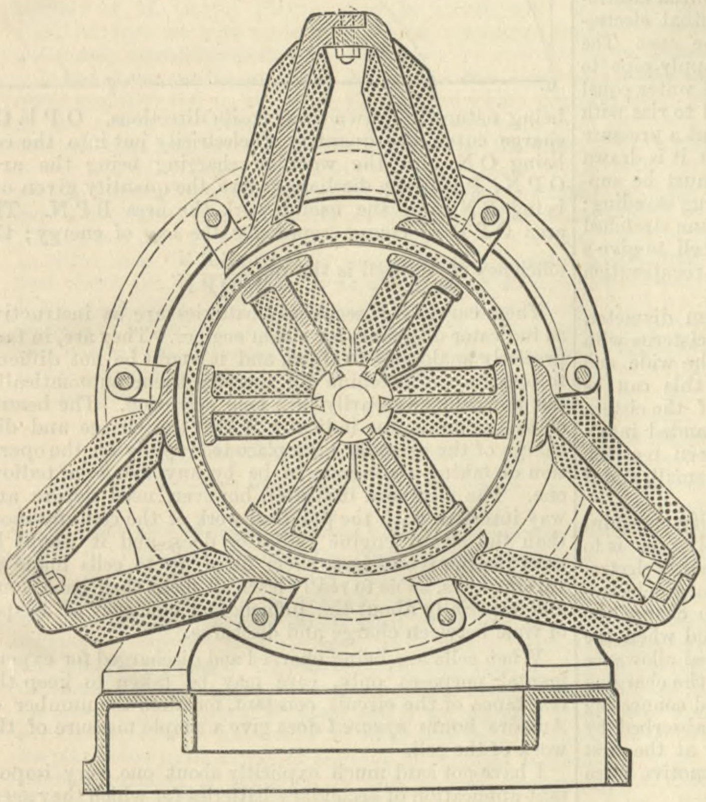
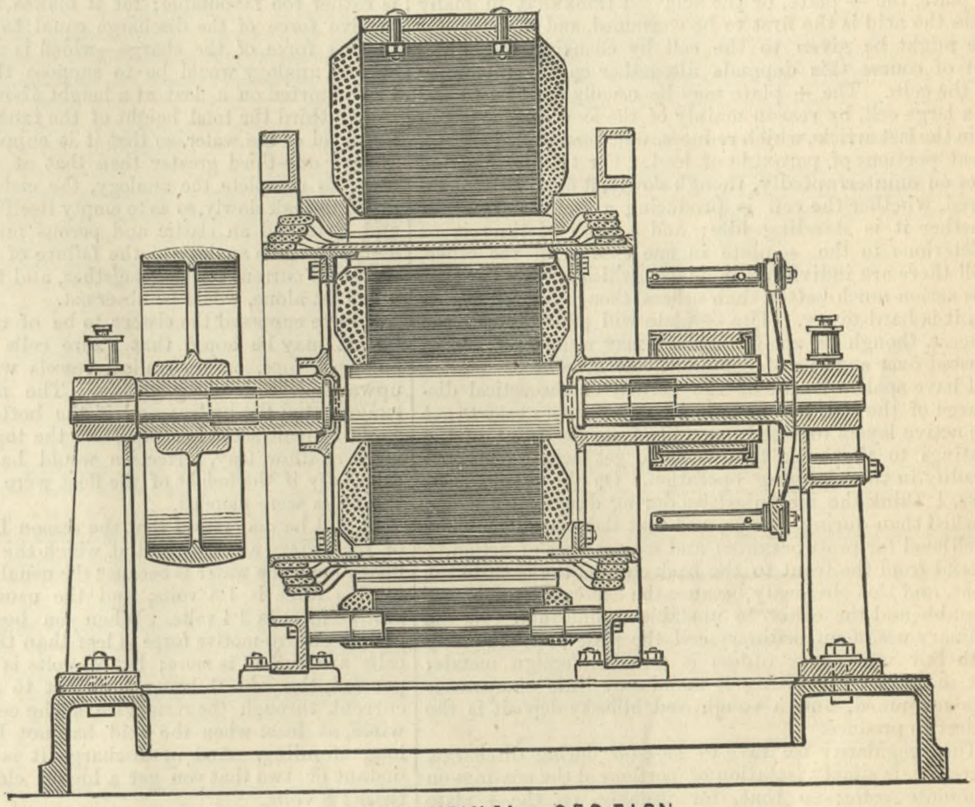
HEATING TOWNS BY STEAM.

For some time the proposal to heat whole towns by a public steam supply, analogous to the water supply of a town, has been talked of, and to a considerable extent carried into effect in New York. Last month a paper, by the late Mr. Robert Briggs, was read before the Institution of Civil Engineers on American practice in warming buildings by steam, which gave some insight into American methods, and showed what questions are considered to represent the greatest difficulties. Heating by steam is certainly adopted to a very much greater extent than in this country, and a higher temperature is usually required in domestic and office premises by Americans than would be felt agreeable by English people. The problem of heating large areas by steam from a central source, and of supplying steam in the same way for motive purposes, has not, however, made much progress; neither has the ventilation of buildings heated by steam received very successful attention. In New York and in other towns a street steam supply has been carried out on a large scale, but from what the *Scientific American* recently said we may gather that it is not everything that is done better in New York than in England, and that the supply of steam to work small motors, to heat and ventilate buildings, to cook with, and to save all the trouble and time occupied in attending fires and fireplaces, may not be an unmixed blessing. That well-known journal said on the 9th inst.:—"The two ends cut into each other, and formed a metallic connection, which has always been successful. In the discussion which followed Mr. Briggs' paper very little was said on the comparative loss of steam by condensation when the steam is only used for heating purposes, and when it is passing with tolerable rapidity through the pipes to supply a motor. Experiments have not, perhaps, been made on steam pipe lines on this subject, but it would be a useful subject for investigation. From experiments we made some time since, as recorded in The Engineer of the 12th February, 1880, we are inclined to think that the rate of condensation per unit of area of the pipes will be found to be much more when the steam is in motion than when it simply fills pipes as in heating; and if this is the case it would be a question for the consideration of the steam heating companies.

Another point which was brought out in the discussion was the increasing condensation with the higher temperature. Mr. Briggs had assumed in a table otherwise valuable, that the rate of condensation per unit area varied with the temperature simply, but extensive experiments made by Mr. W. Anderson have shown that the rate increases more rapidly than the increase of difference of temperature within and without the pipes. In offices and houses the high temperature steam has also the objection that it is always attended with disagreeable smells, probably from the dust collected on the pipes during summer when not in use as well as when in use. Sir W. G. Armstrong, in whose house is a combination of coke



CROSS SECTION



LONGITUDINAL SECTION

ELPHINSTONE AND VINCENT'S DYNAMO ELECTRIC MACHINE.—(*For description see page 14.*)

laying of steam pipes in the streets of the lower part of our city has made rapid progress the past summer and fall, almost too rapid, we think, to be substantial and free from the every-day mishaps now occurring. Defective pipes and fittings and misjudgment in the selection of material for packing the flanges, together with insufficient testing before the closing of the trenches, has resulted in the blowing out of joints, the breaking of flanges, and the digging up and blockading of the streets over and over until the patience of the mercantile community is wellnigh exhausted. The spirit of rivalry between the companies has been carried to the reckless extent of doubling the lines of pipes in many streets, to the detriment of all other franchises and interests, without giving satisfaction to the takers of steam. Although there may be competition wherever there are rival lines, as well as the cutting of rates, the gain is not equal to the nuisance of the continued disturbance of the streets and increased temperature of the water supply from the proximity of so many steam pipes. Is there not room enough for the expansion of two live steam companies in our great city without doubling up their lines of steam pipes under our streets to the detriment of all other interests? The blockade of the streets alone by one company is a nuisance, and what must it be when the rival company repeats it? but when packings blow out to such an extent as to fill the streets with steam and jeopardise life, it becomes time to suspend the extension of the lines, and endeavour to perfect the work already done." The same journal, of the 23rd ult., says:—"There still seems to be trouble in keeping the joints tight under our streets. The screw joints do not seem to hold their own, either from inadequate material to give strength to the fittings, unusual strain by expansion, or unskilled labour in screwing the threads home, as fresh outbreaks are of almost daily occurrence."

The joint making seems from this to be a job which is not always well accomplished by American fitters, and this perhaps explains the fact that Mr. Briggs' paper occupied the attention of the Institution of Civil Engineers for at least twenty minutes with a description of the difficulties attending making the screw joints of wrought iron piping, and of the form of joint most used in the States, some of the points gravely discussed being the commonplace knowledge of steam pipe fitters in general. The difficulties on this point were long since entirely overcome by Perkins, who surfaced the ends of his tubes or one of them, and bevelled the end of the adjoining tube, so that when they were screwed together in a collar the fire and low temperature hot water heating apparatus, said that he had no difficulty with the apparatus either as to joints, regulation of temperature, or smells, but the house of one of his friends, where high temperature steam pipes are used "always smells like an engine house." On the relative advantages, economy and comfort of low temperature and high temperature water or steam pipes for heating, there is much to be said, though comfort alone would decide in favour of low temperature. There is also much room for discussion on the better position of the heating pipes when steam is used, namely, a low level or overhead; while for street service the best arrangement for allowing for expansion and contraction offers a field for invention.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.

By Professor Oliver Lodge.

No. X.

Having charged the cell and allowed it to stand idle for a time, it only remains to discharge it.

The regular and normal operation of discharge would be as follows:—We start with the opposing surfaces—spongy, hydrogenised lead on the one side, and peroxide, more or less saturated with oxygen, on the other—as near together as they can ever be, and with a highly-conducting, strongly acid liquid in the narrow space between. An initial current of great vigour is therefore produced, and any spare oxygen is probably at once consumed. The current continues, with hardly diminished intensity, until the surface hydrogen has also disappeared, and a scum of sulphate forms on the negative plate. This is the first thing that causes any serious weakening of the current; only it must be remembered that it acts by increasing the internal resistance, not by diminishing the electro-motive force to any important extent, and hence, that it may considerably reduce the strength of a powerful current, although a test with an electrometer or high resistance volt-meter might not show any marked deterioration. The more powerful the current demanded, the more is the resistance offered by this scum of consequence, and, moreover, the sooner does the scum form; and this is mainly why a cell refuses to give a very strong current for many minutes together.

On allowing the cell to stand the scum clears off, and the original power is to a great extent restored. And there is this to be noticed about the scum, that the faster it is formed the faster it clears off. If it is formed very rapidly by a very powerful current, the cell need not stand long to recover itself; but if it only forms after a long continuance of a weak current, it is much more permanent, and a long period is necessary for recovery.

The scum always takes longer to clear off than to form, but the two times are not greatly different. The clearing away of the insulating film is due, I believe, to the local action between the hydrogenised lead in the deeper layers of the coating and the dehydrogenised lead of the surface; and if this is so, there must come a time when the film will refuse to clear off, and a permanent increase in the internal resistance will set in, increasing as the action penetrates deeper and deeper into the negative coat until the still metallic lead can only be reached by penetrating through a surface layer of non-conducting matter, consisting mainly of sulphate, but also partly, I think, of the lower oxides of lead.

Messrs. Gladstone and Tribe have made the remarkable observation that patches of *peroxide* form on the — plate during the discharge. The fact has not come under my own notice, as I was so totally unprepared for any such phenomenon that I never looked for it. However, as Messrs. Gladstone and Tribe have detected it by chemical analysis, we must accept the fact, unexpected as it is; and certainly a film of such a substance on the negative plate will account for any amount of falling off of the cell, down to complete stoppage, by reason of its high opposition electro-motive force. Moreover it is certain that local action would speedily clear away such a deposit, and hence, given such a film as this, the loss of power and recuperation of the cell are accounted for in the fullest and most satisfactory manner.

Any difficulty which one feels in perceiving how the peroxide comes to form on the plate during discharge, of course only exists when the cells are discharged separately. When a number of cells are discharged in series, as is common, it is the simplest thing in the world for those which get empty first to begin to charge up in the reverse direction by the current from the others; and the current from a set of cells will therefore cease, not when all are discharged completely, but when the opposition electro-motive force of the worst cells becomes equal to the remaining electro-motive force of the best. Then allowing the cells to stand a bit, the worst cells will lose rapidly their opposition electro-motive force, and accordingly the set will have picked up again and give a residual charge, until the electromotive forces balance again; and so on alternately, the action being precisely analogous in every respect to the residual charge of a Leyden jar with a stratified dielectric, as worked out by Maxwell. But, as Kohlrausch pointed out, to get *Nachwirkung* it is not essential to have a stratified dielectric, so with secondary batteries. A single cell will give it, though not to the same extent as a series.

It is obvious that all these actions are very objectionable, and not at all what is wanted in practice; but as long as cells are not all identical, a series must give these effects in a very marked degree. If it is impossible to make cells really alike, therefore the best plan is to make them as best you can, and then test them and sort them out into qualities, putting all of the same sort together, where they will work much better and more steadily than if mixed with others either better or worse.

A certain percentage will naturally be found exceedingly good; and these, also quite naturally, may be selected for important occasions, such as crossing the Channel.

And now what about the positive plate during discharge. In the normal operation the front layer of peroxide will get reduced to a lower oxide, apparently the yellow oxide litharge, and much of this will be then turned into sulphate by the acid. After this action has gone on for some time the internal resistance of the cell must have increased by reason of the non-conducting layer of lower oxides and of sulphate which intervenes between the active layer of the peroxide and the main body of the liquid.

I apprehend that all reduction of this kind is permanent, and that no recuperative chemical changes go on at this plate when the current is interrupted. Nevertheless it is a certain fact that the power of the + plate too does fall off temporarily while producing a current and pick up again when standing idle, though not, I think, to the same extent nor so soon as the power of the — plate does; in fact, for a long time the fall and rise is not much noticed, but it is most apparent when the active layer is buried at some depth beneath the clogging and non-conducting products of reduction. The cause of the loss of power in this case, I therefore think, is solely due to the exhaustion of the acid inside the porous mass as it combines with the protoxide formed; and the rise of power is due to the renewing of the strength of the acid by diffusion from the main body of the liquid.

If only a weak current is demanded from the cell, the diffusion may be rapid enough to keep the acid fairly strong and no alteration of power need be noticed, but with a powerful current at intervals the alternations are more marked.

Mr. Bosanquet says that with some secondary cells made by him the alternations of power were so marked and so extremely rapid as to cause the carbons of his lamp to chatter. I venture to doubt whether anything like this rate of recuperation is possible, and I have known lamp carbons to chatter when supplied simply from a dynamo.

After the cell has been discharged slowly for a long time, with intervals for refreshment, if necessary, it ultimately is quite exhausted. What has given out, the + plate, the — plate, or the acid? I think that in many cases the acid is the first to be consumed, and that further life might be given to the cell by changing the liquid, but of course this depends altogether on the roominess of the cells. The + plate may be usually the first to fail in a large cell, by reason mainly of the local action spoken of in the last article, which reduces, and, worse still, detaches, great portions of peroxide of lead. For this local action goes on uninterruptedly, though slowly, it must be remembered, whether the cell is producing a useful current, or whether it is standing idle; and a lapse of time is as deleterious to the + plate in one case as in the other. Still there are individual + plates which appear to resist this action much better than others, though for what reason it is hard to say. The — plate will probably last the longest, though its active surface may ultimately get so crusted over as to be of comparatively little use.

I have spoken so far of the normal or theoretical discharge of the cell, but in practice it is no more easy to get the active layers to recede steadily from the front of the coatings to the back than it is to get them to advance steadily in the charging operation. On the whole, however, I think the irregularities during discharge are less marked than during charge, and that there is not the same likelihood for protuberances and excrescences of action to extend from the front to the back as from the back to the front, and this obviously because the one case is analogous to stable and the other to unstable equilibrium. In the ordinary use of an ordinary cell the plate is eaten away with fair uniformity unless it contains foreign metals; but in electro-depositing a metal any little excrescence gets magnified, and a rough and hillocky deposit is the easiest to produce.

The irregularity we have to look for during discharge, therefore, is simply isolation of portions of the coatings on a minute scale; so that, for instance, on the + plate particles of peroxide instead of being reduced may be reduced *round*, and being thus isolated from conducting communication with the + plate, must remain unchanged and useless. In this way grains or particles of peroxide remain mixed up with the reduced matter on the + plate to so great an extent that the reduction of the plate barely changes its colour. The litharge and sulphate formed do give the plate a lighter aspect, but so very large is the proportion of unaltered black peroxide mixed up with them that an unpractised eye could not tell by looking at it, whether a layer of peroxide were "reduced" or not.

The same may be said to a less extent of the — plate, where a large proportion of metallic lead remains in isolated specks uniformly and abundantly distributed through the mass of sulphate and oxide, or whatever the rest of the lead has become changed into.

It must be understood that these detached particles, whether of lead or of peroxide, are of no use whatever, and that they simply act as a clogging obstruction to the current as well as to diffusion, for though themselves conducting, they conduct to nowhere, and no current would think of making use of mere isolated specks of conducting matter lying in its path, but would go round and between them just as carefully as if they consisted of glass dust.

It is for this reason that nothing at all comparable to the quantity of electricity required to form a cell originally can ever subsequently be got out of it. This of itself is not of such pressing importance—except, indeed, where *weight* is a fatal objection; it would be sufficient in practice if all that was put into a cell when re-charging could be got out during the discharge. Unfortunately this also is not possible.

Still the difference between a charge quantity and a discharge quantity is not anything like so great as that between the original form quantity and a subsequent either charge or discharge; and if one were to discharge cells singly, and give them plenty of time, I see no reason why a very large percentage of the charge current should not come out of them. There would necessarily be *some* difference, by reason of the evolution of oxygen during charge, all this being irreversible action; but the amount of this may be kept pretty low. From a series of cells discharged together, however, there will often be a striking difference between the charge and the discharge, as already explained, simply because the cells may not be precisely alike.

Again, if the cells are discharged too rapidly, they can hardly be expected to give the same quantity as if discharged more nearly at the same rate at which they were charged. At the same time I have not many numbers bearing on this point, and the inquiry is complicated by the periods that must be allowed for refreshment when strong currents are wanted.

The number of Ampère-hours a cell can give out, however, is not the really important matter. We must ask also at what electro-motive force does it give them out? The cell should be discharged through an integrating ergometer to give a real measure of what it can do, not through a voltameter or galvanometer; and we should thus find a sad discrepancy between the work put into any cell with which I am acquainted and the work taken out. For the cell during charge is always at its best, and its electro-motive force is high; but during discharge the electro-motive force gradually falls, until the last portions of current are leaked out of the cell with a miserable remnant of force which accomplishes nothing. It is as if we stored energy in a tall cistern, pumping the water in at the top and drawing it off at the bottom. If the cistern leaks there is an obvious loss of power; but even supposing it perfectly water-tight, so that the discharge quantity is equal to the charge quantity, nevertheless there will be a deplorable difference between the work required to pump it in, all at the top, and the work obtained at the bottom from the gradually failing head of water.

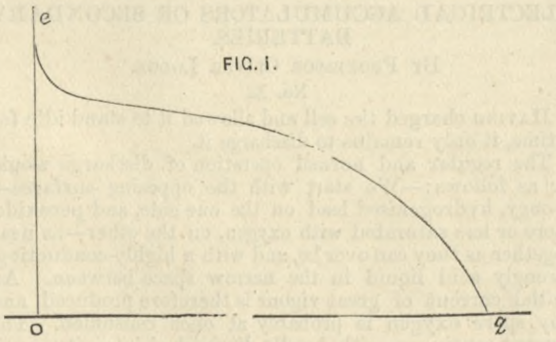
It is fortunately not quite as bad as this with a Faure cell. It is more as if the supply pipe entered the tank somewhere near the middle, while the exit pipe left at the bottom. Thus we should be pumping in the first half of the charge against about half the maximum electro-motive force, and the second half against a gradually increasing force. The discharge electro-motive force would be a continually decreasing one as before. This analogy, however, is rather too favourable; for it makes the initial electro-motive force of the discharge equal to the final electro-motive force of the charge—which is not the case. The closest analogy would be to suppose the supply pipe to be supported on a float at a height above the water equal to one-third the total height of the tank, and to rise with the level of the water, so that it is supplied at a pressure always one-third greater than that at which it is drawn off. To complete the analogy, the cistern must be supposed to leak slowly, so as to empty itself by long standing; and if it had an elastic and porous membrane stretched across it, some analogy to the failure of the cell to give a powerful current for long together, and to its recuperation when let alone, would be observed.

I have supposed the cistern to be of uniform diameter, but it may be hoped that Faure cells are cisterns with enlarged tops, or are conical vessels with the wide end upwards like drinking glasses. The more this can be exaggerated the better; and if the bottom of the cistern could be contracted to a pipe, and the top expanded into a large shallow tray, perfection would have been reached, especially if the height of the float were but small, and if the leaks were mended.

It will be understood that the reason I specify one-third of the cistern as the height at which the supply pipe is to float above the water is because the usual discharge electro-motive force is 1·8 volts, and the usual charge electro-motive force is 2·4 volts. When you begin to charge the cell its electro-motive force is less than this, and when the cells are full it is more; but $2\frac{1}{2}$ volts is a good allowance per cell, the odd ·1 being sufficient to send the charging current through the resistance of the cell and connecting wires, at least when the acid has not been absorbed by long standing. And in discharge it is only at the first instant or two that you get a higher electro-motive force than 1·8 volts.

By observations with an electrometer galvanometer and watch, the shape of the cistern corresponding to any given cell can be constructed; and the shape during charge can also be constructed, and its difference to that of the discharge appreciated without making use of the rough approximation of the float.

The outline of the cistern will be a curve having electro-motive force—or e—as ordinates and $\frac{dq}{de}$ as abscissæ, q being quantity of electricity given out by the cell as recorded by a voltameter, or as observed by means of a galvanometer and a watch. To understand how to draw the curve, first consider observations made with an electrometer and a voltameter, and let their indications be plotted, e for ordinates, q for abscissæ; then draw a curve with the same ordinates having as abscissæ the trig. tangent of the inclination of the tangents of the first curve to the vertical; this will be the outline required.



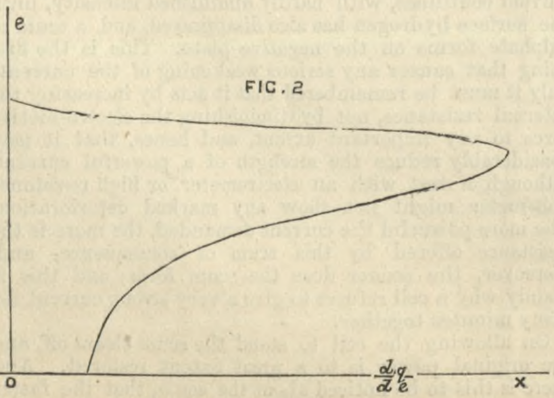
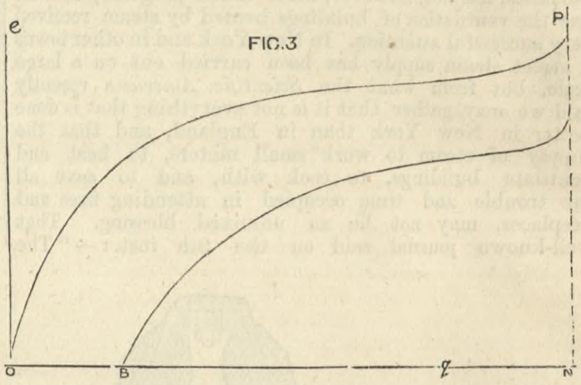


Fig. 1 shows the kind of appearance of the e, q curve; and Fig. 2 shows the curve $e, \frac{dq}{de}$. In the first the total quantity of electricity given out by the cell is represented by the length of the base line Oq, while the area enclosed represents the energy of the discharge. In the second the area enclosed by the curve represents the quantity of electricity, and the work done by the discharge is represented by the moment of this area about O X. We may consider the curve of Fig. 2 as the outline of a cistern, or we may picture it to ourselves as a heavy horizontal plane pivoted on O X as an axis, and consider the rotating moment which it has about O X. But after all Fig. 1 is the simpler curve, and it will show most instructively the relation between the work done in charging and the work obtained in discharging the cell. Fig. 3 shows the charge and discharge curves superposed, the charge and discharge quantities



being naturally drawn in opposite directions. O P is the charge curve, the quantity of electricity put into the cell being O N, and the work of charging being the area O P N; P B is the discharge curve, the quantity given out being B N, and the useful work the area B P N. The area O P B of course represents the loss of energy; the efficiency of the cell is the ratio $\frac{BPN}{OPN}$.

These curves for secondary batteries are as instructive as indicator diagrams for steam engines. They are, in fact, precisely analogous to them, and it would be not difficult to construct a machine for drawing them automatically, but it would necessarily be a long operation. The beauty of the steam engine indicator is that the charge and discharge of the cylinder take place too rapidly for the operation of taking a diagram to be by any means a tedious one. The electrical indicator, however, need not in any way interfere with the practical work of the cell any more than the steam engine indicator does, and it would be most instructive to have them fitted up to cells made in various ways, so as to really learn all about their behaviour, and especially about the influence on efficiency of a lapse of time between charge and discharge.

When cells are being charged and discharged for experimental purposes only, care may be taken to keep the resistance of the circuit constant, for then the number of Ampère hours *squared* does give a simple measure of the work of the cell.

I have not said much explicitly about one very important application of secondary batteries for which they seem better fitted in their present state than for actual storage by retention, viz., their use as regulators, in a branch circuit between the dynamos and lamps. The charge and discharge will then go on almost simultaneously, and the cells will, therefore, be in a high state of efficiency. The only danger is that the + plate may get peroxidised completely and crumble to pieces, a thing which may happen to any Faure cell if much overcharged.

For this regulating work a return to some form of the old Planté cell, with its low internal resistance, might be advisable, as great storage capacity would not be an essential, unless, indeed, the cells had to insure one against an accidental breakdown of the engine or dynamo.

Again, some applications, such as locomotion, require light cells, and also sometimes a powerful current for a comparatively short time, such as a tramcar run. For such cases also something more like the old Planté might be useful; and in general, cells for different purposes will have to be made on different plans, and an electro-store for a town will be a different thing from an electro-tank for a house, and this again from a little electro-box for a tricycle.

A question which naturally occurs to one on reading what I have said about the acid being sometimes the first substance to fail in the cell is why it is not the practice to supply the cells with more acid and more space for it. The answer I think is that the quantity of sulphate of lead in the coatings, and especially in the — coating, would be thereby increased, and that this sulphate of lead is very objectionable, because it is so difficult to reduce. For although Messrs. Gladstone and Tribe have shown that I was wrong in saying that sulphate of lead by itself, and as a paste, was quite incapable of reduction, yet the strength of current used by them, the time allowed, and the consequent waste of power in simply generating hydrogen gas, renders it quite out of the question in practice to attempt to charge a cell whose negative plate is coated with nearly all sulphate of lead; and if an unlimited supply of fresh acid were accessible, this is what the — coating would be likely sooner or later to become.

Another thing I want to say is that in Article No. 3, when speaking of the gas evolved from the cells while charging, I laid more stress on the hydrogen than on the oxygen. This was wrong. The gas evolved from charging cells is little else than oxygen and ozone; and if any hydrogen more than an occasional bubble or two is given off, it means either that the charging current is unnecessarily strong, or else that the cells are nearly full.

I have now concluded the present series of articles, and if it is noticed that I make no mention of the modification of Faure cells in which the coatings are supported in the interstices of cast lead gratings instead of being spread over the outer surface of plates, it is because I am dealing more with the scientific aspect of the subject, than with the microscopic modifications which appear to constitute patentable improvements. What I have said about the active layer of operation during the formation of the cell remains, however, fairly true for these cast gratings, if for "back" we read portions next the lead, and for "front" portions near the centre of each hole; but that the layer of operations recedes in quite the same way during discharge I do not think likely, and it is not quite easy to see how the portion in the very middle of the holes gets acted upon during discharge. But if it does not it matters very little, as it would only remain inert ready for the next charging.

The doing away with the cloth material between the plates would seem to be an improvement, but I cannot think it safe. The risk of short circuiting, whether by dropping of substance out of the holes or by warping of the plates, is so great, and the damage done to a cell by short circuiting is so final, that some continuous insulation between the plates appears necessary, however troublesome and otherwise objectionable it may be.

Although the practical importance of secondary batteries is felt and recognised in a remarkable way at the present time—mainly, no doubt, by reason of the immense weight and enthusiasm of Sir William Thomson's opinion—and though a great deal of experience bearing on the subject from the practical point of view has now accordingly been attained, yet anyone reading the "Recherches sur l'Electricité" of M. Gaston Planté, must be struck with the small advance we have made on his work, considered from the purely scientific aspect.

I had been unable to obtain a copy of this book till quite recently, and am struck on finding the whole details of the action of secondary cells worked out with such completeness and precision. He knows that the loss of power of a cell is caused by a scum on the — plate, a fact which I thought I had observed; he speaks about local action on the + plate as clearly as Messrs. Gladstone and Tribe; and he suggests that the scum on the — plate may in some cases be an extremely thin coat of peroxide—a fact which the researches of these chemists seems now to have established. Whatever future may lie before lead secondary batteries as stores of power on the large scale, the name most imperishably associated with their early development will be that of Gaston Planté.

Liverpool. O. J. L.

OSCILLATION *v.* ROTATION.

By Professor Osborne Reynolds, F.R.S.

No. I.

(1) The two principal motions which are given to the parts of machines are uniform rotation and oscillation. These motions are both possible, and are both capable of performing mechanical operations; and the question as to why one or other should be used gives rise to some interesting points. In some cases, as in that of the lathe, the general purpose of the machine renders one or other of these kinds of motion essential; but this is not so often the case as at first sight appears, for, if we consider, there are few operations performed by machines which cannot be performed in some way or another by animals, and continuous rotation is unknown in the animal mechanics. Nature has worked entirely by oscillation, so that the use of continuous rotation in machinery must be because, for some reason, it is preferred to oscillation. As to the reason for this preference, animal mechanics does not help us, for the constitutions of animals require a certain amount of continuity in the material throughout the entire animal, and this is inconsistent with continuous rotation. In machinery, however, this reason for the choice of reciprocation is altogether absent, and it has to compete with revolution on its merits in other respects.

(2) The respects in which the motions of reciprocation and rotation may be compared are numerous, and sometimes complex; amongst the principal are adaptability to the operation, simplicity of construction, and friction.

(3) The first two of these respects are those in which the relative merits of the two classes of motion are most obvious, and accordingly we may expect to find that the choice of one or other class of motion generally turns on their relative adaptability to a particular operation, and the simplicity of construction of the mechanism involved. It may happen that in both these respects the same motion is to be preferred; but in many very important cases it seems that as regards choice of motion, adaptability to the operation is at variance with simplicity of construction; then the choice is not easy, and there is rivalry between the two classes of motion.

Thus we find that, although one or other class of motion has firmly established itself for certain purposes, there are a vast number of cases in which there has been and still is a contest more or less close. Illustrations are not far to seek. We find reciprocating and rotary pumps and blowing machines, reciprocating pressure engines and revolving wheels or turbines for obtaining power from water, reciprocating and rotary saws. We might say oscillating and rotary propellers, but the rotary motion seems to have established itself for steamboats, although the oscillating oar holds the advantage for manual labour. Numerous other instances might be given, but it will be sufficient to give two, and to these attention will be chiefly directed. The first is the steam engine, and the second the dynamo-electric machine and electric motor.

In the steam engine, although reciprocation has the best of it, the battle has never been given up. This is a case in which simplicity of construction is apparently, at all events, at variance with adaptability to its operation. In some cases, as in pumping engines, the operation involves or admits of reciprocation, and, as is well known, it was to such operations only that the steam engine was confined for about a hundred years after its invention. For these purposes it would naturally seem that the reciprocating motion was most applicable. But so little applicable to move revolving machinery did it appear, that when, after a lapse of a century, Watt improved the engine and saw the importance of applying it to revolving machinery, he kept his improvements waiting for something like ten years while he was attempting to find a revolving substitute for the reciprocating piston. At last he gave up the quest, and found in the crank, or his bastard form of it, a means of applying the reciprocating engine to purposes requiring revolution. But although abandoned by Watt, the quest has been and is still being followed by others. The apparently obvious advantage of a revolving engine, and the apparent simplicity of the problem, offer so tempting a field for invention, that probably nine out of ten of those who commence practical mechanics engage in it until they find how thoroughly others have been over the ground before them. So the reciprocating engine holds its own in the long practical test. This may be said to be on account of its simplicity of construction and the adaptability of the reciprocating piston to the operation of taking the work out of the steam; still nothing approaching to a satisfactory theoretical or scientific explanation of its advantage has been given. Thus the advantage of the reciprocating over the rotary steam engine stands almost entirely as an empirical fact, without explanation, and somewhat in opposition to what has been thought probable from scientific consideration.

On the other hand, if we turn to the dynamo-electric machine, we see that the case is reversed. If there is an operation for which reciprocating motion appears to be adapted, it is to the conversion of mechanical energy into electric currents, particularly into alternating currents, such as are best adapted for the electric light. In this operation there is something approaching to a necessity for continuity in the material, such as that which determines the motions in animal mechanics to be that of oscillation. Reciprocating motion would allow of continuity of material, whereas, in the case of continuous revolution, continuity in the conductors is only imperfectly secured by causing the stationary portion of the conductor to press against the moving portion. Again, the *modus operandi* is to cause soft iron alternately to approach and recede from magnets, or to cause coils of the conducting wire to move so that the lines of magnetic force alternately pass inside and outside the coil. The telephone acts by a reciprocating dynamo and motor, and its efficiency is such as to show how perfectly the motion of reciprocation is adapted for these purposes. Experience in the construction of the dynamo may as yet be called small; but while the records of the "Patent Journal" show that some of the most successful electricians have started with a belief in the adaptability of vibration, all the numerous successful machines have been rotary. It is probable that some reason for this has occurred to those most deeply engaged in the subject, but I am not aware that any has been publicly expressed; so that we may say that the advantage of rotary motion in the dynamo is an empirical fact, and is somewhat opposite to what might be expected. It would seem, however, that this paradox is not so obscure as that of the advantages of the reciprocating engine; and it is not improbable that the explanation of the less difficult paradox may throw some light on that which has so long remained unsolved. In the case of the dynamo the considerations are much narrowed down, and hence the ground for advantage must be more distinct.

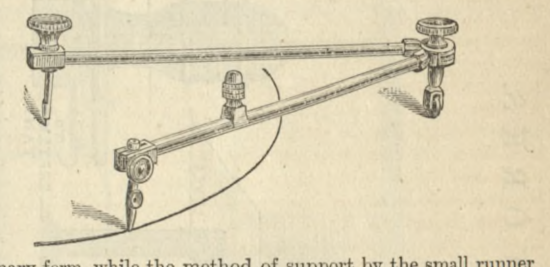
(4) A careful study of the kinetics of the problem shows that there is one important respect not specifically dealt with in the treatise on the theory of machines, in which, as it would occur in the dynamo, reciprocation must be at a great disadvantage as compared with rotation. This respect is the third mentioned in (2). Careful consideration shows that in the dynamo reciprocation must be at a great disadvantage as regards friction. This may not appear to be unnatural. Although the data and methods for investigating the friction of reciprocation, as compared with rotation, have not been formulated, there is a general impression that the balance would be against oscillation. Indeed, it is probable that this impression is one of the reasons which has led to the persistent attempts to produce a rotary steam engine. But such an indefinite impression entirely fails to explain why rotary motion should have an advantage under the circumstances of the dynamo which it has not under those of the steam engine, or why reciprocation should be at a disadvantage in the dynamo electric machine when it is not in the dynamo of the telephone. Under these circumstances it appeared desirable to attempt a more definite study of the friction of reciprocation as applied to circumstances such as exist in the dynamo. This brings out facts which must be of great importance in the theory of machines, and which are altogether in the direction of explaining the foregoing riddles.

