globe. This fortunately was limited in its action, one man being killed, and about twenty more or less injured. No cause is yet assigned.

Messrs. Leith have made another successful hit in their new undertaking, having in the last day or two struck the 6ft. seam.

Coal prices are firm, best especially, with upward tendency.

A meeting of house coal delegates was held on Monday at Llancarach, thirty important collieries being represented. It was decided after some deliberation to fill up the vacancies on the sliding scale committee, and to give a moral support at least to the Staffordshire miners now on strike.

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.

14th August, 1883.

3929. Isometer or Dynamic Sector, H. J. Allison.—(*H. Glover, New York.*)
3930. Artificial Ivory, H. H. Lake.—(*J. B. Edson, Massachusetts, U.S.*)
3931. Fluid Meters, H. H. Lake.—(*F. G. Hesse, U.S.*)
3932. Fibres, P. M. Justice.—(*J. G. Stephens, U.S.*)
3933. Treating Lead, P. M. Justice.—(*F. J. Clamer, Philadelphia, U.S.*)
3934. Dynamo-electric Machines, W. P. Thompson.—(*R. J. Sheehy, New York.*)
3935. Paper, W. P. Thompson.—(*M. W. Brown, U.S.*)
3936. Book-binding, E. de Pass.—(*F. W. Schwarz, Germany.*)
3937. Sizing Woolen Warps, F. Millo, Manchester.
3938. Fabric for Covering Pulleys, &c., C. D. Abel.—(*W. Painter and L. R. Keizer, Baltimore, U.S.*)
3939. Couplings, L. Anderson, Paris.
3940. Roadway, L. Stiebel, London.
3941. Artificial Stone, H. J. Haddan.—(*J. Hemmerling, Germany.*)
3942. Shrapnels or Case Shots, H. J. Haddan.—(*Captain K. Fronhöfer, Germany.*)
3943. Pocket Knives, T. Crookes, Sheffield.
3944. Tubular Wire, W. R. Lake.—(*H. S. Bacon and A. Eppler, jun., Massachusetts, U.S.*)
3945. Chronometer Escapements, W. Clark.—(*A. W. Kientoff, Dallas, U.S.*)
8946. Generating, &c., Electric Currents, P. Higgs, Leith.
3949. Brushing Apparatus, H. Sutton, London.
3948. Pliable Plates, &c., J. J. Sachs.—(*Messrs. Fickeissen and Becker, Germany.*)

15th August, 1883.

3949. Cutting, &c., Minerals, F. W. Turner, London.
3950. Holders for Cigarettes, &c., J. H. Johnson.—(*W. B. Espeut, Jamaica.*)
3951. Traps for Sanitary Purposes, T. S. Truss, London.
3952. Recovery and Use of Tin from Tin-plate Scrap, &c., R. S. Laird, Corstorphine.
3953. Boots and Shoes, A. Bowman, Birmingham.
3954. Obtaining Extract from Hops, E. Edwards.—(*G. Heller, Austria.*)
3955. Weighing Machines, E. & A. Stillwell, London.
3956. Treating Cotton-seed Oil, &c., J. Longmore, Liverpool.
3957. Checking Apparatus for Tramcars, &c., R. W. Vining, Liverpool.
3958. Facilitating Communication of Cash, &c., in a Shop, W. R. Lake.—(*G. R. Elliott, Boston.*)
3959. A New Paint, R. Johnson, Woodbridge.
3960. Chlorate of Potash, E. K. Muspratt, Seaforth Hall, and G. Eschellmann, Widnes.
3961. Treating Calcareous, &c., Marl, R. Bowman, Gateshead-upon-Tyne, C. R. Cowens, Wingate, and W. J. Smith, Trimdon.
3962. Bale-hoop Fastenings, J. W. Allen, Manchester.
3963. Working Telephones, F. Morris, London.
3964. Kitchen Stove-plates, P. Jensen.—(*F. Kohl, Vienna, Austria.*)
3965. Boxes, H. J. Herbert, Richmond.
3966. Button Fastener, W. R. Lake.—(*E. Kempshall, New Britain, U.S.*)
3967. Supports for Telegraph, &c., Wires, S. Woolf, Mexborough.

16th August, 1883.

3968. Printing Machines, C. Pollak, London.
3969. Transferring Designs to Fabrics, T. J. Warwick, London.
3970. Lead Plates for Storing Electro-chemical Force in Accumulators, A. C. Henderson.—(*G. Philippart, Paris.*)
3971. Colouring Matters, T. Holliday, Huddersfield.
3972. Treating Volatile, &c., Fluids, S. M. Eiseman, London.
3973. Detaching Ships' Boats, J. H. Barry, London.
3974. Utilising Galvanisers' Flux, &c., T. Kenyon, Eccles.
3975. Fire-lighters, &c., J. Templeman, Glasgow.
3976. Producing Carbonic Acid from the Carbonates of Calcium, &c., W. L. Wise.—(*Dr. H. Grouven, Leipzig, Germany.*)
3977. Woven Belting, F. Reddaway, Pendleton.
3978. Lock Nuts, R. D. Sanders, Glasgow.
3979. Cigarettes, &c., I. A. Anderssohn, Breslau.
3980. Packings for Pistons, T. H. Taylor, Freemantle.
3981. Appliances to be Worn by Invalids, J. Sainty, East Dereham.
3982. Lace, C. D. Abel.—(*E. Davenière, Paris.*)
3983. Cutting Paper, A. J. Boult.—(*I. Meyer-Fröhlich, Switzerland.*)
3984. Running Gear for Vehicles, A. J. Boult.—(*G. Kelly, Chicago.*)
3985. Furnaces, I. S. McDougall, Chadderton.
3986. Amalgamating Process for Extracting Gold, &c., from their Ores, J. N. Longdon, W. P. Morgan, and W. Stirling, London.

17th August, 1883.

3987. Waterproof Garments, H. L. Rothband and G. and S. Mandleberg, Manchester.
3988. Holders for Paper in the Roll, H. J. Fitch, London.
3989. Producing Wrought Iron, E. P. Alexander.—(*L. D. Chapin, Chicago, U.S.*)
3990. Brakes, J. S. Humberstone, London.
3991. Frames of Bicycles, W. S. Simpson and J. W. Phillips, London.
3992. Gas, &c., Frames, H. E. A. Wallis, London.
3993. Thrashing Machinery, H. Savill.—(*H. Honour, Canterbury.*)
3994. Enabling Foot Soldiers, &c., to Carry Articles, A. E. Wardroper, Chichester.
3995. Lessening the Effects of Shocks, &c., H. E. Newton.—(*F. Pelzer, Germany.*)
3996. Motors, F. W. Scott, London.
3997. Ornaments for Pillars of Metallic Bedsteads, &c., T. Causnett, Birmingham.
3998. Boots or Shoes, T. Lilley and W. B. Skinner, London.
3999. Concentrating Sugar-cane Juice, G. Davies.—(*H. Y. y Lazarte and B. P. Larée, Cuba.*)
4000. Ore Roasting Furnaces, H. H. Lake.—(*T. Walker and J. F. Carter, Philadelphia.*)
4001. Treating Solutions Containing Compounds of Ammonia, A. McDougall, Penrith.
4002. Grinding, &c., Ores, J. Wood, Nottingham.
4003. Telephonic Apparatus, G. H. Bassano, A. E. Slater, and F. T. Hollins, Derby.
4004. Fastener-buttons, E. G. Colton.—(*E. Wuerful, Brooklyn.*)
4005. Promoting the Surface Combustion of Fuel in Furnaces, A. M. Clark.—(*B. Sloper, New York.*)
4006. Looms, T. Crabtree, Shipley.

18th August, 1883.

4007. Internally-fired High-pressure Steam Generators, F. Livet, London.
4008. Gas, &c., Engines, E. K. Dutton.—(*J. Spiel, Germany.*)
4009. Weighing, &c., Parcels, W. Tozer, London.
4010. Trimming, &c., Grain, I. A. Mack, Liverpool.
4011. Packing for Piston-rods, &c., R. H. Harper, London, and J. H. Chapman, Forest Gate.
4012. Cradles, &c., O. J. Haddock, London.
4013. Furnaces, C. D. Abel.—(*J. Ferando, Italy.*)
4014. Shipping, &c., Grain, R. A. Sacré, West Kirby.
4015. Screwing, &c., Metals, W. Heap, Ashton-under-Lyne.
4016. Scribbling, &c., Engines, H. Marsden, Huddersfield.
4017. Stop-valves, J. A. and J. Hopkinson, Huddersfield.
4018. Kilns, D. Rylands and R. Potter, Stairfoot.

20th August, 1883.

