VISITS IN THE PROVINCES.

THE STOWMARKET EXPLOSIVES WORKS.

THE Government, thanks to Mr. Abel and his department, has developed the powers of gun-cotton and applied it admirably to military engineering purposes, so that our Royal Engineers have been for many years familiar with its use as applied to mining and torpedo operations. Our artillery have used it, not only as experimental bursting charges in shells, but also to burst guns filled up with water; and our cavalry have long had an equipment containing gun-cotton in various forms for destroying iron and steel rails, palisades, bridges, &c. Civilians, however, have so little followed the progress of gun-cotton that many of the experiments carried out on Saturday week, during a visit paid to the Stowmarket works, which have been often performed in a matter-of-course way in the Arsenal, were new to some of those present. Certain new things we shall presently notice; but we may point out that gun-cotton does not require anything novel to recommend it, for it has many valuable properties peculiar to itself; what it needs is to establish its claims to trustworthiness and safety. The fact that it can be detonated when wet enables it to be kept in a condition when it is not liable even to burn, much less to explode on the application of fire. Even were it not so, the fact that it can be kept wet and then quickly dried, so as to admit of firing in the ordinary way, without suffering in its quality, is a peculiar advantage; and, be it observed, both these advantages offer increased safety. If all were convinced that gun-cotton was a thoroughly safe and stable compound, the advantages it offers could hardly fail to bring it into use much more widely than at present. Gun-cotton has suffered from earning a reputation and having confidence reposed in it, before it was thoroughly understood. The action of acid on an organic substance like cotton cannot in the nature of things be so simple a matter as the mechanical mixture of three simple substances like sulphur, saltpetre, and charcoal. Great purity and perfection must be obtained for security. Unfortunately, a near approach to this was obtained in a comparatively early stage in the history of gun-cotton, confidence was won, and shaken when accidents occurred which showed the question to have been imperfectly mastered. Thus the danger of the presence of free acid, which might lead to spontaneous combustion, was known almost from the beginning; then it was found that when all free acid was removed the cotton might contain less stable compounds, which, while they for the time took up acid and actually were what they appeared to be—a complete compound—afterwards were much more liable to decompose than the true insoluble gun-cotton proper, and did not offer the same conditions of security. Lastly, it became known that partly decomposed cotton was anything but a safe compound when dry.

Speaking then, not from the manufacturer's point of view, but from that of the purchaser, it is necessary that assurance should be given that we have the most stable form of gun-cotton sold to us under that name; otherwise all the experiments and guarantees that we have had put before us may not apply to the article in our possession, but to something differing from it in a vital respect. This being so we can see the desirability of having the processes of manufacture of gun-cotton fully shown and explained, as was done by the Explosives Company on Saturday week. The programme of experiments dealt with other matter besides gun-cotton pure and simple, as used in the service, namely, a small-arm cotton powder, and also a new form of dynamite which is specially recommended. The importance of this last will appear both in a direct and indirect way—directly as to the merits of the new dynamite, indirectly as strengthening the recommendations of the Stowmarket company on behalf of its gun-cotton, which may be supposed to be a less interested recommendation as compared with its own dynamite than would be the case if it was pushing its own gun-cotton in rivalry with Noble's dynamite. The objects we have specially to consider now are—(1) Gun-cotton proper; (2) gun-cotton sporting powder; and (3) the new form of dynamite. The processes of manufacture of gun-cotton were first seen, then a series of experiments were performed. The main principle to keep in view in manufacture is the completeness of the chemical action of the acid of the cotton in the formation of trinitro cellulose in the form of insoluble gun-cotton, and the removal of every less stable compound or impurity. This is effected mainly by mechanical means, that is, tearing the gun-cotton into minute threads and washing it in the form of pulp. Chemical means, that is the application of alkalies, have been tried, but it may be seen that, however completely free acid may be removed by alkalies, the less stable compounds will not be touched, and as these are found in interior parts of the cotton it is obvious that the only guarantee of security is the disintegration of the cotton, and the washing out of these compounds in virtue of their solubility. Alkali may with advantage be added to gun-cotton for another purpose, namely, to enable it to bear exposure to a high temperature, that is, about 170 deg. Fah., which is the highest to which it is safe to submit it in the judgment of Mr. Abel, whose experience on this question is so great that his opinion may well weigh down that of all private manufacturers combined.