It appears that the amount of friction which has to be overcome in maintaining the motion of reciprocation of a particular piece of a machine controlled as by a crank, is not, as in the case of rotation, a quantity depending merely on the weight, manner of support, and motion of the reciprocating piece, but depends essentially on the forces which the reciprocating part is transmitting during its motion; and in general diminishes as these forces increase up to a certain point, when it vanishes. To take an illustration—in an ordinary steam engine doing full work it can be shown that the friction resulting purely from the motion being reciprocating is zero; but if the load be taken off the engine and the governors act so as to control the speed, the friction due to reciprocation will rise, and will reach a maximum when the engine is doing no work except driving itself. The same would be to a certain extent the case in a crank-driven reciprocating dynamo. When moving unexcited, *i.e.*, with the circuit open or doing no work, the resistance from the friction entailed by the reciprocating motion would be a maximum. When, by closing the circuit, resistance was thrown on to the machine, the work spent in friction from reciprocation would diminish, but it could not altogether vanish. In order that it might vanish altogether, the resistances encountered towards the end of the stroke must bear a certain relation to the weight and velocity, or more correctly, to the energy of motion, of the reciprocating part, and this relation cannot be reached under the circumstances of the practical dynamo, in which the energy of motion of the reciprocating piece bears a much greater proportion to the work done than in the steam engine, and in which the resistances fall off at the end of the stroke. Thus, while in the steam engine the lightness of the piston compared to the pressure which the steam exerts upon it at the commencement of the stroke, allows of its being driven at convenient speeds without entailing—when doing work—any extra friction from the reciprocation; in the dynamo, owing to the smallness of the resistance at the ends of the stroke compared with the weight of the reciprocating piece and the high speed required to develope the power, the friction entailed by reciprocation would be large.

In this comparison both machines are supposed to be controlled by the crank. The friction under such circumstances is not at all the same as when the reciprocating piece is controlled in other ways, as by a spring. In the telephone the motion is controlled by a spring, so that the same argument does not apply here. There are, however, certain limits to such a method of control, which it is not unimportant to consider. In order to render intelligible the reasoning relating to these points, it will be necessary to enter somewhat upon the kinetics of reciprocation, and this will form the subject of my next article.

BROOKES' HORIZONTAL COMPASS.

By the accompanying engraving we illustrate a very useful modification of the trammel or beam compass, made by Mr. W. Harling, mathematical instrument maker, 40, Hatton-garden, W.C. It will be seen to possess several advantages, either as a beam compass or as an ordinary large compass. As a beam compass it is so much more rapidly adjusted to any span than the



ordinary form, while the method of support by the small runner wheel takes the weight off the points, so that the pressure on the centre point be only what is found really necessary to keep it in position. The methods of holding the pencil, pen, or pin point, the latter being Mr. Harling's patent point, are simple and most efficient. To take the place of large compasses the new one is most useful, as it avoids all that digging of a large centre which is avoidable when an outstretched compass is used for a number of concentric circles of large size. There are other advantages which are too obvious to need description.

THE BASIC SLAGS OF CREUSOT AS A SOURCE OF VANADIUM.

In recent times vanadic acid, and several salts of this metal have come to be so largely used in the arts that any plentiful source of them is a thing which is on many grounds much desired. Vanadium occurs in many argillaceous iron ores. By reason of its great resemblance to phosphorus it follows it through all the phases of the manufacture of iron, both are found in a concentrated form in different slags, and especially in the basic slags of the Thomas-Gilchrist process. Among the steel factories of France which employ the new process, the works at Creusot furnish slags which are exceeedingly rich in vanadium. The analyses of the slags found there gives the following numbers :—

Silicic acid	16·50		
Alumina (and little chromium oxide)	3·80		
Lime	46·30		
Magnesia	4·00		
Iron protoxide	7·07	Iron	5·50
Manganese protoxide	5·30	Manganese	4·10
Sulphuric acid	0·63	Sulphur ..	0·25
Phosphoric acid	13·74	Phosphorus	6·00
Vanadic acid	1·92	Vanadium ..	1·08
	99·26		

From this it is computed, by G. Witz and F. Osmond, that the annual yield of the slags of the Bessemer works of Creusot alone is 60,000 kilogs. of vanadium. To prepare it in the form of an ammonium vanadate, or as another new compound of vanadium, they propose the following process :—

1. *Solution of the crude slag.*—It is broken up into coarse fragments and treated with hydric chloride at ordinary temperature until the acid is pretty nearly saturated, and has a density of 36 deg. to 37 deg. Beaumé. The liquid is decanted, diluted with water at 15 deg., and the silicic acid is allowed to settle. The liquid, which now contains the vanadium in the form of hypovanadic acid, can at once, without regard to the other salts present in it, be used without any further refining for aniline-black printing.

2. *Preparation of hypovanadic phosphate.*—The acid solution of the crude slag is neutralised and treated with an alkaline acetate, which throws down a large bluish-green precipitate; this contains the greater part of the vanadium in the form of hypovanadic phosphate, together with other little soluble phosphates. On repeating this treatment a fresh precipitate is obtained, which may contain as much as 20 per cent. of metallic vanadium, while the slag only contained 1·5 per cent. Ordinary slags, in which there is less vanadium, are usually at the outset treated in the following very simple way :—To the acid solution, formed by treating them with acid, an excess of powdered slag is added, whereby the free acid is withdrawn and the metals, the phosphates of which are least soluble, especially that of vanadium, are thrown down. This light granular bluish-grey precipitate is then dissolved in hydric chloride and digested as above with the acetate.

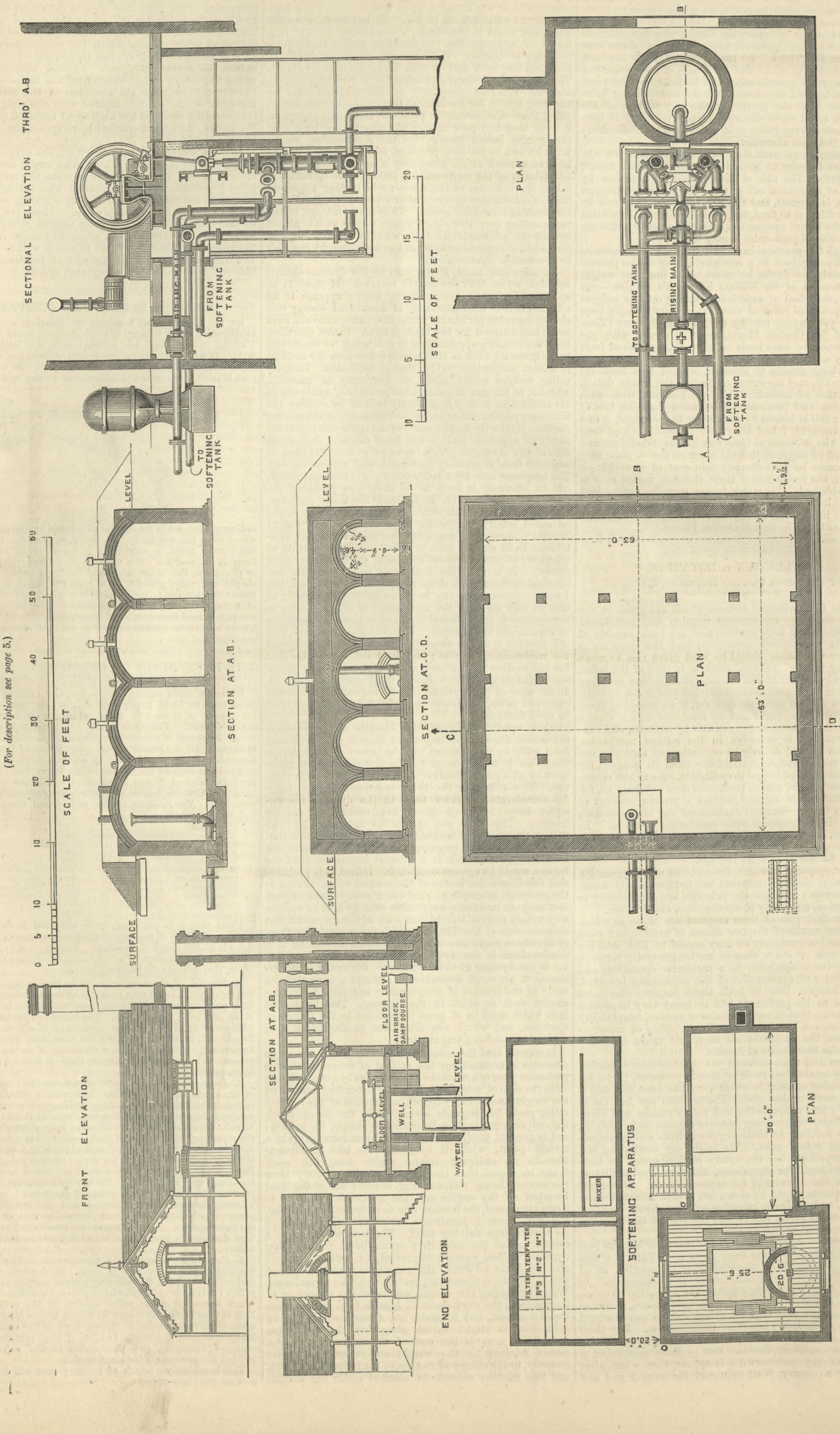
3. *Preparation of ammonium metavanadate.*—The precipitate containing phosphoric acid is dried and roasted, whereby it undergoes oxidation, the pale grey powder turning to an ochrey-yellow; this is then digested with an aqueous solution of ammonia, which forms an orange yellow solution of the orthovanadate. This is then heated till it loses its colour, is now filtered, and the ammonium metavanadate is thrown down in the usual way. A first experiment of treating 14 kilog. of slag, containing 1·5 per cent. of vanadium, and precipitated in the way described, yielded 250 grammes of the metavanadate.

This is evidently a branch of industry that will develope and assume great importance.

HENLEY-ON-THAMES WATERWORKS.

MR. JABEZ CHURCH, M.I.C.E., WESTMINSTER, ENGINEER.

(For description see page 5.)



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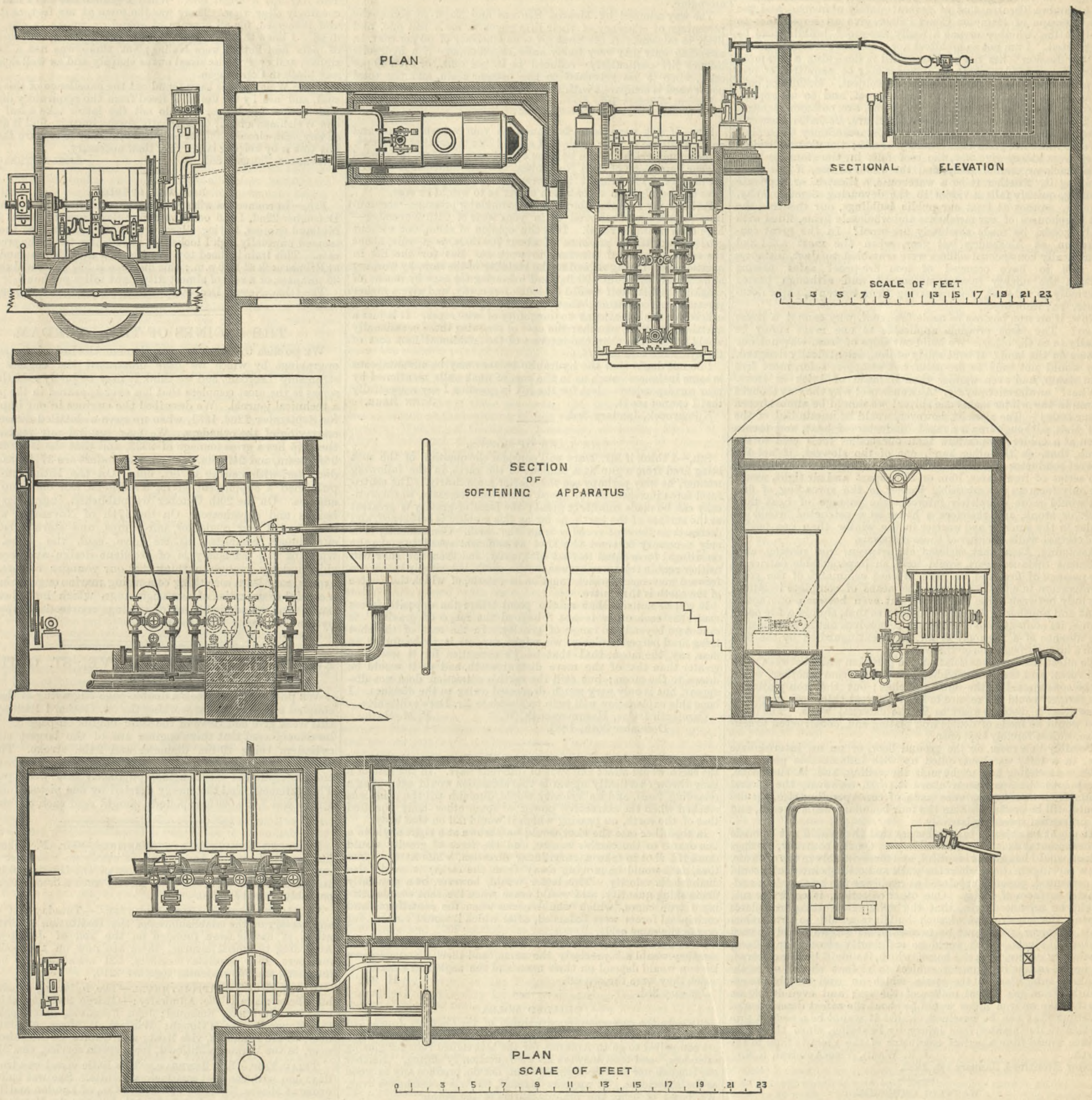


THE WATER SUPPLY OF SMALL TOWNS.

No. V.

THE prettily situated town of Henley-on-Thames, although built upon the river banks, was until recently very badly off for good water, owing to the general practice of going to wells for the water from a porous soil, and to the fact that wells and cesspools were, as is the case now in many towns, so indiscriminately mixed up together that a large quantity of the water used by the inhabitants was of a very impure quality. The local authority having refused to take up the question of a pure water supply, a company was formed in 1880 by a few influential residents, and Mr. Archibald Brakespeare, who was foremost in the project, was elected chairman, and Mr. Jabez Church, M.I.C.E., of Westminster, was called in to advise the board as to the best means to obtain the water supply and carry out the works.

A site of about three-quarters of an acre was chosen, and is situated on the south-west side of the town at a low level, and the reservoir is constructed on the top of Gravel-hill, 170ft. above the pumping station. The shaft of the well is 35ft. deep, formed of cast iron cylinders, 6ft. internal diameter, to shut out the surface water, with brickwork in cement above the surface water line to the engine floor as shown. There is an 8in. boring tube sunk through the bottom of the well into the chalk to a further depth of 210ft., and which is lined with cast iron bore pipes, making a total depth of 250ft. The spring from which the water is taken was struck at a depth of 237ft., when the water rose to within 5ft. of the surface.

After trial pumping the supply was found to be practically unlimited, and upon analysis proved to be of first-rate quality, although extremely hard. Upon the advice of the engineer the board determined to adopt a system of softening which is hereafter described. The engine and boiler houses, with chimney shaft, are, as may be seen, well designed structures, and are built in stock bricks with red string courses, and with the softening, filtering house, and the manager's residence, in which is contained the board-room and office, form a compact and very conveniently arranged premises. The engine-room, with engine machinery, which has a most substantial and business-like appearance, is tastefully decorated. The whole of the machinery, with the engine and boiler houses, are designed so as to be easily duplicated when thought desirable. The boiler is a 14-horse power Cornish boiler, with two safety valves. The engine is of the horizontal type, and jacketted with cylinder, 10in. diameter by 20in. stroke, indicating 26-horse power, with 60 lb. boiler pressure. It is fitted with automatic expansion cut-off valve, working on the back of the main slide, which thoroughly controls the consumption of steam as required for the working load, thereby realising economy in fuel and regularity of rotation. The pumps are two in number, of the lift and plunger type. The diameter of the plunger is 7in., the stroke 21in. These pumps are placed beside the well in a pump chamber, and the connections are so arranged therein that one pump can pump water from the well into the softening house while the other draws softened water through the filters, and *vice versâ*, or both pumps can pump direct from the well into the reservoir, which will be useful in the event of a sudden demand for water, as in the case of fire.

The softening house comprises two portions, one being the softening cistern, over which is placed the automatic mixer, and the other portion is the filter room, also containing the lime cylinder. The hard water from the well is delivered from one pump direct into the "mixer," see plan, a small quantity being intercepted and conducted to the lime cylinder, from which it overflows as a saturated solution of lime water, and joins the main supply of hard water in the "mixer." The exact quantity of lime water allowed to pass to the "mixer" is determined by a regulating valve. The lime water and the hard water become thoroughly blended in passing through the "mixer," and fall into the softening cistern. By this time the water is thoroughly softened, but contains a large quantity of carbonate of lime in suspension. It is then conducted to a series of filters which form the important feature of the process. Each filter consists of a series of hollow discs covered with cotton filter cloth, the discs being mounted on a centre tube. Along the surface of these discs brushes are arranged, the whole being fitted in a cast iron cistern and connected to a pulley outside the cistern, as shown above. The softened water is admitted to either cistern, and can only escape by filtration at either one of the discs, leaving the carbonate of lime on the outside of the filter cloth, the water passing through the hollow disc to the centre tube, where it is carried outside the filter into a pipe, forming the suction of the second pump in the engine-room, whence it is forced up to the reservoir in a softened and brilliantly clear and pure state. At the completion of the day's work the pulley on the filter cistern is thrown into gear, which causes the brushes to revolve in one direction against the surface of the discs revolving in the opposite one, and thus in four or five minutes all the carbonate of lime and impurities accumulated during the day are swept off the surfaces of the discs, allowed to flow down the waste pipe, and the filter is again ready for work. This is a patent apparatus of the Atkins Water Softening and Purifying Company, and was adopted by the engineer as the simplest, most effectual, and economical method of applying Clarke's process to the softening of chalk water. The reservoir to hold three days' supply for the whole of the population is covered in, as shown, and is constructed with stock bricks in cement, with an internal rendering of ½in. of neat cement throughout, and forms a thoroughly sound and water-tight work. As this reservoir is some 200ft. above the principal parts of the town, and the service is constant, there is always a high pressure in the mains day and night, which is most invaluable, not only to water consumers, but in case of fire. There are from five to six miles of main of various sizes, from 8in. diameter, which are laid all over the town. The works were ceremonially opened on the 17th of June last, as described in our impression of the 23rd of that month. The cost of the works, including land, will be under £12,000. The works are most successful, and are much appreciated by the inhabitants of the district.

STRENGTH OF MATERIALS.—On the 9th inst. Professor B. W. Kennedy, M.I.C.E., will commence a course of ten Tuesday evening lectures at the London University College, on the strength of materials. A novel feature in this course will be the demonstration of points dealt with in the lecture by means of the testing machine in the large engineering laboratory of the University College. The lectures commence at six o'clock, and the first is open to the public.

LETTERS TO THE EDITOR.

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

FIRE-PROOF HOUSES.

SIR,—The recent great fire in Wood-street, the destruction of the Alhambra Theatre, that of several stately mansions, and the narrow escape of Hampton Court Palace, give an importance to the question whether or not a really fire-proof building can be constructed. I am not an architect nor a builder; but seeing that the "profession" has not yet succeeded in designing a fire-proof edifice of any kind, perhaps an outsider may be acquitted of presumption in offering a suggestion on the subject. Buildings, both public and private, professing to be fire-proof, and to all appearance constructed chiefly of iron and stone, are common enough, yet, if stored with combustible goods, furniture, &c., a fire occurring in any of them has only to attain a certain ascendency when they prove no more fire-proof than ordinary houses; the floors dividing storey from storey give way, the roof falls in, the stone or brick walls crack or crumble away, and the whole edifice, if not those adjoining it, whether it be a warehouse, a theatre, or a private dwelling, quickly falls a victim to the devouring flames. Why, however, cannot at least our public buildings, our theatres, the vast warehouses of our merchants and wholesale firms, filled with costly goods, be made absolutely fire-proof? In the great conflagration at Alexandria last year, when the most solid and scientifically constructed edifices were crumbled to dust, instances are said to have occurred of iron fire-proof safes passing through the mighty furnace unscathed, and although heated externally to red-heat, yet preserving their contents, paper documents, &c., uninjured.

Now, if an iron box can be made fire-proof, why cannot a house be so? The same principle applicable to one must surely be equally so to the other. We build our ships of iron, why not our edifices on the land? If built solely of iron, scientifically designed, they would not only be fire-proof, but stronger, safer, more free from damp, and even warmer than if made of brick or stone. "What?" an alarmist may cry, "An iron house! why the very thought of iron in the winter makes one shiver! we should be almost frozen in our beds!" The alarmist, however, would be unmindful of the fact that, although iron is a rapid conductor of heat, and thence when at a colder temperature than our bodies feels cold to the touch, that, on the other hand, one of the slowest, if not the slowest conductor of heat, is enclosed air. Hence a wall formed of two series of iron plates, 10in. or 12in. apart and air tight, would not only form an incombustible barrier to the spreading of fire, but would more completely intercept the passage of heat than brick or stone, and therefore a house so constructed would be cooler in the summer and warmer in the winter than one having its external walls of either of those materials.

Assuming, then, that enclosed air between iron plating, at a sufficient distance apart, would form an impenetrable barrier to the passage of fire, and we have at once command of the great desideratum in cities and towns—the means of complete isolation, not only between house and house, but even between one apartment and another in the same building; so that, should a fire occur in one, its contents would only burn themselves out or smoulder in the absence of a re-supply of air, until extinguished by the fireman's hose through one of the windows.

To effect this complete isolation, the partition walls between room and room, and the floors dividing one storey from another, would all be constructed on the same principle; but the iron plating of the former would not require to be of as great thickness or placed at so great a distance apart as in the external walls. The doors also would be made of double iron plating and constructed to self-close, unless forcibly kept open.

Possibly in a room on the ground floor, or on an intermediate one, in a lofty warehouse piled up with inflammable goods, the intense ascending heat might melt the ceiling, and, in succession, burst into the apartments above it. If, however, the several rooms from floor to floor were made of corresponding size, the fire would still be confined within the four boundary walls of each, and be prevented spreading laterally.

It might be objected to such houses that they could not be made as ornamental as our present buildings. On the contrary, castings in iron would be quite as beautiful, and more durable in the open air, than carvings in stone, whilst the walls and ceilings internally could be cemented, papered, or painted as readily as the brick or lath-and-plaster surfaces of to-day. One other objection, it occurs to me, might be advanced, viz., that the noise of rivetting iron plates during the construction of such buildings would be intolerable. This, however, would not be necessary, as screws could be used instead of rivets, which would be sufficiently strong for a fixed, stationary edifice, such as a house, which, it should be remembered, is never, unless in countries subject to violent shocks of earthquakes, submitted to the strain which an iron ship has to encounter from the violent motion of the sea; and even during an earthquake an iron house would be about the safest description of dwelling that can be imagined, whilst it would be a perfect protection to its inmates from injury by lightning, since the whole edifice would form a perfect conductor of the electric fluid to the earth.

J. R. WARD, Vice-Admiral, R.N.

New Brentford, January 1st, 1883.

WARMING CHURCHES.

SIR,—"Enquirer" will doubtless have many replies to his question. In the case of this church, at the beginning of winter I put in two of Musgrave's and Co., of Belfast, hot-air warmers in place of a system previously in use. I have found them admirable in every respect. They are placed in the basement, and the air is delivered from two contiguous gratings into the building, which is lofty and also long—I think 130ft. or 140ft. with chancel—and by thermometers it is found that the temperature is equable throughout. For a district where frost is very severe all trouble from frozen pipes is avoided. I have no interest whatsoever in the firm except the interest I take in anyone who carries out work successfully and reasonably.

Any further information is at "Enquirer's" service, and if he is able to call on me I can show him the warmers in operation.

W. T. FARQUHAR, Hon. Sec.

Pitscandly, Forfar, N.B., Jan. 1st.

HYDRAULIC BALANCE LIFTS.

SIR,—My reason for writing you at first on this subject was to contest the claim of the hydraulic balance lift to a monopoly of the title to be the "simplest form of lift." But as other matters have been introduced, I venture to trouble you with one more letter.

I think most of the readers of this correspondence will be somewhat sceptical of the statement that lumps of cast iron in a balance weight, even with a wheel and wire rope thrown in, are likely to be as costly as an equal, or nearly equal, weight of cast iron in the form of cylinders, glands, and turned rams. Special guides for a balance weight are rarely required, as the main guides of a lift can usually be made to serve for the balance weight also. As regards wire ropes and their duration, I for one would not run a ⅝in. steel rope over a 2ft. pulley. If I could not get in a pulley quite 3ft. diameter I would use chain; and in low-pressure lifts with balance weights a chain is necessary to counterbalance the varying pressure on the ram as the lift ascends or descends.

The building mentioned in the letter on this subject in your last week's impression, where the walls were too weak to bear the weight of the overhead wheels carrying balance weights, must be somewhat abnormal, and I should think in consequence scarcely safe to support the guides of the lift, especially if the load were likely to lurch much to the side when the ram was extended; but surely even in this case the weight might have been carried by the guides.

Mr. Ellington seems to me to treat the matter very fairly when he says that certain situations are more suitable for iron balance weights and certain others for hydraulic balance cylinders, and that he finds the latter the more costly of the two. In cases such as platform lifts, where no overhead gear of any sort is admissible, it may sometimes be desirable to economise power by returning by the weight of the parts in their descent some of the water used in ascending.

The way adopted by Messrs. Stevens and Major of giving the percentage of efficiency of their lifts seems to me a bad one, and likely to mislead. A lift that gives an efficiency of 80 per cent. in ascending only may very likely have its efficiency—if a hydraulic balance lift particularly—reduced to 50 per cent., or even 40 per cent., when it has returned to the bottom again, and the total power used is compared with the net work done.

London, January 1st. BARRON TURNER.

SIR,—If not trespassing too much on your valuable space, and on the patience of your readers, I should like to say that if 20 cwt. is the actual weight of the balance cylinders, rams, &c., illustrated in your impression of 24th November, then the dimensions marked are in error. The weight is nearer 27 cwt. than 20 cwt., and I have not indulged in speculation either as to weight or cost.

Perhaps my remarks about the accumulator pressure—accumulator pressure was referred to in your issue of 24th November—have been misunderstood. It is the opinion of some, not without good reason, that a pressure of about 700 lb. is, as a rule, about the most economical pressure to work at. But for the lift in question, and having regard to the stability of the ram, by working at a pressure of about 400 lb., and balancing the cage by means of weights, the lift itself would be much less costly, and give a higher percentage of efficiency, than with the hydraulic balance. I am obliged for the remarks as to durability of wire ropes. It is just a question, however, whether the cost of renewing these occasionally would not be less than the interest of the additional first cost of the hydraulic balance lift.

I do not doubt that the hydraulic balance may be advantageous in some instances—such as in the case of weak walls mentioned by your correspondents—but for the lift in question I say respectfully that I cannot see it. JOHN BARR.

Kilmarnock, January 3rd.

THE LAWS OF MOTION.

SIR,—I think if Mr. Dare will consider the question of the shot being fired from a gun at a tangent to the earth, in the following manner, he may perhaps see the matter more clearly. The centrifugal force increases as the speed of the shot increases, so theoretically can be made infinitely great; the force of gravity is greatest at the surface of the earth, as far as this problem is concerned, and decreases as the shot recedes from the earth. Consequently it is only necessary to send the shot at sufficient speed to make the centrifugal force equal to that of gravity, and then the shot will neither recede from nor approach the earth, but simply retain its forward movement, which must be in a circle, of which the centre of the earth is the centre.

It will be noticed that as the point where the opposite forces neutralise each other is not "beyond the range of gravity," it cannot go beyond the range of gravity. In the case of the shot being fired perpendicularly, we might suppose it to be forced so near, say, the moon, that that body's attraction for it would be greater than that of the more distant earth, and so it would be drawn to the moon; but still the earth's attraction does not disappear, but is only very much decreased owing to the distance. I hope this explanation will help to elucidate Mr. Dare's difficulty.

Carnforth Lodge, Hammersmith, W. F. M. HAIG.

December 30th, 1882.

SIR,—In the two cases suggested by Mr. Dare the attraction of the earth would affect the shot in different ways. In the case of a body thrown vertically upwards this attraction would act but as a retarding force, and its velocity would diminish till the point was reached when the attractive power of some other body equalled that of the earth, on passing which it would fall on that body.

In the other case the shot would be thrown at a right angle to a line drawn to the earth's centre, and the force of gravity would cause the shot to take a curvilinear direction, while at the same time, as it would be moving away from the earth, it would also diminish its velocity. This latter would, however, be a gradually diminishing quantity, and would cease when the shot was describing a true curve, which would occur when the centrifugal and centripetal forces were balanced, after which it would revolve for ever in the same orbit.

If we assume that the planets were originally thrown from the sun they would act precisely the same, and their distances from the sun would depend on their mass and the angle and velocity at which they were thrown off. H. W.

January 3rd.

CHILLED ROLLS.

SIR,—In the correspondence column of the *Contract Journal* of 13th ult., "Paper-maker" inquires "how it is our paper-makers are compelled to go to America for the best chilled rolls for glazing calenders," and then answers his own question by adding, "Neither our English nor Scotch engineers can, nor do, produce any as good as the Americans. It appears strange, but it is nevertheless true. We boast of being the manufacturers of the world."

And in your last issue of 29th ult. "Paper-maker" replies further to "Paper-maker": "It is quite true that English paper-makers are compelled to go to America for the best chilled rolls. I believe that some Scotch and Lancashire firms profess to supply first-class chilled rolls, but experience has not yet gained them sufficient confidence to supersede those from the United States, when and where the greatest economy is required. 'Cheap and nasty' spells ruination in the paper trade."

Now, Sir, being the only makers of chilled rolls in Scotland, we hope you will, in fairness, permit us a word on this subject. Premising that we have supplied only the engineering trade—none of our rolls passing directly into the mills—we have had to make some inquiry as to the extent of this alleged enormous import calender roll trade; and the result is that during the past two years—1881-2—we have actually turned out of our own foundry here alone about ten rolls for every one that has come from the United States. So much for the results of paper-makers having been "compelled" to go to America in the immediate past. As to the future, all we can say is that we have at this moment orders for considerably more calender rolls than all the American makers combined sent into this country during that period.

Permit us only further to add that we have never, since we commenced the manufacture of chilled calender rolls, had a single one returned to us; but if "Paper-maker" is a paper-maker, and will furnish us with his real name and address, we undertake to direct him to where several calenders of American chilled rolls have been rejected, and where our make of these rolls are giving entire satisfaction. If "cheap and nasty" spells ruination, what would "Paper-maker" spell "dear and nasty?" MILLER AND CO.

London-road Foundry, Edinburgh, January 3rd.

LONDON AND ITS FOGS.

SIR,—I am amused at the correspondence in the *Times* concerning the London fogs and fires of bituminous and anthracite coal. Some of the correspondents seem to think that Welsh steam coal is, first of all, difficult to light, and secondly can only be burnt in stoves. The coal of the 4ft., 6ft., and 9ft. seams can be used in open grates with the same care as bituminous coal, and can be put into London at a profit for £1 per ton. The 4ft., a coal of exceptional value, opens out cauliflower-like in burning, gives a great heat, and, used with a small quantity of bituminous small, will be found an economical coal. The 6ft. and 9ft. are similar coals, but are somewhat objectionable from their white ash.

Permit me to give my experience as regards the smoke of these coals.

Merthyr Tydfil, which with its suburbs has a population of 60,000 people, lies in a valley. Knowing that the coal used by the inhabitants for domestic purposes is steam coal, I went one day lately to that town, and ascended to the top of a mountain several miles distant, from whence I could survey the whole of the district. The day was a bright one. When I gained the top I had an exceedingly clear view. There was the town at my feet, as it were; and it seemed, for all absence of sound or smoke, a city of the dead. I knew that thousands of fires were burning, that thousands of pots and kettles were boiling; but there was not a trace of smoke, and every house stood out as sharply and as well defined as any block in Copenhagen.

If the Welsh people have found out the excellence of this special coal, and are by the use of it freed from the respiratory disorders which affect Londoners, why do not the latter take a leaf out of the Welshman's book? I personally always burn it, find it as cheap as any coal, cleaner, and its only bad tendency is to burn the bars; but this is by keeping larger fires than necessary.

Swansea, January 3rd. SEMI-ANTHRACITE.

RAILWAY SPEEDS.

SIR,—In connection with your leader on "Railway Speeds" on December 22nd, I had occasion a few days ago to travel by the Midland express, leaving Glasgow at 9.15 p.m., and as the speed seemed unusually high I looked into Bradshaw to see the prescribed rate. This train is timed to leave Glasgow at 9.15 p.m., and is due at Kilmarnock at 9.50 p.m.; this distance is 33¾ miles and the time 35 minutes, or a rate of almost fifty-eight miles per hour.

The Glen, Newry, Dec. 30th. HENRY BARCROFT.

THE ENGINES OF THE LEERDAM.

WE publish this week as a supplement the last of the series of engravings by which we have illustrated the engines of the steamship Leerdam, and we think it may be justly said that the series is the most complete that has ever appeared in the pages of a technical journal. We described the engines in our impression for September 22nd, 1881, when we gave a detailed dimensioned engraving of the cylinders. We may remind our readers that the ship has a gross tonnage of 2333, and that she is 320ft. long, 38ft. beam, and 24ft. 8in. deep; her cylinders are 37½in. and 69in diameter, with a stroke of 3ft. 6in. On the 13th October we published a supplement giving a sectional side elevation of the engines. On the 20th October we published engravings of her boilers and superheater. On the 17th of November we gave drawings of her condenser, air-pumps, and stern tube. Our supplement completes, as we have said, the series. The whole of this machinery is of excellent design and workmanship, and we venture to think that our younger readers, at all events, may learn something concerning marine engineering from a careful examination of our engravings, which have been prepared from an admirable set of tracings courteously supplied us by the builders of the machinery.

EIGHT-COUPLED LOCOMOTIVE, ST. GOTHARD RAILWAY.

WE published last week a double-page engraving of the eight-coupled engines used for working the St. Gothard Railway. We this week give end views of the same engine on page 8. It will be remembered that these engines are of the largest class, the cylinders being 20·4in. diameter and 24in. stroke. The total weight of the engine full is 51 tons. A slight error occurred in the description of these engines published last week, page 481. The statement that the energy exerted by one piston during one stroke was 1,000,000 foot-pounds, should read each ten strokes.

PROPOSED BREAKWATER AT HASTINGS.—Mr. F. Johnson, of St. Leonards-on-Sea, has offered privately to construct a large concrete breakwater for the protection of the Hastings fishermen, and present it to the town. The cost of such a breakwater would probably exceed £20,000.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday last was the anniversary of the establishment of the Institution of Civil Engineers, it having been founded on the 2nd of January, 1818. According to official returns, there are now on the books 1321 members, 1585 associate members, 521 associates, 20 honorary members, and 759 students; together 4210.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—George Swinney, chief engineer, to the Victor Emanuel; John Ferguson, chief engineer, to the Monarch, vice M'Gough; William J. Mogg, assistant engineer, to the Himalaya, vice Keat; and James D. Nicholson, engineer, to the Vernon, additional, for torpedo service, vice Mayston.