4019. Horseshoe Nails, S. S. Allin, London.
4020. Self-feeding Flat-forme Printing Machines, W. Brooks.—(*D. P. Simpson, New York.*)
4021. Bracelets, A. Desbats, London.
4022. Utilising the Bye Products in the Coking of Coal, C. and J. Thomson, Glasgow.
4023. Gas Engines, E. Quack, Prussia.
4024. Securing Scarf Pins, A. E. King, London.
4025. Arranging Boilers, &c., for Ships, C. H. Simpson, Bushey.
4026. Lawn-tennis Markers, W. N. Hutchinson, Wellesbourne, Bideford.
4027. Extracting, &c., Fatty Matters from Bones, A. C. Henderson.—(*Dr. W. Schneider, Germany.*)
4028. Covering Wire with Plastic Material, E. T. Truman, London.
4029. Fitting the Seats of Ships, &c., E. S. Copeman, London.
4030. Waterproof, &c., Fabrics, H. H. Lake.—(*D. M. Lamb, New York.*)
4031. Serrated Wedges, W. Pollard and J. Pollard, jun., Burnley.
4032. Galleys, &c., for Holding Set-up Type, J. Heywood and R. C. Ross, Manchester.
4033. Heating Steam Boilers, H. Lane, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

3929. Isometer or Dynamic Sector, H. J. Allison, London.—A communication from H. Glover, Brooklyn, New York.—*14th August*, 1883.
3931. Fluid Meters, H. H. Lake, London.—A communication from F. G. Hesse, Oakland, U.S.—*14th August*, 1883.
3943. Pocket Knives, T. Crookes, Sheffield.—*14th August*, 1883.
3958. Facilitating Communication, &c., of Articles in a Shop, W. R. Lake, London.—A communication from G. R. Elliott, Boston, U.S.—*15th August*, 1883.
3966. Button-fastener, W. R. Lake, London.—A communication from E. Kempshall, New Britain.—*15th August*, 1883.
3989. Producing Wrought Iron, E. P. Alexander, London.—A communication from L. D. Chapin, Chicago, U.S.—*17th August*, 1883.

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

3341. Couplings for Railway Carriages, E. C. Bowen, London.—*17th August*, 1880.
3322. Buffers for Locomotives, &c., D. N. Arnold, Solihull.—*16th August*, 1880.
3311. Grinding Mills, E. W. Anderson, Washington.—*14th August*, 1880.
3321. Effecting the Combustion, &c., of Fuel, W. L. Wise, London.—*16th August*, 1880.
3331. Winding Yarn, W. Knowles, Bolton le-Moors.—*17th August*, 1880.
3376. Asbestos Sheets, S. Pitt, Sutton.—*19th August*, 1880.
3386. Winding, &c., Yarn, J. and T. A. Boyd, Shettleston.—*20th August*, 1880.
3517. Vehicles, H. Ciotti, London.—*30th August*, 1880.
3348. Drawing Corks, A. Muir, Harborne.—*18th August*, 1880.
3360. Sewing Machines, H. Greenwood, Leeds.—*19th August*, 1880.
3343. Jet Apparatus for Ejecting Solids, &c., G. D. Robertson, London.—*17th August*, 1880.
3396. Holding, &c., Eggs, J. Halley and A. Barr, Glasgow.—*21st August*, 1880.
3356. Bib, &c., Valves, E. Smith, London.—*18th August*, 1880.
3387. Washing Fabrics, J., C., L., and M. Jefferson, Bradford.—*20th August*, 1880.

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

3275. Locks and Latches, H. Glendining, Carlisle.—*21st August*, 1876.
3206. Revolving Cylinder Pistons, Baron T. de Mouncie, Paris.—*14th August*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, *7th September*, 1883.)

1834. Folding Bath, &c., O. Wolff, Dresden.—A communication from G. Leüpold.—*11th April*, 1883.
1841. Instrument for Describing Circles, E. Lane, London.—*11th April*, 1883.
1843. Chimney Ventilator, R. Oakley, London.—*12th April*, 1883.
1844. Preventing the Passage of Water Down Ventilating Shafts on Shipboard, R. Oakley, London.—*12th April*, 1883.
1845. Ventilating Stove, R. Oakley, London.—*12th April*, 1883.
1846. Ventilating Buildings, R. Oakley, London.—*12th April*, 1883.
1857. Electric Telegraphs, A. A. Favarger, London.—*12th April*, 1883.
1862. Road Vehicles, W. J. Brewer, London.—*12th April*, 1883.
1863. Washing Machines, W. R. Lake, London.—A communication from K. Grav.—*12th April*, 1883.
1870. Apparatus for Utilising Solar Heat, W. L. Wise, London.—A communication from La Société Centrale pour l'utilisation de la Chaleur Solaire (Brevets, Mouchot et Abel Pifre.)—*12th April*, 1883.
1895. Generation, &c., of Electricity, R. V. Ash, London.—*14th April*, 1883.
1898. Tickets, J. H. Johnson, London.—A communication from M. Vezzosi.—*14th April*, 1883.
1899. Trap for Animals, E. Edwards, London.—A com. from J. A. H. Marty.—*14th April*, 1883.
1904. Looms, T. Singleton, Over Darwen.—*14th April*, 1883.
1906. Stoves, J. A. Hanna and T. F. Shillington, Belfast.—*14th April*, 1883.
1909. Fire-arms, H. H. Lake, London.—A communication from J. Schulhof.—*14th April*, 1883.
1917. Water-meters, O. Imray, London.—A. com. from C. Michel and A. Frager.—*16th April*, 1883.
1923. Screw Propellers, S. W. Snowden, West Hartlepool.—*16th April*, 1883.
1928. Hanging Ships' Rudders, S. W. Snowden, West Hartlepool.—*16th April*, 1883.
1959. Surfacing Lithographic Stones, G. Cochrane, Edinburgh.—*18th April*, 1883.
1962. Coke-ovens, &c., F. C. Glaser, Berlin.—A communication from H. Stier.—*18th April*, 1883.
1991. Dynamo-electric Machines, W. P. Thompson, London.—Com. from B. Cabella.—*19th April*, 1883.
2019. Locking the Nuts upon the Bolts by which Fish-plates are Secured to Railway Rails, G. Grover, Clapham.—*20th April*, 1883.
2025. Apparatus to be used in Telephonic Systems, W. R. Lake, London.—A communication from H. T. Cedergren and L. M. Ericsson.—*21st April*, 1883.
2078. Water-closets, D. S. Keith, Toronto.—*24th April*, 1883.
2167. Sugar, W. R. Lake, London.—A communication from J. H. Ross.—*28th April*, 1883.
2206. Clasps for Garments, H. J. Haddan, London.—A com. from L. D. Minor.—*1st May*, 1883.
2281. Apparatus for Depolarising Electrolytic Baths, A. M. Clark, London.—A communication from C. de Changy.—*4th May*, 1883.
2736. Surgical Fabrics, S. Gamgee, Birmingham.—*1st June*, 1883.
3013. Stench Traps, W. Ayres, London.—*18th June*, 1883.
3134. Cooling Liquids, F. T. Bond, Gloucester.—*25th June*, 1883.
3168. Apparatus for Indicating the Position of a Ship's Helm, J. E. Liardet, Brockley.—*26th June*, 1883.
3384. Boots, W. R. Lake, London.—A communication from P. M. Torrisani.—*7th July*, 1883.
3406. Treating, &c., Gas, J. E. Dowson, London.—*10th July*, 1883.
3433. Working Railway Points, W. Buck, Kilburn.—*12th July*, 1883.
3439. Looms, T. Hanson, Bradford.—*12th July*, 1883.
3488. Water-closets, &c., J. Fairbairn, Edinburgh.—*16th July*, 1883.
3505. Telephonic Apparatus, J. Graham, London.—*17th July*, 1883.
3533. Electric Meter, W. McWhirter, Glasgow.—*18th July*, 1883.
3643. Pickers for Looms, J. K. Tullis, Glasgow.—*25th July*, 1883.
3663. Distributing Blast to Blast Furnaces, &c., P. P. de la Sala, Hackney.—*26th July*, 1883.

(*Last day for filing opposition*, *11th September*, 1883.)