The general arrangement of the works is shown in our engraving. They consist of little more than a series of sheds, in this respect resembling more or less all establishments where explosives are manufactured.

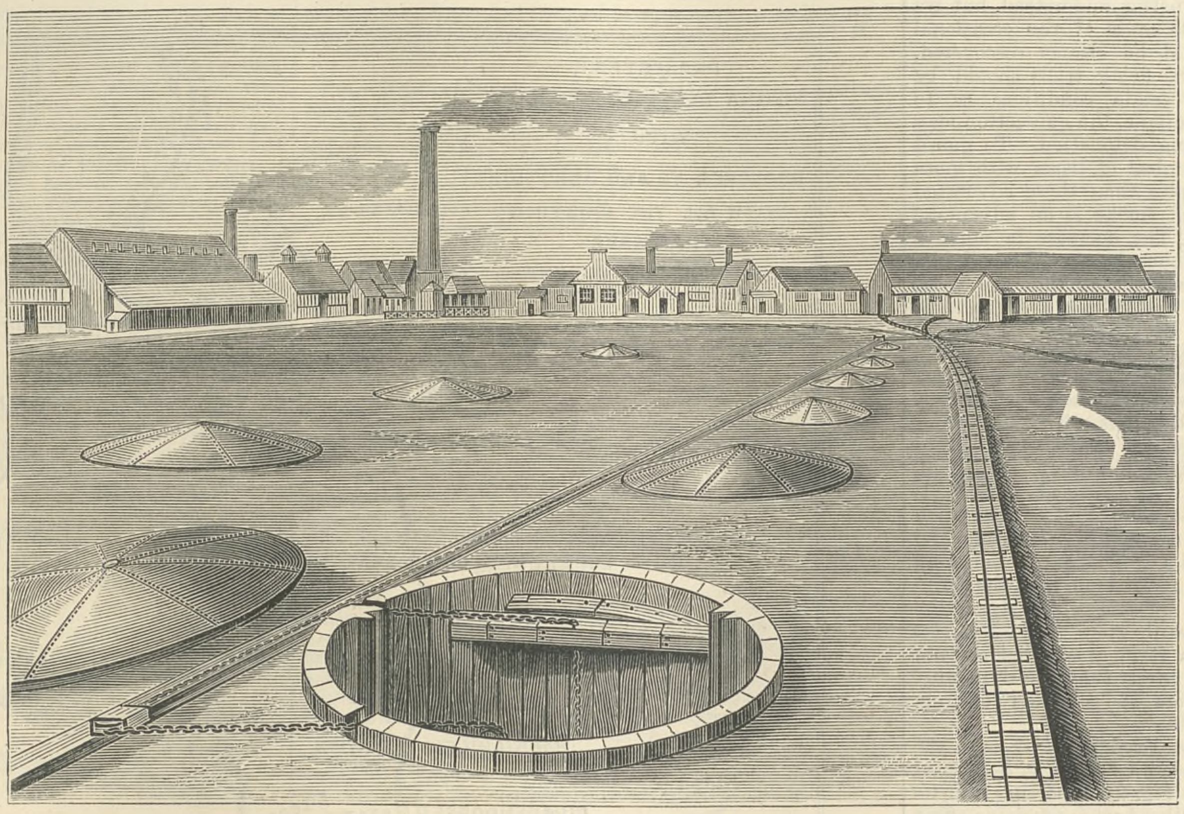
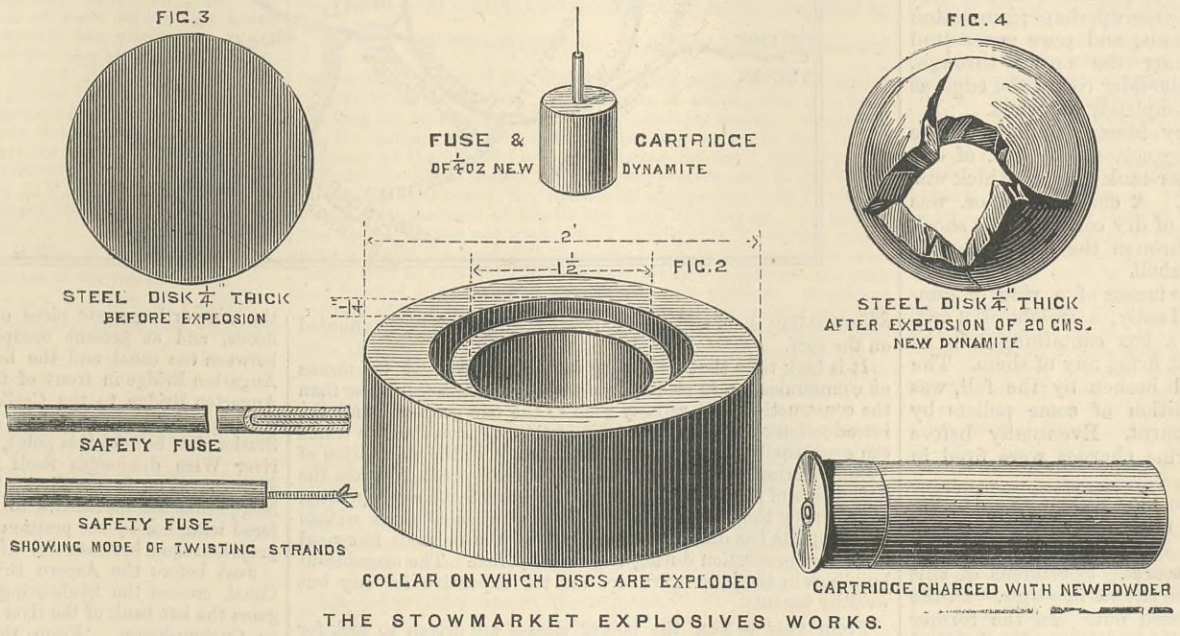