TRIAL TRIP.—S.S. SUNBEAM.—This little vessel was tried a few days ago with the most satisfactory results. She was built to the order of Messrs. Richards, Power, and Co., of London and Swansea, for service on the West Coast of South America, by Messrs. Cochran and Co., Birkenhead, and is fitted with a pair of inverted direct-acting high-pressure engines, and one of their patent multitubular boilers.

TRIAL TRIP.—The paddle steamer Mawuna, which has been built by Messrs. W. Dickinson, of Birkenhead, was taken on her trial a few days ago, and fully equalled all expectations for both speed and carrying power. This vessel is intended for service on the African rivers, and whilst being built more especially for towing purposes, is arranged to carry a maximum amount of cargo on her draft of 3¼ft. She has been specially designed by Messrs. Ashlin and Asbridge, for Messrs. M. Herschell and Co., of Liverpool, and is arranged so that she can be shipped on the deck of the mail steamers from that port. The machinery has been constructed by Messrs. Cochran and Co., of Birkenhead, and consists of a pair of high-pressure steeple engines, supplied with steam by one of that firm's well-known vertical boilers made of Siemens-Marten steel.

TESTS FOR LUBRICATING OILS.—It is stated that a good test for lubricating oils is to place single drops of the different kinds to be compared in line across the end of a piece of plate-glass about 24in. long, one end being 6in. or 8in. higher than the other, to form an inclined plane. The drops of oil run down this smooth plane in a race with each other. The quality of the oils for lubricating purposes is shown by the distances travelled and the trace left by the drops. Thus, on the first day sperm oil will be found in the rear, but it will in time overtake the rest, and retain its power of motion after most other oils have dried up. A light-bodied oil flows quickly, like water, but also dries quickly, whereas what is needed is a good body combined with a limpid flow. Many oils have a good body, but have a tendency to gum, and this will be distinctly shown upon the glass. It is scarcely necessary to remark that the test slip should be covered from dust while the experiment is being made. The above method will show the physical qualities of different descriptions of oil, but if the presence of acid is to be detected, another simple device may be adopted. In a sheet of bright copper a number of shallow pits are made by the blow of a round-faced hammer. Samples of oil left some days in these dishes on a shelf in the engine-room will show, by the formation of verdigris, where acid is present. The existence of a blue tinge of fluorescence in a glass phial of oil is frequently assumed to indicate the presence of mineral oil, but this is an illusory test, since the same effect is frequently observed in the purest and freshest vegetable oils.—*Scientific American.*

RAILWAY MATTERS.

A STRETCH of the Paris and Lyons Railway near the French frontier having been washed away, direct railway communication between this part of Switzerland, France, and Italy, is interrupted. On Wednesday the mails were taken round by St. Julien. The *Times* Geneva correspondent says, intending passengers would do well to take the route by Lausanne.

As a result of the recent agitation at Brighton respecting the accommodation afforded by the London, Brighton, and South Coast Railway Company, eight additional third-class fast trains began running on Monday between the two terminii. Additional facilities are also given to second-class passengers. The service between London and Hastings and Eastbourne is improved, while at Brighton there are some concessions in connection with the purely local traffic.

IN concluding a report on the collision which occurred on the 14th November, between a passenger train and a light engine at the Bishopstoke Station of the London and South-Western Railway, Colonel Yolland says:—"The train, however, was not a properly equipped train. Two hand brakes in a train of thirteen vehicles, independent of the brakes on the engine, is altogether insufficient. If the train had been fitted throughout with continuous brakes, notwithstanding the failure of the steam brake on the engine, the collision would not have occurred."

A TOTAL of about 800 millions—an amount exceeding the whole of the National Debt—is invested in railways in the United Kingdom. Of this sum about 190 millions represents debenture stocks of dividend-paying railways, affording an industrial security as good as National Consols. Nearly 300 millions of the capital consists of Guaranteed and Preference Stocks, and 330 millions—including 40 millions expended upon uncompleted lines, or others which pay no dividend—pays less than 3 per cent. The railways paying no dividend decrease every year, the improvement in the poor lines being much more marked than in those paying good dividends.

IN his report on the collision which occurred on the 18th of November, at Shoreditch Station, on the North London Railway, during a fog, Major Marindin says:—"Like many other accidents of this class, however, it would not have been caused by the mistake of one of the signalmen concerned if the out-of-door signals and the block telegraph instruments had been interlocked, as is now done upon some lines, and it is precisely to such lines as the North London that such a system is best suited. If the fog-signalman's statement as to the position of the detonators is correct, then the driver could have averted the collision if he had had at his command a quickly-acting continuous brake throughout the whole length of the train."

IN his recent inaugural address as president of the Institution of Engineers and Shipbuilders in Scotland, Mr. J. Reid gave some interesting notes on locomotives. The first engines of the old Garnkirk and Glasgow Railway, which was opened about the year 1829, weighed from 8 to 9 tons. They had 11in. cylinders, and wheels of cast iron 4ft. in diameter, with a working pressure in the boiler of 50 lb. per square inch. The Garnkirk engine used to take a train of three carriages, weighing 7 tons gross, at an average speed of sixteen miles per hour, between Glasgow and Gartsherrie. When the old line, eight miles in length, merged in the Caledonian Railway, now comprising a system of about 870 miles, the power of the engines was greatly increased, and at this day there are express passenger engines working over the same ground having 17in. and 18in. cylinders, and wheels of 7ft. and 8ft. in diameter, and weighing, in working order, from 35 to 45 tons. These engines take a gross load of 90 tons at a speed of from forty to fifty miles per hour, burning about 23 lb. of coal per mile run.

THE Turkish railroads have some peculiar freights. The Roumelian line from Constantinople north-westward in its last fiscal year carried 5741 tons of essence of roses, valued at about 320,000 dols. It also carried 1,500,000 melons to Constantinople, but probably, says the *Railroad Gazette*, some of our Southern roads can match that. On the line in Asia Minor leading articles of freight are Angora goat hair and meerschaum. The same journal says:—"The passenger traffic of the Roumelian line illustrates the utter worthlessness of a comparison of the numbers of passengers or tons carried as a measure of traffic. The number of passengers on this road was 971,185, but of these 847,577 passed over only that part of the road—13½ miles—inside of the city line—virtually a street railroad traffic—leaving but one-seventh of that number for the other travel on the 501 miles of railroad. Another instance is that of the Central Pacific, of whose 7,032,366 passengers last year 5,447,050 were ferry passengers, crossing San Francisco Bay and riding less than five miles in the cars to and from their homes in the San Francisco suburbs of Oakland and Alameda, leaving 1,585,316 for the 2050 miles of railroad."

THE *Cologne Gazette* has revived a suggestion which, in one form or another, has been already on several occasions before the travelling public. The taking over by the Imperial Government of various lines of railway has facilitated the introduction of certain reforms, the application of which by private companies would have been attended by some difficulties. It is proposed for railways to issue books of tickets to such persons as travel more or less constantly, and that these tickets should be classified in such a manner as to represent various distances, instead of a journey between two given points. A scale of discounts to be allowed to purchasers at one time of tickets for a certain number of miles is also formulated, ranging from 15 per cent. for 600 miles to 33 per cent. for 6000 miles. The tickets would be for 3, 6, 12, and 60 miles, and would be examined and collected much in the same way as ordinary tickets. The advantages derivable by the railway companies from the application of this scheme are stated to be greater than is generally supposed to be the case. A large sum of money would be received at one time, and from the fact that travellers would in most cases go over more ground than under the present arrangements, it is not expected that any positive diminution of traffic receipts would be caused. There would also be a saving in the booking-office work at terminal stations, and even the sale of these railway coupons would probably be generally provided for without even the necessity of going to a railway station to procure them. A ticket for three miles would be considered as no longer available if a portion of the distance represented were traversed.

THE express passenger engine, having 18in. cylinders and four-coupled 7ft. driving wheels, with four-wheeled bogie in front under the smoke-box, designed by Mr. S. W. Johnson for the traffic of the Midland Railway, is supported on a wheel-base of 21½ft. in length. The engine weighs about 42 tons in working order, and with tender, including coal and water, about 68 tons. The average load taken by engines of this class is fourteen carriages, at the time-bill speed of fifty miles an hour, over gradients of from 1 in 120 to 1 in 130, with a consumption of 28 lb. of Derbyshire coal per mile run. The engine can take, as a maximum load, seventeen carriages between Manchester and Derby, either way, over ruling gradients of 1 in 90 and 1 in 100 for ten miles, at a speed, up the banks, of thirty-five miles per hour; and on a level, or on falling gradients, at fifty miles per hour. The curves on the Manchester line are very frequent, and vary from eleven chains to forty chains of radius. The carriages weigh, with passengers, 11 tons each, making a train of the gross weight of 187 tons. The express passenger engines on the Great Northern Railway, designed by Mr. Patrick Stirling, having 18in. cylinders, and 8ft. single driving wheels, weigh, in working order, about 38 tons, of which about 16 or 17 tons weight is upon the driving wheels. They work the express trains between King's Cross and York. Engines of this class take trains of from sixteen to twenty-two carriages. On one occasion a length of fifteen miles was run in twelve minutes with sixteen carriages of from 10 to 12 tons each. These engines can take a gross load, including the engine and tender, of about 350 tons, on a level, at a speed of forty-five miles per hour, with a steam pressure in the boiler of 140 lb. per square inch.

NOTES AND MEMORANDA.

GERMANY produced in 1881, 2,914,009 tons of pig iron, 560,222 tons of castings, 1,421,792 tons of wrought iron and steel, and 894,425 tons of cast steel.

AMONGST lubricating oils, fine mineral oils stand first on the list of those which adhere well to metal surfaces, but are without perceptible molecular cohesion. Sperm oil stands second; neatsfoot third; and lard oil fourth.

DURING the year just closed there were reported 28 mining explosions, 15 of which were fatal, the number of deaths reaching 241, exactly the average for the past 32 years. Of 32 warnings issued, 19 were justified by subsequent events, 12 were followed within three days by the loss of 139 lives in 15 explosions, and 66 lives were lost on the fifth and sixth days after the issue of warnings. In each case these warnings denoted a continuance of dangerous changes.

THE *American Miller* gives the following composition for tempering cast steel mill bills:—"To three gallons of rain water add three ounces of spirits of nitre, three ounces of hartshorn, three ounces of white vitriol, three ounces of sal ammoniac, three of alum, and six ounces of salt, with two handfuls of the parings of horse's hoof. The steel should be heated a dark cherry red. A large jug of this preparation should be kept corked tight so that it may not evaporate nor lose its strength."

ON the measurement of freeboard the *Nautical Magazine* says:—"It would be the better arrangement to measure freeboard amidships and give a fractional allowance for deck erections, the relation of such an allowance to that for an awning-deck to depend upon the part of the deck covered. This would be obtained irrespective of the sheer of the ship, the latter being an element of the question which should also have its separate and proper effect, irrespective of deck erections. We may add, too, that some such method will best meet the case of deck erections which do not cover the midship point of the ship's length, and which still are of considerable importance and value."

ONE of the highest dignities in the scientific world is that of Associé Etranger, or Foreign Associate, of the Paris Academy of Sciences. The list of those possessing this title is limited to eight names, which at the beginning of last year were those of Owen, of London; Wöhler, of Göttingen, Kummer, of Berlin; Sir G. B. Airy; Tchébichef, of St. Petersburg; De Candolle, of Geneva; the Emperor of Brazil; and Sir W. Thomson. Wölher is now dead, and the Academy has recently fixed on his successor. The names brought forward were those of Bunsen, Van Beneden, Nordenskjöld, Adams, and Hooker. Of forty-three votes given, Bunsen, the well-known physicist and chemist, had thirty, and was accordingly elected.

ALTHOUGH it is optional in England to sell wheat and other grain by measure or by weight, so far back as 1832 an Act was passed by the Isle of Man Legislature making it unlawful to sell coals, potatoes, bread, wheat, barley, oats, peas, beans, rye, flour, or meal by measure or otherwise than by weight. By another Act, passed by the same Legislature in 1880, the weight of a bushel of grain and potatoes was fixed as follows:—Wheat and rye, 64 lb.; barley, 56 lb.; oats, 42 lb.; peas and beans, 60 lb.; and potatoes, 56 lb.; and the weight of a boll as follows:—Wheat and rye, 4 bushels, or 256 lb.; barley, 6 bushels, or 336 lb.; oats, 6 bushels, or 252 lb.; peas and beans, 4 bushels, or 240 lb.; and potatoes, 8 bushels, or 448 lb.

THE Naples correspondent of the *Times* writes that a quadri-valve speculum of great beauty and in a high state of preservation was turned up recently in Pompeii. The mechanism of it is said to be very ingenious. In the National Museum of Naples there are now three Pompeian specula—one a bi-valve, one a tri-valve, and the one just found, a quadri-valve. The last is said to be of such a construction and proportion admitting the expansion of the valves, as to be superior to a modern speculum. It is noted that its various dimensions correspond constantly to a metric scale. It will be found, in fact, on inspecting the National Museum of Naples that many of the instruments ascribed to modern invention are clearly only exhumations of the past.

THE weekly return of births and deaths issued by the Registrar-General shows that the annual rate of mortality for the week ending December 16th, in twenty-eight great towns of England and Wales, averaged 26·9 per 1000 of their aggregate population, which was estimated at 8,469,571 persons in the middle of this year. In the following six towns the rate of mortality was the lowest:—Bristol, 18·9; Birkenhead, 20·5; Brighton, 21·0; Bradford, 21·4; Norwich, 21·7; Portsmouth, 23·3 per 1000. In London 2569 births and 1996 deaths were registered. The annual rate of mortality from all causes, which had been equal to 21·5 and 22·4 per 1000 in the two preceding weeks, rose to 26·8, and exceeded the rate in any week since February last.

THE weekly return of the Registrar-General shows that the annual rate of mortality for the week ending December 23rd, in twenty-eight great towns in England and Wales averaged 27·6 per 1000 of their aggregate population, which was estimated at 8,469,571 persons in the middle of this year. In the following six towns the rate of mortality was the lowest:—Derby, 20·0; Leicester, 21·1; Portsmouth, 21·3; Bristol, 21·4; Brighton, 21·9; Bolton, 23·0 per 1000. In London the annual rate of mortality from all causes, which had been equal to 21·5, 22·4, and 26·8 in the three preceding weeks, rose to 27·1. During the twelve weeks ending December 23rd, the death rate averaged 21·7 per 1000, against 20·2 and 21·1 in the corresponding periods of 1880 and 1881.

AT a recent meeting of the Physical Society Mr. Shellford Bidwell gave an account of some experiments he had made to test the theory of Dr. James Moser, that the action of a selenium cell under light was due to the heat rays making a closer microphonic contact between the selenium and the metal electrode, by expanding the material. He submitted selenium cells to dark heat rays, and found their resistance to rise. Under light rays, however, their resistance fell. He therefore concluded that Dr. Moser's theory was erroneous, and that the fall in resistance due to the light rays is the differential result of the rise due to heat and the fall due to light. He also explained the "fatigue" of a selenium cell by use, as caused by its increase of temperature. When the cell cooled again the fatigue disappeared.

AT a recent meeting of the Chemical Society, Professor W. Foster read a paper "On the Behaviour of the Nitrogen of Coal during Destructive Distillation, with some Observations on the Estimation of Nitrogen in Coal and Coke." It is usually stated in text-books that coal contains about 2 per cent. of nitrogen, which, when the coal is heated in close vessels, usually comes off as ammonia. The author, however, finds that only a small fraction of the total nitrogen comes off as ammonia. Durham coal was employed which contained 1·73 per cent. of nitrogen, and left 74·46 per cent. of coke. A weighed quantity of the coal is placed in a combustion tube sealed at one end, and the issuing gas was washed free from ammonia by hydrochloric acid, the gas thus freed from ammonia was passed through a second heated combustion tube containing slaked lime, the additional ammonia thus obtained came from the decomposition of cyanogen in the gas. Taking the total nitrogen in the coal as 100, only 14·5 per cent. is evolved as ammonia, 1·56 per cent. as cyanogen, 35·26 per cent. is present in the coal gas as nitrogen, whilst 48·68 per cent. remains behind in the coke. Dr. Percy Frankland said that Dr. Hoffmann, in his report in connection with the Exhibition of 1862, stated that only one-third of the nitrogen was evolved as ammonia, two-thirds remaining behind in the coke; and, as far as he knew, nothing had been done with the subject until Mr. Foster had taken it up. He had made some combustions of the coal used by that gentleman, using the apparatus employed in the combustion of a water residue; about ·024 gramme of coal was taken; great difficulty was experienced in getting all the nitrogen off.

MISCELLANEA.

THE offices of W. T. H. Carrington, of the Wire Tramway Company, have been removed to 9 and 11, Fenchurch-avenue.

MESSRS. GEORGE COHEN AND COMPANY have admitted into partnership Mr. Moss Cohen and Mr. Michael Cohen, the firm now bearing the title of George Cohen, Sons, and Co.

THE French Minister of Public Instruction offers a prize of £2000 for the best industrial application of electricity, open to all the world. Claims are to be sent in by 30th June next.

A COMPANY has been formed at Gelsenkirchen for importing petroleum from the United States in specially constructed tank steamers, and distributing it in pipes to the various towns on the Baltic.

THE American pig-iron makers, having met at Pittsburg, have formed a national protective association, and are determined strenuously to resist all attempts to reduce the pig-iron duty below 24s. per ton, as recommended by the Tariff Commission.

WE understand that the contract for the inspection and guarantee of the boilers belonging to the War Department has been given to the Engine, Boiler, and Employer Liability Insurance Company, Limited, of which Mr. Michael Longridge is the engineer.

ON the 28th ult. Messrs. Turton, Brothers, and Matthews, Steel, File, and Spring Works, Sheffield, entertained their managers, foremen, and workmen, at dinner on Thursday, the 28th ult., at the Surrey Hotel. About 200 sat down, the chair being occupied by Mr. Joseph Banham.

COLONEL W. H. MALLORY, inventor of the screw steering propeller which bears his name, died in Bridgeport, Connecticut, on the 8th of November. He was born in 1840, was graduated at Trinity College, Hartford, Conn., in 1860, and earned his military title in active service with Duryea's famous Zouaves.

THE Birmingham Corporation on Tuesday adopted a scheme proposed by their Water Committee for a reduction of water rates upon houses up to £40 rental, to the extent of between £9000 and £10,000 per annum. Two years ago a similar scheme was adopted, effecting reductions to the amount of £5000 per annum.
pressing demand for silver coin. The new engines and machinery by

THE operations of the coinage, which were suspended at the beginning of February to admit of a thorough reorganisation of the Mint works, were resumed on the 8th of December, to meet a Messrs. Maudslay, Sons, and Field, are now in full working order, and the Mint will again be open to the public from Monday next, the 8th of January.

ON the Shropshire Union Canal, at Beeston, Cheshire, considerable damage has been caused by a quicksand, which, it is feared, will prove a source of difficulty in its future navigation. The bed of quicksand extends along the canal for abcut a mile and a-half. The North-Western Railway Company, which works the Shropshire Union Canal, has a large staff of men constantly engaged endeavouring to secure the safety of the canal.

THE King of Portugal has had Ajuda Palace, his town residence, connected with the Lisbon Telephone Exchange, and may claim to be the first European monarch who has become a subscriber to a public telephone exchange. The apparatus was fitted up by the Edison-Gower-Bell Telephone Company of Europe. A special private telephonic system is now being established between the King's library and the various Ministries and the Opera.

IN the course of the past year the production of wrought iron in Scotland has been, comparatively speaking, very large, amounting to 474,000 tons as against 361,000 in 1881, and of the whole 26,000 tons were sent abroad. Both the production and the export of malleable iron are the largest for the last ten years at least. The prospects of the malleable trade are, on the whole, good, it being certain that a very favourable demand will be experienced for the supply of home requirements.

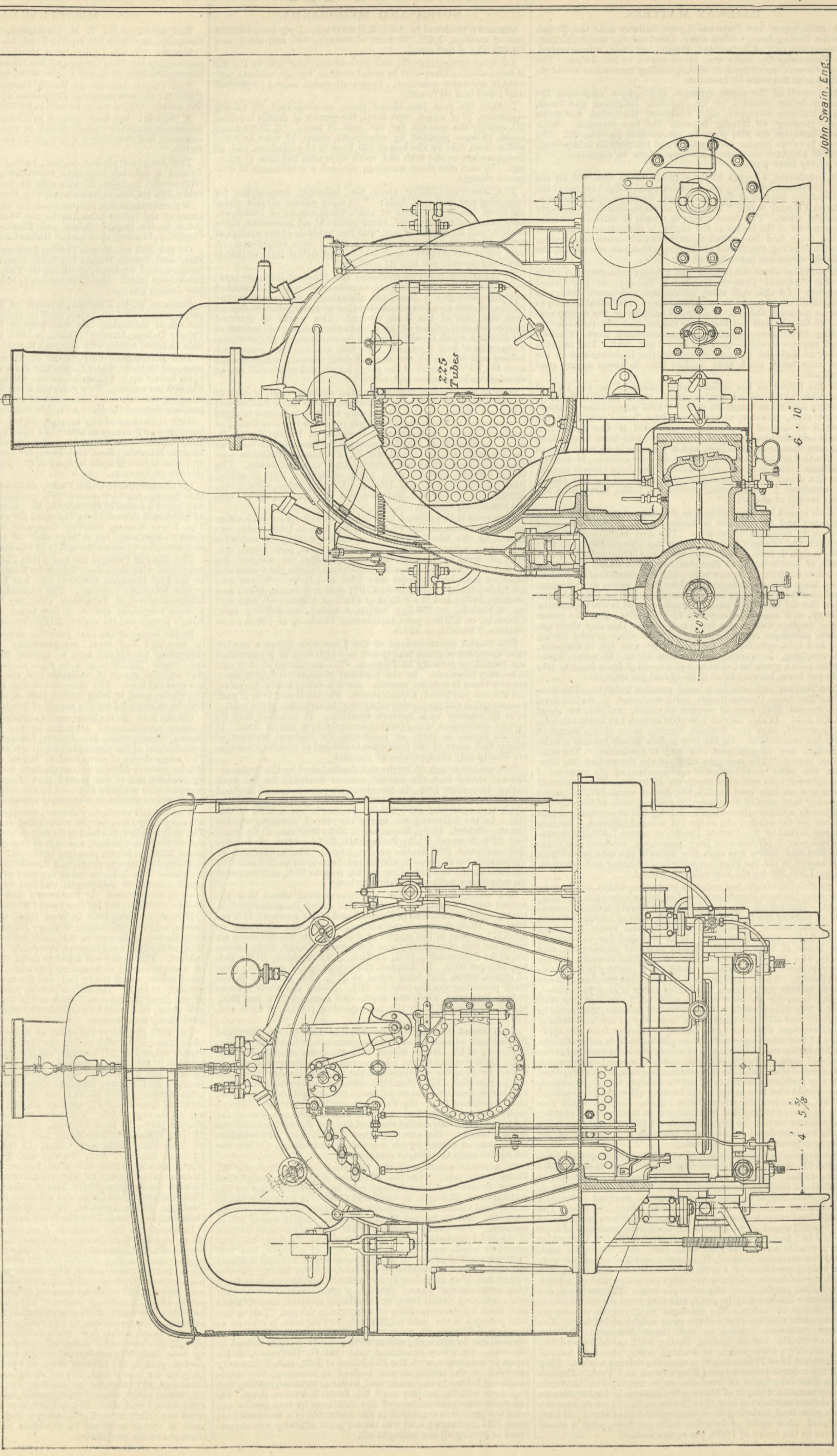
ON the 30th ult. the Mayor and Corporation of Leicester and the leading manufacturers attended at the hosiery manufactory of Messrs. Corah, Sons, and Cooper, Leicester, to witness the first introduction of the electric light into a textile factory in the town. The many shades of yarns used in ladies' jerseys and other fancy fabrics make it difficult to manufacture and make up these goods by gaslight, but it was proved that colours undistinguishable by gaslight were perfectly disclosed by the electric light. The experiments were regarded as completely successful.

A FATAL fall of a factory chimney occurred last week at Bradford, whereby fifty-three people were killed and about forty injured. The mill is called Newland Mill, and is situated in Upper Castle-street, Bowling Old-lane, a suburb of Bradford. The chimney was about 220ft. in height, standing in the mill-yard. It fell upon the spinning and drawing sheds, and demolished a large portion of the premises. The fall occurred at the time of breakfast, when only a small number of workpeople, who had brought their breakfasts, were on the premises. It was known that the chimney was in an unsafe condition, and for two years this had been asserted.

HOUSES are being built in West Ham without any damp-proof course, and the Nineteenth Century Building Society can hardly keep its temper because of the indifference with which the West Ham authorities have received the society's communications on the subject. The society was asked to make the usual advance on one of these houses by an intending purchaser, but there is no damp-proof course, which is very bad, and the society cannot advance on property so built. The matter is to be placed before the President of the Local Government Board, so the society will have time to cool down, and would-be purchasers to look for other houses which have damp-proof courses.

THE following shows the result of the oversea trade to the port of London for the week ending the 23rd of December:—Number of vessels entered in 238, tonnage 133,477; steamers entered in 141, tonnage 93,759; vessels entered out 121, tonnage 71,862; steamers entered out 91, tonnage 58,828; cargo vessels cleared out 140, tonnage 89,437; cargo steamers cleared out 97, tonnage 64,486; total British vessels cleared out 115, tonnage 81,275; British steamers cleared out 77, tonnage 59,450; British sailers cleared out 38, tonnage 21,825. Thirty-five vessels entered inwards from French ports, 35 from German, 26 from Guernsey and Jersey, 24 from Holland, 19 from Spain and Portugal, 16 from Belgium, 19 from East Indies and China, 13 from the United States, 12 from Russia, 7 from Norway and Sweden, 6 from British North America, 4 from the West Indies, 3 from Australia, and 19 from other ports. Of the vessels cleared out with cargoes, 18 were for Belgium, 28 for France, 15 for Germany, 13 for the United States, 11 for China and the East Indies, 10 for Spain and Portugal, 10 for Australia, 10 for Holland, 3 for Russia, 3 for Guernsey and Jersey, 7 for the West Indies, and 12 for other ports.

IN March the Port Elizabeth Agricultural Society will hold a show, at which the following prizes will be distributed for machinery and agricultural implements:—For the best portable steam engine, not exceeding 8-horse power, £25; thrashing machine, to be worked by steam power, £15; steam corn grinding mill, £10; horse-power thrashing machine, with horse-gear complete, £10; corn mill adapted either for grinding or crushing, for hand or horse-power only, £3; reaping machine, £10; winnowing machine, £5; harvester and binder, £10; mealie sheller, for hand or power, £3; colonial or imported churn, £2; forage cutter, £3; root cutter, adapted to cut prickly pear, mangel wurzel, &c., £5; three-furrow plough, £5; two-furrow ditto, £3; one-furrow ditto, for breaking up new land, £2; one-furrow plough for general purposes, £2; garden plough, £2; hill-side ditto, £2; potato plough, £2; set of harrows for heavy land, £3; set of harrows for light land, £3; horse hoe, £1; cultivator or scarifier, £3; seed drilling machine, £3; steam pump, adapted for irrigation, to be worked on the dam, £25; second best ditto, £15. Exhibitors for this class can only enter one article for each prize offered, and machines for which no prize is offered must not be exhibited on the same stand with those shown for competition.



EIGHT-COUPLED LOCOMOTIVE, ST. GOTHARD RAILWAY.

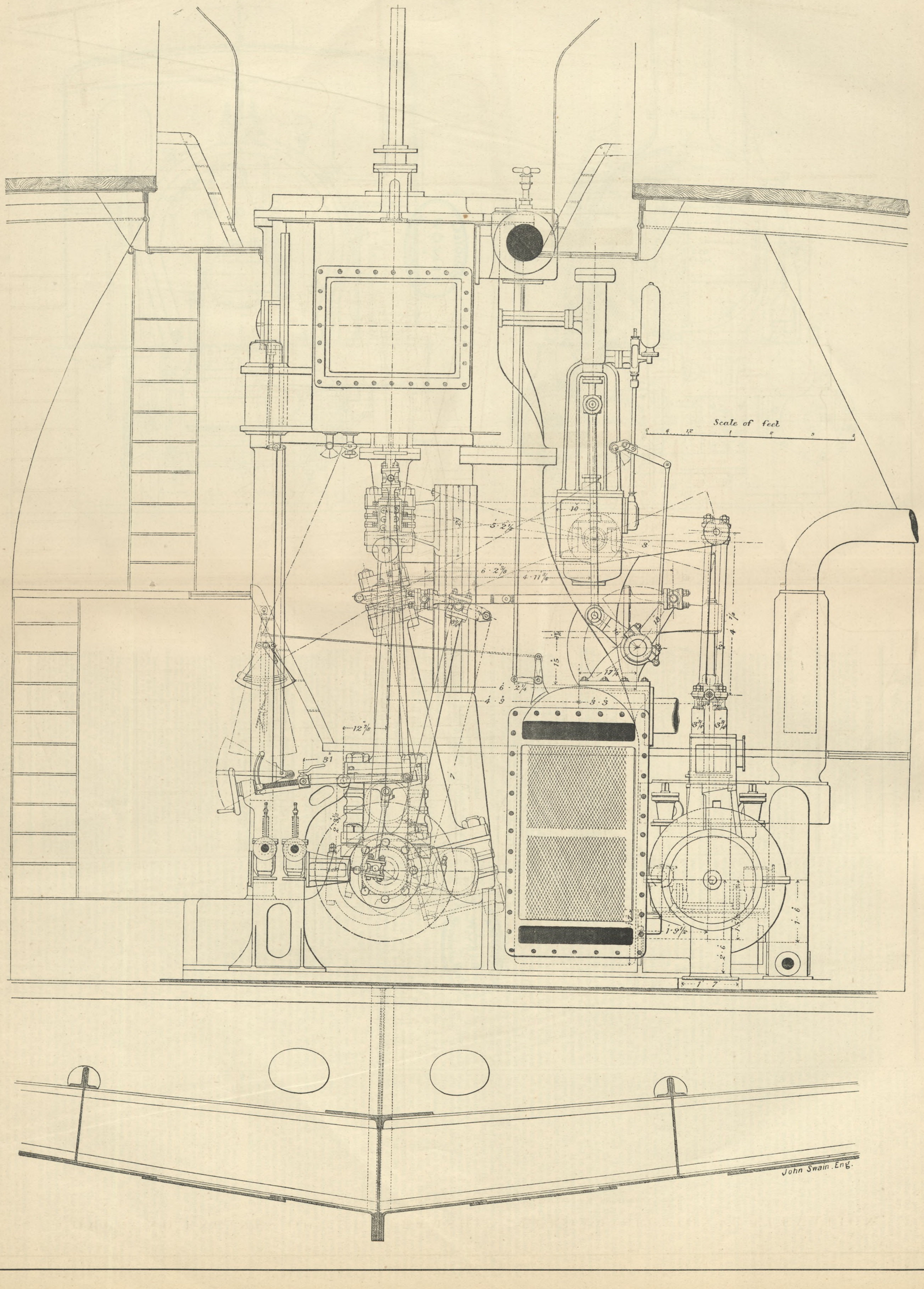
CONSTRUCTED BY MESSRS. MAFFEI, MUNICH, FROM THE DESIGNS OF HERR J. STOCKER.

(For description see page 6.)

COMPOUND ENGINES OF THE STEAMSHIP LEERDAM—SECTIONAL ELEVATION.

THE NETHERLANDS STEAMBOAT COMPANY, FYENOORD, ROTTERDAM, ENGINEERS.

(*For description see page 6.*)



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*** *With this week's number is issued as a Supplement, an illustration of the Compound Engines of the Steamship Leerdam—Sectional Elevation. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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.*

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W. L. (Didsbury).—*No.*
F. M.—*The address of Prof. A. Graham Bell is Volta Laboratory, 1221 Conn. Avenue, Washington, U.S.A.*
BOILER FUEL ECONOMISERS.—*A letter on this subject awaits the application of our correspondent "Economiser."*
H. P.—*Letters intended for publication should reach us by Wednesday morning. Your letter has been forwarded to S. C. and Co.*
J. H.—*The wood usually used for mangle rollers for washing machines is sycamore. We do not precisely know what you mean by "machinery for making mangle rollers." The only machine wanted is a common wood-turner's lathe.*

SOLUTION FOR DIPPING BRICKS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your numerous readers help me out of the following difficulty? I am working a large field of clay, and the harder the bricks are burned the whiter they become on the faces exposed to the fire. Is there any cheap solution to dip them in so as to keep the colour red?

ENQUIRER.

WALTON'S (?) WHEEL SCALE.

(*To the Editor of The Engineer.*)

SIR,—I notice in THE ENGINEER of Dec. 1st, 1882, an inquiry from "A Constant Reader" in reference to Walton's wheel scale for setting out the teeth of wheels. I respectfully suggest that he means Walker's wheel scale, not Walton's. Walker's wheel scale, one of which I have had for several years, was invented by John Walker, an English mechanic residing in this country, and bears date as having been patented here Feb. 1st, 1871. I have been informed that Mr. Walker is now employed at Poole and Hunt's foundry in Baltimore, U.S.A., superintending the making of wheels by one of Scott's wheel moulding machines.

WILLIAM H. BROWN.

Bush Hill Ironworks, Philadelphia, Pa., December 18th.

CAST STEEL CHAIN CABLES.

(*To the Editor of The Engineer.*)

SIR,—Can any reader inform me if ship's cables made of cast steel links have ever been tried, and whether they could be relied upon for the purpose? Also please say what are the Admiralty tests for the various sizes of cables.

T. B.

Cleckheaton, January 1st.

[You will find a table of Admiralty cable tests in "The Sailor's Pocket-book," published by Griffin and Co., Portsmouth, page 423. We can only find space for two or three figures. 1in. cable must stand 27 tons; $1\frac{1}{2}$in. cable, 60·75 tons; 2in cable, 100·8 tons; and $2\frac{1}{2}$in. cable, 157·5 tons.—ED. E.]

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 9th, at 8 p.m.: Inaugural address of Mr. Brunlees, F.R.S.E., as President.

CHESTERFIELD AND DERBYSHIRE INSTITUTE OF MINING, CIVIL, AND MECHANICAL ENGINEERS.—The next general meeting of the members of the Institute will be held in the Lecture-room of the Stephenson Memorial Hall, Chesterfield, on Saturday, Jan. 13th, at 2.45 p.m., when the following papers will be open for discussion:—The late Mr. C. T. Owen's paper "On a Compensating Air Compressor." See Part II., vol. ix. Mr. Sebastian Smith's paper "On Mining Coal by Compressed Lime, under Sebastian Smith and Moore's Patent." Mr. G. E. Smith's paper entitled "The Electric Exhibition at the Crystal Palace, London; closed June 3rd, 1882." The following paper will be read:—"Owen's Patent Air Compressor; Description of Trial," by Mr. John Oliver. The following will be read or taken as read:—"On the Electric Light and Transmission of Power by Electricity," by Mr. Sydney F. Walker.

DEATH.

On the 24th ult., at 26, Upper Grosvenor-road, Tunbridge Wells, CHARLES VINCENT WALKER, F.R.S., F.R.A.S., F.M.S., Past President of the Soc. Telegraph Engineers, 37 years Telegraph Engineer to the South-Eastern Railway Company, in his 71st year.

THE ENGINEER.

JANUARY 5, 1883.

1883.