1793. Boat-disengaging Gear, N. Hamblin, jun., Poplar.—*9th April*, 1883.
1914. Furnace-bars, G. L. Scott, Manchester.—*16th April*, 1883.
1929. Metallic Springs, J. Pring, Sandbach.—*17th April*, 1883.
1935. Oil Vessels, G. A. D. Schott, Bradford.—*17th April*, 1883.
1938. Life-boats, N. Hamblin, jun., Poplar.—*17th April*, 1883.
1946. Cutting Fabrics, A. J. Boult, London.—A com. from G. Hoyer and Cie.—*17th April*, 1883.
1949. Unhairing Skins, A. Galwey, Upton.—A communication from A. Depierre.—*17th April*, 1883.
1951. Movement for Swing Looking Glasses, C. I. Bell, Greenwich.—*17th April*, 1883.
1956. Telegraphic Apparatus, E. J. Houghton, Peckham.—*18th April*, 1883.
1957. Bottles and Stoppers, J. Edwards, Holloway.—*18th April*, 1883.
1958. Padding, &c., Apparatus, C. A. Patterson, Stirling.—*18th April*, 1883.
1971. Automatically Exposing Bodies to the Sun's Rays, W. Cooke, London.—A communication from R. Schlotterhoss.—*18th April*, 1883.
1976. Making Hats, J. Eaton, Stockport.—*19th April*, 1883.
1984. Mercurial Air-pumps, J. Barrett, London.—*19th April*, 1883.
1987. Lamp Burner, A. Rettich, London.—A communication from Messrs. Schwintzer and Graff.—*19th April*, 1883.
1998. Electric Batteries, B. W. Webb and H. P. F. and J. Jensen, London.—*19th April*, 1883.
2001. Drilling Flues, &c., S. Borland, Manchester.—*20th April*, 1883.
2020. Telephone, &c., Apparatus, H. A. C. Saunders and A. C. Brown, London.—*20th April*, 1883.
2033. Delivering Goods, J. G. Sandeman and P. Everitt, London.—*21st April*, 1883.
2036. Attachment for Sewing Machines, H. J. Haddan, London.—A communication from J. Gutmann.—*21st April*, 1883.
2062. Thermo-electric Generators, H. Woodward, Shepherd's-bush.—*24th April*, 1883.
2089. Self-acting Feed-water Regulator, &c., A. M. Clark, London.—A communication from J. S. Clarke, J. F. Dunneback, and C. Moran.—*24th April*, 1883.
2091. Utilisation of Waste Materials used in Purifying Coal Gas, J. Walker, Leeds.—*25th April*, 1883.
2095. Pipe Keys, J. S. Beeman, London.—*25th April*, 1883.
2112. Purifying Water, E. M. Dixon, Glasgow.—*26th April*, 1883.
2134. Centrifugal Dressing Machines, R. Lund and T. F. Hind, Preston.—*27th April*, 1883.
2263. Making Acids, L. Q. and A. Brin, Paris.—*3rd May*, 1883.
2287. Cutting Metals, W. W. Hulse, Manchester.—*5th May*, 1883.
2429. Rock Drills, A. M. Clark, London.—A communication from T. W. Sterling.—*12th May*, 1883.
2435. Treating Phosphatic Slags, C. Pieper, Berlin.—A com. from C. Scheibler.—*15th May*, 1883.
2445. Controlling Supply of Gas, S. Hyams, Guernsey.—*15th May*, 1883.
3030. Propelling Ships, &c., J. Robinson, Londonderry.—*19th June*, 1883.
3073. Abstracting Heat from Stoves, C. J. Henderson, Edinburgh.—*21st June*, 1883.
3114. Mariners' Compass, W. R. Lake, London.—A communication from E. Bisson.—*22nd June*, 1883.
3232. Paper Boxes, H. J. Haddan, London.—A communication from A. Brehmer.—*29th June*, 1883.
3303. Binding Books, H. J. Haddan, London.—A communication from A. Brehmer.—*3rd July*, 1883.
3329. Boring Holes in Coal, G. E. Vaughan, London.—A com. from J. Werndl.—*5th July*, 1883.
3481. Governing the Flow of Gases, &c., J. Lewis, London.—*14th July*, 1883.
3484. Tires for Wheels, W. H. Carmont, Manchester.—*16th July*, 1883.
3500. Horse-rakes, J. Howard and E. T. Bousfield, Bedford.—*17th July*, 1883.
3583. Heating Water, M. Steel and T. Smales, Gosforth.—*21st July*, 1883.
3672. Apparatus to be employed in the Manufacture of Millinery, W. Askham, Nottingham.—*27th July*, 1883.
3684. Iron Ships' Compasses, B. Biggs, Cardiff.—*27th July*, 1883.
3685. Securing Doors, &c., W. A. Bonella, London.—*27th July*, 1883.
3736. Hats, &c., W. R. Lake, London.—A communication from A. C. Couch.—*31st July*, 1883.
3748. Binding Books, A. Brehmer, Leipzig, and G. Brown, Glasgow.—*31st July*, 1883.
3837. Adjustable Chairs, W. R. Lake, London.—A com. from W. S. Liscomb.—*7th August*, 1883.
3989. Producing Wrought Iron, E. P. Alexander London.—Com. from L. Chapin.—*17th August*, 1883.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 17th August*, 1883.)

715. Extracting Ammonia from Solutions produced in the Manufacture of Soda, L. Mond, Northwich.—*9th February*, 1883.
804. Dynamo-electric Machines, H. T. Barnett, London.—*14th February*, 1883.
914. Keyless Watches, C. Lange, London.—*19th February*, 1883.
915. Utilising Raw Vegetable Fats, C. A. Meinert and P. Jerisch, Berlin.—*20th February*, 1883.
918. Steam, &c., Joints, E. D. Penning, London.—*20th February*, 1883.
928. Apparatus for Pointing Guns, H. J. Haddan, London.—*20th February*, 1883.
932. Carding Engines, R. Tatham, Rochdale, and R. Sellers, Scholes.—*20th February*, 1883.
933. Arrangement of Blocks suitable for Building Purposes, W. Lee and D. F. Beale, Maidstone.—*20th February*, 1883.
935. Permanent Way, P. M. Justice, London.—*20th February*, 1883.
938. Steam Boilers, &c., J. Hall, Manchester.—*20th February*, 1883.
945. Tanning Leather by Electricity, L. Gaulard, London.—*20th February* 1883.

949. Making Ink, &c., A. A. Nesbit, London.—21st *February*, 1883.
954. Card Can Rings, J. Rothwell and G. McMillan, Farnworth.— 21st *February*, 1883.
955. Cleaning Wool, J. C. Walker and S. Beaumont, Leeds.—21st *February*, 1883.
971. Window Fasteners, T. H. Collins, Winchester.—22nd *February*, 1883.
972. Separating Liquids from Solid Matters Suspended therein, H. J. Haddan, London.—22nd *February*, 1883.
985. Forming Letters from a Distance, M. T. Neale, London.—23rd *February*, 1883.
995. Purifying Coal Gas, J. T. McDougall, Manchester.—23rd *February*, 1883.
1040. Ventilating Ships, G. A. Calvert and F. C. Kelson, Liverpool.—27th *February*, 1883.
1045. Making Coke, W. W. Pattinson, Felling.—27th *February*, 1883.
1058. Clip Pulleys, R., J., and H. Wilder, Wallingford.—27th *February*, 1883.
1061. Sensitising Photographic Paper, &c., W. R. Lake, London.—27th *February*, 1883.
1073. Transferring Liquids, F. J. Brougham, London.—27th *February*, 1883.
1079. Mechanical Telephone, H. J. Allison, London. —28th *February*, 1883.
1145. Utilising Steam Engines, H. J. Haddan, London.—3rd *March*, 1883.
1235. Lathes for Turning Shafts, W. Allan, Sunderland.—7th *March*, 1883.
1293. Traction Engines, A. Greig and G. Achilles, Leeds.—10th *March*, 1883.
1322. Governors, F. M. Rogers, London.—13th *March*, 1883.
1477. Spanners, &c.. F. J. Drewry, Burton-on-Trent. —21st *March*, 1883.
1492. Union Joints, J. T. Garratt, London.—21st *March*, 1883.
1545. Rotary Engine, H. A. Bonneville, Paris.—27th *March*, 1883.
1546. Locomotives, H. A. Bonneville, Paris.—27th *March*, 1883.
1553. Metals, &c., J. Lewthwaite, Halifax.—27th *March*, 1883.
2175. Steam Boilers, S. Pitt, Sutton.—30th *April*, 1883.
2234. Detaching, &c., Boats, J. Linkleter, Tynemouth. —2nd *May*, 1883.
2427. Making Sugar, J. Gorz, Berlin.—12th *May*, 1883.
2629. Power Looms, S. C. Lister and J. Reixach, Bradford.—26th *May*, 1883.
2698. Chimney Tops, J. Waple, Brixton.—30th *May*, 1883.
2773. Weighing Scales, A. H. Emery, New York.—5th *June*, 1883.
2775. Weighing Machinery, A. H. Emery, New York. —5th *June*, 1883.
2777. Testing Strength of Materials, A. H. Emery, New York.—5th *June*, 1883.
2817. Electrical Signalling, &c., Apparatus, C. Hodgson, Kilburn.—6th *June*, 1883.
2909. Drying Ovens, G. F. Edwards, Notting Hill.—12th *June*, 1883.
2923. Carriages for Ordnance, W. Anderson, London. —12th *June*, 1883.
3141. Elevator Stops, F. P. Canfield, Boston, U.S.—25th *June*, 1883.
3160. Compound for Lining Furnaces, &c., J. Imray, London.—26th *June*, 1883.

(*List of Letters Patent which passed the Great Seal on the 21st August*, 1883.)