FIG. I.



THE STOWMARKET EXPLOSIVES WORKS.

Picking.—The cotton employed is the best bleached white waste obtained from Manchester; it contains from 5 to 12 per cent. of dirt and impurity, which can be removed by picking. This is done by female labour; three girls can pick about 700 lb. per diem.

Teasing and Carding next follows. The cotton is now carded and wound on to rollers taking 28 lb. each.

Air-drying.—The cotton of three rolls is now dropped into a cylinder with a steam jacket; the hot air at a temperature of about 160 deg. Fah. is drawn through the cotton by exhaustion effected by a fan. After this the cotton is left further to dry in a zinc cylinder until it contains only about ½ per cent. of moisture, when it is fit for the application of the acid.

Acid Mixing.—The sulphuric acid comes in carboys containing varying quantities of acid, generally about 160 lb. The nitric acid in bottles containing 73 lb. Both are supplied from Messrs. Prentice's works. A charger divided into two unequal parts then receives in one division 219 lb. of sulphuric and in the other 73 lb. of nitric acid; on opening the bottom both are allowed to descend into a closed vessel, where they are mixed by the agitation of a T-piece, to which motion to and fro is imparted by a crank. The acid is run into tanks containing about 2½ tons each.

Application of Acid.—The cotton is immersed in the acid in quantities of 1 lb. weight. It remains in the acid for about two and a-half minutes. For the sake of those who are wholly unfamiliar with gun-cotton, we may observe that the nitric acid alone acts on the cotton, the sulphuric acid being used only to take up the water which would otherwise be formed to the detriment of the nitric acid, which would check the action on the cotton and spoil it. It may be seen that the sulphuric acid is to the nitric in the proportion of 3 to 1, and fresh acid is employed for every pound of cotton. The acid is pressed out of the cotton to a certain extent, and the latter left for about five minutes, when it is placed in an earthen jar containing only the pound of cotton with its acid.