WITH the exception of the tin-plate trade, and to some extent the coal trade, the year that has just passed away has been a busy one in nearly all industries and the engineering profession. At the beginning of the year engineers and manufacturers had generally a goodly quantity of work on their books, and the prospects of a busy year have been fully realised in almost all branches. At the close of the year, and now at the beginning of the new, there is not so much work in hand, though in some branches, particularly perhaps in agricultural engineering and in the manufacture of high-class small stationary and semi-portable engines, some firms are very busy. The low price to which coal had fallen stimulated the adoption of better class winding and pumping engines, boilers and plant; for even where coal is on the spot it has become essential that every source of economy shall be studied if a profit is to be made. The same thing applies to iron and steel works and tin-plate works, and hence old works have been closed or the plant remodelled or renewed, the changes in the processes of manufacture thus placing work in the hands of constructors of iron and steel-producing plant. Though trade has been plentiful, it is, no doubt, generally true that in old-established manufactures profits have become less, though consumption has in most cases increased, large profits being obtainable only on specialities. Our foreign engineering and iron trades have been good during the year, and even with America, in spite of the enormous import duties, it will probably turn out to have been as high as in 1880, though perhaps less than in 1881. The artificial activity of the American iron and steel trade, especially the rail trade, has recently entered a trying ordeal, and it does not seem that Americans will long remain satisfied to pay as much as £5 15s. per ton on steel rails in order to foster manufacturers who could not make the profits they require without being thus nursed by taxation. It is not very likely, however, that the import duty will be sufficiently reduced to encourage our manufacturers to hope for much from American trade, for Americans have a good margin to work upon, the present price of American rails being over £3 less than for imported rails.

On the whole, the outlook at home for the coming year is good, and the very numerous private Bills in Parliament for session 1883 promise plenty of work of well-known kinds to engineers and manufacturers, while the private Bills relating to new fields of engineering enterprise in the application of electricity promise to afford more work than those at present really engaged in that branch can execute. The total number of Bills lodged is 276, including 138 railway Bills, 34 tramway Bills, 28 miscellaneous, 26 water, gas, and lighting, 25 town improvement, 16 harbour, dock, and port, 6 road and bridge, and 3 canal. There is also a very large number of applications for provisional orders, including three for electric lighting. Abroad the engineering work demanding supplies from home is extensive, particularly in railway work in the Australian colonies and India, while there is great probability of extended engineering enterprise in Egypt; for although the recent war stopped a great deal of engineering work for a time, this will soon be overtaken, and new fields opened up, not the least being the very probable commencement of a second ship canal starting from Alexandria.

Of the completion of works of the kind commonly termed civil engineering, the chronicles of the past year record none of special magnitude or interest. The year has really been one of incubation and quiet progress rather than of completion, whether we look at home or abroad. At the present time tunnels and canals constitute the most prominent of the works in progress under this head. Of those at home the Severn and the Mersey tunnels occupy the first place. The great irruption of water from a land spring, which so seriously delayed the Severn tunnel works, has not been followed by any similar misfortune since the water was pumped out. The work, in the hands of Mr. T. A. Walker, progresses rapidly, and the Great Western Railway Company will probably, before the year is out, be taking measures for dealing with a prospective large coal trade direct from South Wales to London, thus realising, by a tunnel located and designed by Mr. Charles Richardson, the proposal of Thomas Deakin, who, in 1835, wrote, "The Great Western Railroad from London to Bristol will be accomplished no doubt, and why not continue it under the Severn mouth, near Chepstow, Monmouthshire, through Glamorganshire, and to Milford Haven in Pembrokeshire? It would then traverse the coal-field of South Wales throughout the whole extent—a tract of country possessing also inexhaustible stores of ironstone." To Deakin's question a practical reply has now been given, for with the completion of the tunnel, the "railroad," as it was then in England called, just as it is now in America, will be found already complete from London through to Pembroke. The tunnel works have progressed without interruption during the past year. The length of arch already turned is 7000ft., and the progress in the last three months has averaged 500ft. per month. There are four shafts used exclusively for winding, three shafts for winding and pumping combined, and four shafts for pumping only. There are eleven 15in. pumps, four 18in., two 26in., two 28in., and one 35in., and the quantity of water raised daily is nearly 12,000,000 gallons. Only about half the pumps are continuously working, the others being held in reserve. The tunnel when completed will be $4\frac{1}{2}$ miles long, $2\frac{1}{2}$ under the river Severn, and two miles under the land. The strata under the river are now all hard and sound. The loose ground on the Gloucestershire side has all been bricked. Less water enters the works in the part under the river than in that under the land. The brickwork is executed in vitrified Cattybrook or Staffordshire bricks set in Portland cement. The number of bricks used weekly has risen to 500,000, equal to 26,000,000 a year. The number of men employed is about 3000, for whom about 200 large and commodious houses have been built. 14,000lb. of explosives are used per month. Perfect ventilation is obtained by a Guibal fan and four Baker's blowers, and six air compressors are always at work, supplying air at 60 lb. pressure to the drills and pumps.

At the same time that Deakin made the remarks already quoted, he spoke of a Mersey tunnel as having been proproposed, and thus forty-seven years ago was speaking of the desirability of the two tunnels now in course of construction. In one respect these two tunnels are similar—namely, in the material in which they are made, the Mersey being through red sandstone, and the Severn through similar material under the river, but through hard pennant under the Gloucester shore. The former is under three-fourths of a mile in length, however, as compared with $2\frac{1}{4}$ miles, and the rail levels will be respectively 144ft. and 163ft. below high water, the difference being in the thickness of material between the tunnel and river bed, that of the Severn being 40ft. as a minimum. Both these tunnels are being driven in the ordinary way without shields of any kind; but in both cases very large pumping power has been required. The works of the Mersey tunnel are being proceeded with vigorously, under Messrs. Brunlees and Fox, Mr. John Waddell being contractor. A total length of 800 yards has been driven. At Birkenhead both the tunnel and the drainage heading are well under the river; and notwithstanding this, the quantity of water being pumped on that side is rather less than it was a year ago, due, it appears, to the brickwork in the drainage heading, and to a short length of tubbing in the shaft. Colonel Beaumont's machine is about to be adopted, similar to that used in boring the heading of the Channel tunnel. It is expected to drive the driftway at the rate of some 30 yards per week. The necessary works for forming the junction with the London and North-Western and Great Western Railways are just being commenced.

The only other tunnel which we need mention at present being made under a river is that under the Hudson at New York. It is about a mile in length and through a silty bed, through which the work is carried partly by means of a form of shield supplemented by the use of compressed air in the working, which is employed to keep out water and to act as a support to the ground instead of timbering. It is clear that the air cannot act as a support, and in fact a failure in this respect caused the death of a number of men a few months after the tunnel was commenced. After this a permanent masonry bulkhead was built up near the tunnel shaft, in which an air lock is placed, a large iron tube, large enough for a man to get easily through, being built into the bulkhead. The tunnel is built of masonry within a plate iron shell. The plate iron shell is built of segments of boiler plate in lengths of 15ft., a temporary boiler plate bulkhead being built at the end of the shell. In proceeding, one plate of the plate iron bulkhead is removed, and the earth removed from behind it. If this is effected without trouble of any kind, another plate is taken out and the earth removed from behind it. A segment of the sheet iron shell lining of the tunnel is then bolted to the so far completed part. After this another plate from the bulkhead is removed, and another plate added to the shell, and so on. The air pressure employed is about 26 lb. on the square inch—or somewhat above that due to the head of water above the upper part of the cutting—and the men are said to experience no inconvenience from this. There is sometimes a difficulty from the escape of air, and this is overcome by holding dry cement near the escaping place; the rushing air thus carries the cement into the hole. These leaks are often stopped with a few handsful of cement, but sometimes a good deal of ingenuity has to be brought to bear to overcome the difficulties in this respect, and also of getting the shell plates in. In fact, without a good deal of mechanical ingenuity the work would not have been carried so far, and though the scheme may possibly be carried through, it must be looked upon as somewhat problematical, inasmuch as there are times when the temporary bulkhead is far from complete. Even since the above was written we learn that the tunnel works are stopped, and, it is said, for want of funds. We question, however, whether it is not primarily for want of confidence in the method of construction, not only on the part of capitalists, but on the part of workmen, for some of the American papers express the hope that before it is recommenced a more satisfactory method of procedure will be found.

The St. Gothard Tunnel, or series of tunnels, which had for years taken a leading place in our annual retrospect, was completed last year, but the railway system, of which the main tunnel forms an expensive link, was opened with much ceremony in May last, and already the traffic upon it promises to exceed even the estimates of its promoters, and to have a material effect on the direction of goods as well as passenger traffic between Italy and Northern Europe and this country.

Of bridges in course of construction, the most interesting is the East River bridge between New York and Brooklyn. This bridge is designed for three purposes—the outside roadways for ordinary vehicular traffic, the centre road for foot passengers or promenade, and for railway traffic on each side between the two former. It is a suspension bridge, with a main central span of 1595ft. 6in., with two side spans of 930ft. each, supported by galvanised oil-coated steel wire cables, with parallel wires of 12ft. to the pound wrapped to a solid cylinder of $15\frac{3}{4}$in. diameter, the cables having an ultimate strength of 12,200 tons. The towers are 278ft. above high water, the clear height of the centre span above high water being 135ft. at 90 deg. Fah. The construction of the bridge was commenced just thirteen years ago, and it was expected to be opened for foot and ordinary traffic before the end of the year just closed. Mr. W. A. Roebling is the engineer.

Of bridges about to be commenced, that designed by Messrs. Fowler and Baker to cross the Forth is the most interesting, not only because it will be the widest span bridge in the world, but because it is of a new type, built with what may even yet be looked upon as a new material—namely, modern steel. We so recently gave a full account of this bridge that it is unnecessary that we should do so here. The principle of the design is the employment, on two river piers, of enormous balanced cantilevers, which leave a space in the middle span. This space is filled in with a long lattice girder carried on the ends of the cantilevers. The proportions far exceed anything hitherto attempted; but it is not necessary because of this to condemn the design as involving strains which cannot be met, as has recently been done by Sir G. B. Airy, who seems to have been unacquainted with the modern development of the theory of strains in large structures. The contract for the Forth Bridge was let a short time ago to Sir Thos. Tancred, Bart., Mr. T. H. Falkiner, Mr. J. Phillips, and Messrs. Arrol and Co. for £1,600,000, the amount of the engineer's estimate. The contract for the Siemens steel which is to be employed has been sublet to the Landore Steel Company and to the Steel Company of Scotland, the tests imposed being higher than have been adopted before for bridge work—namely, for steel in tension, a tensile strength of from 30 to 33 tons per square inch, with 20 per cent. elongation; and for steel in compression, a resistance of from 34 to 37 tons, and 17 per cent. elongation. The steel will be delivered at Queensbury, and the bridge will be manufactured entirely on the spot in workshops now under construction. Timber staging for sinking the piers is also being commenced, no less than 7000 tons of timber having been purchased.

The great Attock Bridge, which forms an important link in the completion of the railway communication from Calcutta to Peshawur, a distance of 1600 miles, is progressing towards completion. Trains will probably run over it in May next. Three out of the five spans are completed, and the two remaining spans are in course of erection. The tunnel under the hill of Rajah Hodi has been bored through, but there is a considerable amount of work to be done yet on this section of the work, which is on the Khairabad side of the river. The line of railway on the Attock side of the Indus is completed up to the river bank, and is ready for use. The piers, which ranged from 86ft. to 132ft. high, are four in number—two 132ft. long, one 109ft., one 86ft.—and weighing 985 tons, were made by A. Handyside and Co., of Derby. The superstructure was made by Messrs. Westwood Bailie and Co., of London.

The London Bridge question has as usual cropped up with spasmodic vigour, but the inertia of the opposing interests has, also as usual, effectually prevented any effective onward movement. Sir Joseph Bazalgette has reported to the Board of Works on the general question, and while admitting the superiority of a low level bridge, he considers that the cost of buying out the vested interests in the wharves between the proposed new bridge and the existing bridge is so enormous, that while the bridge itself might be made for £240,000, the compensation would bring up the cost to £3,000,000, the bridge being placed between the Tower and the St. Catherine Docks. He is of opinion that a low level opening bridge would fail to meet the requirements of either road or river traffic, and would entail such compensation to wharfingers that it would cost £2,000,000. We have several times urged that the only satisfactory structure would be a low level bridge. Only one thing stops the construction of such a bridge, namely, the compensation to the owners of the wharves. Now, instead of paying about two millions sterling as compensation for real and imaginary obstruction to navigation to a few wharves, the best mode of procedure would be to buy these wharves right out, improve the frontage, and build really good warehouses. This would represent a big capital outlay, but the rent obtainable from warehouses built so as to make the most of the frontage would afford a most profitable return on the expenditure. On the other hand, if over two millions are handed over to wharfingers for compensation, yet leaving the wharves in their hands, it would very soon be found that the two millions was clear profit to them, for almost all the shipping would still reach them under altered conditions, to which the small shipping would soon conform. The wharfingers would have this enormous compensation and their wharves also, with no detriment whatever after a very short time. This should be guarded against by the absolute purchase of the property. The report of Sir Joseph Bazalgette shows this shipping to be utterly insignificant compared with the value of a river crossing. The purchase of the whole property would probably turn out to cost not a great deal more than the estimated compensation; but even if it cost three millions, this appears to be the only effectual way of getting a low level bridge below the Tower.

During the year several bridge failures have occurred that remind us that bridges built over twenty years ago were not intended for the heavy traffic of to-day, as well as that they are not as strong now as when they were built. There are hundreds of bridges in this country which ought to have the most searching inspection and recalculation of their strength, while there are many others of the lattice type the bracing of which should be protected from damage by derailed engines or wagons, by means of one or two horizontal fenders, like string courses, which might be made of old rails. Many engineers supported the idea that it was possible that a derailed engine on the Tay Bridge led to its destruction by breaking one or more struts or ties. Engineers thus admit the possibility of destruction in this way, and they should guard against it. It should be done, amongst others, on the Blackfriars Bridge of the London, Chatham, and Dover Railway, for although trains never run at a very high speed over the bridge, the bridge is entered from either end by short curves, and the speed is quite high enough to do great damage should derailment occur. A railway viaduct has recently been completed across the Kinzua Valley to carry the New York, Lake Erie, and Western Railway. Its loftiest pier is 297ft. in height, and the average is 176ft.; but although they are close together, the girders having each a span of 61ft., they are so light that the whole viaduct, except the superstructure, has the appearance of a monster wire fence. Without going carefully into the calculations of strength, we should not like to say that the thing would not carry its load a few years; but we should rather not cross it during a heavy wind, and would rather walk across the valley at any other time. Too much dependence is placed on each individual member, to commend the design to English engineers, and not enough sectional area has been given to the diagonal ties to confine their elongation within limits safe for the structure.

Amongst the railways in progress in England, perhaps the most interesting is the Inner Circle Extension and completion of the Metropolitan Underground Railways. As we announced in our impression of the 2nd September, the piece from Liverpool-street has been completed as far as Tower-hill. Since then the remaining portion to the Mansion House has been in progress under a joint committee of the Metropolitan and Metropolitan District Companies, and rapid progress is being made at several parts of the line. Starting a little east of the Mansion House station, the line runs into Cannon-street, where a station will be formed; thence it runs under the centre of Cannon-street to what will be known as the London Bridge station at the bottom of King William-street. Along this portion of the line the most progress has been made, and few of the hundreds of thousands of those who have passed recently along Cannon-street have had the least idea that all the houses, offices, and warehouses on each side were being underpinned, the pavements mere shells, and that the street itself was little other than a plank floor under which the railway tunnel side walls were being built, the sewers diverted, and even the tunnel arch being completed by nearly four hundred men working by gaslight. The tunnel arch is already turned under a part of Great Tower-street. The underpinning is of cement concrete, widths of about 4ft. being worked at a time. The concrete walls are built and allowed to stand a short time, the pinning being completed from the top of the concrete, which is below the house footings about 3ft., with brickwork in cement. The large sewer is being removed, and the sewage diverted into two cast iron sewers laid under the pavement. So rapid is the progress of the work, that Londoners, to the date when they may go from, say, Westminster to Liverpool-street, may be counted in months. The work is being carried out under Mr. John Woolfe Barry, M.I.C.E.

The railway next in interest and importance is the Hull, Barnsley, and West Riding Junction Railway, by which the Barnsley coalfield will be placed in direct communication with Hull. During the past few years the trade of Hull has grown so rapidly that the existing dock and railway facilities are quite unable to meet the demand for space and transportation, and the merchants complain that they cannot deliver goods sent to Hull in contract time, and shippers, that their vessels are unduly delayed at this port. On the 16th ult. a special meeting of the Hull Chamber of Commerce and Shipping was held "for the purpose of an interchange of opinion and views between the shipowners, merchants, the Dock Company, and the representative of the North-Eastern Railway Company, as to the best means of avoiding the present detention of steamers discharging at this port, and the removal of the block of traffic which now exists in the Hull docks and on the railways running into Hull." This is a promising state of things for the Hull and Barnsley Railway, in connection with which a new dock is being made under Mr. Abernethy, and the substructure forming the bottom has proved to be of a most satisfactory character.

The whole of the land for the railway has been purchased, and the line fenced. The quantity of earthwork executed on the railway has reached 3,200,000 cubic yards, out of a probable total of 6,000,000 cubic yards, and this, which is measured work, has been accomplished in the first two years. Tunnels, five in number, are either completed or in a very forward state. All the ordinary bridges are in progress as the earthwork advances. The more important bridges over the Ouse, Aire, and at Hull, are progressing at the works, and the cylinders are being sunk for the foundations. About twelve miles of permanent way, single line, have been laid, and the normal number of men employed is 4500, beside steam navvies and skilled labour in the manufacture of ironwork. The total quantity of ironwork in the bridges will be nearly 6000 tons, of which about five-sixths has been designed and is in the hands of the contractors. The engineers are Mr. Shelford, Great George-street, Westminster, and Mr. Bohn, at Hull.

The Manchester, Sheffield, and Lincolnshire Company has given notice of intention to seek powers to make experiments in the Humber with a view to the construction of a tunnel so as to unite the railways north and south of the estuary, and thus avoid the ferry worked by the Sheffield company, and the detour at present necessary, *viâ* Selby or Doncaster on the route southwards, to escape the Humber. The estuary is about three miles wide across the line between Hull and New Holland, and it is questionable whether such a costly link as the tunnel would be is justified by the probable traffic.

Amongst the railways which have received sanction in our colonies the most important is that which is to connect Brisbane in Queensland with Port Darwin in the Gulf of Carpentaria, involving altogether the construction of about 1000 miles of railways. The contractors are, it is said, under obligations to get the line completed in seven years and a-half. Queensland has taken up this railway with great vigour, as she has railway matters generally, as shown by the fact that Queensland has 800 miles of working lines, not a fraction of which was made until 1864. The trial survey for the line now sanctioned was made less than four years ago. The road is to be constructed on the land grant system, and there can be little doubt that though the construction of such a railway is a bold scheme, it is judicious. To this and to other proposals for trans-continental Australasian railways we referred at length in our impression for the 2nd of September, 1881, when we pointed out the necessity for uniformity of railway gauge, and it must ever be felt that it is a pity that Queensland, with its 3ft. 6in. gauge and little over half the railway mileage of Victoria, should have been left to make this important line, which will, of course, be on the 3ft. 6in. gauge, and not the 5ft. 3in. gauge of Victoria.

With the Channel tunnel nothing, as is well known, is now in progress on this side, and Sir E. Watkin's influentially accompanied visits to the boring along the shore west of Dover have ceased. The Channel Tunnel Railway Company and the South-Eastern and Channel Tunnel Railway Company have, however, lodged Bills in Parliament—the former company's Bill relating to necessary works at St. Margaret's Bay, and the latter to alterations of route so as to bring the entrance within easy range of Dover Forts, and to construct a branch line connecting the tunnel and Chatham and Dover line by junction north of Dover. That permission will some day be obtained to make a Channel tunnel is quite possible, but so long as the Government withhold it, it seems useless to lodge private Bills in Parliament, or, at any rate, questionable as to how they will be dealt with after they have passed the standing order examinations. On the French side about sixty men are employed, and it is said that the heading is making rapid progress. From the bottom of the main shaft the lead into the submarine works is through a tunnel of considerable dimensions, worked out of the grey chalk by pick and powder. 167 yards, about 12ft. square, have thus been got out. Beyond this the tunnel has been pierced for more than a quarter of a mile, 7ft. in diameter, by the Beaumont drill. The submarine tunnel takes a curve in an easterly direction to avoid uncertain ground at the Quenoes. On the Channel tunnel question generally we cannot enter here, and as we published the excellent paper on the subject, read by Mr. John Clarke Hawkshaw at the British Association meeting at Southampton in August, we cannot do better than to refer to it for precise information, and to Mr. Crampton's paper on boring the tunnel, also printed in our pages.

Of canal works completed during the year the most important is the Sirhind Canal in the Punjab, of which we gave some account in our impression of the 1st ult. The canal is over 500 miles in length, and has subsidiary channels of about 2000 miles in length, distributing the waters of the Sutlej over 750,000 acres of thirsty land.

Of canals in progress, that across the Isthmus of Panama has attracted most attention. Almost all the final surveys for this have been completed, and the work is progressing at several points, including Colon, Gorgona, Bas-Obispo, Emperador, Culebra, and Paraiso. At Colon 14,258 cubic metres of earthwork were removed in October, and in September rather more, harder material having been met with in October. The more definite surveys, and the excavations so far, have indicated that less rock will have to be cut through than was expected. A large quantity of machinery has been ordered, including large dredgers from Philadelphia.

The Isthmus of Corinth Canal is making rapid progress, and the earthwork being in alluvial material, about 300,000 cubic yards will be moved per month, chiefly by the aid of Priestman's excavators and by dredgers. Italian workmen are chiefly employed by the contractors, the Société des Ponts et Travaux en Fer, late Joret and Co., associated with the Association des Constructeurs. The total estimated quantity of earthwork is about thirteen million cubic yards, about one million of which is dredging, and 1,700,000 earth and rock semi-hard, and one million of rock below water. In France a large quantity of canal work is in progress, the value of inland navigation being there fully appreciated. For the Manchester Ship Canal, of which we have recently given full particulars, a Bill has been lodged in Parliament.

A very important canal project is a rival for the Suez Canal between the Mediterranean and the Red seas. This project is very warmly and influentially supported, and besides affording a ship passage, it would be of inestimable value for irrigation purposes. We gave some particulars of the project in our impression of the 29th of September last. It is to be a sweet-water canal fed by the Nile, and will require the removal of about 160 million cubic yards of material, or about double that involved in the construction of the Suez Canal. This quantity, however, is no more than was removed by the late Khedive during the first ten years of his rule in the enlargement of existing and construction of new canals, and, with modern appliances, is certainly not a quantity which would prevent the necessary outlay from being a profitable one. A well-known English engineer of large experience in Egypt, recently writing on the subject, said:—"Apart from questions of land reclamation, a sweet-water ship canal from Alexandria to Cairo and Suez would be of inestimable benefit to the country. At present the irrigation system of Egypt is most defective, and very commonly one-half of the crops are handed over to the labourers as a payment for watering the same by shadoof or otherwise. All this would be saved if the proposed canal and associated works were carried out. Water would be delivered to the cultivators at a sufficiently high level to inundate their lands without pumping. It may be stated that the present irrigation canals are of two classes, known as 'Sefi' and 'Nili,' the former being perennial, and the latter simply inundation canals receiving water only after the rising of the Nile. Headworks with sluices are provided where the canals leave the Nile, and at intervals down the canals similar dams are constructed, in order that by closing the sluices the water may be ponded back, and so brought more nearly to the level of the surface of the adjoining lands. Such a system is not only inefficient as regards supply of water, but also involves an incredible amount of labour in cleansing annually the canals of the sediment deposited by the still water. To afford sufficient irrigation to the lands of Lower Egypt, at least 80 per cent. of the total low Nile discharge should be withdrawn from the river and thrown into the canals. It has been found that an average of 7 tons of water per acre per day is required in Egypt for efficient irrigation. Since the area to be dealt with is about 3,000,000 acres, this is equivalent to a supply of 250 tons of water per second, while the minimum Nile discharge is 300 tons. To show how far the present system is from realising this desideratum, it is only necessary to state that the Menoufieh

Canal, which has its intake at the apex of the Delta, and the Behera Canal, on the left bank of the Nile, together convey only 17 tons of water per second during the months of May and June, though they are of ample size to convey, and do, when the Nile has risen, convey more than the desired 250 tons per second. The proposed Alexandria and Suez Canal would have sufficient capacity to supply the above quantity of irrigation water at lowest Nile, without in any way interfering with its functions as a ship canal. An area of about 500,000 acres in the province of Behera, and of 1,000,000 acres in the province of Charkieh and Dakalieh would thus be irrigated direct from the canal, while the lands between the Rosetta and Damietta branches would be supplied with irrigation water, either by large syphons laid from the ship canal near the barrage and under the Nile to the Delta, or by the reconstruction of the barrage projected by Mehemet Ali, and engineered by M. Mougel, which is a part of the programme of the projectors of the sweet-water ship canal. By raising the level of low Nile, the barrage will facilitate the passage of ships across the river, and also reduce the quantity of excavation in the main canals. No land beyond that required for the construction of the canal and contingent works would be sought to be acquired by the canal company, whose revenue would be made up of tolls upon shipping and water rates upon lands irrigated by their works."

In tramway engineering nothing of any unusual importance or interest was accomplished during the past year, and of the work to be done this year the Highgate wire rope traction tramway is, perhaps, the most interesting, for though the system has been well tried in America it is new here, and may be looked upon as a satisfactory solution of the mechanical haulage problem. It is most profitably at work in several American towns, and while it offers the advantage of low cost of haulage, as proved in America, and by less complete forms of application in our coal mines, it removes the difficulties ordinarily attaching to steep gradients. Ground has been or will be broken this week on the Highgate tramway, and the system is expected to be at work in May. The line will be about three-fourths of a mile in length, starting with a junction with the North Metropolitan Tramway at the foot of Highgate-hill, and rising to the Old Tavern Toll-bar; but power is being sought this session to make a line along North-hill and return *viâ* Archway-road, passing through the archway and joining the line again at the Old Tavern, thus circuiting Highgate-hill. Two 50-horse power fixed engines will be employed to work the cable, 50-horse power engines being fixed with a view to future extension, one of the two engines only working at any time. This line is being carried out under Mr. James Cleminson, and similar lines, under the same engineer, have received the consent of the local authorities of the Spen Valley and Dewsbury District Tramways, for the Edinburgh Northern Tramways, and powers are already obtained for the Birkdale and Southport, and Brighton and District Tramways, which are partly constructed, and will be converted to this wire cable system, which is the invention of Mr. Hallidie. Other lines at home and on the Continent will also be worked in the same way.

The great and devastating floods of the Rhine district and those of the Upper Thames Valley remind us that at last, after years of negotiation, the scheme prepared by Sir John Hawkshaw in 1878 for prevention of floods in the Oxford district is about to be carried out. An agreement has been concluded between the Thames Valley Drainage Commissioners and the Thames Conservancy, by which three-fourths of the cost of the works will be defrayed out of rates levied by the Drainage Commissioners, and one-fourth by the Conservators out of the Upper Navigation Fund, the works being carried out by the Conservators. The flood of last October, which rose to within a few inches of that of 1875, has no doubt hastened this result.

No very remarkable projects for the supply of water are coming before Parliament in the ensuing session. The Southwark and Vauxhall Water Company proposes to extend its boundary, so as to include Richmond, Wimbledon, Mortlake, and several other places. It likewise seeks powers of amalgamation. The revolution which was to overtake the London Water Companies at the hands of the Legislature, as proposed by the Government, is now postponed, pending the re-arrangement of the local authorities. When the new municipal power is created it will then be time to look after the metropolitan water companies. In the interval these well-abused bodies are increasing in their prosperity, and—as some people think—in their rapacity. They are unquestionably adding to their income, and they are learning how to combine the constant supply with a more economical use of the water. By this means they will get more work out of their present plant, thereby saving their capital and enhancing their dividends. The phenomenon of a decreasing consumption of water in the metropolis, in the face of an increasing population, is remarkable, especially as it is found to proceed hand-in-hand with the extension of the constant service. Beyond doubt there has been a great waste of water in London and its suburbs, and if the supply is to be constant, the companies must apply a check. Concerning the water supply of towns in general, Dr. Angus Smith, in his recent report as Inspector under the Rivers Pollution Act, details some novel experiments, which apparently show that the vitality of disease germs in water is capable of being more easily overcome than Dr. Frankland and some others have been disposed to admit. The views of Dr. Smith may be described as favourable to the use of river water, under certain conditions, as a source of supply for drinking purposes. The Local Government Board may accordingly choose between Dr. Smith and Dr. Frankland. In rural districts we find that wells are often very dangerous sources of supply. But there is peculiar difficulty in getting a good supply of water for small communities, owing to the disproportionate expense of the requisite works.

Several cases have occurred during the past year in which the Local Government Board have met with considerable opposition from local authorities in getting wells superseded by pipes. In other instances, where the water supply already takes the form of regular works, but where the source is a highly polluted river, there is frequently great unwillingness to incur the necessary expense for bringing in a supply which shall be wholesome. River water cannot always be made drinkable at every point, and there are towns which clearly require an improvement in the water which the people have to consume. In some cases—as at Plymouth—the water may be good, but there is a necessity for enlarging the volume. But anything which taxes the ratepayers, or which threatens to do so, is apt to be unpopular. This fact influences the local authorities, and a long contest of this kind has been going forward at Ely, where there appears to be great risk that the Local Government Board will have to interfere with all the weight of Imperial authority. Respecting litigation on the subject of the water supply, considerable interest has been excited in London by the dispute between Mr. Archibald Dobbs and the Grand Junction Company. Unless an appeal to the House of Lords should reverse the present decision, the company will remain secure in charging on the basis of the gross rental as the "annual value," instead of being limited to the mere rateable value of the premises. The Thirlmere scheme of the Manchester Corporation has been the occasion of a troublesome arbitration case with the Countess Ossalinski, concerning the value of her land, followed by legal proceedings on the part of the Corporation to set aside part of the award, on a point of law reserved by the arbitrator. It is not altogether improbable that the Corporation will even go a step further, and will seek to set aside the award in its entirety, the amount decreed by the arbitrator being characterised by the counsel for the Corporation as "preposterously exorbitant."

The most important event relative to the sewage question which has happened during the past year has been the appointment of a Royal Commission to inquire into the alleged pollution of the Thames by the metropolitan drainage outfalls. The Metropolitan Board having obtained Parliamentary power to expend £160,000 on the enlargement of their sewage reservoirs at Barking and Crossness, it was represented to the Home Secretary that before such a scheme was carried out there ought to be an investigation into the working of the main drainage system, great complaints having been made as to the extent to which the river was rendered foul in the vicinity of Woolwich and elsewhere by the sewage of the metropolis. In consequence of these representations, Sir William Harcourt obtained the appointment of a Royal Commission, having Lord Bramwell at its head, to take evidence and present a report as to the effect of the outfalls on the purity of the stream, and the best mode of remedying any proved mischief. The Home Secretary inadvertently included two gentlemen on the Commission who were already committed to an adverse opinion with respect to the outfalls. Apparently with a view to balance this error, two other names were subsequently added, thus raising the total number to eight. The inquiry is conducted with closed doors, and apparently has not made very rapid progress. In the meantime the enlargement of the sewage reservoirs is deferred. If the report of the Royal Commission should propose the discharge of the London sewage at points farther down the river than the present outfalls, a very serious expenditure will have to be contemplated by the metropolitan ratepayers. Another incident in respect to the drainage of the metropolis is worthy of note. A new sewer of considerable size and cost has been constructed by the Metropolitan Board, extending from Lee Bridge, Lewisham, to a junction with the southern high level sewer at Deptford Broadway. But the Greenwich District Board have obtained an injunction which, if strictly enforced, would prevent the use of this sewer. It would be lamentable that an outlay exceeding £27,000 should thus be neutralised, either wholly or partially. As a matter of fact, we believe the difficulty has been overcome by an amicable settlement, and the sewer will soon be in use. But it is certain that the Greenwich Board have been in litigation against the Metropolitan Board on this question of sewerage. So, also, we see the Corporation, as connected with the Port Sanitary Authority, fighting against the Metropolitan Board on the subject of the outfalls. Incidents like these will lend a point to the Parliamentary debates on the forthcoming scheme for the municipal government of London.

Plans for the treatment of sewage excite less notice now than they did a few years ago, when they served as the occasion of a speculative mania. But something is being done towards the purification of the rivers throughout the country, though the public excitement on the subject has very much abated. Birmingham has supplemented its lime and tank system by filtration through land, one acre being thus rendered as effective in the final process as eight or ten acres without the preliminary treatment by precipitation. Aylesbury adheres to the A B C method. Bradford makes use of lime in subsiding tanks, supplemented by filtration through coke breeze. The sludge is given away, and the working expenses are £4000 per annum. Rochdale is carrying on its pail system. But there is sewage still to be dealt with, and the Corporation have expended £30,000 in procuring land on which to discharge the liquid refuse as soon as the main trunk sewer, which is now being laid down, comes into full operation. The ventilation of sewers is a matter which attracts increasing attention, and has been made notable during the past year by the controversy raised in the *Lancet* respecting the healthfulness of Brighton. An important report on the "Treatment of Sewage" was presented to the Local Government Board early in the year by Dr. Angus Smith, containing some results and reasonings of a more encouraging nature than those which are generally promulgated on this subject in official quarters.

We have little to record concerning novelties in mechanical engineering brought into effective operation during the past year. The development of new inventions appears to have been almost wholly confined to electrical work. To the various new, or quasi-new, dynamo machines which were produced in 1882 we have already referred at length. The absence of novelty in other departments of mechanical science is in some respects striking. There is no diminution apparent in the number of patents taken out during the past year, and this supplies all the requisite evidence that the inventor worked just as hard in 1882 as during any previous year. But the distance between an invention which has been only patented and one in successful operation is enormous. A great gulf lies between the patent and the successful and general use of the thing patented, and into this gulf are thrown year after year great sums of money and myriads of hopes and aspirations. Shall we say that lives, too, are lost now and then in this abyss? The volumes of THE ENGINEER contain a weekly record not only of the work of patentees, but of the progress of inventions into favour. In them will be found not only lists of all the patents taken out in this country, but descriptions and illustrations of the best machinery that Great Britain, Europe, and America can produce. It is only necessary to turn over the leaves of our last two volumes to learn that little very new and important was produced by mechanical engineers in 1882. Numerous small improvements have been effected in matters of detail, but no considerable advance has been made in any single department of mechanical engineering that can be named. The reason appears to be that the year was, on the whole, unusually prosperous; and that for this reason invention was not stimulated, nor was the inventor encouraged by the manufacturer. The latter was, indeed, too busy to launch into new schemes. He had his hands full in endeavouring to keep up with the orders which poured in upon him. It may also be added that no great demand for novelties appears to exist. In other words, the great mass of engines, machines, and tools made in Great Britain are so satisfactory in their operation, so economical in their working, and so substantial in their construction, that the world of users and purchasers seems to be for the moment content, and to demand nothing new. That the world is right in this in certain respects is incontrovertible. That it is right in all respects is not true; and we propose here to call attention to one or two departments of mechanical science in which progress is imperatively demanded.