796. Velocipedes, W. J. Spurrier, Birmingham.—13th *February*, 1883.
977. Weighing Machines, E. Wölner, Liverpool.—22nd *February*, 1883.
979. Working Railway Signals, H. O. Fisher, Cardiff.—22nd *February*, 1883.
980. Treating Steel Ingots, G. J. Snelus, Workington.—22nd *February*, 1883.
989. Mathematical Instruments, A. Leo, and P. S. Marks, London.—23rd *February*, 1883.
1007. Supplying Sensitive Plates in Photographic Cameras, J. H. Hare and H. J. Dale, London.—24th *February*, 1883.
1009. Sewing Machines, J. Warwick, Manchester.—24th *February*, 1883.
1013. Ladies' Costume Stands, B. Sigrist, London.—24th *February*, 1883.
1020. Applying Variable Resistance to Electric Currents, L. Gaulard and J. D. Gibbs, London.—24th *February*, 1883.
1021. Bottle-stoppers, &c., W. R. Lake, London.—24th *February*, 1883.
1025. Hydraulic Machinery, W. R. Lake, London.—24th *February*, 1883.
1026. Actuating Saws, J. Richmond and W. Whiting, London.—24th *February*, 1883.
1027. Steam Engines, I. W. Boulton, Ashton-under-Lyne.—26th *February*, 1883.
1028. Furniture, W. Shepherd, London.—26th *February*, 1883.
1029. Hoops for Securing Tools to their Shafts, T. Brown, Sheffield.—26th *February*, 1883.
1035. Signal Lamps, J. Rogers, London.—26th *February*, 1883.
1041. Surface Condensers, R. Norton, Newcastle-on-Tyne, and J. B. Edmiston, Liverpool.—27th *February*, 1883.
1052. Tilling Machines, W. P. Thompson, London.—27th *February*, 1883.
1055. White Lead, L. Brumleu, Wrexham.—27th *February*, 1883.
1064. Heating Air, W. Brierley, Halifax.—27th *February*, 1883.
1090. Raising, &c., Liquids, J. H. Kidd, Wrexham.—28th *February*, 1883.
1106. Combined Bed, Table, Chair, and Cloth Rail, G. Bürklein, Munich.—1st *March*, 1883.
1107. Pianofortes, &c., H. J. Haddan, London.—1st *March*, 1883.
1142. Grooved Tires, G. Davies, Manchester.—3rd *March*, 1883.
1146. Ridge Ploughs, H. J. Haddan, London.—3rd *March*, 1883.
1151. Hoists, &c., J., J., T., and D. Barker, Oldham.—3rd *March*, 1883.
1167. Boiler Furnaces, H. J. Haddan, London.—5th *March*, 1883.
1184. Regulating Speed of Engines, P. W. Willans, Thames Ditton.—5th *March*, 1883.
1191. Chimney Flues, W. G. Hudson, Manchester.—6th *March*, 1883.
1259. Making Fabrics, J. Imray, London.—8th *March*, 1883.
1260. Extracting Soluble Matters, C. D. Abel, London.—8th *March*, 1883.
1295. Igniting Gases, A. R. Molison, Swansea.—12th *March*, 1883.
1350. Envelopes for Projectiles, S. Pitt, Sutton.—13th *March*, 1883.
1351. Rolling on Edge Spiral Bands of Steel, R. H. Brandon, Paris.—13th *March*, 1883.
1391. Latches, &c., E. R. Wethered, Woolwich.—15th *March*, 1883.
1478. Repairing Last, H. Morris, Blackburn.—21st *March*, 1883.
1780. Sifting Agricultural Produce, B. Page, Essex. —9th *April*, 1883.
1977. Self-adjusting Saw Handle, B. Goulton, New Zealand.—19th *April*, 1883.
2122. Extracting Gold from Auriferous Pyrites, &c., T. Bowen and J. Napier, Swansea.—26th *April*, 1883.
2356. Self-acting Readers, R. W. Sutleffe, London. —9th *May*, 1883.
2434. Producing, &c., Electricity, E. L. Voice, London.—15th *May*, 1883.
2604. Doubling Yarns, &c., W. H. Jones, Middleton. —25th *May*, 1883.
2675. Electrical Meters, T. J. Handford, London.——30th *May*, 1883.
2679. Creel Pegs, P. Coonan, Rishton.—30th *May*, 1883.
2703. Starch, J. Polson and J. M. Harley, Paisley.—31st *May*, 1883.
2716. Ships' Berths, H. J. Haddan, London.—31st *May*, 1883.
2785. Making Cigars, C. Morris, London.—5th *June*, 1883.
2814. Looms, H. J. Haddan, London.—6th *June*, 1883.
2822. Putting Instruments Connected with a Central Telephone Station into Communication with Each Other, W. R. Lake, London.—6th *June*, 1883.
2846. Felt Carpets, J. Barcroft, Waterfoot.—7th *June*, 1883.
2850. Electric Incandescent Lamps, W. J. L. Hamilton, Wandsworth.—7th *June*, 1883.
2857. Generation, &c., of Electricity, T. J. Handford, London.—7th *June*, 1883.
2868. Railway Car-couplers, H. J. Haddan, London. —8th *June*, 1883.
2882. Supplying Air to the Interior of Torpedo, &c., Boats, A. H. Arnold, Portsmouth.—9th *June*, 1883.
2928. Machines for Moulding Plastic Materials, W. R. Lake, London.—12th *June*, 1883.
3016. Weldless Chains, J. Imray, London.—18th *June*, 1883.
3096. Food for Infants, &c., H. J. Haddan, London. —21st *June*, 1883.

List of Specifications published during the week ending August 18th, 1883.

124*, 4d.; 3555*, 4d.; 5779, 6d.; 5971, 6d.; 6005, 2d.; 6007, 2d.; 6011, 4d.; 6017, 2d.; 6021, 2d.; 6024, 8d.; 6028, 2d.; 6030, 2d.; 6032, 4d.; 6035, 2d.; 6036, 2d.; 6041, 2d.; 6043, 4d.; 6045, 6d.; 6046, 2d.; 6048, 8d.; 6053, 2d.; 6056, 2d.; 6060, 2d.; 6064, 2d.; 6065, 2d.; 6067, 2d.; 6068, 6d.; 6077, 6d.; 6079, 6d.; 6080, 2d.; 6081, 2d.; 6089, 4d.; 6090, 8d.; 6098, 6d.; 6099, 2d.; 6100, 8d.; 6101, 2d.; 6102, 2d.; 6105, 6d.; 6106, 6d.; 6107, 6d.; 6108, 6d.; 6109, 6d.; 6110, 4d.; 6112, 2d.; 6114, 6d.; 6115, 6d.; 6117, 4d.; 6118, 2d.; 6119, 2d.; 6120, 6d.; 6121, 1s.; 6122, 8d.; 6123, 6d.; 6124, 6d.; 6125, 6d.; 6126, 6d.; 6127, 6d.; 6128, 2d.; 6130, 1s. 2d.; 6134, 4d.; 6135, 4d.; 6136, 6d.; 6140, 4d.; 6141, 2d.; 6142, 6d.; 6143, 4d.; 6146, 8d.; 6147, 4d.; 6149, 4d.; 6154, 6d.; 6156, 6d.; 6157, 6d.; 6158, 8d.; 6159, 2d.; 6160, 6d.; 6161, 6d.; 6164, 8d.; 6166, 6d.; 6167, 6d.; 6168, 8d.; 6169, 4d.; 6171, 10d.; 6175, 2d.; 6176, 4d.; 6185, 6d.; 6186, 1s.; 6195, 6d.; 6196, 4d.; 6197, 6d.; 6200, 6d.; 6207, 6d.; 6211, 6d.; 6215, 6d.; 6216, 4d.; 6217, 6d.; 6226, 4d.; 6228, 6d.; 6239, 6d.; 5, 6d.; 19, 6d.; 29, 6d.; 66, 6d.; 192, 6d.; 265, 6d.; 1377, 6d.; 1663, 6d.; 2085, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

4738. Meters for Recording Quantity of Electricity, *A. E. Porte, Clontarf, and J. Lesware and J. Chancellor, Dublin.—5th October*, 1882.—(*Provisional protection not allowed.*) 2*d*.

Relates to a meter in which clockwork is set in motion by a lever when and so long as a current passes.

5610. Block Signalling and Locking Apparatus on Railways, *F. Swift, West Drayton, and A. J. M. Reade, Slough.—25th November*, 1882. 6*d*.

The object of this invention is to employ an extra lever in the signal box in which the electrical appliances are fitted, this lever being so arranged in connection with rods and catch hooks as to hold the signal at the next signal box at "line clear" or at danger, until a moving train has passed the second signal box, so as to ensure that the line between the two boxes is safe and that no two trains can be on the same section at one time.

5633. Telephonic Apparatus, *H. H. Lake, London. —27th November*, 1882.—(*A communication from C. A. Randall, New York.*) 8*d*.

This relates to that class of telephonic instruments in which the two poles of a magnet act upon each other to produce the vibrations, which result in the production of sounds. The inventor dispenses with the ordinary diaphragm. The instrument consists of an electro-magnet, one pole of which is placed in contact with one side of the case of the instrument, this latter receiving the vibrations from the magnet and rendering them audible. Other improvements are also described and illustrated.

5644. Secondary Batteries, *J. Lea, Regent's-park.—28th November*, 1882.—(*Not proceeded with.*) 2*d*.

The object is to increase the conductivity of electrodes, and to lessen the weight of the accumulators.

5625. Telephonic Apparatus, &c., *J. B. Spence, London, and J. E. Chaster, Southport.—27th November*, 1882. 2*d*.

The inventors claim the use of fused metallic sulphide of iron for the manufacture of microphonic points.

5645. Primary Voltaic Batteries, *G. G. André, Dorking.—28th November*, 1882. 8*d*.

This relates to a battery in which the negative electrode is not immersed in the exciting liquid in which the positive electrode is placed. The negative electrode is also separated from the solution by an absorbent diaphragm. The negative electrode consists of small pieces of highly-burnt coke; the positive, of zinc or iron. The object is to construct a battery of simple materials that shall produce powerful and constant currents.

5677. Regulating the Production of Electricity, *H. Wilde, Manchester.—29th November*, 1882. 2*d*.

Relates to a method for regulating the current in the main circuit, according to the number of lamps in use at any particular time.

5702. Telephonic Receivers, *T. Torrey, West Kensington.—30th November*, 1882. 6*d*.

The inventor dispenses with the ordinary metal vibrating disc, and constructs his instrument so that the whole mass of a magnet pole, sufficiently rigid to maintain its adjustment, shall be thrown into vibration; this vibration is amplified and communicated to the ear by means of an expanded ear piece of thin metal attached to the vibrating pole.