Digesting.—Each jar of acid and cotton is now placed in water to a depth of 6in. to 8in., and left to cool for about twenty-four hours; each pound of cotton takes with it about 10½ lb. of acid.

Wringing.—Six charges of cotton and acid are now placed in a rotating wringer, which by centrifugal force wrings out about 9½ lb. of acid out of each 10½ lb.

Water-washing.—The cotton is now washed under a free stream of cold water, the cotton being stirred about on a perforated copper bottom by a pole by hand for about ten minutes or a quarter of an hour.

Centrifugal Water-washing.—Water is now run on the cotton while moving in a centrifugal machine or cylinder making about 1700 revolutions per minute.

Boiling.—From 500 lb. to 600 lb. of cotton is now placed in a boiling vat on a wood grating. Boiling is effected by the passage of steam up through the water at a pressure of about 10 lb. The time which this process is continued varies from about four to twelve hours, depending on the chemical tests obtained in the case of each vat. The water should be neutral to test paper before the cotton is removed.

Beating.—About 500 lb. of cotton is now thrown into a tank with a wheel working in it against a raised portion of the bottom with steel strips; the wheel has also steel edges or blades, which shear the cotton against the strips and divide it finely. The revolution of the wheel causes all the water and cotton to pass round and round past it. Moving at a rate of 4000 to 5000 revolutions per minute, the wheel reduces the cotton to pulp in the water.

Poaching.—The pulp is now mixed in a "Poacher" or oblong wooden tub with wheel, with the addition of more water; the wheel in the poacher has three beaters, and revolves at the rate of 8 revolutions per minute.

The Pulp Centrifugal House.—In a centrifugal machine the pulp now has the water carried out of it till it contains only about 25 to 30 per cent. It is now in the condition of pure gun-cotton.

Pressing.—Charges of about ½ oz. of cotton are now weighed out by girls and passed on to a table, where boys press it in pipes with plungers into pellets sufficiently firm to enable them to be put horizontally into chambers in a metal plate, and pressed by hydraulic pressure—2¼ tons to the inch—until its specific gravity is about 1·5, in which state it contains about 12 per cent. of moisture.

Packing.—Brown paper prepared in resin, and rendered water-proof, is used for packing the gun-cotton pellets, previous to which, however, they are dipped and made to take up about 25 per cent. of moisture. If required, cotton pressed in this way can be cut by a revolving saw, which can be safely used when the cotton has 12½ per cent. of moisture—in fact, 40 tons were recently cut up in this way. The limiting quantity of moisture determining whether gun-cotton will burn or not is about 5 or 6 per cent. It is stored in boxes containing 50 lb. or 100 lb. in the moist condition—12 per cent. of moisture. If sent by rail, warning for a special van should be given, although, as a matter-of-fact, gun-cotton in this state does not readily ignite under ordinary conditions. Magazines are made in the form of circular pits dug 12ft. deep and lined with wood, as shown in the foreground of our engraving. It may be seen that this form of magazine is simple and suitable. The gun-cotton being damp the conditions of storage are quite different from ordinary dry powder, for which an unventilated hole in the ground would be very unsuitable. In speaking of damp gun-cotton as safe, it is of course contrary to reason to suppose that in a mass of fire it would not eventually become dry and ignite, or explode, according to circumstances. In The Engineer of May 3rd, 1872, will be found a detailed account of the burning of magazines filled with dry and wet gun-cotton, when certain conditions as to confinement seemed to determine when explosion and when ordinary burning would take place. The experiments, however, were not fully made with wet cotton.