First upon our list comes the prevention of smoke. For the moment we shall not refer to household fires; concerning them we have written frequently. We are dealing now with boiler furnaces, and those to be found in manufactories, ironworks, glass works, potteries, and so on. Leaving boiler furnaces out of consideration for the instant, it may be said of other furnaces that while it is certainly possible to prevent smoke, it is not possible to do so without incurring trouble and expense. There is only one true method of accomplishing the given end, and that consists in burning gas where the heating work has to be done, and solid fuel where the gas has to be made. The Siemens furnace is the embodiment of the principle in the fullest degree; but the cost of a complete set of Siemens furnaces is very great, and the room taken up by them is considerable. There is besides this a certain inflexibility in the working of a Siemens furnace which tells against it in practice, and for these reasons the use of the gas furnace is limited. Indeed it is only wealthy firms who resort to this perfect but expensive means of attaining a very desirable end. We have next what may be termed the compromise system, as carried out in the Casson furnace and its modifications, as used by Messrs. Morewood at their Soho works, a description of which appeared in our pages last February. Yet even here the expense of the requisite plant is very considerable, and the space occupied so great as to entirely preclude its adoption in many establishments. We find, indeed, that in not a few instances where gas furnaces of various types have been put up at heavy expense, their use has been abandoned. It is difficult to find out precisely why, but the explanation we have usually received is that on the whole they did not pay; or they proved too troublesome in operation. To work gas furnaces to advantage everything must be very complete, and work must be carried on on a fairly large scale. Thus twenty gas producers can be made to give admirable results, when two may secure nothing but disappointment. Setting Siemens' furnaces on one side, and dealing only with those furnaces which produce gas close to a hearth, and then burn it—self-contained furnaces we may call them, such, for example, as Price's—it will be found that in all instances they require special arrangements for charging them with fuel. Thus a tramway has to be put up over the tops of the furnaces, and the coal has to be run along this in trucks and dropped into suitable hoppers. In other cases endless chains of buckets have to be employed; or cranes must be used to lift the coal out of canal boats or railway trucks; sometimes all three devices are employed. These things cost money; but they do more than this, they occupy space. In rolling mills, for example, we find furnaces dropped down, as it were, in all kinds of impossible places, so shut in and surrounded by machinery that it is as much as men can do to find their way to them with coal in barrows. If new works are to be started on a large scale, in localities where there is plenty of room, then the gas furnace system can be applied; but, as a matter of fact, we have to deal with old works and old plant representing millions sterling, and it is almost impossible to supersede in such cases the ancient system of hand firing, which gives excellent results in every respect save two—it is heavy on coal and it produces a great deal of smoke. Is it possible to produce self-contained heating furnaces, let us say, which shall be hand-fired and yet shall produce little or no smoke and prove, at least, fairly economical? It is not improbable that something may be effected in this way, and that by very simple means. We call to mind a case which came under our own notice some years ago. A heating furnace, used for wash heating shingled blooms, produced dense clouds of smoke. It was an unusually large furnace and was very hard driven. The mill manager thought he would try an experiment to get rid of the smoke, so he had about 10ft. of brickwork built on to the top of the chimney stack, which was already some

35ft. high, and just at the base of the chimney he had several holes made in the brickwork. The result was very satisfactory; the air admitted supplied the oxygen wanted by the intensely hot gases going up the stack and ignited them. Instead of smoke bright flame came from the top, and the draught, instead of being injured by the air-holes at the bottom, was improved, for, in the first place, the stack was raised 10ft. or so, as we have said, and in the second, the temperature within it was considerably augmented by the firing of the gas. Of course all the heat thus produced was wasted, but the end had in view was achieved; the smoke was prevented; and here we wish to point out that success was attained because the mill manager did not attempt too much. If he had tried to utilise the heat wasted in any way, he would, of course, have cooled down the gas and produced smoke. The important lesson which we wish to impress on the minds of our readers is that the prevention of smoke is one thing, and economising fuel is another thing, and there is no direct connection between the two; and we believe that in many instances if furnace owners would content themselves with the first, without attempting to obtain the last in connection with the first, they would succeed, and succeeding would do much to clear the air of our great manufacturing towns.

When we turn to the questions involved in preventing smoke in steam boiler furnaces, we find ourselves beset with difficulties. All our experience, extending over many years, goes to show that when the production of smoke is prevented by special devices for admitting air, either there is an increase in the consumption of fuel or a diminution in the production of steam. A noteworthy instance of this came under our notice recently. An extremely simple and elegant device for preventing smoke was submitted to an engineer. He was so much pleased that he had it fitted to the furnaces of a large Lancashire boiler, one of a pair, either of which could be used at will. An experiment was made by firing the boilers alternately week about, the same coal being used, and the same work being done by the engine, the same fireman being employed. The result was that smoke was practically entirely prevented; that there was no reduction in the steaming powers of the boiler; that the invention gave the fireman no trouble, and required no attention, and that the consumption of coal was *increased* by about 2 cwt. per day. The best smoke-preventer yet devised is a good fireman; and providing the boiler is large enough for its work, the coal fairly good, and that the air is admitted—not too much—in a thin sheet, as by a Martin's fire-door, such a man will prevent the production of smoke, and get admirable results. There is one type of boiler, however, which seems up to the present to have baffled every attempt to make it smokeless, namely, the modern marine boiler. A good deal of this is due to the work which such boilers have to do. They are, as a rule, hard fired; their grates are comparatively small, and there is no room for the hot gas to burn in. At sea smoke is of little or no consequence, as far as nuisance is concerned, but it means a serious waste of coal—not, indeed, as is commonly supposed, because a great deal of fuel goes unburned up the chimney, but because the tube surfaces become coated with soot, which is an admirable non-conductor. Thus, for example, it will be found that after tubes are swept, a lump of zinc will hardly melt if hung in the smoke-box in front of the tube ends; but before twelve hours are over the zinc will not stand five minutes in the same place, and in a little time the smoke-box doors will become red-hot. We have heard it argued that the engineers ought to sweep oftener, and the answer is that half an hour after sweeping the tubes will be thickly coated with soot again. As an example of the evil effects of soot, we may cite the case of economisers, such as Green's. These are always fitted with scrapers, and it is well known that if from any cause the scrapers get out of order the economiser soon becomes useless because of the deposit of soot on it; indeed, the relative efficiency of economisers can almost be expressed in terms of the efficiency of the scrapers in removing soot. It is far more easy to point out the difficulty that exists in the case of marine boilers than it is to suggest a remedy. There is, however, a plan which it might be worth while to try, derived from practice with blockade runners during the American war. The system which we are about to describe bears strongly on the scheme for working marine boiler furnaces with a forced draught, not only advocated by Mr. Marshall in his celebrated paper read before the Institution of Mechanical Engineers at Newcastle in 1881, but now being actually adopted in several of her Majesty's ships.

It may be taken for granted that with rather more draught than is now to be had in marine boilers, the coal would be burned to greater advantage. In the first place, the air would have a better chance of forcing its way through a thick fire; and secondly, thinner fires would be carried, as steam would be got with less forcing. The system of forced draught advocated hitherto consists in shutting up the stokehole, and driving air into it with a fan. To this very grave objections exist, not the least being that stokers regard it with terror and aversion. During the American war not a few blockade runners were fitted up on a different system. They were provided with fans, and these fans delivered into a main running under the stokehole plates. From this main a branch extended to each ashpit. When the fires were to be forced the ashpit doors were closed and fastened, and the fan then raised the pressure in the ashpit. No difficulty was experienced in firing, the smoke, ashes, or flame not coming into the stokehole; but in any case a simple register was provided, so that the fireman could shut off the draught with a motion of his foot. The difficulty of the system was that the stokeholes became intolerably hot from the absence of ventilation. This might have been avoided, no doubt, by improved arrangements for supplying the fans with air from the stokehole. Now, we suggest a modification of this scheme. Let every furnace, say, 6ft. long, be fitted with an ashpit door half way down its length; this will divide the ashpit transversely into two lengths just about the place where the centre grate bearer comes. Let a fan deliver air into the further end of the ashpit. Thus one-half the length of the fire would burn with a much stronger draught than the other, or front half, which could be worked in the ordinary way. The raw coal should be fed on the front of the grate as much as possible, and from it pushed back. It would be partially coked before it reached the back grate, and the fire there would always be comparatively clear; the smoke coming from the raw coal would be ignited, because, in the first place, it would be intensely heated, and in the second place, because it would get a supply of oxygen from the forced draught, which would readily make its way through the comparatively thin fire at the back. Of course, we have not gone into details. Practical engineers will see that there are no insuperable obstacles in the way of adopting this system. The fan, with its mains, has already been tried and given satisfaction. The ventilation of the stokehole would remain practically unchecked; the second or inner ashpit door could be so made that it could be hauled out in less than half-a-minute when fires were being cleaned and replaced as easily; the steaming powers of the boilers would be greatly improved, and none of the defects of a closed stokehole would be incurred. The arrangement would probably effect a considerable saving of fuel in the great Atlantic steamers, which in racing as they do between this country and the United States—not, it is true, with each other, but against time—use fuel in a very reckless fashion, everything being sacrificed to get as much steam as possible out of the boilers. It may perhaps be said that we have devoted too much space to the consideration of such a secondary matter as the prevention of smoke; but in our opinion it is not a secondary matter. It is, on the contrary, a very important question, and it is remarkable in that the problems presented have hitherto practically baffled engineers, most probably, as we have endeavoured to show, because they have tried to do two things at once, namely, save fuel and prevent smoke. It is a mischievous delusion, and one the propagation of which has done much harm and caused much disappointment, that if only smoke is prevented economy of fuel must follow. The truth is very nearly the reverse. The mere coal contained in smoke, that is to say, the black dust and soot, is so small in quantity that it does not require a moment's consideration whether it is or is not to be burned. The waste is really carbonic oxide, and this may be freely given off from a nearly smokeless fire. As a rule the prevention of smoke is secured by the admission of a great deal of air, and this air all subsequently escapes at a high temperature, representing so much loss of heat. Thus, under proper arrangements about 18 lb. of air will suffice to burn a pound of coal. Some of the smoke consumers admit as much as 30 lb.; say that they admit 10 lb. too much. Taking the specific heat of air at 0·23, it follows that the 10 lb. of air, if it escapes at 600 deg., carries off as much heat as would have raised 2·3 lb. of water through 600 deg., or in round numbers, it represents the conversion of considerably over 1 lb. of water into steam. Thus a boiler which was evaporating 7½ lb. of water per pound of coal may have its furnace so far improved that heat enough will be developed in it to evaporate 8 lb. of water; but inasmuch as extra heat equivalent to the evaporation of 1 lb. of water is absorbed and carried off by the extra air admitted the boiler will, after the improvements (?) have been effected, and after smoke has been prevented, evaporate but 7 lb. of water per pound of coal. These truths ought to be generally known, but we regret to say that they are persistently overlooked.

Two subjects stand out prominently and claim attention. These are the progress of ocean shipbuilding and the manufacture and use of steel. To neither can we give here the consideration which both deserve; but an article such as this would be incomplete were it silent on these subjects. They are, as it happens, closely interwoven with each other just now, and if we speak of one we shall speak of both.

The past year has been one of unusual prosperity for the ocean steam trade, and especially for the trade between England and America. We shall not, we have reason to believe, be far wrong if we assert that such vessels as the Alaska, Servia, Gallia, &c., earn each voyage from £18,000 to £20,000, quite one-fourth of which is profit. The "voyage" consists of a run from Liverpool to the United States and back again, and will occupy from four to five weeks. The enormous first cost of the huge steamers which now constitute the ocean Liverpool fleet is so great that their purchase is quite beyond the means of private firms; and it is no secret that the ships sailing under various well-known house flags and nominally owned by private firms really belong to large syndicates, backed up by important banking establishments. In this way, and in this way alone, can be obtained that almost unlimited command of capital which has produced the finest steamers in the world. We cannot possibly now attempt to deal in detail with the prospects of fast ocean shipbuilding in 1883. We may cite one ship, however, as an example of the utmost limit that has yet been reached. This is the Oregon, a new steamer for the Guion Line. It is anticipated that she will be ready for her trial trip about midsummer, and she is intended to excel in speed the fastest ship now afloat. She will not be much larger than the Alaska; but her engines are to indicate no less than 13,000-horse power. She will have but one screw, as we understand about 24ft. in diameter, with a pitch of nearly 40ft. Steam will be supplied by twelve boilers, each with six furnaces 3ft. 6in. diameter, the grates being a little over 6ft. long. We may compare her with the Alaska, which ship has nine boilers with six furnaces in each, of about the same size. Comparing grate areas, we find that the aggregate surface in the Oregon will be 1512 square feet, divided among seventy-two furnaces, while that of the Alaska is 1134, divided among fifty-four furnaces. As the Oregon will burn about 20 lb. of coal per square foot of grate per hour, her consumption in twenty-four hours will not be much under 300 tons; and allowing that each ton of coal evaporates 9 tons of water, we find that no less than 2700 tons of steam will pass through her engines every twenty-four hours. A tank 100ft. square, to hold 2700 tons of water, must be nearly 10ft. deep to prevent the water from running over the edge. If the tank were 50ft. square, the water would stand 38ft. 10in. deep in it. If the water were supplied to a town, allowing 4 cubic feet or 25 gallons per head per day, it would suffice for a population of 24,000 souls; 6000 tons of air will pass through her furnaces, representing a volume of 174,720,000 cubic feet through a pipe 11ft. 4in. diameter. This volume of air would flow at the rate of 13·8 miles per hour, a strong breeze to walk against. The total weight of water evaporated on the run across the Atlantic will not be far short of three times that of the whole ship's cargo, engines and all. We give these figures to enable our readers to form some idea of what 13,000-horse power means; and we may supplement them by adding that it is equivalent to 191,517 tons lifted a foot high every minute, or the same weight lifted 1440ft. in twenty-four hours. Assuming that she makes 20 knots an hour, or, omitting fractions, 2028ft. per minute, the thrust of her screw—that is to say the force pushing her ahead through the water—will amount to over 94 tons, or about as much as twenty of the most powerful locomotive engines in England would exert if all were pulling at her together. Among the other difficulties which crop up when we have to deal with such enormous powers as these figures represent, we mention that of getting the coal to the fires. We see that in the case of the Oregon no less than 300 tons a day, the full load for a coal train of thirty trucks, will have to be handled every twenty-four hours. If the ship were at rest, the problem would not be easy of solution, but it becomes very hard indeed to deal with in a rolling and pitching vessel. All is done, of course, that can be done in arranging boilers and bunkers to accommodate each other, but it is evident at a glance that out of a total quantity of, say, 2500 tons of coal a great deal must be stowed at a considerable distance from the furnaces. It does not appear that any mechanical device has yet been hit on in the way of a railway which answers better than the existing arrangements, by which the whole of the work is effected by sheer manual labour.

Before leaving the subject of large passenger ships it may be worth while to call attention to the fact that foreigners are now buying large ships extensively. Thus Messrs. Napier, of Glasgow, have in hand three Italian mail steamers, each of 4000 tons and 5000 indicated horse-power. They are also building for a Mexican firm three vessels of 4000 tons and 4000-horse power, to run between Liverpool and South America. These ships represent at least three-quarters of a million sterling in one shipyard alone; nor do Messrs. Napier stand alone. Messrs. John Elder and Co. are building for the New Zealand Steamship Company three vessels of 4000 tons each. We could extend the list were it necessary. As to the smaller class of cargo steamers, their number is legion, and it is practically impossible at the present moment to place an order anywhere for a new steamer for delivery within six months.

Coming now to marine engines, we find that the only changes which have been made during the past year, or which are likely to be made in the present year, are in the direction of using higher pressures. There are many steamers now afloat carrying 120 lb.; few new steamers carry less than 90 lb. The Mexican steamers to which we have just alluded will carry 140 lb. steam worked in triple expansion engines. It does not appear that there is any economy effected, as far as coal is concerned, by the use of these extreme pressures, but it is found that smaller boilers may be used, which is of considerable importance. With moderate pressures it is very difficult to get dry steam without a very large steam space, and for this reason boilers are made bigger in diameter than they need otherwise be. But with steam of 100 lb., twice as much of it by weight as of 50 lb. can be got into a given space. The bubbles rising through the water from the heating surface are also smaller by one half, and the ebullition is less violent; therefore priming is reduced and dry steam is supplied to the engines. The boilers being kept down in diameter no augmentation in the thickness of plates is required. In some cases the two top rows of tubes are suppressed, apparently without detriment to the steaming powers of the boiler; but the tendency is to rather augment than diminish grate surface. So long as the pressure is kept below 120 lb. or so, there is no more expansion employed than when steam of 80 lb. was used, and the terminal pressures are accordingly higher, the aggregate result being that out of a given weight of engines and boilers more power is got in very nearly the ratio of the augmentation of pressure. These appear to be the sole gains, and they are well worth having. The supply of dry instead of wet steam, the suppression of priming, and a reduction in weight, are almost invaluable at sea.

The three-cylinder type of engine appears to be gaining in favour. The City of Aberdeen, whose engines were illustrated in our pages not long since, has given great satisfaction. A comparison may be made between her performance and that of a nearly sister ship, the Hankow. The displacement of both vessels is about the same, and their lines are, we believe, not very dissimilar. The Hankow in a voyage of forty-six and a-half days, made without a stop at any port, burned just 36 tons of coal a day, including all coal used for the galley, donkey pumps, &c. The City of Aberdeen made precisely the same voyage in forty-one and a-half days, burning in the same way 34½ tons per day. Of course, the data are to some extent vague, but they go to show that the City of Aberdeen is a very successful ship, and we may add her boilers and machinery have given no trouble whatever. After one voyage of over six weeks' duration she was ready to proceed to sea again in twenty-four hours, nothing being needed but the letting together of brasses, the packing of glands, and a general cleandown and overhaul. A new method of creating and maintaining a vacuum in surface condensing engines was, by permission of Mr. Alfred Holt, tried on board the steamship Cyclops on Saturday week. It is the invention of Mr. Robertson, and is patented by him. By it the ordinary air pump is dispensed with entirely, an air extractor being fitted by which the circulating pump is able to maintain the vacuum without in any way interfering with its ordinary work, thus saving the cost of fitting and maintaining an expensive air pump, and materially reducing the drag and friction of the engines. There was a strong north-westerly gale blowing during the trial, and a heavy sea running, but a steady vacuum of 26½in. was maintained throughout, and the engines ran more freely than with the air pump connected, showing an increase of nearly a revolution per minute. The Cyclops proceeded on her voyage to China with the air pump disconnected, and a further account of the working of the extractor during the voyage will be given on her return. The air and water are taken away from the condenser by separate pumps; the water by a fixed pump placed below the condenser bottom is forced either direct to the boiler or through a feed heater as may be desired. The air is taken from the surface of the water before entering the feed pump, and after passing through a separator is finally extracted.

Inseparably bound up now with steam shipping, and, indeed, with mechanical and civil engineering generally, is the progress of the steel manufacture. Of the 291 vessels launched during 1882 on the Clyde alone, sixty were of steel, with an aggregate tonnage of 108,254; and to give an idea of the growth of steel shipping, it may be stated that in 1881 the steel tonnage put in the water was 66,609 tons; in 1880 it was 42,000 tons; and in 1879 it was only 18,000 tons—so that in the short space of four years the amount of the Clyde steel shipbuilding has increased six-fold; but it is not of steel shipbuilding we would speak now, but of a later development of the use of the metal. One of the greatest difficulties met with in marine engineering work is the production of trustworthy crank shafts. Mr. W. Parker, chief engineer surveyor to Lloyd's, has, perhaps, done more than any other man living to put the cause of the breaking of shafts in its true light, and he has been ably aided by his assistants, and backed up by Lloyd's, who have spared no pains and no money to arrive at the truth. It has now been established beyond fear of refutation, that crank and screw shafts break because they are not kept in line; and it is very difficult to keep them in line, because a ship's hull is more or less flexible. When a shaft is not in line it is bent at every revolution. The bending may be quite imperceptible to the senses, but it is none the less effective in destroying the shaft. As Mr. Parker and Mr. Milton have pointed out, the rapidly altering strains of great intensity, first tending to bend the shaft in one direction and then in another, coupled with the sudden changes in the form of the metal, unavoidable in a crank shaft, are extremely fatiguing to the metal, and even the best material is at last strained beyond the limit of endurance by a much less force than it would have previously borne. "It is, therefore," says Mr. Parker, "necessary, in making crank shafts, to use only a material which will have a great amount of endurance when subjected to oft-repeated and varied strains." The soundness of this statement is indisputable, but it implies more than is seen at first sight. We have to ascertain what is the material which complies with the stated conditions, and on this point a wide diversity of opinion exists. Messrs. Parker and Milton's investigations go to show, however, that it is not necessarily either the strongest or the reputedly toughest metal which meets the case, and steel makers will do well now to turn their attention to the production of a class of metal which will endure the greatest number of often repeated reversed strains without deterioration. We believe we may say the Terre Noir steel made by M. Pourcel has given results equal to those obtained by any other maker. The necessity for getting something better than forged iron for shafts has led to the trial of cast steel crank and propeller shafts, the last either when of small size being cast in one or two pieces, with the cranks and pins complete, or when of large size made either on Turton's or Dickinson's system, both of which have been illustrated in THE ENGINEER. Built-up cranks of Whitworth steel have been in use for some time, noticeably, for example, in the City of Rome; but there is now a tendency at least manifesting itself to produce steel crank shafts whole, so to speak, in the foundry, and it is not improbable that before the present year is out important advances will be made in this direction. It is noteworthy, however, that not only is there no uniformity of opinion among steel makers as to the best way in which to produce large masses of sound steel, but that their practice is as diverse as their theory; and that each man insists that he alone is right and everyone else wrong; and all the while the processes most condemned seem to be capable of giving results hardly distinguishable from those obtained by the best. It will be instructive to consider here what is the present attitude of steel makers on this subject; and first let us see what Sir Joseph Whitworth, a veteran smith, holds concerning steel. He asserts that to get steel sound it must be compressed while fluid under a pressure of 20 tons on the square inch, and as this cannot be done with large castings, because no moulds could be made strong enough, then he puts on all the pressure he can while the steel is fluid, and he afterwards chews the steel, if we may use the term, in great steel squeezers, and by this means, as he says, alone gets to the centre of a big ingot or casting. The result of this squeezing is that blocks of steel as they leave the squeezers are convex at the ends instead of concave, because the insides have been squeezed out of them. Mr. Haswell, of Vienna, dealt with steel in much the same way with his hydraulic stamping machine, which could also be worked as a squeezer, more than a dozen years ago, and with admirable results. But his plant would not deal with such masses of steel as Sir Joseph handles; nor indeed did they exist at the time. It has been asserted that the fluid compression process is simply useless. Be this as it may, it is quite certain that Sir Joseph Whitworth has succeeded in producing a very admirable material—albeit its cost is very high indeed.

Messrs. Jessop and Sons hold views not only opposed to those of Sir Joseph Whitworth, but of nearly all other eminent steel makers. They maintain that castings can only be properly made from crucible steel, because in this way only can uniformity of texture be secured. When the contents of two or three hundred crucibles are all mixed together in one ladle, diversity of texture becomes impossible, because an average must be struck between the characteristics of the steels in the various crucibles. The firm produces all its castings in this way, the steel being made by the old cementation process from selected Swedish iron. Messrs. Jessop also hold that steel castings cannot be improved by forging, because no hammer can reach the inside of a big mass, and hammering the outside only introduces variations in texture. In this respect they hold much the same view as Sir Joseph Whitworth. He, however, as we have explained, kneads or chews his steel in tremendous squeezers; but Messrs. Jessop content themselves with letting the casting cool very slowly, and there is every reason to believe that they turn out splendid castings of very large size, without a trace of blow-holes or imperfections. We may point out that their system of working is in many respects identical with that exclusively pursued by Krupp for many years, and still largely employed at Essen.

Turning now to Messrs. Vickers, we find that they make all their heavy steel castings on a principle introduced by themselves, and known as the "Vickers-Siemens system." The lower ends only of very heavy ingots are used, and these are forged into shape, and they rely on the continual use of test pieces to get good results. Nearly the same method is pursued by the Bolton Steel Company. Messrs. Spencer, of Newburn, use the Siemens process, and they hold that, while forging is practically useless, slow annealing is essential to success; and annealing is accordingly practised by the firm in the most complete way. The Steel Company of Scotland relies on the addition of silicon to steel made by the Siemens process in order to get rid of blow-holes. Virtually the process used is that of M. Pourcel, as practised at Terre-Noir.

This rapid summary indicates the practice of the principal, if not the only, firms who produce large masses of steel in the shape of crank shafts, stern frames, parts of machinery, &c. Now it is a noteworthy fact that, while there is such a diversity of practice, all the firms have succeeded in obtaining excellent results. It will be seen that the only firms producing steel castings in the strict sense of the word are Messrs. Jessop, Spencer, and the Steel Company of Scotland; all the others manipulate the steel in some way after it has been cast. It may be urged that the practice of cementing Swedish bars, breaking up the blister steel, melting it in crucibles and casting it, cannot fail to be very costly. This is true; but then the whole cost of forging is saved. The real stride made we may say during the last twelve months consists in casting steel directly into the shape that is required, instead of first casting an ingot and forging that into shape. Not only is there now a prospect that screw shafts of large size will be cast whole, but that a multitude of the smaller details of marine engines will be so produced. In short, everything that a smith finds it troublesome to forge will be cast in steel. It has long been the practice of many firms to cast small parts of machinery in iron, and subsequently to render them "malleable" by burying them in hematite ore, and keeping them at a bright red heat for some hours, or even days when the casting is large. In this way the iron is decarburised and rendered tough. Such castings have long been used in enormous quantities and with the greatest success, but the limit of size beyond which the process cannot be applied is soon reached. Steel promises to begin just where malleable cast iron leaves off; and so far as can be seen at present, there is no limit to the size of the castings which may be made. We should not be in the least surprised to hear that a 50-ton crank shaft had been cast whole in one piece, and with perfect success. Steel begins to unfold its secrets; and once the causes of the troubles met with hitherto in making big steel castings is known, steps can be taken to deprive them of malign influence with some prospect of success. As an example of what we mean, we may point out that at last it has been fairly proved that the unsound portions of every large casting are at or near the top, because the bubbles of occluded gas rise in the mould. Various attempts have been made to draw off the gas—on the whole without success. As the gas cannot be got out of steel, steel is provided for its reception in a place where it can do no harm. Thus Messrs. Jessop and Sons and Spencer and Sons always provide a "dead head" to every casting. This head is frequently heavier than the casting. Into it the gas bubbles rise, and are there retained, the casting proper being perfectly sound. Another point worth notice is that the harder the steel the more easily it fuses and the better it runs. The soft steels unfortunately require so high a temperature for fusion that the molten metal melts ordinary moulding sand or loam, and the surface of the sand has to be coated with some infusible protective material, such as ganister. In working in this direction considerable improvements are still needed, and it is to be hoped that means will be found ere long of coping with a very serious difficulty. The injury to the interior of a mould may render a casting useless; and even when the mischief done is not quite so serious, the surface of the casting will be spoiled.

In conclusion we may state that Messrs. Parker and Milton have, we understand, reported to Lloyd's that the use of cast steel crank shafts may be permitted tentatively, provided test pieces show that the metal will not stand a greater strain than 30 tons per square inch, and that 1½in. square bars may be bent cold 90 deg., with a radius of 1½in. This is a step in the right direction, and its success may, we think, be confidently anticipated.

One or two old schemes revived may be worth notice. In the United States it has been proposed once more to propel street cars by coiled springs. It may be taken as proved that a spring, in whatever form, cannot be trusted to take up more power than would suffice to lift it about 60ft. Thus a spring of 1 lb. weight might have 60 foot-pounds of energy stored in it, and so on. A company has been formed in Philadelphia to work street cars in the following way:—Each car will be fitted with six springs coiled upon a cylinder. Each spring will be made of a flat bar of steel 300ft. long, 6in. wide, and ½in. thick. These springs are, it is claimed, tempered by a new process so uniformly and delicately that their power becomes tremendous. After first being coiled so that their diameter is 18ft., they are tempered, and then wound up until the diameter is 7½ft. In this condition they are placed upon the car and adjusted. The weight of each spring will be about 1500 lb., and it will store about 90,000 foot-pounds. If we stretch a point in its favour, we may say that it will represent 3 indicated horse-power exerted for one minute. Six such springs give 3-horse power for six minutes, or one horse-power for eighteen minutes. But as the weight of the springs and their appurtenances, to be moved cannot be less than 5 tons, it will be seen that the chances of the success of this invention are very minute. Another old project revived is the construction of a flying machine. M. Tissandier, the French aeronaut, is projecting the manufacture of an elliptical balloon, which is to be driven by a dynamo machine and storage batteries. The balloon will be 131ft. long, and will have a capacity of more than 100,000 cubic feet. It is calculated to give a lifting power of 3½ tons, which will, when the machinery is in place, allow for a ton of passengers and ballast. The only novelty here is the storage battery, but on storage batteries the aeronaut cast the eyes of desire the moment M. Planté made his invention known.

The year's work in electricity, and the outlook into the immediate future, claim our attention. When there is a decided unrest in political circles, the political writer is apt to describe the condition of things by the simile of the rumblings and mutterings of a volcano immediately preceding a gigantic outburst. We know of no more apposite analogy than this for the condition of things pertaining to electrical work. The year has been one of intense activity, but the activity has been more internal than external, more in preparatory work than otherwise. The fool alone attempts to prophecy without absolute knowledge, but there is such a thing as deducing a conclusion from given premises without trespassing upon prophetic grounds. The premises then which are open to the consideration of the world lead us to draw certain conclusions, which may or may not be correct, according as we translate rightly or wrongly the premises before us. It is well known that for many years the question of coal supply has been one of the greatest interest to economists, politicians, and manufacturers. We have reasons for placing these classes in the above order, inasmuch as we take the work of manufacturers to belong more to the absolute present than that of the politicians or economists. In fact, the latter look, as they ought to look, to the centuries ahead as well as the centuries gone by. England owes much—how much we leave others to determine—to the possession of fuel, ore, and water. Fuel in the shape of coal seems as yet to be an absolute necessity; and assuming for the moment that it may be unlimited in amount, it is certain that to obtain it becomes annually a more and more costly process, and will continue to do so as the works grow deeper. There must then be a gradual accumulation of industries that will languish and fail because of this increased cost, and it behoves us as wise men to look ahead, and at the earliest moment indicate the chances of obtaining the energy required in these industries from a new source. Then, again, we must look at the destructive distillation of coal as a means of obtaining a lighting gas as sheer waste if the necessary light can be obtained equally well in some other way. A most important question, then, relating to the development of the applications of electricity is, How can it affect the consumption of coal? The answer to this would require a monograph in the *Quarterly*, rather than one of our columns. We may, however, briefly refer to the future in one or two directions. If we by any means upset electrical equilibrium we obtain electrical phenomena, and in certain cases can take advantage at the point chosen by ourselves of the energy developed by nature's attempt to reinstate the electrical condition. We say nature's attempt, because it is a fundamental law that the tendency is to return to the normal state of things. It has been shown that we can disturb the electrical equilibrium at one point, and obtain energy developed by such disturbance at another point. The latter point must, however, be somewhere in what is known as the electrical circuit. Electrical action is in closed curves. The analogical case of water helps us very much to explain this action. Disturbing the electrical equilibrium is very similar to putting water at some height above the sea level. The energy due to head of water can be used at any point down to sea level. In the case of electricity we have given a difference of level—or potential as it is called—and as water flows from a high to a low level, so electricity passes from the state of high potential to the state of similar potential. Further, just as work has to be done in raising the water, a certain percentage of which can be got back during its fall, so work must be done to obtain electricity at a high potential, a certain percentage of which can be got back during the fall of potential. One direction in which electricians are looking is to the utilisation of electricity for the transmission of power. They are trying to obtain a good apparatus by means of which the natural forces—such as wind, tides, rivers, waterfalls, &c.—can be used to supply electricity at a high potential, and this apparatus is to be connected through the point where it is desired to utilise the power by means of a suitable conductor. Let anyone try to calculate the foot-pounds of work due to natural forces in any country idly dissipated to-day, and hence to arrive at an idea of the coal which could be saved by using this now wasted energy. We can only urge investigators and wealthy men to strive more earnestly in this direction. Why should coal, which will one day be almost invaluable, be wasted when other natural agencies are ready to assist in giving the energy required for our work? England is well favoured in some respects with regard to its natural forces. It is a small country, it is insular, and hence tidal power could be transmitted to a considerable extent. The Manchester Ship Canal may be a gigantic sceme; but we can conceive of works on a far larger scale—works to store millions of tons of water at high tide, this water to be used in driving turbines, &c., and these again connected to dynamo machines. We have, at the cost of many millions, created a network of rails and telegraph wires. Is it improbable that even at a somewhat similar expense we shall one day have a network of lines to carry power? A different meaning may be given to an old axiom, and the words be transposed, still stating a grand truth, "Power is wealth." Here, to use an algebraic expression, power equals foot-tons.

As regards dynamo electric machines, those that have made most noise in the world in 1882 are those of Gordon and Ferranti. These are both alternate current machines. Gordon's machine is the largest ever constructed and used, and has, as has also the small one of Ferranti, been fully described in our columns. We are not yet convinced that an alternate current machine is *the* machine for the future. Thomson, Varley, and others have proved that an appreciable amount of time is required to charge and discharge a cable. The electric light conductors, we imagine, will mostly consist of insulated wires, that is, wires similar to cables, and therefore long lengths of such conductors will require an appreciable time to charge and discharge. How many miles of conductor will be required in a large installation of the electric light upon the lines suggested in the provisional orders now lodged with the Board of Trade? Whatever be the number, and though it may not reach one-tenth of the 3000 miles of an Atlantic cable, there will come in the function time as regards charge and discharge. It would not be difficult to state the conditions under which neither Ferranti's nor Gordon's machines would work, and the reply to our criticism will be that the machines will never be required to work under such conditions—that is, their value will be admitted to be limited. Alternate-current machines to supply from five hundred to five thousand lights will be useful, and probably highly so, in the immediate future. We are greatly surprised that, with the one exception of Edison, no one has constructed a continuous-current machine to supply over a thousand incandescent lamps. Although not so simple in construction, the latter seems the better machine, in that not only can it be directly used for lighting purposes, but may be employed to transmit power, to charge storage batteries, for electro-plating, &c. It must be remembered, however, that with electric machines, as with other machines, the best effect is obtained when the machine is designed specially for the object in view.

Any account of the year's work would be incomplete without a reference to storage and secondary batteries. It is well understood by this time that electricity is one result of chemical action. The secondary battery does not store up electricity, but an electric current sent through it simply causes a chemical action. When the current ceases, a reverse chemical action takes place, giving a current of electricity. The action of the secondary battery has been completely explained in our columns by Professor Lodge. It may be briefly said that all the secondary batteries of importance approach more or less in construction to the FitzGerald-Crompton type. The plates of this battery consist of minute particles of lead, obtained by chemical or mechanical action, which are slightly oxidised and then compressed. The compression rubs off the oxide, bringing pure metal points into contact, and so giving metallic continuity to the whole. The plate obtained is similar to a sponge. The Sellon-Volckmar battery consists, we believe, of a lead plate perforated with comparatively large holes, these holes being filled with spongy lead. Theory points out that the filling up of holes in such a manner is imperfect, inasmuch as under the action of the current the lead-holder gets "formed"—that is, rendered spongy. It then deteriorates as a holder, and also as giving metallic continuity from the plugs through the mass. Then, it seems, the plugs must, in the first place, be of compressed material, and how far such compression is permissible is a question of a legal character, into which it is not for us to enter. It is said that great strides have been made in perfecting the Faure battery, but it may be taken for granted that the new Faure battery is little better than the old Faure, nor is it probable the Faure battery as popularly known will be worked on a large scale. The plastering on a lead plate of minium and holding it there by any means will be put aside, and the Faure battery in its new dress will be found to approximate very closely to some other secondary batteries. Professor S. P. Thompson has expressed the conviction that the Planté plate, after all, is the best plate for secondary batteries. To a certain extent we agree with him; but it must be seen that an enormous amount of energy has to be wasted in "forming" a lead plate. It seems to us that the FitzGerald-Crompton plate avoids this loss, the highly compressed plate being similar to a "formed" Planté, and hence requiring little or no loss of energy in the formation. The secondary battery is wanted at once to regulate and to insure against a temporary breakdown of engine and dynamo machine, also to allow of a short period of rest to engine or dynamo machine.