5742. Electric and Magnetic Apparatus for Telephonic or other Purposes, *S. P. Thompson, Bristol, and J. D. Husbands, London.—1st December*, 1882.—(*Not proceeded with.*) 4*d*.

This invention consists in utilising, as means for producing mechanical movements, the property of differential magnetic expansion and contraction, or, the action due to the different degree of expansion or contraction of different metals when magnetised.

5744. Automatically Regulating Electric Currents, *J. T. King, Liverpool.—2nd December*, 1882. —(*A communication from J. R. Finney, Pittsburgh. U.S.*) 8*d*.

This invention consists in the combination of an electro-magnet and core arranged to receive motion from the passage of a current through a main or subsidiary circuit with a movable contact maker. The core is connected to the contact maker by pulleys and cords, and the contact maker is arranged to move on a lever slide in contact with the armature of the generator. Any variation in the resistance in the circuit causes motion to be imparted to the core, and thus to the contact maker, and the relative position of this latter and the armature is so altered that the current passing in the circuit is increased or diminished as required.

5747. Generating and Utilising Electric Energy, *A. J. Boult, High Holborn and Liverpool.—2nd December*, 1882.—(*A communication from B. Faquant, Springfield, Mass., U.S.*)—(*Not proceeded with.*) 4*d*.

The object of this invention is the construction of a motor which shall be automatic—that is, when once set going it will generate enough electricity to keep it going.

5754. Electrical Switch, *G. W. Bayley, Walsall.—2nd December*, 1882. 6*d*.

The object of this invention is to construct a switch in which sparking is reduced to a minimum.

5757. Manufacture and Preservation of Insulated Electric Conductors, *E. T. Truman, Old Burlington-street.—2nd December*, 1882. 4*d*.

The inventor insulates conductors with a compound consisting of plumbago or graphite, combined with gutta-percha or india-rubber or ozokerit. By mixing in the following proportions the inventor obtains a durable compound, viz., ·3 ozokerit, 10 blacklead, and 15 gutta-percha.

5767. Accumulators or Secondary Batteries, *W. A. Barlow, London.—4th December*, 1882.—(*A communication from L. Encausse and Canésie, Paris.*) 6*d*.

The inventor constructs his electrodes as follows:—A thin sheet of lead is rolled around in a long spiral, and in the centre of the roll is arranged a strip of lead, which extends out at each end of the roll; the latter then has insulated wire coiled round it, and on the two ends of the spiral are fixed two india-rubber rings. Over the whole a second sheet of thin lead is rolled, so as to cover the coil and the india-rubber rings, and in the last turn of this second roll is placed a strip of lead, extending out at each end of the roll; a winding of insulated wire as before completes the element. The lead sheets employed are covered with an insulating varnish, and the surfaces of the spirals are not in contact.

5779. Electric Lamps, &c., *A. Fergusson, Southwark. —5th December*, 1882. 6*d*.

This relates to electric lamps in which the light is formed in a vacuum, and to electric switches, by which the current is turned on and off therefrom. The carbon used is preferably made from bass wood fibre, twisted or looped into various forms, so as to expose a large surface, and then carbonised in the usual manner. The carbons are attached to the wires by small hollow carbon cylinders. Below the shank of the globe the connecting wires terminate in loops to receive the wires of the switch, which are connected to terminals on the switch casing, which receives a support enclosing the shank of the globe. One switch wire leads directly from the terminal to the corresponding wire of the globe, and the other is attached to a conducting plate embedded in insulating material, the circuit being completed by a movable conducting screw, touching the plate after passing through the switch casing.

5783. Magneto and Dynamo-electric Machines, *W. A. Barlow, London.—5th December*, 1882.—(*A communication from W. E. Fein, Stuttgart.*)—(*Not proceeded with.*) 2*d*.

This relates to improvements in ring armatures, so as to utilise their coils to the utmost, prevent Foucault currents, keep the ring cool, &c.

5796. Electric Lamps, *W. R. Lake, London.—5th December*, 1882.—(*A communication from R. H. Mather, Windsor, Conn., U.S.*) 6*d*.

This relates to arc lamps. To regulate the carbons the inventor uses a spring clamp, in connection with the armature of a shunt magnet and a switch magnet, which supports the upper carbon, and releases it automatically as the carbons are consumed, allowing it to descend towards the lower carbon by the action of gravity. Multiplicity of parts is avoided in this lamp, and the frame is cast in two parts, easily united.

5797. Primary Voltaic Batteries, *T. J. Jones, Hanover-square.—5th December*, 1882.—(*Not proceeded with.*) 2*d*.

The inventor's battery is formed of a porous vessel containing a suitable electrolyte, in which is immersed a positive element of zinc. The porous vessel is surrounded by a silver plate, the negative element, both corrugated and perforated, so as to allow atmospheric oxygen to depolarise it as much as possible.

5814. Igniting Gas by Means of Electricity, *J. A. Koerber, Soho.—6th December*, 1882.—(*Not proceeded with.*) 2*d*.

At the lower end of a tube is provided a small battery, from which wires are led to the upper end of the tube and connected to a platinum wire. A button for making and breaking the circuit is provided at the bottom of the tube.

5833. Incandescent Electric Lamps, *J. Wavish, Forest-gate, and J. Warner, Whitechapel.—6th December*, 1882.—(*Not proceeded with.*) 2*d*.

The object of this invention is to prevent rupture of the glass stems of this class of lamp, where the wires pass through said stems.

5861. Gaso-electric Lamps, *P. M. Justice, Southampton-buildings.—8th December*, 1882.—(*A communication from J. H. Loder, Brussels.*)—(*Not proceeded with.*) 2*d*.

This relates to the combination of the electric arc formed between the points of two carbon rods with the flame of a gas-burner, the carbons being placed in the flame.

5866. Electric Commutators, *J. Gordon, jun., Dundee.—8th December*, 1882. 4*d*.

To prevent wear and friction in commutators, the inventor drills a row of holes in each segment, and fixes in them a series of plugs of anti-friction material, such as metalline.

5926. Applying Electric Currents to Organic Bodies for Various Purposes, &c., *H. Haug, Dortmund, and A. Wienand, Pforzheim, Germany.—12th December*, 1882. 8*d*.

This relates to an improved method, called the bisolenoidal-electric method, of applying currents to organic bodies and to eggs and seeds, for breeding, heating, and other purposes; it also relates to improved instruments and articles of wear, and methods of applying them, &c.

5971. Covering Stairs with Carpet, &c., *H. Hawgood, Richmond.—14th December*, 1882. 6*d*.

A separate piece of carpet is used for each stair instead of a continuous length, and each piece is secured to a frame hinged to brackets, arranged beneath the nosing of each stair, so that the frame may be turned back to brush the tread, or entirely removed to enable it to be washed.

6005. Lifts or Hoists for Warehouses, &c., *J. T. Donald, Glasgow.—16th December*, 1882.—(*Not proceeded with.*) 2*d*.

This relates to means by which gates or doors giving access to the cage are closed on the cage passing from them, and opened as it approaches them; and it consists in causing projections on the cage to act upon slides connected by chains with the gates or doors.

6007. Furnaces of Steam Boilers, &c., *J. Williams, Cardiff.—16th December*, 1882.—(*Not proceeded with.*) 2*d*.

A blast of air is passed between each bar at the front of the grate by means of a chamber at the furnace mouth, the top of which forms the dead plate, and the back being perforated to allow a blast of air and steam to pass between each bar and up through the fuel. The blast is produced by a jet of steam from the boiler. Air and steam are also caused to issue from another perforated chamber at the back of the bridge.

6011. Grinding Oval Glasses, Mirrors, &c., *E. A. Brydges, Berlin.—16th December*, 1882.—(*A communication from Schwarz Brothers, Bavaria.*—(*Not proceeded with.*) 4*d*.

This relates to the use of a disc to receive the mirror adjustable on a shaft to which an elliptical movement is transmitted, and the grinding and polishing stones are caused to revolve and bear on the edge of glass.

6017. Glazing Roofs, &c., *W. Ferguson, Guernsey.—16th December*, 1882.—(*Not proceeded with.*) 2*d*.

The object is to glaze roofs without the use of putty, and it consists in hollowing out the upper surface of the sash bar, and when the panes are laid in position securing them by screws passing between the contiguous edges and taking into the sash bar. The groove carries off any water falling between the panes.

6021. Steam Generator for use of Liquid Fuels and Apparatus for Burning Liquid Fuels therein, *H. Montgomerie, Durham.—16th December*, 1882.—(*Not proceeded with.*) 2*d*.

The boiler has one or more furnaces extending through the entire length and terminating in a combustion chamber formed separately from the boilers and protected from radiation or over heating. From the combustion chamber the flame and gases return through side flues to the front, and then by small tubes above the flues to a second combustion chamber at the back, again returning by small tubes to the front and passing to an uptake. A special burner is described consisting of an inner and an outer cone, with an annular space between them that can be adjusted as desired.

6024. Manufacture of Screw Nuts and Machinery for Tapping the same and for Screwing Bolts, *A. S. Paterson, London.—16th December*, 1882.—(*A communication from H. A. Harvey, New Jersey, U.S.*) 8*d*.