The sporting or rifle powder is made of a combination of gun-cotton with nitrates of potash and soda, being, in fact, very nearly Mr. Abel's nitrated gun-cotton; it is incorporated in a mill under metal rollers, and granulated in a perforated zinc revolving cylinder, and eventually passed through a sieve suited to the size of grain desired. The grain appears to be hard and firm, comparing favourably with Shultz's powder; also, it is glazed so as to admit of being thoroughly wetted and dried again, which of course might be of great advantage if used on service. As we shall see presently both bullets and shot are fired with this powder. At the same time we cannot advocate the use of gun-cotton cartridges with bullets generally, until exhaustive experiments have been made. In the Royal Arsenal, many years ago, it was found that very unexpected results were occasionally produced; indeed, rifles were burst without apparent cause. It may be said the cotton powder is now much better understood, but we think that to be satisfactory the cause of the occasional burst formerly obtained should be clearly discovered, and a very extensive series of firing trials should be successful. Possibly under certain conditions as to strength of cap and length of nipple, the gun-cotton may be fired in a manner approaching detonation. To guard against such a possibility a number of trials with more powerful caps and shorter nipples than those advocated might be made. The absence of smoke is an advantage justly claimed for gun-cotton. The decrease in noise is very well as far as it goes, but the absence of recoil is a much more questionable matter, implying that the work done on the piece is more local and sudden, and therefore more dangerous to the piece. In the Royal Arsenal, as the conditions became more satisfactory, a recoil was produced. In short, whatever may be done with shot cartridges, it would be well to proceed cautiously with bullets.

After firing a rifle with shot and bullets, with both powder and cotton cartridges, in order to exhibit the advantages claimed of absence of smoke and non-recoil, the following experiments were carried out:—(1) Charges of five kinds of explosive compound of $\frac{1}{2}$ oz. each were exploded in lead cylinders 4in. in diameter, 1in. bore, length 5in.—(1) Gunpowder: This hardly acted on the lead. (2) Nobel's dynamite: This enlarged the cylinder and tore it open. (3) The company's new dynamite. This tore the cylinder open still more violently. (4) Mining gun-cotton, which is a form of nitrated cotton: This tore the lead rather less violently than the dynamite. (5) Pure gun-cotton, which tore the cylinder entirely across, dividing it into fragments.

The same compounds were now tried in order as to the effect produced on a steel disc $\frac{1}{4}$in. thick—Fig. 3—placed in a collar of the form shown in Fig. 2 supporting it at its circumference. The powder produced no appreciable effect on its disc. Nobel's dynamite bent it into a shallow cup. The new dynamite effected a little more perhaps; gun-cotton No. 2 gave nearly the same result, and pure gun-cotton produced a deeper cup, breaking the crown through, showing the impression of the shoulder round the edge as shown in Fig. 4, but no metal completely detached.

Rails—80 lb. steel—made by Messrs. Cammell, were broken by detonating 7 oz. of dry cotton with 1 oz. of dry cotton used as a primer. A water-tank over 1in. thick was blown in pieces by gun-cotton. A charge of $1\frac{1}{3}$ oz. was detonated with the help of 1 oz. of dry cotton. The shock in this case was transmitted through the incompressible water, as in the case of a water shell.

A tree was next cut in two by means of a ring of gun-cotton pellets placed round it. Lastly, a weight of 2 cwt. was dropped about 10ft. on to a box containing 5 lb. of pellets of dry gun-cotton without firing any of them. The cotton, which was crushed and broken by the fall, was proved to be dry by the ignition of some pellets by a match, when they readily burnt. Eventually before leaving the works two submarine charges were fired in the canal.

We have said nothing of the new dynamite. It consists of nitroglycerine absorbed more completely and held more tenaciously than hitherto by a medium, the ingredients of which are at present secret. Specimens of this substance and that of Nobel were shown in water. In the latter the nitroglycerine had oozed out. In the former there were no signs of it. If this quality can be obtained it is just the sort of explosive that is most valuable to engineers generally. The physical condition which enables a man to apply it to almost any mining job ought to recommend it strongly, while the prevention of escape of free nitroglycerine is most important as to safety. It may be added that this nitroglycerine is said not to freeze at so high a temperature as Noble's.

THE VIENNA CIRCULAR RAILWAY.

No. I.