We have to chronicle little as regards improvements in arc or incandescent lamps; still minor modifications are continually going on, bringing them nearer and nearer to the perfect state. The year has, in one way, been extraordinary, viz., in regard to the formation of companies, rash speculation, and failure. It is ascertained that forty-nine companies have been brought out having some connection with electricity, with a nominal capital of £16,378,000, the capital offered to the public amounting to £10,026,900. It is not too much to say that at least one half of the $1\frac{1}{2}$ millions or so of capital subscribed to these companies has been absolutely wasted. In many instances there never was the slightest chance of the proposed company doing work, and there is no doubt that many of these companies were floated by men who knew the worthlessness of the systems so loudly vaunted. From the middle of 1881 to the beginning of 1882, a rush was made to put up installations of electric light plant—for money if money could be obtained—but, to put them up for much, little, or nothing. A system of business was introduced that hardly commends itself to the laws of economies. The introduction of such a system has to answer for many of the failures of the year. Looking back through 1882, we find that the Pilsen system of arc lighting has increased in favour, as has perhaps the Crompton; but so far as we can gather the Brush and Brockie have declined, whilst the Jablochkoff may be deemed to have held its own. The André lamp has been exhibited satisfactorily, the Fyfe-Main and the Weston have been installed in one or two instances, and so on. No lighting, however, on a large scale. It is agreed upon all sides that the arc system has but a comparatively limited field of usefulness, and that to its rival, the incandescence system, we must look for great progress. Another twelve months must elapse before a satisfactory installation is complete that will enable us to judge fairly between it and gas. There are we know times and places when gas cannot compete with electricity; but taking London as the centre of enterprise, what can we judge at present? The gas companies supply thousands upon thousands of burners; when electric light companies do the same then will come the true period of comparison. It is needless to say, we think, that electricity can be as easily, safely, and cheaply supplied as is gas. The recent legislation will enable the electric light to be placed on somewhat the same footing as gas. After the sanctioning of the provisional orders, which may be soon after Parliament meets, definite plans will have to be made by the companies for carrying out the work undertaken. Two or three years are given for completing the work, and we are well within the mark when we say that twelve months must elapse before anything on any extended scale will be complete. The largest installation carried out during the year is that at the theatre at Brünn in Lower Austria. The Edison system is adopted, and has been fitted under the superintendence of Mr. F. Jehl. Fifteen hundred lamps are fixed, which can be used almost in any way desired—singly, in groups, giving a full or a partial light, shaded, or otherwise. In speaking of this work we had not forgotten the larger work at New York, which, however, is as yet incomplete. The Edison installation at Holborn is on a fairly large scale, and we believe the third dynamo machine is being placed in position. These machines are the largest in public use—that of Gordon being used at the constructor's—and are nominally 1000 or 1200-light machines. The standard light is here the Edison A lamp of 16 candles; so that these three machines are capable of supplying easily some 3500 such lamps. With one or two exceptions the lamps have been lighted with all the regularity that could be desired. The experience gained since the starting of the Holborn station has been of a valuable nature, and the Edison Company believes that, when a larger area has been covered by the requisite network of conductors, and various recent improvements have been introduced, central station lighting will be in a position to return a satisfactory dividend on the capital invested, even at the present price of London gas. The company has made several isolated installations in public buildings, factories, ships, &c. The Edison Company has during the year reduced the price of its incandescent lamps, first from 5s. to 4s., and now, we believe, to 3s. Given a lamp of 16-candle power, to last a minimum of 1000 hours, at three shillings, and we find that the cost of lamps alone amounts to one half that of gas to give the same light at 3s. per 1000 cubic feet. But recent improvements in the machines and lamps tend to greatly increase efficiency and economy.

Messrs. R. L. Crompton and Co. have during the year built a large number of dynamo machines of the Bürgin type, and latterly several compound machines. The firm has greatly improved the arc lamp known as the "Crompton lamp," and have carried out a large number of installations upon the arc system; others where Swan incandescent lamps are used, besides having carried out contracts for the Swan United Company. The principal of these installations have from time to time been referred to in our columns, such, for example, as those at the new Law Courts and at the Birmingham Town Hall. There has been a great diversity in the work, showing how applicable the electric light is to illumination for all kinds. At the Nine Elms goods yard, for example, twenty-eight arc lights are used, the motor engines being by Messrs. Davey, Paxman and Co. At the new mansion of Mr. O. E. Cope, M.P. — Berechurch Hall—Swan incandescent lamps are used. The engine used here is also one of Davey, Paxman and Co.'s At the Law Courts, 450 Swan lamps are already fixed, the engine used being one by Messrs. Marshall, Sons, and Co. An extension of the system at Risca colliery has been carried out during the year. The Swan Company has fitted the lamps into a number of steamers. Among others we may mention H.M.S. Himalaya—the first public vessel so lighted—the Mairapouri, and the Wairaraka, vessels of the New Zealand Steamship Company; the Goorkha, belonging to the British Indian Steam Navigation Company; the Lonsdale, Cephalonia, and Pavonia, belonging to the Cunard line. The steam yacht Empress has been fitted with Swan lamps, by Messrs. Crompton, and through Messrs. Johnson and Phillips the new vessel belonging to the Eastern Telegraph Company—the Volta—is lighted by electricity, with Swan lamps and Bürgin machines. We may here say that Messrs. Johnson and Phillips have carried out almost the whole of the fitting of the Volta. Various installations have been supplied by Messrs. Crompton in Scotland, through Messrs. H Bennett and Co., of Glasgow; in Ireland, through Mr. J. H. Greenhill, of Belfast; in the North of England, through Messrs. Norman and Sons, of Barrow; in the Birmingham district, through the new firm of Crompton, Winfield, and Co.; in Italy and South Germany, through Mr. Bollinger, of Milan, as well as in Spain, Denmark, Egypt, &c. We ought, perhaps, to mention that the General Post-office building at Glasgow is now lighted throughout by twenty Crompton arc lamps and 300 Swan incandescent lamps. We have sufficiently indicated the work carried out by the combined firms of Crompton and Co. and the Swan United Company, although we could add very extensively the the list of installation if such a list were desirable.

It is well known that the Brush parent company has not been carrying out work, but has restricted itself to the manufacture of apparatus. Next to this is perhaps the Hammond Company, which lighted the town of Chesterfield with Brush arc and Lane-Fox incandescent lamps. The arc lamps have gone very well, but for a long time the Lane-Fox lamps were severely criticised. We are told that within the last few weeks better lamps of this class have been fixed, and that the light is now considerably improved. The best installation, however, of the Brush arc lamp, so far as we know, is at Brighton. We are informed this installation was carried out by the Hammond Company. During the latter part of the year the company's efforts seem to have been concentrated in acquiring rights to the Ferranti machine. This machine we have already referred to.

We have now shown that a fair amount of activity has been going on during the year, but far below what is proposed when the provisional orders are sanctioned. Various small installations by minor companies have been carried out, but it suffices to mention the fact, and it is needless to refer specially to every tiny one.

Turning from electric lighting to the now rather out-in-the-cold subject of telegraphy, we must give a few details of that more important branch, submarine work. There is comparatively little in land work to interest engineers, but submarine cable work involves the use of carefully-designed, complicated, well-made machinery; and success in laying and preparing cables is due in a great measure to a just knowledge of engineering principles. The two great cable-manufacturing companies, viz., the Telegraph Construction and Maintenance Company, and the Silvertown Company, have between them manufactured and laid something like 7000 miles of cable during the year. The following is, we think, a fairly complete list of the cables:—Trieste-Corfu; Malta-Tripoli; Alexandria-Port Said—manufactured by the Telegraph Construction and Maintenance Company for the Eastern Telegraph Company; the Grutsiel-Valentia cable, manufactured by the same company for the German Union Company; the Ceara-Maranham, Madeira-Lisbon, and Lipari-Salina cables, also manufactured by the Telegraph Construction Company. The Silvertown Company has been very busy during the year over the West Coast of America and other cables. The sections of these cables are Chorillos-Payta, Payta-St. Helena, Galveston-Brownsville, St. Helena-Buenaventura, Buenaventura-Pearl Island, Salina Cruz-Libertad; Libertad-S. Juan del Sur; S. Juan del Sur-Pearl Island. These are all, as will be seen, from America, as were several others. The company manufactured the Saghalien-Tartary cable for the Great Northern Company, the Aberdour-Granton cable for the Post-office, and some others. Messrs. Siemens have, it seems, done little cable work during the year, the principal being the Land's End-Dover Bay, and the Jeddah-Suakin cables. The total lengths of these cables, as we have said, is about 7000 miles, and the manufacture has been pretty equally distributed between the two great companies. Roughly speaking, we may estimate the cost of making and laying a cable at some £200 per mile more or less, and this would give the capital for the year's work at something like a million and a-half. The largest cable company is the Eastern, which, with its connections, has a system comprising about 22,000 miles of cable, and if to this the system of the Eastern Extension is added—for the whole is really one system—the mileage reaches nearly 33,000 miles. During the year some notable repairs have been effected by the ships and staff of the Telegraph Construction and Maintenance Company. The Kangaroo repaired the 1874 Atlantic cable off Newfoundland in the spring; in August the Seine repaired the Lisbon-Porthcurnow cable in 2700 fathoms of water off the coast of Spain. During the laying of the duplicate Madeira-Lisbon cable a new shoal was found and the course of the cable diverted. The shoal rises to within 100ft. of the surface, and the depth of water rapidly increases to over 2000ft. The shoal is now marked on the Admiralty charts as the Seine shoal. A similar shoal was found along the original line of cable, and is known as the Gettysbury shoal.

THE ELPHINSTONE-VINCENT DYNAMO MACHINE.

On page 1 we illustrate a machine upon which the designers have been working for some years, endeavouring to make it as perfect as possible before commencing their manufacture on a large scale. The diagrams explain clearly the construction of the machine, and it is claimed that there is but little waste wire used in it, and that the various parts are removable and easily replaceable. The cross section shows twelve magnet poles, six on one side the cylindrical armature, six on the other; that is, the armature revolves between three horseshoe magnets opposite three similar horseshoe magnets, an inside N pole being opposed by an outside S pole. The armature consists of a cylinder of papier maché, upon which are laid saddles of wire, these saddles or flattish coils of wire, answering the same purpose as the coils of wire on a Gramme ring armature. The one end of one saddle coil goes to the commutator, and the other to the beginning of the next coil, and so on. The armature has 18 sections wound with double wire, thus making 36 coils. The resistance of the armature between brushes is ·0374 ohms. The resistance of a single outside arm of the field magnet is 1·93 ohms. The electro-motive force of the machine at the brushes depends, of course, upon speed, external resistance, &c., but may be taken as varying between 68 and 90 volts. The weight of the machine is about 26 cwt. There is no iron in the armature. The speed at which it runs depends upon its strength, and hitherto a thousand revolutions per minute has been the maximum. It is said that with a speed of 855 revolutions, 288 Swan lamps can be used. It should be mentioned that the field magnets can be coupled in series, giving a total resistance of 17 or 18 ohms, or in multiple arc with one-fourth this resistance. With the field magnets in multiple arc the electric efficiency claimed is about ·82 per cent.; when in series the electric efficiency claimed is about ·9 per cent.

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

(*From our own Correspondent.*)

THE condition of the manufactured iron trade in the West Midlands during the year which has now closed has fluctuated considerably, and the "revivals" which have now and again manifested themselves have not proved to be enduring. The branch which has been more prominently to the front than any other has been the sheet trade. These makers have been favoured with a steady and increasing demand, for the galvanisers have been very large consumers, and merchants have bought very extensively for export. As to bars, makers of second and third-class qualities have been better employed than the "list" houses, and this circumstance has operated to deter these latter from advancing prices to the extent that they otherwise would have done.

Taking the state of the market at the dates of the various quarterly meetings as the best indication of the course of business, we find that marked bars opened the January quarterly meetings at £8 2s. 6d. for the Earl of Dudley's brand, and at £7 10s. for bars of most of the other houses; but John Bradley and Co. declared a rise of 10s., bringing their price to £8. Second-class bar makers asked £7, and third-class £6 15s. easy. For boiler-plates the "list" firms quoted £9 to £9 10s. Sheets were firm at £8 10s. to £8 15s. for galvanisers' singles, and £10 for doubles. Hoops were £6 15s. to £7, nails sheets £7 5s. to £7 10s., and best wire rods £9 10s. to £10. Galvanisers quoted £15 10s. for the standard gauge delivered in bundles at Liverpool or London. During the quarter, as trade improved, one or two of the leading marked bar houses "withdrew quotations," but did not go the length of openly quoting the £8 figure of Messrs. Bradley.

At the April quarterly meetings the standard price for bars was without alteration, but unmarked bars had eased, and were quoted at £7 to £6 10s. Common sheets—singles—were steady at £8 10s. The galvanisers reduced their quotations 10s., bringing their figure down to £14 10s. Trade improved during June and July, and at the July quarterly meetings best bar prices were very firm, but unmarked bars might have been had at from £6 15s. to £6. Sheets—singles—had by this time fallen to £8, and doubles to £9; yet the galvanisers met and decided to put on the 10s. that had been previously lost, thus standing again at £15.

The October quarterly meetings were excited, and prices were all sixes and sevens. During the previous month or six weeks there had been a spurt in trade, and actual selling prices had improved to the extent of 5s. per ton. When the quarterly gatherings came round therefore marked bars were advanced 10s.—to £8 per ton, with the usual 12s. 6d. extra for Lord Dudley's brand; but the New British Iron Company and Messrs. Philip Williams and Sons declined to join in this advance, and reaffirmed their old quotation. Common bars were from £6 10s. to £6 12s. 6d., and medium descriptions were strong at £7. The general firmness extended to sheets, which were from £8 5s. to £8 10s. for singles. Boiler plates were £9 to £9 10s.

The three months which have closed the year have pretty much proved the wisdom of the two bar firms mentioned above, who still quote £7 10s. The demand has not warranted the extra 10s. asked by the other firms, who, however, say that they were forced to it by the higher price of coal and the increase in ironworkers' wages.

Among the "list" houses Noah Hingley and Sons have been, and still remain, amongst the best employed, since they turn their attention largely to chain and cable and anchor iron, which has been in well-sustained request, and they are also doing a good Australian trade.

The pig iron trade has not during 1882 developed any particular features. The demand has been only fairly steady, and the production of the forty-eight furnaces which were blowing when the year opened has been found to be sufficient. At the January quarterly meetings all-mine hot-blast pigs were quoted £3 10s., and cold-blast £4 10s.; part-mines were priced at 57s. 6d. and 60s., and cinder pigs at 47s. 6d. At date, all-mine hot-blast have fallen to £3 7s. 6d. easy, part-mines to 55s., and cinder pigs to 42s. 6d. and 41s. 3d. More business would have been done by our pig makers but for the great quantities of Northampton, Derbyshire, South Yorkshire, Leicestershire, and such like foreign pigs which have come into the district.

In reviewing the past year and in speculating about the probabilities of the new year, traders on 'Change in Wolverhampton yesterday and in Birmingham this afternoon were mostly engaged rather than in transacting new business. For buyers still prefer to postpone ordering until the quarterly meetings next week. The probabilities concerning those meetings are that marked bars will be redeclared at £8 12s. 6d. to £7 10s., and all-mine pigs at 67s. 6d to 70s., although in actual business good all-mines are abundant at 65s.

The market gathers strength this week from the expectations which some ironmasters are beginning to indulge concerning the benefit which the iron trade of the West Midlands would derive should the proposed reductions in the American tariff be adopted by Congress.

Hoop and bar makers would probably be the first to receive an accession of American orders. Of late, both these branches have been doing a good trade on Australian account, and inquiries are still promising from merchants doing business with that market. Hoops are quoted this week £7 easy at works; good medium bars also at £7 to £6 15s., and common bars, £6 10s. to £6 5s.

Notwithstanding the general quietude in the wrought iron tube trade, gas strip is in steady sale, and the price asked to-day was £6 10s. to £6 12s. 6d. per ton. Nail rods are about £6 10s. to £7 for common sorts, and superior qualities go up to £7 15s. and £8. Good rivet iron is about £8 10s. per ton easy.

Sheets required by the galvanisers are an average of £8 upwards for singles, £8 15s. to £9 for doubles, and £10 for lattens. The production of this class of iron is still increasing, and there seems a prospect of this manufacture being almost as much overdone as that of tin-plates in South Wales.

A large works at Highfields, Bilston, owned by the Barborsfield Iron Company, and which have been standing idle for six years past, since Messrs. Morewood ceased to manufacture there, have now been renovated, an expensive lot of new plant put in, and have just been sold to a firm of Walsall ironmasters. The new owners, whose name has not yet been authoritatively made known, will start the works early next month upon the production of sheets.

It is authoritatively made known this week that the Staffordshire Steel Company has decided to erect its works at Spring Vale, near Bilston, on land adjoining Mr. Alfred Hickman's blast furnaces. The company has purchased the Bessemer plant of the Mersey Steel and Iron Company, and will remove it to the Bilston site. The intention is to convey the iron in a molten state from Mr. Hickman's furnaces direct into the Thomas and Gilchrist converter, and thus save the intermediate expense of remelting.

Inquiries for pigs keep fairly numerous. "Ulverstone" hematites are quoted at 65s. delivered, and "Tredegar" hematites 67s. 6d. The "Westbury"—Wiltshire—brand of pigs is quoted 50s. delivered, but may be had for rather less. The "Willingsworth" brand of native pigs is quoted 45s., and some other common native pigs 42s. 6d.

The leading cast iron hollow-ware firms of this district have issued circulars announcing an increase of 5 per cent. in their discount off tinned hollow-ware, making their present discount 50 per cent. Messrs. Baldwin, of Stourport, have made a similar increase in their discount off butt hinges as well as tinned hollow-ware.

The hands at the engineering works of Messrs. Joseph Evans and Sons, of the Calwell Foundry, Wolverhampton, and the Engineering Works, Heath Town, to the number of about 150, struck work on Monday owing to a disagreement as to working hours. For a long time these have been from 7 a.m. to 6 p.m., but they have been found inconvenient, and the employers proposed from 6.30 a.m. to 5.30 p.m.; but were not accepted. On Wednesday, however, an amicable settlement was arrived at between masters and men, the men agreeing to resume work on Monday from 6.30 a.m. till 5.30 p.m. for the first five days of each week, but only to work from 6 a.m. to 1 p.m. on each Saturday.

At the Cannock and Rugeley Collieries, Hednesford, there has recently been introduced with satisfactory results a locomotive air engine for underground work. The engine brings all the coal from the hewers at the face of each stall out to the end of the engine plane, whence the coal is taken by rope to the shaft bottom.

At a meeting of the Mines Drainage Commissioners in Wolverhampton on Wednesday the chairman announced that £27,500 towards the loan of £30,000, required for Tipton drainage, had been promised. It was resolved that in future false declarations of returns of minerals raised should be made punishable, owing to false returns having been furnished by some colliery owners in the past.

The fireclay measures in the Spring Bank Colliery, Willenhall, have this week been drowned out by the sudden inflow of a surface brook which runs near to the colliery, and which carries off the surplus water from the canal. The primary cause of the inflow is that one portion of the brook has been dammed up by an accident. Four horses which were down the pit at the time have been drowned, and the water now stands 14 yards deep in the shafts. By engine and tank power, 200 tons of water are being raised per hour, but it will be a fortnight or three weeks before the disaster is got over.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The year opens with the prospect of a struggle between buyers and sellers as to the maintenance of the present basis of prices, and in the meantime there is little or nothing doing. Amongst buyers there is a general and strongly entertained belief that prices will have to give way materially, and where inquiries are put forward prices are boldly offered which makers say are considerably below the actual cost of production. There is no doubt that in many cases orders which have hitherto kept makers going are rapidly working down to a point which will necessitate new business being sought on some terms; but, on the other hand, there is also the fact that consumers have allowed their stocks to run very low, and it remains to be seen which side will be compelled to come into the market first. For the moment, as I have already intimated, there is a lull, makers showing no great anxiety to push sales at low prices, and buyers making very few offers.

The first market for the year at Manchester on Tuesday was fairly well attended, but with the holidays not over, so far as the works were concerned, and with stock-taking still in progress at many of the establishments, the actual business done was little more than nominal. Lancashire makers of pig iron, who with the commencement of the year have made a further reduction on their list rates, were open to book orders on the basis of 47s. 6d., less 2½, for both foundry and forge qualities, delivered equal to Manchester, but were not able to do business at this figure. In district brands of pig iron one or two exceptional sales were reported at 6d. to 1s. per ton under current rates, but makers generally were not quoting any lower, Lincolnshire remaining at 47s. 4d. to 48s. 3d., less 2½, and Derbyshire at 48s. 6d. to 50s., less 2½, as the minimum for delivery equal to Manchester; these figures, however, in the absence of business are only nominal, and buyers are not at all disposed to give them.

The finished iron trade is exceedingly quiet, and there is a complete absence of any buying on the basis of the present quoted price of £6 10s. per ton for bars delivered into the Manchester district. Manufacturers, who in most cases have still some orders on their books to keep them going, prefer to wait the result of the quarterly meetings next week rather than at present come down to the prices which buyers offer, which in some cases are as much as 5s. below current rates. There is, however, no doubt that business might be done at some concession upon the present quoted prices.

With regard to the engineering trades there is no specially new feature to report. Works generally have been stopped for half the week for the New Year holidays, and at present there are very few new orders being given out. Most of the leading firms are, however, fairly supplied with work to commence the year.

Business in the coal trade has to a considerable extent been practically suspended during the week. The stoppage of mills and works for the holidays has considerably curtailed the requirements for manufacturing purposes, whilst but few orders have been coming for house fire consumption, and the pits have been closed for several days. Nominally prices are unaltered, and in the Manchester district the leading coalowning concerns may be said to be firm at late rates. The mildness of the season is, however, causing a strain upon prices, which so far as the better classes of round coal are concerned, may lead to some concessions before long; other classes of fuel for manufacturing purposes are fairly steady, with slack showing a tendency to stiffen. At the pit mouth the average quoted prices are about as under:—Best coal, 10s. to 10s. 6d.; seconds, 8s. to 8s. 6d.; common house coals, 6s. 6d. to 7s.; steam and forge coals, 6s. to 6s. 6d.; burgy, 4s. 9d. to 5s. 3d.; and the better qualities of slack, 3s. 9d. to 4s. 3d. per ton.

In the shipping trade a fairly active demand has sprung up since the holidays, and as the stoppage of the pits has tended to restrict the supplies, rather better prices have been obtainable. Steam coal delivered at the high level Liverpool or Garston Docks has been difficult to get under 8s. 6d. per ton, and in some cases more than this has been obtained.

Barrow.—The iron trade remains quiet, and orders are few in number, but makers show very little disposition to sell for forward delivery, preferring to make stocks for forward delivery in anticipation of better times. Prices are steady but low, and 54s. is about an average value for Bessemer qualities of metal at works. Steel makers are well employed, and have in hand a large number of orders for both rails and merchant steel. Stocks of metal in the hands of makers and holders are shown to be about 175,000 tons, and this is not considered an excessive aggregate. The general feeling is in the direction that better trade will soon spring up, and that spring orders of importance will soon be booked on both home and continental account.

Much progress has been made in the foundations of the new Town Hall at Barrow, and the work of building the superstructure will soon be commenced.

The arbitration cases in reference to the purchase of the necessary property to construct the continuation of the high-level bridge at Barrow are proceeding, and the value of only a few properties has yet to be determined on. Upon this being done the work of constructing the bridge will be commenced.

being £106,885, or an increase of £15,662; cutlery ranks for £55,455, which is a decrease of £13,777. The great cause of the

THE SHEFFIELD DISTRICT.

(*From Our Own Correspondent.*)

THE event of the week is the official return of Sheffield exports to the United States for the quarter ending December 30th, 1882, which completes the trading for the year, and enables us to ascertain how we stand with regard to America, still in some respects the key to Sheffield business. My recent letters have made it pretty evident that the return for October, November, and December, would fall far short of the corresponding period of 1881, but no one was prepared for so serious a falling off as £103,000 in three months. The total value was £201,851, while during the same period in 1881 the value was no less than £304,977. In steel there is a decided improvement on the quarter, the value exported decrease during October, November, and December, has been the collapse of the American demand for steel rails. Not a rail has been sent from Sheffield to the United States during the quarter. Taking the whole year, the value of the exports for 1882 is £1,174,537, as compared with £1,287,401 for 1881, being a decrease of £112,864. The year opened with every prospect of quite a different result. For the first quarter the return showed a total value of £334,671, as compared with £281,376 for the corresponding period of 1881—an increase of over £50,000. A reaction then set in. April showed a decrease of £24,712, and in the third quarter there was a further decrease of £16,996; while, as I have stated, the last quarter of the year shows a sharp and severe fall from £304,977 to £201,851. The most gratifying feature of the return is the improvement in steel. During the year the value of steel exported to the United States was £418,371, which is an increase of £89,042. Cutlery shows a decrease of £17,334, the exports in 1882 amounting to £252,755 as compared with £270,090 in 1881.

Messrs. Charles Cammell and Co., Limited, have commenced the work of removing the plant and machinery from the Dronfield Steel Works to Workington.

The Clay Cross Colliery Company contemplates trying the use of lime cartridges in dislodging coal, and the men warmly approve of the proposal.

The death is announced of Mr. Joseph Nelstrop, of Ackworth Lodge, near Pontefract, at one time a principal partner in the great cutlery firm of Joseph Rodgers and Sons, now a limited company.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE effect of the holidays was still apparent in the scanty attendance in the Middlesbrough Exchange on Wednesday last. Not more than half the usual number was present, and few remained long. Quietude, flatness, and indisposition to transact business were the chief characteristics of the market. No. 3 g.m.b. was offered at 43s. f.o.b., and No. 4 forge at 1s. less; but there were few if any buyers.

Manufactured iron was equally little in demand. Prices were nominally unchanged, but no transaction took place. Ship plates were quoted at £6 10s. to £6 12s. 6d.; and angles, tees, and bars were to be had at £5 10s. Old rails are down to £3 12s. 6d. per ton for double heads, and £3 7s. 6d. for flanged sections. Consumers, however, are well stocked for some time to come and decline to buy. Purple ore may now be had for about 18s. per ton delivered into buyers' works at Middlesbrough, and sellers are anxious for orders. Steel rails are in poor request at £5 12s. 6d. at works.

It is reported that a new shipbuilding firm are about to commence operations at Middlesbrough. The site for the works is not yet fixed, but it is thought probable that they will select one at or below Southbank, or else on the Durham side of the river Tees, a little above Port Clarence. Such an enterprise would be a good thing for the town, especially if floated during the present period of slackness.

The Westbourne Ironworks at Stockton, which have been standing idle for a considerable length of time, are to be restarted in two or three weeks'. It will be remembered that these works were lately sold by auction and purchased by Messrs. William Whitwell and Co., of the Thornaby Ironworks, South Stockton. It is intended to put the works into full operation, and employment will be given to upwards of 300 hands.

The workmen employed at the Bishop Auckland Iron and Steel Works recently sent a letter to the directors of the company asking them to say whether there was any likelihood of work being resumed. Mr. Robert Leng, the secretary, has just replied on behalf of the directors. The following occurs in his letter:—"The directors at their last meeting have been reluctantly compelled to close their works, as the prices now obtainable for plates are such that it is impossible to manufacture them at Bishop Auckland without loss. They trust that this is only a temporary measure, but at the present moment they cannot hold out hopes of an early resumption of work. You alluded to the fact that the Bishop Auckland Works have worked irregularly during the past six months. This has been caused partly by a breakdown, partly by alterations which the directors hoped would increase the output of the works and cheapen the cost of production, but largely by the hostile action taken by the local authorities and the Ecclesiastical Commissioners. Very soon after this present company took possession of the works the local board began to harass the company by complaining of the smoke and cinder heap, and in a short time the company was summoned before the magistrates."

Considering the stormy weather which prevailed during December it is not surprising to find that the quantity of pig iron shipped was but small. The total for the month is only 57,134 tons, against 77,557 tons in December, 1881, and 78,385 tons in December, 1880. The bulk of the pig iron was disposed of as follows:—Scotland, 21,041 tons; France, 12,825 tons; Holland, 9594 tons; Belgium, 3183 tons; Germany, 2920 tons; and Spain, 1770 tons. Of manufactured iron and steel 23,426 tons were exported, being about the average quantity. The exports from the Tees for the past year have been—pig iron 931,273 tons, and manufactured iron and steel 316,293 tons, giving a grand total of 1,247,566 tons, which is the highest figure ever reached in one year. In 1881 the quantities were—pig iron 931,411 tons, and manufactured iron and steel 280,446 tons; total, 1,211,857 tons.

Returns have just been issued showing the number of vessels built on the Wear during the year just closed. The total number was 123, with a tonnage of 212,491 tons and 19,522 horse-power. Of these Messrs. J. L. Thompson and Sons have made thirteen vessels, of 27,891 tonnage; Messrs. Short Bros. come next with fifteen ships, 26,685 tonnage; Messrs. James Laing and Sons turned out nine of 23,004 tonnage; and Messrs. Doxford and Sons fourteen smaller vessels, 22,231 tonnage. Most of the builders on the Wear have orders in hand to keep them employed during the greater part of the year.

Messrs. Turnbull and Son, iron shipbuilders, of Whitby, have also done well during the past year, having built eight ships with a gross tonnage of 13,048 tons. This is an increase over 1881 of 4191 tons. They have work in hand which will carry them through this year.

There are now about seventy-five electric lights at work at Messrs. Bell Brothers' Page Bank Colliery, near Spennymoor, and they are giving every satisfaction. The lights in the stables are furthest from the dynamo machines, being 430 yards distant. Nevertheless, they burn well and steadily. It is said that several other collieries in the district, including Haswell and Ryhope Collieries, are shortly to be lighted in the same way.

The electric light is also coming more into use at Middlesbrough. A company, called the Yorkshire Electric Light and Power Company, Limited, has already commenced operations. Their plan is to supply Brush lights at a rental of £25 per annum per light, the renter paying also for carbons consumed, estimated to cost a further £5 per annum. Messrs. Jones Brothers; B. Samuelson and Co.; Gjers, Mills, and Co.; and the North-Eastern Steel Company, have already become renters.

The electric light will not, however, be without serious competition. The Gas Committee have undertaken to put up the Sugg lamp at Messrs. Fox, Head, and Co.'s works, free of cost to them, except so far as that they are to pay for the gas actually consumed. It is computed that the cost of supply of gas will not exceed one-sixth the cost of the electric light, and that the illuminating effect of the Sugg light, if not equal to its rival, will at all events be far ahead of anything which has been in use at rolling mills before.

It is stated that the Skerne Ironworks Company has stopped operations for the present, and it is unknown when it will resume. The present unremunerative prices obtainable for ship plates is the cause of the stoppage.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been very little doing in the Scotch iron trade this week. During the greater part of the week the iron and engineering works have either been closed altogether or only kept in such a condition as to prevent deterioration of plant. The warrant market has also been flat, with little disposition for business on account of the New Year holidays. Several days must yet elapse before it will be possible to decide in a precise way how much of the apparent business apathy is due to the holidays, and what proportion to other causes. At present, however, it may be noticed that there is undoubtedly a strong feeling of confidence in commercial circles as to the condition of business in the immediate future. The various reports which the close of the year has evoked with reference to trade are in the main highly favourable, and with respect more particularly to the iron trade, there is certainly no reason for despondency. The shipments of pig iron have been comparatively good in the course of the week, comparing favourably with those of the corresponding week of last year.

Some of the special brands of makers' iron are comparatively scarce, but although business has been circumscribed there is a reduction in the stocks of Messrs. Connal and Co.'s stores for the week of about 700 tons. The quotations of makers' iron are firm as follow:—Coltness, f.o.b. at Glasgow, per ton No. 1, 67s. 6d.; No. 3, 56s.; Gartsherrie, 64s. and 55s.; Summerlee, 63s. and 53s.; Langloan, 67s. and 56s.; Calder, 63s. and 52s. 6d.; Govan, 50s. and 48s. 6d.; Carnbroe, 56s. and 51s.; Monkland, 50s. 6d. and 48s. 6d.; Clyde, 53s. 6d. and 51s.; Glengarnock, at Ardrossan, 55s. 6d. and 50s.; Eglinton, 51s. 6d. and 49s. 6d.; Dalmellington, 51s. and 50s.; Shotts, at Leith, 66s. and 56s.; Carron, 51s. 6d.—selected, 57s. 6d.

Business was done in the warrant market on Friday at 48s. 10d. to 48s. 11½d. cash, and 49s. 1d. to 49s. 2d. one month. The market was closed on Monday, and there was only a forenoon meeting on Tuesday, when business was done at 48s. 11d. to 48s. 9d. cash, closing buyers 48s. 9½d. cash and 49s. one month. On Wednesday the market was quiet, with business between 48s. 7d. and 48s. 9½d. cash. To-day—Thursday—transactions were effected at 48s. 10½d. cash, and 49s. 1d. one month.

The coal trade has been active during the past week, for a holiday time, and the exports have in most cases been satisfactory. Upwards of 24,000 tons were shipped at Glasgow, about 3000 tons at Leith, and 3500 at Grangemouth, the quantities despatched from the other ports being fair. There is no change in quotations. It is likely that the next week's returns will not show so well on account of the holidays.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

SOME degree of stagnation prevailed at all the ports last week, consequent on the holidays, and the total of coal dispatched from all Wales was less than from Cardiff alone the preceding week. This, however, will soon be made up. During the past three or four days every colliery has been busy, and all the shipping that was able to come in was promptly put under the tips. Coal prices are well sustained. Small steam is now at 5s. 3d. f.o.b. at Cardiff and advancing. Coalowners hold good contracts, and a capital spring trade is one of the certainties.

I am glad to note that the attitude of the men continues excellent. It was feared that some little outcry would have been raised on account of the advance conceded to the Ocean men. In former days an isolated advance would have put the whole colliery community into a blaze. Now it would appear that the men working under the sliding scale arrangements of the Association are very well satisfied with their scale, and are fully aware that in all its details it yields more advantages than the one which has just conferred an advance of 1¼ per cent. The South Wales colliers do not approve, so far, of the Leeds programme, and I shall be much surprised if they favour any limitation of output.

The pumping engine of the Middle Duffryn Colliery broke down on Saturday, and the greater part of the underground work has been suspended. I am afraid, too, that a large part of the workings will get flooded.

The iron market is firm. 20,000 tons of foreign ore were put into Newport last week, and about 10,000 into Cardiff. Prices are stationary. Pitwood is easy, and prices are falling. There was such a rush to fill up the vacant places that the market begins to look glutted.

Welsh ore is in demand, but very little can be had. I hear of one enterprising gentleman who has bought all up, and the get of Welsh ore from the coal seams is too slight to admit of there being any for sale again for some time.

A little agitation is going on between the engine and train men of the Taff Vale Railway, and the result of a meeting on Sunday last at Cardiff, no other day being suitable, was the forwarding of a petition to the directors praying a reduction of hours. The burden of the petition is to have something like an arrangement of sixty hours per week or ten hours per day.

The tin-plate failures have improved the tone of the market. Ordinary coke plates, which were at 15s. last January, are now quoted at 17s. This is better, but still not sufficient. I have heard that these plates cost 16s. per box to make, and we all know that they have been selling freely at 15s., some forced sales even at 14s.

Some novel electrical experiments have been carried out lately at the Trafalgar Collieries, Forest of Dean. This has taken the form of using an electric motor to drive a pump in the underground workings. The total vertical lift of the electric pump is 115ft. The electricity is generated by a dynamo machine at the surface of the colliery, and the wires connecting this with the pump extend down the shaft a distance of 500 yards.

LAYING 1500 bricks on outside and inside walls is given as an average day's work for a bricklayer; on facings and angles and finishing around wood or stone-work, not more than half of this number can be laid.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

26th December, 1882.