The object is to automatically effect the feeding of nut blanks to tapping mechanism, to tap the blanks, and release and discharge them from the machine. A multiple nut tapper is provided, and a single-feeding apparatus presents successively each one of a series of nuts in position to be operated upon, and is combined with a revolving head containing a number of radially arranged taps constantly rotating round a common centre, and also rotating on their axes, first in one direction to tap the blanks, and then in the opposite direction to release them from the nuts. A sweeping arm takes the bottom nut from a tube, and a pusher forces it on to the tap, the blanks being prevented from turning by contact with the arm. Several other improvements are described, including the substitution of dies for the taps for the purpose of cutting the threads of bolt blanks.

6028. Fastenings for Trunks, Boxes, &c., *W. H. Jones, Wolverhampton.—18th December*, 1882.—(*Not proceeded with.*) 2*d*.

The ordinary locking hasp is connected rigidly to a horizontal round bar running across the face of the lid; at a slight distance above the lower edge on either side of the bar from the middle is fixed one or more clips which pass round and under a moulding on the upper part of the front of the box, so as to give great resistance to the lifting of the lid on either side.

6030. Apparatus to be used in the Manufacture of Gas for Controlling the Passage thereof into the Hydraulic Mains, *J. W. C. Holmes, Huddersfield, and S. Lindley, Durham.—18th December*, 1882. —(*Not proceeded with.*) 2*d*.

The object is to prevent the back pressure in hydraulic mains caused by the sealing of the dip pipes. A double flanged or socket pipe has a recessed chamber at right angles to the gas passage, and through this chamber passes a spindle working through a gland, and on which is a lever or crank, extending to the centre of the pipe, with a vertical rod attached to it, and carrying a seal cup at its lower end. Outside the chamber the spindle carries another lever, to which a chain is fixed, so that the spindle may be moved, and the seal cup raised or lowered, whereby the dip pipe is sealed or unsealed as required.

6032. Shielding Velocipedes from Inclemency of the Weather, *A. Tomkins, London.—18th December*, 1882.—(*Void.*) 4*d*.

This relates to a collapsible hood composed of five ribs, covered with waterproof material.

6035. Window Fasteners, *G. T. Ball, Essex.—18th December*, 1882.—(*Not proceeded with.*) 2*d*.

This consists in forming a tapped hole in the lower rail of the top sash, and a corresponding hole in the top rail of the bottom sash, to receive a screw bolt for securely fastening the window.

6036. Automatic Pneumatic and Hydraulic Apparatus to be Applied to Steering and other Purposes on Board Steamships, &c., *E. Wimshurst, London.—18th December*, 1882.—(*Not proceeded with.*) 2*d*.

An iron cylinder is fitted in the engine-room, and engine pump air or water into it to any required pressure, which is regulated by a piston valve acting as a governor to close the steam valve on the engine when the desired pressure has been attained. Pipes lead the air or water to the steering gear or other machinery to be actuated.

6041. Malting Grain, &c., *C. D. Abel, London.—18th December*, 1882.—(*A communication from Dr. L. Mautner, Ritter von Markhof, Vienna.*)—(*Not proceeded with.*) 2*d*.

This relates to the use, with an arrangement for ventilating germinating grain, of means for absorbing as completely as possible the radiated heat produced by the germinating process, and it consists in the use of rotating drums in which the germination is effected, and which are formed of thin wire woven or plaited so that the heat generated can be radiated through the openings, and converged away by surfaces formed of a good heat-conducting material and placed in proximity to the drum.

6043. Drying and Roasting Malt, &c., *C. D. Abel, London.—18th December*, 1882.—(*A communication from Dr. L. Mautner, Ritter von Markhof, Vienna.*) —(*Not proceeded with.*) 4*d*.

This relates to a process which permits of continuous working, which can be regulated in all stages, so that a uniform product is obtained. Instead of hurdles, drums of perforated metal or wire gauze are used and heated air driven through them by a fan. The drums are arranged one above the other, and the malt passes in succession from the top one to the bottom one.

6045. Coupling Apparatus for Shafts used in Transmitting Motion to Machinery, *H. H. Lake, London.—18th December*, 1882.—(*A communication from W. Johnston, Philadelphia.*) 6*d*.

The object is to construct a coupling for shafts which will allow perfect freedom of motion to the shafts at any angle within certain limits. The two heads A of the coupling are each formed in sections *a b c* connected by bolts, and the shafts X Y are secured to the sections *c*. In section *a* a depression is

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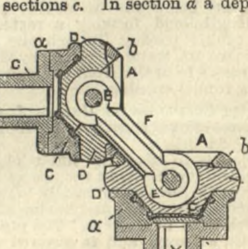


formed to receive an oscillating block C formed with journals D resting in the sections *a*, and retained by section *b*, which is of annular form. In block C is an opening extending at a right angle to the journals D, and receiving an oscillating pin E, to which is keyed one end of a coupling link F, the end of which enters an opening block C, the link serving to connect the two heads of the coupling, the edges of which are bevelled, and rest in contact with each other.

6046. ELECTRIC LAMPS OR LIGHTING APPARATUS, *H. H. Lake, London.*—18*th December*, 1882.—(*A communication from J. Kremenezky, Vienna.*)—(*Not proceeded with.*) 2*d.*

This consists in the use of two solenoids, one above the other, and each having a central tubular core, through which the upper carbon holder passes. The solenoids are so arranged in relation to each other that the coil for the primary current is carried above the coil in the derived or shunt circuit by three columns. The lower coil is on the base plate of the lamp, and a space is left between the solenoids for the regulating mechanism. The cores are connected by links, and act together upon two pawls with forks attached to a socket free to slide upon the upper carbon rod. The pawls are connected to the upper core by double-jointed links, and can move up and down with them. The upper carbon holder has two slots to receive two cords, which pass over pulleys and are connected with the lower holder, which has guide rollers on each side and a piston moving in a cylinder filled with mercury or glycerine.

6048. MACHINES FOR SEWING STRAW PLAITS OR BRAIDS OR OTHER MATERIAL IN STRIPS INTO HATS OR OTHER ARTICLES, *J. H. Johnson, London.*—19*th December*, 1882.—(*A communication from C. H. Willcox, New York.*) 8*d.*

This relates to means to enable braid or strips to be sewn on articles so that the stitches will not show on the right side, but will be covered by the edge of the overlying strip, and it consists of a guide which turns up the edge of the overlying braid so that the needle can so form the stitches that when the braid lies flat they will be concealed. The work guide is provided with a separator to keep the fabrics apart in their passage to the needle, and the presser foot is cut away in front to leave a slot, between which and the work guide the turning-up guide is placed. A further improvement relates to a table which can be brought into position to form a continuation of the sewing machine worktable.

6053. BOTTLES AND THEIR STOPPERS FOR MEASURING LIQUID BY DROPS, *J. Chaillet and T. Rougnon, Paris.*—19*th December*, 1882.—(*Not proceeded with.*) 2*d.*

The upper part of the neck of the bottle is formed with two apertures, one on each side, and communicating with two grooves, one on either side of the stopper, and serving, one to admit air, and the other for the exit of the liquid drop by drop.

6056. EXTRACTION OF GOLD FROM AURIFEROUS PYRITES, *J. Plaisted (Lord Penzance), Grosvenor-square.*—19*th December*, 1882.—(*Not proceeded with.*) 2*d.*

The iron is calcined, and then smelted with a suitable flux in a cupola or smelting furnace. The regulus or matt obtained is crushed and treated with dilute sulphuric acid, preferably heated to boiling point, the sulphuretted hydrogen given off being drawn off and utilised. The result of this treatment is to convert all the iron present into sulphate of iron, which remains dissolved in the liquid, and is drawn off, while the insoluble residue contains the gold, together with other metals and silica if present in the ore. The residue is melted with lead in a reverberatory furnace, and the gold and silver afterwards separated therefrom in the ordinary manner.

6060. DISTILLATION OF COAL TAR, &c., *E. Drew, Bayswater.*—19*th December*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to means whereby the various products of coal tar are obtained at one distillation in a sufficiently pure state for commercial purposes, and it consists in passing the vapours from coal tar through a series of condensers, each maintained at a lower temperature than its predecessor, and at the same time reducing the pressure within the condensers by an air pump.

6064. CALCINATION OF REGULUS OR MATTE, AND THE UTILISATION OF THE SULPHUR CONTAINED THEREIN, *J. W. Chenhall, Glamorgan.*—19*th December*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a mode of calcining regulus so that the sulphurous acid produced by the combustion of the sulphur it contains is obtained in a state suited for conversion into sulphuric acid by the ordinary chamber process, and it consists in grinding the regulus, mixing it in a mortar mill with moist clay, and fashioning the mixture into balls which, after being dried, are burned in kilns similar to those used for burning pyrites in connection with sulphuric acid chambers.

6065. MICROSCOPES, *W. E. Hancock, Halifax.*—19*th December*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to a stand which will allow the microscope to move up and down to give a more accurate and true adjustment of the focus, and it consists in the use of two slides, the bottom one worked by a very fine screw.

6067. ELECTRICAL GAS LIGHTING APPARATUS, *S. E. Pattison, Birmingham.*—19*th December*, 1882.—(*A communication from W. A. Drysdale and C. W. Bailey, Philadelphia.*)—(*Not proceeded with.*) 2*d.*

This relates to apparatus in which the gas is automatically turned on or off and the gas ignited by electrical devices, and it consists in the combination of the rotary gas-cock plug with a permanent magnet secured thereto, and an electro-magnet adapted to give a partial rotary motion to the permanent magnet.