The idea of an intra-mural railway within the ramparts of Vienna is by no means a new one. As far back as 1872 several schemes, all more or less of a similar character, were brought before the public, in the shape of plans, sections, or pamphlets, by engineers and others; but owing to their impracticability, to the lack of enterprise that prognosticated the approaching crisis of '73, or to the want of confidence on the part of capitalists in schemes which were never properly worked out, very few of them ever passed the embryo stage of "Vorconcession," and those which survived the ordeal of "study" and investigation are now helping to swell the lists of abortive speculations which lie buried in the archives of the Ministry of Commerce.

There is no city in Europe that needs improvement in its internal communication as badly as Vienna. The seven different railways that converge on it are all either outside or only just within the ramparts, and on an average half an hour by cab from the centre of the town. The expense of using these vehicles is further increased by reason of the higher cab fare—a sort of poll tax on strangers and travellers—permitted by the authorities to be charged for any distance, no matter how short, to and from any railway station to any part of the city. The tramways which run in the immediate neighbourhood of the termini are of very little service to any but literally "local travellers," as no one is allowed to take with him a greater package than he can carry in his hand. The miserable rate at which the cars travel, the uncertainty as to their time of passing a station, and the circuitous routes they are forced to take to avoid steep gradients and other obstacles, make no saving in time to an ordinary pedestrian should they by chance take the direction that suits him. To anyone coming from a long journey the possible overcrowding of a tramcar is an insurmountable objection, and as it is no uncommon thing to see sixty and even more unfortunate passengers packed like sardines in a box in a vehicle constructed and licensed to carry the maximum number of twenty-four, the probability of getting a seat is in the inverse ratio to the certainty of being crushed and possibly robbed.

The only remaining vehicles for public convenience are the antediluvian specimens of coach building denominated omnibuses. The cattle employed in propelling them appear to be contemporary in origin, and although they may be interesting as illustrations of the tenacity of equine vitality, they are no less a disgrace to humanity and modern civilisation. The vehicles are, however, largely patronised on account of the impossibility of overcrowding them and the moderate facility for luggage afforded on the roof.

It is high time that something be done to improve the means of communication in so important a city, and nothing less than the construction of a railway such as the one proposed, and the introduction of a systematic organisation of metropolitan traffic can ever supply the remedy. The increase in the population of Vienna during the last few years has been great; no less the demolition of old houses for the city improvement; consequently, as shown by the last census, the number of inhabitants within the ramparts has diminished, and that of the suburbs increased in greater proportion during the same period. The magnificent buildings in the inner town are far too expensive for any but wealthy tenants.