6165. Composition of Flour, &c., W. P. Thompson.—*(P. Thorpe, New York, U.S.)*
6166. Litter for Stables, H. Symons, Totnes.
6167. Fire-arms, &c., A. Reddie.—*(E. Starr, U.S.)*
6168. Joining Ends of Leather Belts, &c., H. H. Lake.—*(A. Johnston, Bainbridge, U.S.)*

27th December, 1882.

6169. Silica Fire Bricks, &c., H. Edwards, Braich-y-Cymmer, and H. Harries, Glyn Neath.
6170. Bar-rolling Mills, J. Imray.—*(U. Haskin, U.S.)*
6171. Vacuum Brake, J. Gresham, Salford.
6172. Kilns for Burning Bricks, &c., H. Knowles, Woodville.
6173. Toilet Soap, S. Birley, Haverstock Hill.
6174. Door Locks, W. Morgan-Brown.—*(O. Belzer and F. Preller, Germany.)*
6175. Corking Bottles, H. J. Worssam, London.
6176. Glucose Syrup, &c., H. J. Haddan.—*(H. Endemann, New York, U.S.)*
6177. Tramways, &c., J. C. Mewburn.—*(G. Michelet, Brussels.)*
6178. Velocipedes, W. Woods & B. J. Mills, London.
6179. Box for Parcels Post, F. C. Nutter, London.
6180. Paper Board, S. H. Hamilton, Bushnell, U.S.
6181. Parallel Vices, H. F. Read, Brooklyn, U.S.
6182. Horseshoe Machines, F. Wolff, Copenhagen.
6183. Electrical Generators, &c., T. J. Handford.—*(T. A. Edison, Menlo Park, U.S.)*
6184. Obtaining Motive Power, E. Eyland, Bristol.
6185. Electric Arc Lamps, A. M. Clark.—*(La Société Solignac et Cie., Paris.)*

28th December, 1882.

6186. Motive Power Engines, T. Hancock, Wolverhampton.
6187. Collapsible Packing Case, R. Blandy, London.
6188. Printing Machines, &c., J. H. Johnson.—*(E. Anthony, Lincoln's-inn.)*
6189. Looms for Weaving, J. F. Brown, Glasgow.
6190. Kneading Dough, R. Alexander, Glasgow.
6191. Construction of Steam Boilers, S. Thackeray, Huddersfield.
6192. Brushing Hair, F. Willoughby, Heaton Norris.
6193. Incandescing Electric Lamps, T. J. Handford.—*(T. A. Edison, Menlo Park, U.S.)*
6194. Drop-down Guns, J. H. Hannay, London.
6195. Illuminating Lighthouses, J. R. Wigham, Monkstown.
6196. Insulating Conductors for Electric Lighting, W. Smith, London.
6197. Shoots for Loading Coals, &c., S. W. Snowden, West Hartlepool.
6198. Covers of Carding Engines, &c., W. Hurst, Rochdale.
6199. Distributing Electrical Energy, T. J. Handford.—*(T. A. Edison, Menlo Park, U.S.)*
6200. Drying Starch, W. Lake.—*(L. Maiche, Paris.)*
6201. Obtaining Cellulose from Wood, &c., W. R. Lake.—*(The Austrian Chemical and Metallurgical Products Manufacturing Association, Bohemia.)*
6202. Coupling Apparatus for Railway Vehicles, W. G. Thresher, Wilton.
6203. Felt or Felted Fabrics, A. J. Boult.—*(T. Jegler and J. Offermann, Germany.)*
6204. Velocipedes for Use on Railways, &c., W. P. Thompson.—*(S. H. Walz, Three Rivers, U.S.)*

29th December, 1882.

6205. Washing Machines, J. Proudley, Manchester.
6206. Incandescing Conductors, &c., T. J. Handford.—*(T. A. Edison, Menlo Park, U.S.)*
6207. Attaching Reversible Cuffs to Shirt Sleeves, F. S. Turner, London.
6208. Making of Bread, A. Esilman, Manchester, and H. Esilman, Glasgow.
6209. Carriage Brake Blocks, W. Cary, Manchester.
6210. Repeating Actions for Pianofortes, E. A. Brydges.—*(A. Lexow, Berlin.)*
6211. Turning Leaves of Music, J. C. Mewburn.—*(O. Erganian and O. E. Torrossian, Constantinople.)*
6212. Boots, &c., T. Laycock, Northampton.
6213. Match-boxes, J. Darling and J. Long, Glasgow.
6214. Gas Engines, W. Watson, Leeds.
6215. Registering Mileage of Vehicles, J. Imray.—*(F. Bisson, Paris.)*
6216. Tubular Boilers, J. Armer, Dartford.
6217. Velocipedes, J. Harrington, Coventry.
6218. Controlling Current in Electric Circuits, J. Jamieson, Oldham.
6219. Purifying Oil, W. Lake.—*(E. Dangiville, Paris.)*
6220. Looms for Weaving, W. Smith, Heywood.
6221. Brushes for Casks, &c., J. W. Lowe and F. West, Southampton.
6222. Cocks for Steam, &c., A. Bradshaw, Accrington.

30th December, 1882.

6223. Spinning Machinery, N. Macbeth and R. N. Cottrill, Bolton-Le-Moors.
6224. Spinning Frames for Spinning Jute, &c., A. Frier, Dundee.
6225. Glass Bottles, J. S. Davison, Sunderland.
6226. Galvanic Batteries, T. J. Howell, London.
6227. Fire-grates, J. Moore, New Thornton Heath.
6228. Telephonic Transmitting Instruments, J. Imray.—*(J. Ochorowicz, Paris.)*
6229. Treating Ingots of Steel, H. C. S. Dyer, Manchester.
6230. Traction Engines, W. Wilkinson, Wigan.
6231. Steam Traps, J. J. Royle, Manchester.
6232. Treating India-rubber, H. Gerner, London.
6233. Ornamenting Articles in Glass, W. B. Fitch, Deptford.
6234. Furnaces for Melting Glass, &c., W. B. Fitch, Deptford.
6235. Electric Arc Lamps, &c., W. Fitch, Deptford.
6236. Manufacture of Screws, W. R. Lake.—*(A. Faugier, Lyons.)*
6237. Electric Lamps, W. Lake.—*(R. Mondos, Paris.)*
6238. Discharging Fire-arms, N. G. Green.—*(J. L. Galt and J. P. Freeman, New York, U.S.)*
6239. Umbrellas and Parasols, L. Engel, London.
6240. Indicating Pressure of Wind, &c., L. M. Casella, Hampstead.
6241. Toggle Machine, A. M. Clark.—*(E. Dervaux-Ibled and G. N. Schoenberg, Paris.)*

1st January, 1883.

1. Dynamo-electric Machines, F. J. Cheesbrough.—*(E. R. Knowles, Brooklyn, U.S.)*
2. Storage Batteries, F. J. Cheesbrough.—*(E. R. Knowles, Brooklyn, U.S.)*
3. Electrical Apparatus for Domestic, &c., Light, F. J. Cheesbrough.—*(E. R. Knowles, Brooklyn, U.S.)*
4. Electric Lamps of Arc Type, F. J. Cheesbrough.—*(E. R. Knowles, Brooklyn, U.S.)*
5. Electric Lights of Arc Type, F. J. Cheesbrough.—*(E. R. Knowles, Brooklyn, U.S.)*
6. Incandescent Electric Lamps, F. J. Cheesbrough.—*(E. R. Knowles, Brooklyn, U.S.)*
7. Feeding Paper to Printing Machines, F. Hoyer, Liverpool.
8. Securing Rapid, &c., Consumption of Fuel in Furnaces, J. Howden, Glasgow.
9. Smelting Furnaces for Heating Ores, J. Swain, Oldham.
10. Tricycles, J. Cameron, Lauriston.
11. Umbrella Furniture, E. J. James, London.
12. Toilet Apparatus for Ships, H. J. Haddan.—*(D. Wellington, Boston, U.S.)*
13. Cleaning Fibres of Tow, &c., F. C. Glaser.—*(T. Calow and Co., Germany.)*
14. Secondary Batteries, T. Rowan, London.
15. Suspension Devices for Heavy Bells, A. J. Boult.—*(H. Roy, France.)*
16. Calculating Machines, J. Edmondson, Halifax.
17. Electric Lighting, &c., Systems, S. Pitt.—*(R. T. Starr, Pennsylvania, and W. J. Peyton, U.S.)*
18. Locomotive Engines, H. Simon.—*(C. Hagans, Germany.)*
19. Gas Motor Engines, P. F. Forrest, Paris.
20. Boots, &c., H. H. Lake.—*(E. H. Buckley, U.S.)*
21. Gas Motor Engines, J. R. Woodhead, Leeds.
22. Indicating Apparatus for Cabs, W. L. Wise.—*(C. de Cuyper, Belgium.)*
23. Breech-loading Fowling Pieces, H. W. Holland and J. Robertson, London.
24. Generation, &c., of Electricity, J. S. Williams, Riverton, U.S.
25. Railway Vehicles, H. H. Lake.—*(T. Hersee, U.S.)*

Invention Protected for Six Months on Deposit of Complete Specifications.

6180. Use of Paper Board, S. H. Hamilton, Bushnell, U.S.—*27th December*, 1882.
6181. Parallel Vices, H. F. Read, Brooklyn, U.S.—*27th December*, 1882.

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

5310. Gas, H. A. Bonneville, London.—*29th December*, 1879.
5312. Road Locomotives, G. P. Harding and W. L. Holt, Paris.—*29th December*, 1879.
5336. Extraction of Metals from Ores, J. F. N. Macay, London.—*31st December*, 1879.
5305. Self-acting Water Ejectors, J. S. Stubbs, Manchester.—*29th December*, 1879.
128. Magazine Fire-arms, W. R. Lake, London.—*12th January*, 1880.
5315. Grand Pianofortes, J. Turvey, Southport.—*30th December*, 1879.
5335. Telephones, A. White, London.—*31st December*, 1879.
16. Treating Oils, P. M. Justice, London.—*1st January*, 1880.
90. Forming Furrows of Millstones, H. Smith, Titchfield.—*8th January*, 1880.

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

365. Combing, &c., Wool, H. W. Whitehead, Holbeck.—*29th January*, 1876.

Notices of Intention to Proceed with Applications.

(Last day for filing opposition, 19th January, 1883.)

4035. Metal Cans, &c., J. A. Lloyd, London.—*23rd August*, 1882.
4069. Getting Coal, C. G. Robinson, Barnsley.—*25th August*, 1882.
4071. Printing, W. C. Haigh, Manchester.—*25th August*, 1882.
4081. Friction Couplings, F. Glaser, Berlin.—Com. from F. Braun and A. Stackfleth.—*26th August*, 1882.
4096. Gas Burners, W. R. Lake, London.—A com. from E. Z. I. Téterger.—*26th August*, 1882.
4098. Balloons, J. A. Fisher and C. G. Spencer, London.—*28th August*, 1882.
4125. Roasting Coffee, W. T. Sugg, London.—*29th August*, 1882.
4148. Generating, &c., Electrical Energy, P. de Villiers, London.—*30th August*, 1882.
4334. Boiler Furnaces, J. R. Russell, Glasgow.—*12th September*, 1882.
4335. Machines for Hulling, &c., Rice, J. R. Russell, Glasgow.—*12th September*, 1882.
5275. Millstone, W. R. Lake, London.—A communication from P. Vérat.—*4th November*, 1882.
5327. Valves, F. Gill, South Shields.—*8th November*, 1882.
5472. Floor-cloths, &c., S. Hawksworth, Scarborough.—*17th November*, 1882.
5687. Harrows, J. Howard and E. T. Bousfield, Bedford.—*29th November*, 1882.
5689. Couplings for Vehicles, C. Roberts, Wakefield.—*29th November*, 1882.
5809. Treating Hydrochloric Acid, J. Hargreaves and T. Robinson, Widnes.—*6th December*, 1882.
5815. Furnaces, O. D. Orvis, New York, U.S.—*6th December*, 1882.

(Last day for filing opposition, 23rd January, 1883.)

4104. Portable Boats, L. W. Jelf, London.—*28th August*, 1882.
4106. Printing Ink, &c., C. F. Claus, London.—*28th August*, 1882.
4107. White Pigments, &c., C. F. Claus, London—*28th August*, 1882.
4108. Preparing Materials for Filters, C. F. Claus, London.—*28th August*, 1882.
4111. Dynamo-electric Machines, H. H. Lake, London.—Com. from S. van Choate.—*28th August*, 1882.
4121. Fastenings for Scythes, A. J. Boult, London.—A com. from A. Hagedorn.—*29th August*, 1882.
4122. Safety Stirrups, A. J. Boult, London.—A communication from F. Lehmann.—*29th August*, 1882.
4130. Making Boxes from Paper, &c., H. J. Haddan, London.—A communication from E. B. and H. S. Munson.—*29th August*, 1882.
4131. Silicate of Zinc, &c., C. F. Claus, London.—*29th August*, 1882.
4147. Galvanic Batteries, S. H. Emmens, London.—*30th August*, 1882.
4158. Measuring, &c., Electric Currents, A. L. Lineff, London.—*31st August*, 1882.
4180. Making Carbons, J. Jameson, Newcastle.—*1st September*, 1882.
4181. Producing High Vacuum, J. Jameson, Newcastle.—*1st September*, 1882.
4187. Breech-loading Small-arms, E. James, Birmingham.—*2nd September*, 1882.
4194. Covering Railway Trucks, &c., H. S. King, London.—Com. from H. Davies.—*2nd September*, 1882.
4200. Handles for Bicycles, &c., G. S. Kelsey, Birmingham.—*4th September*, 1882.
4212. Treating Carbonised Material, J. Johnson, London.—Com. from A. Caron.—*5th September*, 1882.
4225. Pitch Chains, S. Pitt, Sutton.—A communication from J. M. Dodge.—*5th September*, 1882.
4227. Fire-escapes, A. M. Clark, London.—A communication from G. M. Smith.—*5th September*, 1882.
4232. Holding Cords of Blinds, J. Hudson, Bolton.—*6th September*, 1882.
4238. Incandescent Lamps, W. Crookes, London.—*6th September*, 1882.
4274. Portable Case for Disinfectants, N. M. Rapp and H. W. Herbst, London.—*8th September*, 1882.
4301. Distributing Water, J. T. Foot, Hammersmith.—*9th September*, 1882.
4346. Mechanical Pianofortes, &c., W. R. Lake, London.—A communication from J. Lacape and Co.—*12th September*, 1882.
4548. Transporting Goods, &c., by Electricity, F. Jenkin, Edinburgh.—*23rd September*, 1882.
4557. Looms, H. Lomax, Darwen.—*25th September*, 1882.
4601. Using Cables for Hauling Vehicles, W. R. Lake, London.—A communication from S. H. Terry.—*27th September*, 1882.
4659. Treating Sewage, J. Young, Kelly.—*30th September*, 1882.
4713. Elevators, W. M. Clark, London.—A communication from A. D. Fox.—*3rd October*, 1882.
4743. Fastening for Doors, &c., H. Hancock, Kennington.—*5th October*, 1882.
4789. Typefounding, A. J. Boult, London.—A communication from H. J. Kolf, C. A. J. Gursch, and C. H. J. Klemm.—*7th October*, 1882.
5448. Anchors, J. H. Kidd, Wrexham.—*15th November*, 1882.
5459. Sounding Depth at Sea, W. J. Mackenzie, Glasgow.—*16th November*, 1882.
5865. Gas-motor Engines, J. J. Butcher, Newcastle.—*8th December*, 1882.
5949. Safety Apparatus for Ships' Holds, R. C. Scott, Liverpool.—*13th December*, 1882.
6180. Paper-board, S. H. Hamilton, Bushnell, U.S.—*27th December*, 1882.
6181. Parallel Vices, H. F. Read, Brooklyn, U.S.—*27th December*, 1882.

Patents Sealed.

(List of Letters Patent which passed the Great Seal on the 27th December, 1882.)

2865. Railway Car-wheels, H. A. Bonneville, London.—*17th June*, 1882.
3027. Fitting for Horseshoes, J. Vernon, Newton Stewart.—*27th June*, 1882.
3034. Collecting Excrementitious, &c., Matters, F. A. Bonnefin, London.—*27th June*, 1882.
3036. Dynamo-electric Machines, W. E. Ayrton and J. Perry, London.—*27th June*, 1882.
3045. Slicing Materials into Slips, J. B. Whytehead, Ilkley.—*28th June*, 1882.
3065. Cleaning, &c., Fur, J. Woodrow, Stockport.—*29th June*, 1882.
3067. Screw Propellers, J. Carr, Newcastle-on-Tyne.—*29th June*, 1882.
3074. Treating Hops, W. G. Forster, Streatham.—*29th June*, 1882.
3076. Mills for Grinding Corn, W. R. Lake, London.—*29th June*, 1882.
3080. Stop-valves, J. A. and J. Hopkinson, Huddersfield.—*30th June*, 1882.
3095. Overflows of Valve-closets, H. Conolly and A. E. Hubert, London.—*30th June*, 1882.
3096. Water-waste Preventers, H. Conolly, London.—*30th June*, 1882.
3103. Bricks and Tiles, W. A. McI. Valon, Ramsgate.—*1st July*, 1882.
3113. Rendering Peat Suitable for Litter, S. D. Cox, New Charlton.—*1st July*, 1882.
3114. Uniting Articles of Glass, C. H. Stearn, Newcastle-upon-Tyne.—*1st July*, 1882.
3115. Steam Generators, L. P. Martin, Vienna.—*1st July*, 1882.
3200. Wheel Tires, A. C. Guerrier, Fulham.—*6th July*, 1882.
3224. Tack-making, &c., Machine, R. H. Brandon, Paris.—*7th July*, 1882.
3228. Cartridges, F. Wirth, Frankfort-on-the-Main.—*7th July*, 1882.
3277. Stopping Runaway Horses, B. J. B. Mills, London.—*11th July*, 1882.
3311. Preserving Hides, &c., J. C. Mewburn, London.—*12th July*, 1882.
3313. Folding Chairs, L. Field, Birmingham.—*12th July*, 1882.
3332. Making Boxes, A. Millar, Glasgow.—*13th July*, 1882.
3333. Purifying Metals, A. M. Clark, London.—*13th July*, 1882.
3339. Arc Regulator Lamps, R. E. B. Crompton, London.—*14th July*, 1882.
3393. Electric Lamps, J. D. F. Andrews, Glasgow.—*17th July*, 1882.
3494. Rubbing Mechanism for Carding Machines, C. A. Day, London.—*22nd July*, 1882.
3545. Treating Steel Ingots, J. Gjers, Middlesbrough-on-Tees.—*26th July*, 1882.
3550. Ensuring Safety in Case of Fire in Theatres, &c., C. S. Beauchamp, London.—*26th July*, 1882.
3562. Treating Sewage, J. Young, Kelly.—*27th July*, 1882.
3568. Hoes, J. P. Goss and F. Savage, King's Lynn.—*27th July*, 1882.
3790. Paint for Preserving Metals, &c., E. P. Wells, Notting Hill.—*9th August*, 1882.
3840. Neckties, D. T. Keymer and F. Theak, London.—*11th August*, 1882.
4390. Electric Lamp Holders, J. W. Swan, Newcastle, and C. Swan, London.—*15th September*, 1882.
4495. Machines for Making Bricks, W. R. Lake, London.—*20th September*, 1882.
4580. Decomposing Alloys, W. R. Lake, London.—*26th September*, 1882.
4590. Treating Soap Lyes, A. J. Lawson, and H. L. Sulman, Bristol.—*27th September*, 1882.
4690. Safety-hooks for Harness-traces, H. H. Lake, London.—*2nd October*, 1882.
4868. Lounge, A. J. Wilkinson, London.—*13th October*, 1882.
4945. Blasting Coal, &c., M. Settle, Bolton.—*17th October*, 1882.
4949. Fluids for Washing Animals, B. Nickels, London.—*18th October*, 1882.

29th December, 1882.

3081. Swivel for Use in Making Jewellery, W. Skelhorn, London.—*30th June*, 1882.
3102. Trapping "Micas," J. Lovering and R. Martin, St. Austell.—*30th June*, 1882.
3107. Secondary Batteries, C. H. Cathcart, Sutton.—*1st July*, 1882.
3110. Door Furniture, J. Brownrigg, Windermere.—*1st July*, 1882.
3123. Syphon, F. Sara, Plymouth.—*1st July*, 1882.
3124. Combined Steam and Hand Steering Apparatus, J. Hastie, Greenock.—*3rd July*, 1882.
3130. Fan for Exhaust, &c., Purposes, G. M. Capell, Northampton.—*3rd July*, 1882.
3138. Tunnelling Slate, G. Hunter, Egham.—*3rd July*, 1882.
3140. Tapes for Venetian Blinds, T. French and J. Monks, Manchester.—*4th July*, 1882.
3148. Ventilating Clothes, A. Sachs, Berlin.—*4th July*, 1882.
3153. Generating, &c., Gas, W. F. Browne, London.—*4th July*, 1882.
3155. Evaporating Liquids, W. F. Browne, London.—*4th July*, 1882.
3157. Hydraulic Motor, G. W. von Nawrocki, Berlin.—*4th July*, 1882.
3158. Cooking Food, G. W. von Nawrocki, Berlin.—*4th July*, 1882.
3159. Extracting Grease from Bones, &c., G. W. von Nawrocki, Berlin.—*4th July*, 1882.
3174. Horseshoes, M. Bauer, Paris.—*5th July*, 1882.
3197. Tension Couplings, J. T. Mitchell, Mere.—*6th July*, 1882.
3210. Looms, W. Buckley, Delph, and J. Hollingworth, Dobcross.—*6th July*, 1882.
3235. Collectors, J. T. Mitchell, Mere.—*7th July*, 1882.
3295. Ink-distributing Apparatus, W. R. Lake, London.—*11th July*, 1882.
3312. Water-level Indicator, G. R. Hugon, London.—*12th July*, 1882.
3361. Metallic Glazing Bar, &c., T. Hughes, Market Drayton.—*15th July*, 1882.
3713. Electric Arc Lamps, E. G. Brewer, London.—*4th August*, 1882.
4302. Indicating Amount of Salt in Water, J. W. Plunkett, London.—*9th September*, 1882.
4452. Guard Rails for Boats, J. Gunn, Golspie.—*19th September*, 1882.
4897. Materials for Charging Cartridges, W. Smethurst, Wigan, and J. Collins, Bolton.—*14th October*, 1882.
5047. Locomotive, &c., Engines, M. P. W. Boulton and E. Perrett, London.—*23rd October*, 1882.
5111. Timepieces, C. D. Abel, London.—*27th October* 1882.

5153. ANTISEPTIC, C. M. Pielsticker, London.—30*th October*, 1882.
5171. LOADING MERCHANDISE, &c., H. Bessemer, London.—30*th October*, 1882.
5173. FASTENERS FOR WEARING APPAREL, J. N. Aronson, London.—31*st October*, 1882.
5197. FLUSHING WATER-CLOSETS, &c., W. R. Lake, London.—31*st October*, 1882.
5279. CLOCKS FOR SIGNALLING BY ELECTRICITY, W. R. Lake, London.—4*th November*, 1882.

(*List of Letters Patent which passed the Great Seal on the 2nd January*, 1883.)

3142. SUBMARINE TELEGRAPH CABLES, G. E. Vaughan, London.—4*th July*, 1882.
3143. GRAPNELS, G. E. Vaughan, London.—4*th July*, 1882.
3145. RACK-PULLEYS, C. Priestland, Birmingham.—4*th July*, 1882.
3150. DYNAMO, &c., MACHINES, R. Werdermann, London.—4*th July*, 1882.
3152. BOOTS AND SHOES, T. Morgan, London.—4*th July*, 1882.
3154. MAKING, &c., GAS, W. F. Browne, London.—4*th July*, 1882.
3167. RAILWAY SIGNALLING APPARATUS, D. Knight, Cambridge.—5*th July*, 1882.
3170. PAVEMENT, &c., LIGHTS, T. G. Webb, Manchester.—5*th July*, 1882.
3171. APPARATUS FOR GOVERNING MARINE ENGINES by ELECTRICITY, W. W. Girdwood, Poplar.—5*th July*, 1882.
3175. ELECTRIC INSULATING APPARATUS, W. F. Bottomley, J. H. Barry, and J. J. Lundy, London.—5*th July*, 1882.
3190. ELECTRIC, &c., TELLTALES, A. Schweitzer and T. Lawrie, London.—6*th July*, 1882.
3196. FILLING IN WOOL upon PATTERN CARDS, W. Greenwood, Halifax.—6*th July*, 1882.
3202. COMBING WOOL, &c., F. Fairbank and J. Robertshaw, Allerton.—6*th July*, 1882.
3204. GENERATION, &c., OF ELECTRIC CURRENTS, W. R. Lake, London.—6*th July*, 1882.
3226. ELECTRO-MAGNETIC MOTOR, E. Toynbee, Willesden.—7*th July*, 1882.
3234. BOTTLES, &c., O. G. Abbott, Huddersfield.—7*th July*, 1882.
3245. SEPARATING TAR from AMMONIACAL LIQUOR, &c., J. Dempster and R. Dempster, jun., Elland.—8*th July*, 1882.
3251. OVENS FOR BREAD, &c., A. M. Clark, London.—8*th July*, 1882.
3261. SPINNING, &c., J. Myers and B. Berry, Bradford.—10*th July*, 1882.
3262. DYEING COTTON, &c., E. Heppenstall, Huddersfield.—10*th July*, 1882.
3265. EMERY-WHEELS, R. R. Gubbins, New Cross.—10*th July*, 1882.
3285. INDICATING LENGTH OF FABRIC IN ROLLS, &c., J. Darling, Glasgow, and J. Darling, Shotts.—11*th July*, 1882.
3288. BRAIDING MACHINES, W. R. Lake, London.—11*th July*, 1882.
3294. REGULATING SPEED OF MARINE ENGINES, A. J. Boult, London.—11*th July*, 1882.
3302. ROLLER MILLS, T. Bouwens and T. Voss, London.—12*th July*, 1882.
3338. CLAY PRESS TRAYS, J. Brindley, Burslem.—14*th July*, 1882.
3340. SECURING GLASS to ASTRAGALS, &c., A. Drummond, Edinburgh.—14*th July*, 1882.
3356. VARNISHING PAPER, &c., W. R. Comings, London.—14*th July*, 1882.
3357. MAKING LACE, &c., F. E. A. Büsche, Westphalia.—14*th July*, 1882.
3382. ELECTRIC LIGHT APPLIANCES, H. J. Haddan, London.—17*th July*, 1882.
3390. CANDLE-HOLDERS, C. Keibel, Tauer, Germany.—17*th July*, 1882.
3544. ELECTRIC REGULATOR, &c., W. Laing, Paris.—26*th July*, 1882.
3551. PUMPS FOR RAREFACTION OF AIR, &c., W. R. Lake, London.—26*th July*, 1882.
3553. LUBRICATING BOSSES, W. R. Lake, London.—26*th July*, 1882.
3593. TREATING GRAIN, A. W. L. Reddie, London.—28*th July*, 1882.
3599. SEWING MACHINE NEEDLES, J. Darling, Glasgow.—29*th July*, 1882.
3689. REGULATING TRANSMISSION OF ELECTRICAL ENERGY, W. R. Lake, London.—2*nd August*, 1882.
3724. MAKING CERTAIN SULPHO-ACIDS, &c., F. Wirth, Frankfort-on-the Main.—4*th August*, 1882.
3823. ENDLESS BAND KNIVES, T. Clark, London.—10*th August*, 1882.
3826. KNITTING MACHINES, A. M. Clark, London.—10*th August*, 1882.
3836. CUTTING CLOTH, &c., E. Dredge, Hoxton.—11*th August*, 1882.
3867. IRONING MACHINE, H. Podger and W. H. Davey, London.—14*th August*, 1882.
4057. MAKING AMMONIA, &c., E. P. Alexander, London.—24*th August*, 1882.
4102. CRANES, A. Grafton, London.—28*th August*, 1882.
4518. MOUNTING so as to FACILITATE the SHIPPING, &c., the RUDDERS OF SHIPS, M. Horsley, Hartlepool.—21*st September*, 1882.
4587. REGULATING TRANSMISSION OF POWER, J. Johnson and R. Talbot, Blackburn.—27*th September*, 1882.
4619. STAYS, &c., R. A. Young and R. Neilson, Bristol.—28*th September*, 1882.
4736. PREVENTING RADIATION OF HEAT from PIPES, &c., J. Roberts, Oldham, and G. Travis, Failsworth.—5*th October*, 1882.
4792. TREATING HIDES, W. Maynard, Liverpool.—7*th October*, 1882.
4986. MAKING IRON, C. Cochrane, Stourbridge.—19*th October*, 1882.
5011. SLIDE-VALVES, J. Dunbar, Southampton.—21*st October*, 1882.
5060. PRODUCING, &c., ELECTRIC CURRENTS, J. S. Fairfax, London.—24*th October*, 1882.
5127. BOTTLE ENVELOPES, A. W. Abrahams, Notting-hill.—27*th October*, 1882.
5145. STRAIGHTENING RAILS, L. Richards, Dowlais.—30*th October*, 1882.
5235. INCREASING DRAUGHT in CHIMNEYS, P. A. Bayle, Paris.—2*nd November*, 1882.
5241. ELECTRIC TIME-BALL APPARATUS, W. R. Lake, London.—2*nd November*, 1882.
5273. BREECH-LOADING SMALL-ARMS, A. Henry, Edinburgh.—4*th November*, 1882.

List of Specifications published during the week ending December 30th, 1882.

1771*, 4d.; 5107*, 4d.; 1799, 2d.; 2154, 6d.; 2249, 6d.; 2306, 6d.; 2394, 4d.; 2400, 4d.; 2401, 4d.; 2402, 4d.; 2403, 6d.; 2404, 2d.; 2405, 6d.; 2406, 6d.; 2407, 4d.; 2408, 4d.; 2410, 2d.; 2411, 4d.; 2412, 4d.; 2415, 2d.; 2417, 2d.; 2419, 6d.; 2420, 6d.; 2423, 4d.; 2421, 2d.; 2424, 6d.; 2427, 6d.; 2431, 4d.; 2432, 6d.; 2433, 6d.; 2434, 2d.; 2435, 6d.; 2436, 2d.; 2437, 6d.; 2438, 4d.; 2439, 8d.; 2441, 6d.; 2442, 2d.; 2443, 2d.; 2444, 2d.; 2445, 6d.; 2446, 2d.; 2447, 6d.; 2448, 6d.; 2449, 2d.; 2450, 2d.; 2451, 2d.; 2456, 2d.; 2458, 6d.; 2459, 1s.; 2461, 6d.; 2462, 2d.; 2463, 8d.; 2464, 2d.; 2465, 2d.; 2466, 6d.; 2467, 6d.; 2468, 6d.; 2469, 6d.; 2472, 2d.; 2473, 10d.; 2476, 2d.; 2478, 4d.; 2481, 4d.; 2482, 2d.; 2484, 4d.; 2486, 6d.; 2488, 2d.; 2489, 2d.; 2491, 2d.; 2492, 6d.; 2493, 2d.; 2494, 2d.; 2495, 2d.; 2497, 2d.; 2498, 6d.; 2499, 6d.; 2500, 4d.; 2501, 4d.; 2502, 2d.; 2504, 2d.; 2505, 6d.; 2506, 6d.; 2507, 2d.; 2508, 6d.; 2509, 2d.; 2511, 6d.; 2513, 2d.; 2514, 6d.; 2515, 6d.; 2516, 2d.; 2521, 6d.; 2524, 8d.; 2530, 6d.; 2534, 2d.; 2549, 8d.; 2604, 6d.; 2625, 2d.; 2626, 2d.; 2627, 2d.; 2628, 2d.; 2643, 2d.; 2645, 2d.; 2651, 2d.; 2660, 4d.; 2665, 2d.; 2700, 4d.; 2886, 8d.; 3978, 6d.; 4010, 6d.; 4054, 6d.; 4348, 6d.; 4428, 2d.; 4688, 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.*

1799. STARTING, STOPPING, REVERSING, AND TURNING MARINE AND OTHER MOTIVE POWER ENGINES, *A. W. Pattie and G. W. Robertson, Glasgow.*—15*th April*, 1882.—(*Not proceeded with.*) 2d.
This consists in the employment of an engine with three oscillating cylinders, arranged and constructed according to patents No. 3320, A.D. 1879, No. 1742, A.D. 1881, and No. 2749, A.D. 1881.

2154. LUBRICATING COMPOSITION, &c., *H. Montgomerie, Cleadon.*—8*th May*, 1882. 6d.
In one form the composition consists of plumbago (in an impalpable powder), 25 parts; lime water, 12½ parts; Gallipoli oil, 12½ parts; flour of sulphur, 10 parts; and tallow, 40 parts. The invention also relates to apparatus for lubricating.

2249. REELS FOR THREAD, &c., *A. J. Boult, London.*—12*th May*, 1882.—(*A communication from A. Deschamps, Lille.*) 6d.
The reel consists of two hats or dishes of cardboard or metal united at their central parts by means of one or more eyelets or their equivalents.

2306. FOUNTAIN INKSTANDS, *F. F. Benvenuti, Swansea.*—17*th May*, 1882. 6d.
This relates to means for regulating the supply from the reservoir to the dip cup.

2394. PIANOFORTES, *S. Peppler, London, and J. Carter, Southampton.*—22*nd May*, 1882.—(*Void.*) 4d.
This consists essentially in the application of a sounding chamber in the space behind the ordinary sounding board.

2400. SAUCES, *C. Bourdon, Paris.*—22*nd May*, 1882. 4d.
This relates to the employment of extract of meat and concentrated powders and ingredients.

2401. AGGLOMERATING MINERALS, *J. Wetter, New Wandsworth.*—22*nd May*, 1882.—(*A communication from A. Simon and V. Petit, Paris.*) 4d.
This relates to a binding material for agglomerating minerals, comprising a combination of asphalte, or bitumen, or resin, or colophany, or a mixture of two or more of these substances, with sulphur and gum lack.

2402. TUBES, *B. Rhodes, London.*—22*nd May*, 1882. 4d.
This relates to the use of asbestos paper or asbestos woven cloth for the formation of tubes.

2403. FRAMES FOR PRINTING PHOTOGRAPHS, *P. M. Justice, London.*—22*nd May*, 1882.—(*A communication from G. S. Street, Moncton, Canada.*) 6d.
This consists in the application and use in photographic printing frames, or frames for direct photography or blue printing, of a pressure cushion.

2404. MANUFACTURE OF IRON AND STEEL, *P. Williams, Blaenavon.*—22*nd May*, 1882.—(*Not proceeded with.*) 2d.
This relates to the arrangement of the tuyeres.

2405. APPLIANCES FOR "KNOCKING-UP" SHEETS DELIVERED FROM PRINTING MACHINES, &c., *J. W. Bewson, London.*—22*nd May*, 1882. 6d.
This consists of a forked or a plain strip of metal or other material hinged or otherwise fitted on the board or table close to where the edges of the sheets fall. This strip of metal or other material is connected by rods, cords, or chains to a crank, lever, cam, or other mechanical contrivance, so as to receive a motion therefrom to pull it close up to the edge of the pile, and in doing so to shift the top sheet or sheets to form an even pile with those below.

2406. TRICYCLE, *H. H. Hazard, London.*—22*nd May*, 1882. 6d.
This relates to the employment of an extra hind wheel to an ordinary bicycle.

2407. COMPOSITION FOR BLASTING, *H. H. Lake, London.*—22*nd May*, 1882.—(*A communication from J. Gemperlé, Vienna.*) 4d.
This composition is composed of nitrate of potash or soda, sulphur, charcoal, bran, and sulphate of magnesia, and it is made into cylinders or cartridges.