6068. OPEN STOVES OR FIRE-GRATES, *E. R. Hollands, Stoke Newington.*—19*th December*, 1882. 6*d.*

This relates to improvements on patent No. 4448, A.D. 1880, in which a rake is caused to enter the fire basket and raise the ignited fuel, so as to form a space for the fresh fuel, and it consists in special apparatus for actuating the rake.

6077. TIPS FOR BOOTS AND SHOES, *L. A. Groth, London.*—20*th December*, 1882.—(*A communication from L. Loeser and J. Kyeser, New York.*) 6*d.*

This relates to a shoe tip of leather with a metallic binding frame at its lower edge provided with spurs or teeth projecting backwards, which are forced into the sole, and being perforated so that the tip may be further secured by pegs or nails.

6079. CONSTRUCTION OF SHIPS TO FACILITATE PROPULSION, *F. H. F. Engel, Hamburg.*—20*th December*, 1882.—(*A communication from G. de Laval, Stockholm.*) 6*d.*

The object is to reduce the resistance to vessels travelling in water, and it consists in forming the lines of the vessel below the water-line parallel to the vessel's length, and forming a rectangular funnel-shaped opening passing through the length of the vessel, so that the water displaced by the vessel in its progress passes in at the front end and out at the rear end of the funnel opening.

6080. PIPE COUPLINGS OR UNIONS, *J. Chapman, Nottingham.*—20*th December*, 1882.—(*Not proceeded with.*) 2*d.*

The object is to effect the union of pipes without soldering, and it consists in the use of a hollow cylindrical box piece screwed internally to receive the piece to be connected to a pipe, and having at its other end a conical piece to fit the pipe. The pipe is inserted in a tube with a flange, and is screwed to fit the box piece, so that the conical end is forced into the pipe.

6081. SEPARATING HAIR FROM COTTON, LINEN, OR OTHER VEGETABLE FIBRE IN MIXED FABRICS, *C. Harrison, London.*—20*th December*, 1882.—(*Not proceeded with.*) 2*d.*

The fabric is placed in a vat and treated with a solution consisting of 1 part strong commercial sulphuric acid mixed with 30 parts water. After from fifteen to twenty minutes the fabric is removed and allowed to drain, and is then dried in a water oven. The cotton warp will be found to be rotten, and will separate easily from the hair.

6082. HAND SHEARS FOR CUTTING CLOTH AND OTHER FABRICS AND THIN METALS, *E. Nunan, London.*—20*th December*, 1882. 6*d.*

One jaw is a fixture so as to rest on the cutting board, while the other is movable on a pin under the position occupied by the ball of the thumb when cutting. An arm extends from the stock of the fixed blade, and to it the upper handle is pivotted and serves to work the movable blade by means of a toggle.

6086. BANJOS AND SIMILAR INSTRUMENTS, *W. R. Lake, London.*—20*th December*, 1882.—(*A communication from F. H. Chase, Boston, U.S.*) 6*d.*

The ring or rim is of metal with one or both edges curved inwards, and the handle is secured to one side only of the rim, while a suitable stretcher hoop and clamp are employed to stretch the parchment head over the top of the rim.

6088. ROTARY KNITTING MACHINES, *W. Cotton, Leicestershire.*—20*th December*, 1882. 1*s.* 2*d.*

This relates to an automatic narrowing apparatus for effecting the narrowings necessary in forming the foot-piece of socks or stockings.

6089. TREATMENT OF FERMENTED LIQUORS FOR THE REMOVAL AND PREVENTION OF ACIDITY, *A. G. Salamon, Clapham Park.*—20*th December*, 1882. 4*d.*

This consists in the application to fermented liquors of the alkaline borates, and particularly magnesic borate, for fixing the acid or acids produced by after fermentation and simultaneously destroying the germs or organisms which produced such acid or acids.

6090. MANUFACTURE OF LEGGINGS, &c., *F. W. Hemming, Pall Mall.*—20*th December*, 1882. 8*d.*

The object is to form a legging having the appearance of a Hessian boot without its disadvantages, and it consists in forming a legging which can readily be secured to and removed from the boot.

6091. FURNACES FOR STEAM BOILERS AND OTHER STRUCTURES, &c., *E. Bennis, Bolton.*—20*th December*, 1882. 6*d.*

This relates to improvements on patents No. 1308, A.D. 1870, No. 4360, A.D. 1878, and No. 3443, A.D. 1879, and consists in the use of a special pusher and shovel worked from the same shaft and serving to distribute the coal better, and to prevent iron nails, bolts, or hard lumps of coal interfering with the action of the apparatus. The fire bars are of special form, so as to prevent the fuel leaving the front end too rapidly, the upper surface of the bars being sloped so as to retard the passage of the fuel, while the bars are of bridge form and have holes formed in them, and being used in combination with steam jets.

6092. VESSELS FOR CONTAINING AND PRESERVING LIQUIDS, *W. R. Lake, London.*—20*th December*, 1882.—(*A communication from A. J. Gay, Paris.*) 6*d.*

The object is to prevent access of air to liquids when a portion thereof is withdrawn from the vessel containing them, and it consists in placing a float on top of the liquid, the edge of which fits the vessel containing the liquid so as to prevent the passage of air, or the liquid may be contained in a collapsible air-tight bag placed in a case to which the air has free access.

6095. SHEARING OR CUTTING PILE FABRICS AND OTHER TEXTILE FABRICS FOR OBTAINING ORNAMENTAL DESIGNS THEREON, *C. D. Abel, London.*—21*st December*, 1882.—(*A communication from La Société A. Labrosse et J. Richard, Paris.*) 6*d.*

This consists in supporting the fabric to be operated upon, upon a table or roller in which the required design is formed in recess, so that the cutter will only act upon the parts of the fabric resting upon the raised part of the bed or roller.

6096. PENCIL OR LEAD HOLDERS FOR COMPASSES, &c., *H. J. Haddan, Kensington.*—21*st December*, 1882.—(*A communication from G. Schönner, Germany.*) 4*d.*

A hollow sleeve with a pointed end encloses a second sleeve acted upon by a spring so as to grip the lead and hold it in position until the spring is forced back by means of a button projecting through the outer sleeve.

6098. SEWING MACHINES, *B. J. B. Mills, London.*—21*st December*, 1882.—(*A communication from C. Vernay and F. Roux, France.*) 6*d.*

The object is to produce a fast and elastic sewing by a single thread contained in a shuttle working under the table, and a double hook used in place of the usual needle. One hook draws the thread up through the work, which then advances the length of a stitch, when the other hook carries the thread down through the work, and the shuttle passes through the loop, the hook releasing the same and catching hold of the thread that has just passed through the loop, so that when drawn up through the work the previous loop is drawn up tight.

6099. COAL VASES OR COAL BOXES, *J. T. Beston, Birmingham.*—21*st December*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to the application of a sliding cover to the opening of coal vases, in place of the usual hinged door.

6100. APPARATUS FOR CULTIVATING LAND, *D. Greig, Leeds, and G. Greig, Edinburgh.*—21*st December*, 1882. 8*d.*

The object is to enable two or more implements to be pulled by one rope, so that any length may be ploughed without the rope having to travel the full distance. The difficulty in working this way is that the strain for pulling the second or third implement has to pass through the first implement, and the rope has to pass back from one side of the first implement to the second as this portion of the rope must be out of the way of the ploughs. The first implement is in consequence dragged sidewise and pulled over the land in that position. To avoid this, to the centre of each instrument a two-armed crank is pivotted, the arms being at an obtuse angle to one another, and one passing towards one end of the implement and the other towards the other end. The pulling ropes are connected to the ends of the crank arms. One implement carries a drum, and by winding a portion of the intermediate rope thereon the distance between the implements is adjusted.

6101. DIES USED IN THE MANUFACTURE OF ROOFING AND OTHER TILES, *C. Major, Bridgwater, Somerset.*—21*st December*, 1882.—(*Not proceeded with.*) 2*d.*

The two moulds are made without the overlapping ends, and also without perforations for the escape of air. The clay is placed on the lower mould and covered by the upper one, and pressure exerted to squeeze out the superfluous clay all round the edges. These edges are then covered by a collar, which strikes off the superfluous clay and the pressing continued.

6102. INSULATOR FOR TELEGRAPHIC AND LIKE WIRES, *A. G. Bossomaier, Kingsland.*—21*st December*, 1882.—(*Not proceeded with.*) 2*d.*

This consists of a base to be fixed by screws to poles or other supports, and having a lug at one side for the attachment by a pin of a top strap, the opposite end of which is connected by a stud to the opposite end of the base. Both the base and the strap receive flanged half rings of porcelain or other insulating material.

6103. INSTRUMENT FOR ADMINISTERING MEDICINE TO HORSES, &c., *P. Fonnereau and W. Fielding, London.*—21*st December*, 1882. 4*d.*

This relates to a drenching funnel capable of holding the liquid.