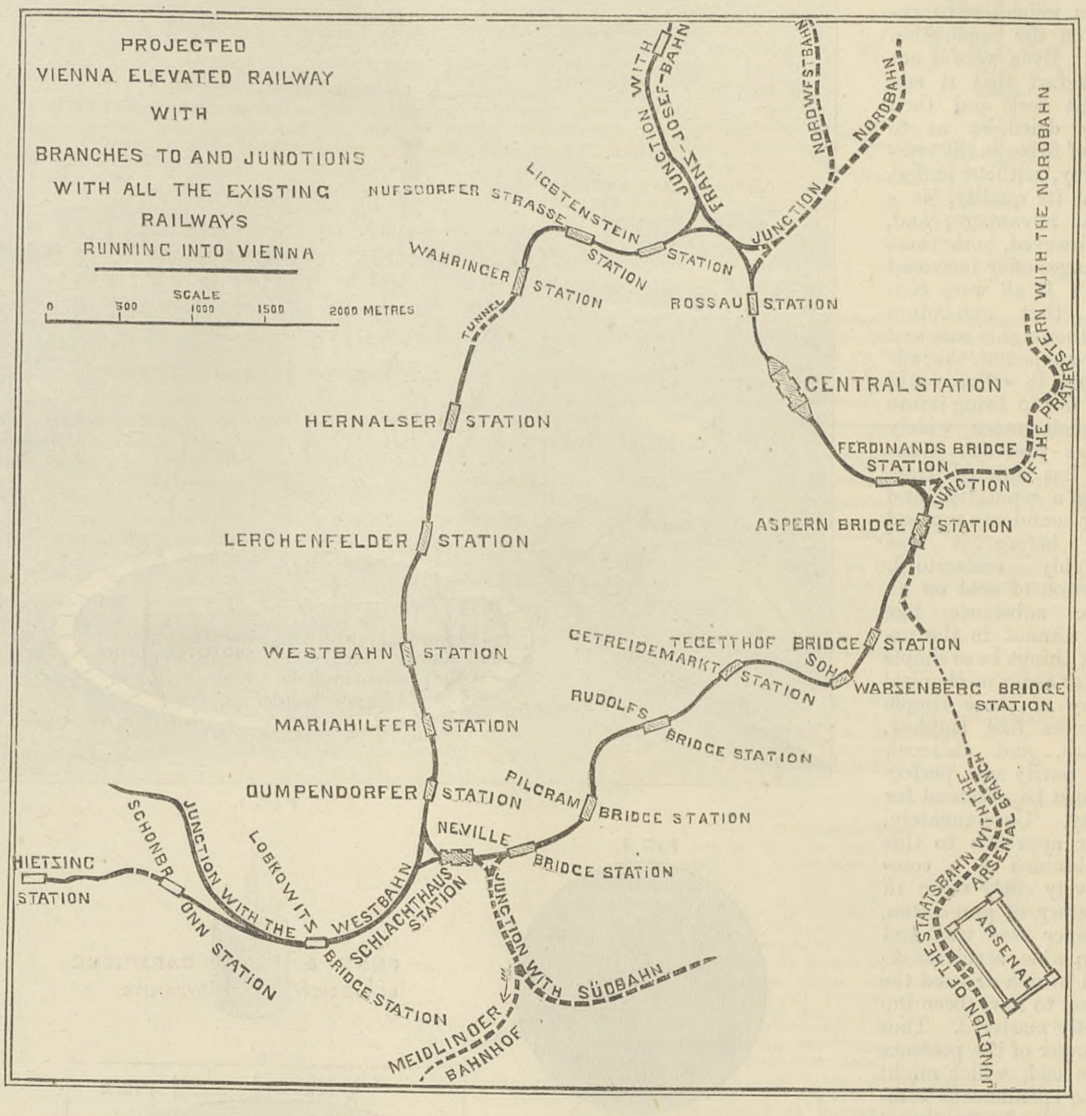
From year to year the poorer classes are driven to look for cheaper dwellings beyond the lines, or to herd more thickly in the old houses inside the ramparts in numbers equally prejudicial to health and morality. The facilities for conveying the inhabitants of the suburbs to the scenes of their labours in the city are in most cases inadequate to the demand, and generally beyond the means of those who need them most. The custom amongst the business men of removing their families from Vienna during the intense heat of summer to some of the beautiful retreats on the south and western railways, within a moderate distance by rail from their offices, has become an absolute necessity of existence. But even the boon of fresh air and cooler nights is robbed of half its advantages by the expense of private, and by the absence of sufficient public, conveyances from the termini to the city.

The Circular Railway has been designed to meet the requirements of every class of traffic, by connecting the suburbs with one another and with the city in one continuous circuit, and by connecting the circuit with every railway entering Vienna. No city in the world offers the same facilities for the execution of so large a work with so little destruction of property as Vienna in its present state of transition. The waste lands on the banks of the Danube Canal and of the river Wien, as well as the long strip of common between the city and suburban road, which run parallel to one another along the projected boulevard of the Gürtelstrasse, allow $\frac{11}{12}$ths of the route to be built without the demolition of more than ten houses; the remaining $\frac{1}{12}$th is projected through one of the oldest slums, and will enable new and better houses to be erected in place of the wretched hovels that now exist. Every advantage has been taken of these conditions in designing the work, and where it has been found necessary to come into collision with, or into the neighbourhood of, any existing work of art or building, special regard has been paid to their respective architectural features in determining the character of the structure.