2408. MACHINES FOR COILING WIRE, *H. H. Lake, London.*—22*nd May*, 1882.—(*A communication from G. Gale, Canada.*) 6d.
This consists of a spindle having a conical or taper portion, and adapted to be rotated within a thimble or tube having a spiral face, in such a manner that as the wire is coiled upon the spindle it is pressed onward by the said spiral face to enable a continuous coil to be formed upon the said spindle.

2410. HORTICULTURAL AND PRUNING SCISSORS, *E. G. Brewer, London.*—22*nd May*, 1882.—(*A communication from J. E. Donop, Paris.*)—(*Not proceeded with.*) 2d.
The scissors is made in two parts, one of which is intended to hold the stem before the section of same is effected, while the other effects the section in such manner that the operation is accomplished with one hand.

2411. PREVENTING SLACK ROPES IN PIT SHAFTS, *A. J. Boult, London.*—22*nd May*, 1882.—(*A communication from Messrs. Gildemeister and Kamp, Dortmund, Germany.*)—(*Not proceeded with.*) 4d.
This relates to the employment of claws, the motion of which is controlled by the pressure in a hydraulic cylinder.

2412. APPARATUS FOR MARKING GROUND FOR LAWN TENNIS, &c., *T. Green, Leeds.*—22*nd May*, 1882. 4d.
This relates to an apparatus in which a disc, having hollows in its periphery, revolves in a tank and takes up whiting or pigment mixed with water and deposits it on the periphery of a marking wheel.

2415. INDICATING THE LEVEL OF WATER IN STEAM BOILERS, &c., *G. Binsewanger, London.*—22*nd May*, 1882.—(*Not proceeded with.*) 2d.
This relates to the employment of an electric bell or other alarm worked by a float.

2417. RING FRAMES FOR SPINNING AND DOUBLING, *J. Nuttall, Farnworth, and J. P. Tapley, Patricroft.*—22*nd May*, 1882.—(*Not proceeded with.*) 2d.
The object is to obtain a uniform drag or tension of the thread or yarn during its passage from the front roller to the tube, bobbin, or spindle.

2419. IMPROVEMENTS IN ELECTRIC ARC LAMPS, *W. H. Akester, Glasgow.*—23*rd May*, 1882. 6d.
In this lamp the holder of the upper carbon is fixed to a spindle formed with one or more screw threads of quick pitch, and which, without itself turning, works in an internally screwed block or short tube fitted so that it can turn freely in a short tube or guide. The internally screwed block is arranged to be acted on by the core of a solenoid, which core, when itself raised by the action of the solenoid, lifts the block by parts, preventing it from turning, but these parts become disengaged when the screw tube is lowered, so that the tube can then turn and allow the spindle to descend, which it does by its own weight. The current passing through the solenoid coils may either be the main current actuating the lamp or a shunt current.

2420. MATERIALS FOR COVERING AND DECORATING WALLS, &c., *W. S. Morton, Edinburgh.*—23*rd May*, 1882. 6d.
This consists principally in the producing of Scott-Morton's modelled canvas, a material having a woven fabric or canvas as its principal constituent.

2423. MOTORS ACTUATED BY THE EXPLOSION OF COMMINUTED LIQUIDS, &c., *W. P. Thompson, Liverpool.*—23*rd May*, 1882.—(*A communication from S. Marcus, Vienna.*) 10d.
This invention relates, First, to making the explosive mixture; Secondly, to the exploding of the same; Thirdly, to the motor in which the gas is exploded.

2421. APPARATUS FOR EXHIBITING ADVERTISEMENTS, *J. Hickisson, Hackney.*—23*rd May*, 1882.—(*Not proceeded with.*) 2d.
This relates to the arrangement of tablets or plates in a frame.

2424. COMBINED STEAM AND HAND STEERING ENGINES, &c., *A. W. Pattie and G. W. Roberson, Glasgow.*—23*rd May*, 1882. 6d.
This invention, which relates to improvements in combined steam and hand steering engines, parts of the said engines being also applicable to the starting, stopping, reversing, and turning of marine and other motive power engines, and for other purposes where motive power is required, consists of an engine with three oscillating cylinders arranged and constructed on the principle described in patent No. 1492, A.D. 1881.

2427. MANUFACTURE OF ERASING KNIVES, PAPER KNIVES, &c., *C. H. Wood, Sheffield.*—23*rd May*, 1882. 6d.
The handle is cast in any suitable metal upon the blade or tang of the blade.

2431. PRODUCING MOTIVE POWER, *W. Muir, New Cross.*—23*rd May*, 1882. 4d.
The object is the production of motive power by arranging a series of air-tight boxes in endless chain-like form over two axles, one of which is used for communicating motion to machinery or mechanism as desired.

2432. IMPROVEMENTS IN INCANDESCENT ELECTRIC LAMPS, *G. G. André, Dorking, Surrey.*—23*rd May*, 1882. 6d.
This relates to improvements in the method of preparing carbon filaments described in the inventor's patent No. 4654, 1881. He now employs flax, cotton, or similar vegetable fibre, and immerses it in boiled linseed oil. The thread is then drawn through the fingers and also blotting paper to remove as much of the oil as possible. It is subsequently exposed to a temperature of 140 deg. Fah. until the oil is fully oxidised. The filament is made like an inverted V, with the top part rounded into a curve of short radius. This part is made thicker than the rest by coating with copper or carbon. The inventor also claims a method of carbonising filaments under mercury and other improvements.

2433. RECIPROCATING SHUTTLE SEWING MACHINES, *A. Greenwood, Leeds.*—23*rd May*, 1882. 6d.
This consists in the application to reciprocating shuttle sewing machines which have their shuttle below the work of means for ensuring the passage of the shuttle through the loop of the thread of the eye-pointed needle when that thread is charged with shoemakers' wax, and for tightening the stitch.

2434. TENNIS RACQUETS, *J. Gibb, London.*—23*rd May*, 1882.—(*Not proceeded with.*) 2d.
The object is to utilise the entire area of gut as a striking surface.

2435. APPARATUS FOR SIGHTING ORDNANCE, *J. H. Johnson, London.*—23*rd May*, 1882.—(*A communication from A. Deport, Paris.*) 6d.
This relates to apparatus for pointing guns especially adapted for guns used for coast defences, and it has for its object to enable aim to be taken with speed and precision, and with proper allowance for altitude, range, and windage.

2436. CLOSING AND OPENING HERMETICALLY-SEALED METALLIC VESSELS, *J. F. Farwig, London.*—23*rd May*, 1882.—(*Not proceeded with*) 2d.
The inventor closes the bottom or underside of the vessels, after being filled with the ends reversed, by hermetically sealing them in the ordinary manner. But in order to facilitate the opening of such vessels, the top plate or upper end is so arranged that it can be readily forced inwards, either by suitable pressure or by a blow from a hammer or other instrument.

2437. IMPROVEMENTS IN TELEPHONIC APPARATUS, *W. R. Lake, London.*—23*rd May*, 1882.—(*A communication from C. E. Chinnock, Brooklyn, New York.*) 6d.
This relates to improvements in telephonic apparatus and circuits on the metallic system, whereby on two subscribers being placed in connection with each other, that part of the circuit extending between them and the exchange is cut out, and their conversation rendered private.

2438. CASES FOR MILLSTONES, *B. Edwards, London.*—22*rd May*, 1882.—(*A communication from F. D. C. Iwand, Breslau, Germany.*) 4d.
The cases are made of a material composed of the following ingredients:—White-blue clay containing about 5 per cent. of iron; gray-blue clay containing about 20 per cent. of iron; clay, easily fusible, containing about 15 per cent. of iron; blue clay, fusible with difficulty, containing about 2 per cent. of iron; quartz, easily fusible, containing about 20 per cent. of iron.

2439. MACHINES FOR PASTING TOGETHER "SHOE UPPERS," *A. J. Boult, London.*—23*rd May*, 1882.—(*A communication from S. L. Wiegand, Philadelphia.*) 8d.
The machine embraces the following devices in combination:—A series of forms for receiving and holding the upper, a paste fountain and brush, a clamping device, and a discharging mechanism.

2441. MACHINERY FOR COMPRESSING FODDER, &c., *J. Wetter, New Wandsworth.*—23*rd May*, 1882.—(*A communication from M. Laporte, Aine, Paris.*) 6d.
The apparatus comprises a long wooden chest closed at the top by two hinged doors, and at each end by a door provided with slits, through which are passed the ties for the bale of fodder after the latter is compressed. The compression takes place alternately at the two ends of the chest by means of a movable platform made of wood, and provided with recesses to give room for the ties. The motion is obtained by employing hydraulic cylinders and suitable accessories.

2442. DARNING LASTS, *G. A. Cochrane, Montreal' Canada.*—23*rd May*, 1882.—(*Not proceeded with.*) 2d.
This consists in providing a last for darning, of whatever shape and material, with means whereby a fabric, either of greater or less superficial area than the last itself, may be securely attached thereto.

2443. APPARATUS FOR CLIPPING HORSES, &c., *C. P. Collis, Alresford.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This relates to a means of imparting a reciprocating motion to the knives, blades, or clippers.

2444. RAILWAY BRAKE APPARATUS, *F. H. Hebblethwaite, Manchester.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This relates to automatic brakes actuated by a piston or diaphragm, and consists partly in means of arranging the admission of air to the cylinder.

2445. APPLIANCES FOR STOPPING AND STARTING TRAMWAY CARS, &c., *J. H. Betteley, London.*—24*th May*, 1882. 6d.
This relates, First, to means for obtaining a larger amount of brake surface in a minimum width for stopping tramway cars and other vehicles; Secondly, the method of assisting the horse or horses or other propelling power in starting tramway cars and other vehicles by the driver of the same.

2446. MANUFACTURE OF STEMS OF LUCIFER MATCHES, *F. H. V. Byrt, Peckham.*—24*th May*, 1882. 2d.
The stem consists of twisted wires forming a spiral screw or screws, in combination with fibrous material twisted therein.

2447. OPENING AND CLOSING WINDOW CURTAINS, *R. Henry, Edinburgh.*—24*th May*, 1882. 6d.
The curtain or window rings are pulled backwards or forwards by means of master rings which work along a screw-threaded rod.

2448. YARN WINDING MACHINES, *E. Ashworth, Bolton-le-Moors.*—24*th May*, 1882. 6d.
The object is to increase the stability of the coiled yarn, and this is effected by winding the yarn into the form of a cylinder with coned or bevelled ends.

2449. TREATING THE SPENT LYES OF SOAP WORKS, *F. H. T. Allan, Warrington.*—24*th May*, 1882. 2d.
This consists in precipitating gelatinous and albuminous matters and other impurities contained therein by the addition thereto of alum, chloride of lime, or crude pyroligneous acid, and withdrawing the said precipitate from the bottom of the retort.

2450. SECURING OR LOCKING NUTS, *H. Kemmler, Wurtemburg.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
The bolts or screws are made of any other form than circular, and the nut is formed of corresponding shape and secured by means of pins or teeth.

2451. IMPROVEMENTS IN TELEPHONE TRANSMITTERS, *C. Moseley, Manchester.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This relates to improvements on patent No. 2497, 21st June, 1879, granted to A. Marr. It consists in mounting on the back of the diaphragm cells to contain the electrodes and the powdered carbon.

2456. IMPROVEMENTS IN APPARATUS FOR DRIVING DYNAMO-ELECTRIC MACHINES, *J. Swalwell, Battersea, London.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This relates to the direct driving of a dynamo machine by means of a friction pulley keyed on the armature shaft, in combination with a number of shafts carrying loose friction pulleys driven by the flange of a wheel keyed on the shaft of the motor.

2458. STOPPERS FOR BOTTLES, JARS, &c., *N. Thompson, Brooklyn, U.S.*—24*th May*, 1882. 6d.
The inventor claims the combination of a ball or handle with a stopper in such manner as to act as a locking means to such stopper, and at the same time as a means for facilitating the removal thereof from the bottle or jar.

2459. MACHINE FOR SWEEPING OR SCRAPING STREETS, &c., *B. W. Stevens, Birmingham.*—24*th May*, 1882. 1s.
This relates to the construction and combination of parts for collecting and lifting the dirt or mud swept or scraped into a ridge by means of scrapers or a rotating brush, or by scrapers and a rotating brush in combination, to a tank or receptacle mounted upon a carriage drawn by a locomotive engine; that is to say, by means of a mud or dirt trough, scoop, collector or case situated at the rear of the machine, and an endless band carrying a series of buckets or brushes or blades.

2461. MANUFACTURE OF FLOUR, *W. R. Lake, London.*—24*th May*, 1882.—(*A communication from W. Warren, Chicago, U.S.*) 6d.
This relates to a process for producing whole wheat flour, and also the apparatus therefor.

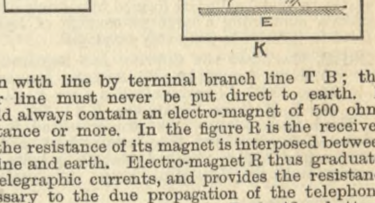
2462. MARKING OUT LAWN TENNIS COURTS, *C. A. Collins, Trowbridge.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This relates to the employment of a chain and an apparatus or frame to obtain the right angles.

2463. LIFTING AND CARRYING CLOTH, &c., *T. Stead, Leeds.*—24*th May*, 1882. 8d.
This relates to the employment of a table which can be raised or lowered within a framework mounted on wheels.

2464. PULPING APPARATUS, *W. H. Crispin, Hampstead.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This consists of a perforated cylinder in which works a plunger.

2465. SLIDE VALVES, *J. W. Joyce, Durham.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
This relates to a special arrangement of valve and also of the cylinder face.

2466. IMPROVEMENTS IN TELEGRAPHIC AND TELEPHONIC APPARATUS, *W. R. Lake, London.*—24*th May*, 1882.—(*A communication from F. van Rysselberghe, Schaerbeck, Belgium.*) 6d.
This invention relates to means whereby telephonic conversations can be carried on and telegraphic messages sent on the same wire. It consists in separating the ordinary telegraph circuits from the undulatory telephone currents by means of induction. The telegraph currents are gradually produced and extinguished, instead of being instantaneous. The figures show how this is done; A is a condenser, one face of which is connected to line L, and the other to terminal branch line S C, leading to telephone office T O, where the apparatus is arranged in the ordinary manner. The telegraph office K is in direct communi-



cation with line by terminal branch line T B; this latter line must never be put direct to earth. It should always contain an electro-magnet of 500 ohms resistance or more. In the figure R is the receiver, and the resistance of its magnet is interposed between the line and earth. Electro-magnet R thus graduates the telegraphic currents, and provides the resistance necessary to the due propagation of the telephonic waves through the condenser. B signifies battery, and E earth.

2467. COTTON PRESSES, *W. R. Lake, London.*—24*th May*, 1882.—(*A communication from S. B. Steers, New Orleans, U.S.*) 6d.
This relates to improvements in the general construction of the press.

2468. BELL ALARMS, *W. P. Thompson, Liverpool.*—24*th May*, 1882.—(*A communication from F. N. Cottle, Boston, U.S.*) 6d.
This relates to improvements in bell alarms particularly adapted as a burglar alarm for doors, windows, or money drawers, and, with a slight modification, as a gong or bell alarm for bicycles.

2469. SHUTTLE-BOX OR REVOLVER APPARATUS FOR LOOMS, *W. P. Thompson, Liverpool.*—24*th May*, 1882.—(*A communication from E. Lepainteur, Paris.*) 6d.
The revolver possesses a continuous circular movement always working in the same direction, which is communicated to it by a spring or any other appropriate device, and the mechanisms which act upon it at the will of the weaver have for their function to suspend its revolution at the moment when the required shuttle comes opposite the shuttle-throwing apparatus ("picker stick").

2472. OVERSHOES OR PATTENS, &c., *C. Mayer, Cologne.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
The sole plate is made of metal and provided with hinged parts.

2473. PIANOS AND PIANINOS, *F. C. Glaser, Berlin.*—24*th May*, 1882.—(*A communication from A. Battes, Cologne.*) 10d.
This consists in pianos and pianinos having crossed strings, of the arrangement of the strings with only a slight inclination from the horizontal line, in combination with an arrangement of striking mechanism wherein the hammer is caused to strike downwards, by which means the upper part of the instrument is rendered of moderate height and capable of being transported separate from the lower part, which is is rendered available as a cupboard.

2476. ROTARY ENGINE, *W. Southwood, Blackheath.*—24*th May*, 1882.—(*Not proceeded with.*) 2d.
The object of this invention is an improved rotary engine in which the piston occupies rather more than one-half the area of the cylinder and is caused to rotate

on an axis arranged excentrically, but moving concentrically to the axis of the shaft which it drives, the steam space being always charged with live or operating steam capable of expansion against the face of the moving piston.

2477. FIREPLACES, *J. Smith, Liverpool.—25th May, 1882.* 6*d.*

This consists in the combination of a fire-grate or basket, coking chamber, sliding bottom, ashpit, air ways, and valves or dampers.

2478. TENTERING, STRETCHING, PRINTING, CALENDERING, AND TREATING FABRICS, *J. Ashworth, Rochdale.—25th May, 1882.—(Not proceeded with.)* 2*d.*

This relates partly to the employment of a guider.

2480. IMPROVEMENTS IN THE MANUFACTURE OF COMPOUNDS SUITABLE FOR ELECTRICAL INSULATION, &c., *F. Field, Beckenham, Kent.—25th May, 1882.* 2*d.*

The inventor mixes woody fibre or cellulose in a fine state of subdivision with "black wax," or the residue of the distillation of the mineral ozokerit, produced either according to Matthiessen's patent No. 3778, 1869, or Field and Talling's patent No. 1938, 1875. After mixing, the whole is subjected to pressure.

2481. LOOMS, *W. Thompson, Blackburn.—25th May, 1882.* 4*d.*

This consists in the employment of a number of tooth-by-tooth or otherwise graduated studs, or intermediate differentially-geared toothed wheels, for the purpose of using the same as change wheels, in combination with the ordinary change pinion wheels, in the "taking-up' motion of looms for weaving.

2482. ORGANS, HARMONIUMS, &c., *J. B. Hamilton, Hammersmith.—25th May, 1882.—(Not proceeded with.)* 2*d.*

The invention consists of a compound oscillating reed, so constructed that it is partially fixed at both ends and partially free at both ends.

2483. UNIVERSAL EMBROIDERY MACHINES, *W. E. Gedge, London.—25th May, 1882.—(A communication from E Cornely, Paris.)* 10*d.*

This relates to improvements on patent No. 2482, A.D. 1877, the object being to render the machine apt for universal embroidery, and as capable of working as well with a number of needles as the original "Bonnay" machine can work with a single needle.

2484. METALLIC ALLOYS, *G. A. Dick, London.—25th May, 1882.* 4*d.*

This consists, First, in the method of manufacturing alloys of copper, zinc—with or without tin—and iron, by previously alloying the iron in definite proportions with the zinc; Secondly, in deoxidising the oxide or oxides contained in alloys of copper and iron, of copper, iron and zinc, of copper, iron, and tin, or of copper, iron, zinc, and tin, by the employment of manganese-copper; Thirdly, in introducing into the last-named copper alloys, by the employment of manganese-copper, a certain definite quantity of manganese beyond that required for the deoxidation of the oxides present; Fourthly, in adding lead to the alloys containing manganese as lastly referred to.

2486. SUPPORTING TENNIS NETS, CLOTHES-LINES, &c., *J. M. Croisdale, Manchester.—25th May, 1882.* 6*d.*

The rope passes over a pulley and is attached to one end of an arm or stud mounted upon the pole, and which arm or stud is capable of sliding along the pole so long as it is held at or about at right angles thereto, but when inclined in the direction of the pull tightens itself self-actingly.

2487. VELOCIPEDES, *L. C. Tippey, Balsall Heath.—25th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to the employment of two steadying wheels, one on each side of the large wheel of the bicycle.

2488. EVAPORATING AND DRYING APPARATUS FOR TREATING SEWAGE, *G W. von Nawrocki, Berlin.—25th May, 1882.—(A communication from S. Adamczewski, Poland.)—(Not proceeded with.)* 2*d.*

This relates to improvements in evaporating pans.

2489. VALVE GEAR FOR ENGINES, *W. R. Dawe, Grantham.—25th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to an improved arrangement of parts for communicating a variable extent of motion to the valve by the governor in order to maintain as nearly as possible a regular speed to the engine.

2490. MEASURING RULES, *H. Green, Handsworth.—25th May, 1882.—(Not proceeded with.)* 2*d.*

This consists in improvements in jointing measuring rules, whereby they may be converted into T squares either at right angles or at any bevel required.

2491. IMPROVEMENTS IN SECONDARY BATTERIES, *C. W. Vincent, Holloway, Middlesex.—20th May, 1882.—(Partly a communication from Baron Elphinstone, Canada.)—(Not proceeded with.)* 2*d.*

Relates to the construction of secondary battery plates by metal cylinders formed from finely deposited metals containing a large percentage of hydrogen. Lead in solution is preferably employed.

2492. MACHINES FOR CUTTING AND BENDING METAL TO FORM LINKS, &c., *W. R. Lake, London.—25th May, 1882.—(A communication from R. D. Evans and R. M. Green, Washington, U.S.)* 6*d.*

The inventor claims, First, the crosshead B, having dovetail grooves and the independent adjustable cutter and binder attached thereto by bolts having correspondingly dovetailed heads, in combination

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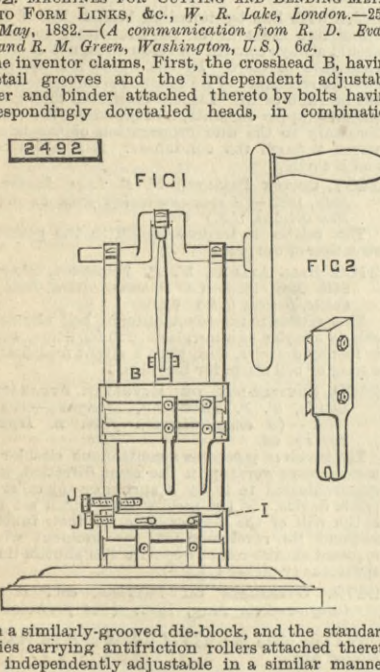

with a similarly-grooved die-block, and the standards or dies carrying antifriction rollers attached thereto, and independently adjustable in a similar manner; Secondly, the combination, with the standards or dies, and the antifriction rolls attached thereto, of the slotted plate I and the screws J J[1].

2493. HYDROCHLORIC ACID, *J. W. Leather, St. Helens', Laucaster.—25th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to a means of producing hydrochloric acid practically free from arsenic and sulphuric acid.

2494. RAILWAY BRAKES, *J. M. Hollinshead, Newcastle-under-Lyne.—25th May, 1882.—(Not proceeded with.)* 2*d.*

The object is to so construct and apply brakes that the operating power for applying the brakes is obtained from the momentum of velocity or weight of the train itself.

2495. SOUNDING ALARMS, &c., *W. H. Willots, Canterbury.—25th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to a clockwork arrangement which causes caps upon nipples to be struck at certain intervals, and thus give an alarm.

2496. BREECH-LOADING ORDNANCE, *T. Nordenfelt, Westminster.—25th May, 1882.* 8*d.*

This relates to patent No. 4523, April, 1880, and consists in improvements in the arrangement of the firing mechanism.

2497. PROJECTILES, *E. A. McEvoy, London.—25th May. 1882.—(Not proceeded with.)* 2*d.*

The object is to cheaply manufacture projectiles with a band or bands of copper or other suitable metal around them to centre them in the bore of the gun when fired, and to take the rifling.

2498. DOOR FASTENERS, *A. M. Clark, London.—25th May, 1882.—(A communication from C. A. Crongeyer, Detroit, U.S., and G. W. Busch, Walkerville, Canada.)* 6*d.*

This relates to an apparatus provided with a hook, which is forced into the jamb of the door, for the purpose of fixing the fastening.

2499. MACHINERY FOR DRILLING OR BORING METALS, *A. Higginson, Liverpool.—26th May, 1882.* 6*d.*

A hydraulic engine of any suitable construction is connected directly to the spindle or bar carrying the drill or boring tool without the intervention of

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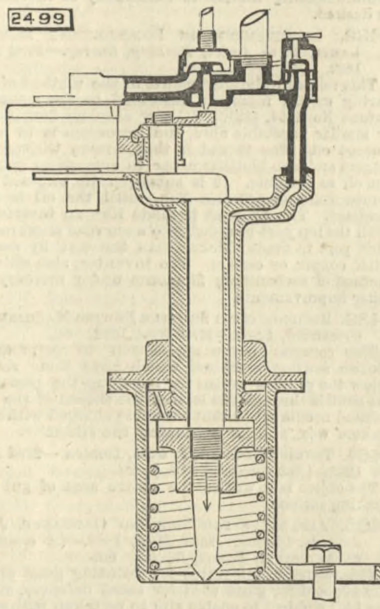

gearing, and the forward motion of the drill or boring tool is obtained by means of fluid pressure acting on the drilling or boring spindle or bar.

2500. HEELS FOR BOOTS AND SHOES, *E. A. Brydges, Berlin.—26th May, 1882.—(A communication from M. Rachel, G. Henneberg, and J. Rothziegel, Vienna.)* 4*d.*

The heels are made of sheet metal, and provided with teeth to attach them to the boots. The hollow part is filled in with a light material.

2501. AN IMPROVED COMBINATION OF MATERIALS TO BE EMPLOYED AS AN INSULATOR FOR ELECTRICAL PURPOSES, *B. Rhodes, Bow-road, and G. Binswanger, Aldermanbury, London.—26th May, 1882.* 4*d.*

This relates to the combination of asbestos, shellac, resin, sulphur, finely powdered, and india-rubber and gutta-percha. The whole is mixed and passed through heated rollers.

2502. LOOMS, *W. Mould and T. Grimshaw, Preston.—26th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to means for simplifying the construction of the "dobby."

2504. VELOCIPEDES, *J. Simonton, Ireland.—26th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to a machine in which there is only one wheel having contact with the ground.

2505. AXLE-BOXES, *H. Simon, Manchester.—26th May, 1882.—(A communication from La Société Anonyme des Ateliers de la Dyle, Louvain, Belgium.)* 6*d.*

This relates to a means of constructing axle-boxes for revolving axles of wrought iron or steel.

2506. EXTERNAL LAMPS FOR RAILWAY TRAINS, &c., *R. M. Silber, London.—26th May, 1882.* 6*d.*

The inventor claims, First, the construction of single reflector chimney for a lamp, consisting of an internally brightened parabolic conoid penetrated transversely by a tapered chimney tube containing at its lower end the burner and air cone; Secondly, the construction of double-reflector chimney for a lamp, consisting of a pair of opposite parabolic conoids penetrated transversely by a chimney tube containing the burner and air cone.

2507. HOT PLATES, *A. J. Boult, London.—26th May, 1882.—(A communication from L. Bracco, Troyes, France)—(Not proceeded with.)* 2*d.*

This relates to means for heating plates and dishes by a gas-burner.

2508. MACHINERY FOR CUTTING SCREW THREADS, *J. H. Johnson, London.—26th May, 1882.—(A communication from W. D. Forbes, Bridgeport, U.S.)* 6*d.*

The drawings show one form of instrument, and it consists of cylinder A with a hub X into which the pipe is inserted and secured by screws. The die-carrying ring D is screwed into the casing and has

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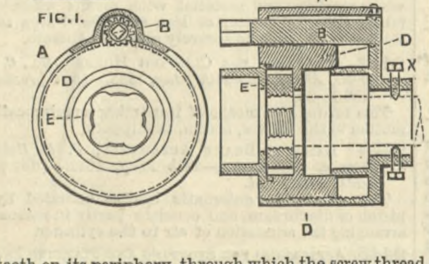

teeth on its periphery, through which the screw thread is cut; pinion B gears with these teeth and is rotated by a suitable handle. The threading die E is held in ring D by projections so as to turn with it. Other forms are described.

2509. AERIAL NAVIGATION, *A. J. Boult, London—26th May, 1882.—(A communication from A. Werner, Magdeburg, Germany.)—(Not proceeded with.)* 2*d.*

On a suitable board are fixed balloons filled with gas, and on the outer side of the board are fixed shafts, which carry a suitable number of propellers.

2511. CARRIAGES, &c., *S. Andrews, Cardiff.—26th May, 1882.* 6*d.*

This relates to the manufacture of carriages and other vehicles for common roads with springs outside the wheels, and also to the manufacture of axles and axle furniture.

2513. DRESS FASTENINGS, *F. Tew, London.—26th May, 1882.—(Not proceeded with.)* 2*d.*

This relates to improvements in fastenings or clips for supporting stockings and for fastening gloves and purses, and for fastening and supporting other articles of dress.

2514. SIGNALLING ON RAILWAYS, *J. White, Bermondsey.—26th May, 1882.* 6*d.*

This consists in mounting inclines in such a manner that when the signals are set to danger the inclines shall be brought into a position centrally between the two rails of the line of railway, and when the signals are not set at danger shall be moved away from this central line.

2521. HYDRAULIC LIFTS, &c., *J. M. Day, W. R. Green, and H. C. Walker, London.—27th May, 1882.* 6*d.*

The inventors claim, First, in a hydraulic lift, causing the water from the supply tanks or available source to enter immediately below the piston or ram of the accumulator or balancing cylinder; Secondly, the application of the invention to an ordinary multiplying cylinder, whereby the use of balance weights and chains are entirely dispensed with; Thirdly, the construction of apparatus for controlling the descent of the ram and cage.

2524. CENTRAL BUFFER AND COUPLING GEAR, *W. R. S. Jones, India.—27th May, 1882.* 8*d.*

This relates to the construction of combined central buffer and traction gear, so as to allow the buffer when working to be flexible. D is a rigid bar acting as buffer and drawbar, and is provided at each end with nuts and a washer plate, and with springs H to withstand the tensile strain when it is acting as the draw-

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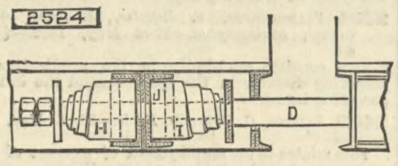

bar. I is the buffer spring to oppose the motion of the bar when acting as the buffer bar. The hole J, through which the bar passes, is rounded, tapering, or wide-mouthed, so as to permit the bar D to take a new position when the carriage deviates from a straight line either laterally or vertically.

2541. ARCHITECTURAL WORK, *P. Ross, Harrow-on-the-Hill.—30th May, 1882.—(Complete.)* 4*d.*

This consists of framework panels constructed with open-work ornamental figures or designs.

2604. IMPROVEMENTS IN THE MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS, *F. des Vœux, Derby.—2nd June, 1882.—(A communication from A. Bernstein, Boston, U.S.)* 6*d.*

This relates to a means for insuring increased durability in incandescent lamps. This the inventor accomplishes, as shown in the figure, by clamping between the enlarged ends of the carbons an oval body

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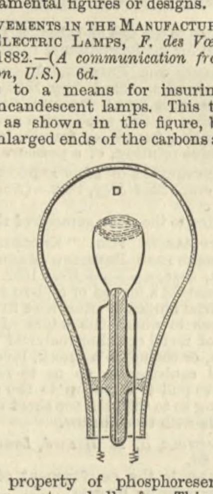

D having the property of phosphoresence, such as calcined egg or oyster shells, &c. This light-giving part D is partly or entirely covered with a film of carbon deposited chemically or mechanically.

3025. IMPROVEMENTS IN DYNAMO-ELECTRIC MACHINES, &c., *E. A. Sperry, Cortland, New York, U.S.—27th June, 1882.* 10*d.*

This relates first to a dynamo machine. It is shown in plan with armature and pole pieces in horizontal section in Fig. 1 herewith. A is the armature composed of an annulus of soft iron O O, upon which is wound insulated wire P P. The armature is secured to a non-magnetic disc C, by bolts R, as shown in Fig. 2. The field magnet is composed of a casting E, to which are bolted the cores of the helices F F[1], &c. To the

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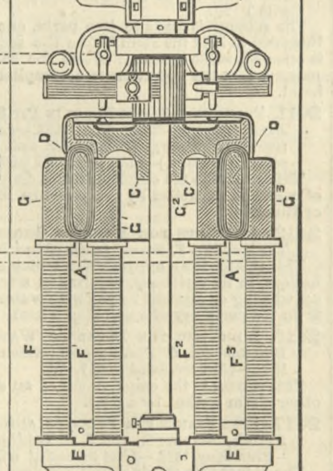

free end of each of these cores are secured castings G G[1], &c. G and G[1] are, say N, when G[2] and G[3] are S in polarity. This arrangement, the inventor claims, renders that portion of the coil lying internal to the ring equally efficient to that which is external thereto. He also claims the following amongst other things: The combination with the commutator brushes of an electric machine mounted so as to turn freely concentric with the commutator of a centrifugal governor connected therewith by suitable mechanism in such a

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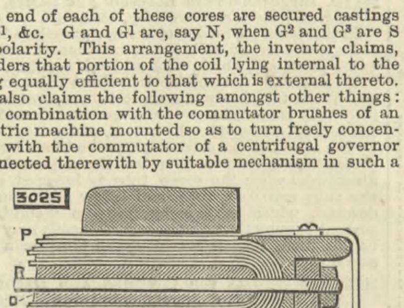

manner as to automatically control the movement of said brushes relative to those points on the commutator which coincide with the neutral points of a transversely wound annular armature. The invention also relates to an arc lamp, the carbons of which are regulated by differential solenoids.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

268,477. SINGLE TRUNK COMPOUND ENGINE, *J. Fish, Summit, N.J.—Filed February 24th, 1882.*

Claim.—In a compound engine having a single trunk and a trunk casing extending the length of the

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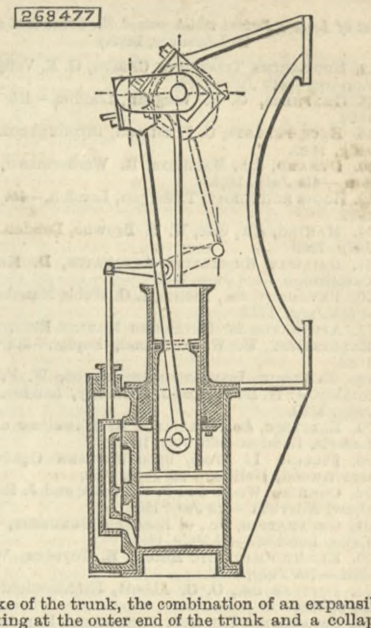
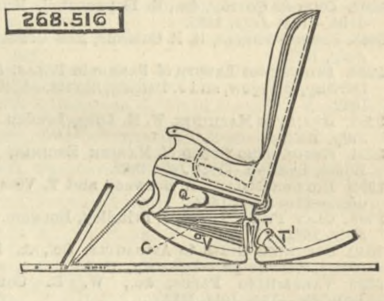


stroke of the trunk, the combination of an expansible packing at the outer end of the trunk and a collapsible packing at the inner end of the trunk casing, substantially as described.

268,516. ROCKING CHAIR, *Emil Michbach, Cincinnati, Ohio.—Filed August 2nd, 1882.*

Claim.—The fanning and cushioning attachment

268.516



for rocking chairs, consisting of double-chambered bellows C, springs Q, shackle connection T T[1], and the discharge pipes or nozzles V V[1], substantially as and for the purpose set forth.

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SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Dec. 30th, 1882:—On Tuesday and Saturday, free, from 10 a.m. to 10 p.m., Museum, 16,852; mercantile marine, Indian section, and other collections, 5922. On Wednesday, Thursday, and Friday, free, from 10 a.m. till 10 p.m., Museum, 13,005; mercantile marine, Indian section, and other collections, 6991. Total, 42,770. Average of corresponding week in former years, 28,907. Total from the opening of the Museum, 21,582,101.