6105. ELECTRIC METERS, *F. H. Varley and J. R. Shearer, London.*—21*st December*, 1882. 6*d.*

The apparatus is based on the power of electricity to decompose fluids or deposit metals, and in one form a water voltameter is rendered a self-recording instrument by suspending a bell receiver from each end of a scale beam, one being fitted with a self-acting valve. The receivers are immersed in the fluid to be decomposed, the one with the valve being placed over the electrodes, and the other one filled with air. When the receiver over the electrodes is charged with gas it floats, and the beam moves until it comes in contact with a stop, when the receiver continuing to rise opens the valve and discharges the gas, so that the receiver falls again to be recharged. The motion of the beam is transmitted to registering mechanism. In a second form the electro deposition of metals is utilised by attaching one electrode to a float immersed in the liquid and carrying a graduated scale, so that as the metal is deposited the float sinks, the scale registering the decrease in buoyancy of the float.

6106. SELF-ACTING AND ADJUSTABLE CLUTCHES, *J. S. Taylor and S. W. Challen, Birmingham.*—21*st December*, 1882. 6*d.*

This relates to improvements on patent No. 5187, A.D. 1879, and it consists in adding to the clutch a concentric ring attached to the cam portion of the clutch, and capable of sliding along the press shaft. Near one end of the body of the sliding cam, when made adjustable, an annular recess is made to receive an adjustable clip, which firmly embraces the cam, which can then be moved by a foot lever. The other end of the cam forms a curved wedge, serving to operate the driving key between the driving wheel and the press shaft while the press is at work, so as to disengage the driving wheel when desired. The cam does not at any time rotate with the press shaft, but is held between two arms that guide its sliding motion, these arms being operated by the foot lever, and the whole so combined that when pressure is removed from the foot lever the cam is forced towards the wheel by a spring and the key operated by the wedge, so as to break the connection between the driving wheel and the shaft until pressure is again applied to the foot lever.

6107. HAT LININGS, *W. H. Knowles and J. Faulkner, Lancashire, and R. J. Metcalfe and W. N. Raines, Chester.*—21*st December*, 1882. 6*d.*

The object is to make hat linings by one stroke out of one piece of silk or other material, and it consists in the use of a hollow dome heated by suitable means, and upon which the material is placed, and a cup brought over it and pressure exerted so as to form a pleated dome-shaped lining.

6108. VELOCIPEDES, *R. C. Fletcher, near Preston.*—21*st December*, 1882. 6*d.*

This relates, First, to a method of double driving by a chain wheel, in which a central bearing is dispensed with and three or more bevel pinions employed; Secondly, to a method of double driving by ratchet teeth and a sliding pawl; Thirdly, to a method of double driving by balls and a row of ratchet cavities; Fourthly, to a method of double driving by friction discs and rollers; Fifthly, to parallel springs forming a bracket for carrying the lamp; and Sixthly, to appliances for lighting the lamp without opening the door.

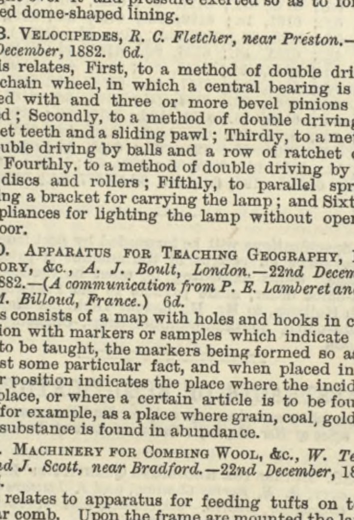
6120. APPARATUS FOR TEACHING GEOGRAPHY, HISTORY, &c., *A. J. Boult, London.*—22*nd December*, 1882.—(*A communication from P. E. Lamberet and A. M. Billoud, France.*) 6*d.*

This consists of a map with holes and hooks in combination with markers or samples which indicate the facts to be taught, the markers being formed so as to suggest some particular fact, and when placed in its proper position indicates the place where the incident took place, or where a certain article is to be found, such, for example, as a place where grain, coal, gold, or other substance is found in abundance.

6125. MACHINERY FOR COMBING WOOL, &c., *W. Terry and J. Scott, near Bradford.*—22*nd December*, 1882. 6*d.*

This relates to apparatus for feeding tufts on to a circular comb. Upon the frame are mounted the large and small circular combs B and C and a reciprocating gill head D placed outside the combs, and the fallers of which are curved to the same radius as the inner

6125

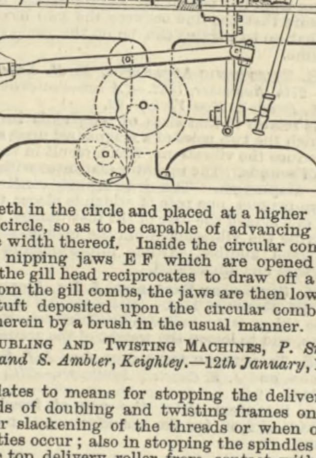


row of teeth in the circle and placed at a higher level than the circle, so as to be capable of advancing over the whole width thereof. Inside the circular comb is a pair of nipping jaws E F which are opened and closed as the gill head reciprocates to draw off a tuft of wool from the gill combs, the jaws are then lowered and the tuft deposited upon the circular comb and dabbed therein by a brush in the usual manner.

192. DOUBLING AND TWISTING MACHINES, *P. Smith, jun., and S. Ambler, Keighley.*—12*th January*, 1883. 6*d.*

This relates to means for stopping the delivery of the threads of doubling and twisting frames on the rupture or slackening of the threads or when other irregularities occur; also in stopping the spindles and lifting the top delivery roller from contact with the bottom rollers when piecing up or when otherwise required. The threads pass through weighted levers I,

192



and when the tension slackens the weighted end of the levers falls, and its bent end comes in contact with a traversing bar which actuates a slide G, on which is an incline N, and which, when brought in contact with roller O, lifts up the head P and grips the thread between it and the roller R. To each spindle is fitted a lever D actuated by a treadle M, so as to bring a brake F in contact with the wharle, and at the same time lifting the top delivery roller A through lever X.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

281,353. DYNAMO OR MAGNETO ELECTRIC MACHINE, *Thomas A. Edison, Menlo Park, N.J.—Filed September* 13*th*, 1882.

Claim.—(1) In a dynamo or magneto electric machine, the combination with a revolving armature, of the field magnet provided with convergent polar extensions nearly surrounding the armature, substantially as set forth. (2) In a dynamo or magneto-electric machine, the combination, with the field magnet and its polar extensions having reduced opposite active ends made with curved faces, of an armature revolving in the space formed by the curved faces of the reduced active ends of the polar extensions, and nearly surrounded by such curved faces, substantially as set forth. (3) In a dynamo or magneto-electric machine, the combination, with a revolving armature, of a field electro-magnet composed of polar extensions, each of which is magnetically in one piece and two or more pairs of wound cores attached to such polar extensions, and provided with magnetically separate yokes or back pieces, sub-

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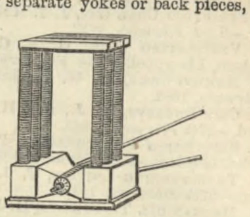
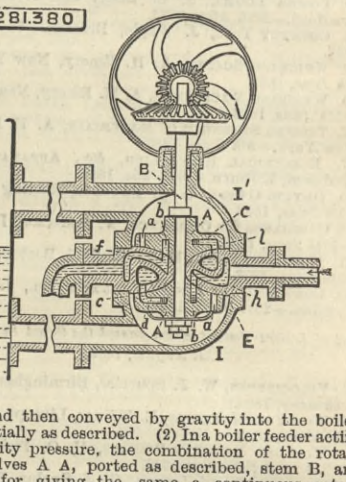


stantially as set forth. (4) In a dynamo or magneto-electric machine, the combination, with a revolving armature, of a field magnet provided with convergent polar extensions nearly surrounding the armature, and two or more pairs of magnet cores, substantially as set forth. (5) In a dynamo or magneto-electric machine, the combination with a revolving armature, of the field magnet provided with convergent polar extensions made each in one piece magnetically and nearly surrounding the armature, and with two or more pairs of magnet cores having separate magnetic yokes or back pieces, substantially as set forth.

281,380. BOILER FEEDER, *Richard Lauckner, Bay City.—Filed January* 31*st*, 1883.

Claim.—(1) The cylinder E and shell I I^1, in combination with the two continually rotating twin valves A and a series of intercommunicating ports, whereby alternate communication is made and broken between the water space in the cylinder, water supply and overflow, and between said water space, steam space, and the water space in the boiler, whereby, first, a quantity of feed-water is admitted to the water

281.380



space and then conveyed by gravity into the boiler, substantially as described. (2) In a boiler feeder acting by gravity pressure, the combination of the rotary twin valves A A, ported as described, stem B, and devices for giving the same a continuous rotary motion, substantially as and for the purpose set forth. (3) In a mechanical boiler feeder, the water cylinder E and valves A A, in combination with the ports *k l*, *a a*, *b b*, *c c*, and ducts *d f* and *h*, when constructed, arranged and operating substantially as and for the purpose specified.

CONTENTS.

NEW ZEALAND IRONSAND.—A recent *Otago Daily Times* says:—"Chamber's smelting works at Onehunga, for treating the immense ironsand deposit of Manukau Harbour, commenced work to-day, and several ingots of marketable iron of excellent quality were produced."

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Aug. 18th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11 482; mercantile marine, Indian section, and other collections, 6513. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1566; mercantile marine, Indian section, and other collections, 1749. Total, 21,310. Average of corresponding week in former years, 19,421. Total from the opening of the Museum, 22,304,894.