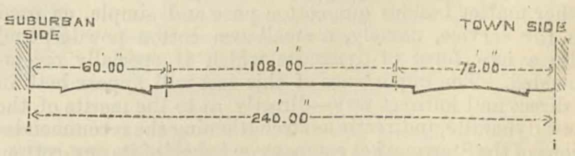
With regard to the position of the Central Station—the keystone of the system—necessity, no less than choice, required that the only available site for such a structure should be adopted; nor is there any other open space in the whole of the city so suitably situated for the purpose as the so-called Franz Josef's Quai Park on the bank of the Donau Canal.

Situated in the heart of the most populous district, in the very centre of the actual city, or the business part of the town comprised between the Ringstrasse on the south-west and the Leopoldstadt on the north-east of the canal, it lies contiguous to the Exchange, Custom-house, Government and post-offices, and to the landing places of the Danube Steam Navigation Company, and is not ten minutes distant from the principal streets, warehouses, shops, and the magazines and offices of the busiest part. All the other station sites have been fixed by their position in reference to street traffic and the main arteries of circulation.

By reference to the accompanying map, it will be seen that the zero—in this case an arbitrary choice—has been chosen in the neighbourhood of the Brigitta Bridge over the Danube Canal, not far from the terminus of the Franz Josef's Railway. From this point the line, which is double throughout, is carried on an elevated structure along the right bank of the canal on the more or less waste piece of ground subjected to occasional floods, and at present occupied by stacks of paving stones, between the canal and the houses of the Rossau as far as the Augarten Bridge in front of the Rudolf's Barracks. From the Augarten Bridge to the Carl's Steg opposite the Hôtel Metropole a part of the Franz Josef's Park is occupied by the Central Station, but beyond this point, until a short distance before the river Wien discharges itself into the canal, no land of the slightest value is required. The railway is carried at such a height that the approaches to the bridges are in no way interfered with, nor by the position of the columns will any future projected Quai between the bridges be prejudiced.



Just before the Aspern Bridge the line leaves the Danube Canal, crosses the Stubenring on an ornamental viaduct, and gains the left bank of the river Wien, nearly opposite the Zollamt or Custom-house. From the Aspern Bridge as far as the slaughterhouses at Gaudenzdorf, the structure is elevated throughout, occupying for the most part the useless slope of the river, and only in one or two places requiring the demolition of inferior property. After passing the slaughterhouses, the circular railway turns sharp to the north, and, after crossing the main road to Gumpendorf on a viaduct, suddenly enters cutting in the common land of the Gürtelstrasse, before mentioned, at a point where the rapidly rising configuration of the ground enables this change of structure to be effected without interfering wiih the passage of streets. This so-called Spiegelgrund, or waste piece of common land, lies in the centre of the new outside Boulevard in course of construction round Vienna, the nature of which will be seen from the following cross section.



From this point the line remains in cutting with a rising gradient under the main road from Schönbrunn to Vienna by the Mariahilfer line outside the ramparts, until it reaches its summit just after crossing underneath the main road that leads from the town through the Westbahn line to the large manœuvre grounds on the Schmelz, near kil. 8·700. Between this road and kil. 10·800, the line alternates between viaduct and cutting, necessitated by the natural contour of the ground, with a ruling descent of 1 : 60, and from the latter point is carried for about 450 metres in a tunnel under the high ground at the back of the Irren Anstallt, or lunatic asylum, and thence in open cutting with retaining walls below the main road to Währing until it leaves the route of the Gürtelstrasse and again enters the ramparts of the city at kil. 11·800.

As the ground within the ramparts falls rapidly towards the Danube Canal, advantage has been taken of this circumstance to return to the system of elevated structure, and the line is carried through the low levels of the Thury on masonry and iron viaduct until it forms a junction with the starting point by the Brigitta Bridge and completes the circle.

We commence this week, at page 400, the publication of a series of engravings illustrating the system of construction adopted. In a second article we shall further describe the line.

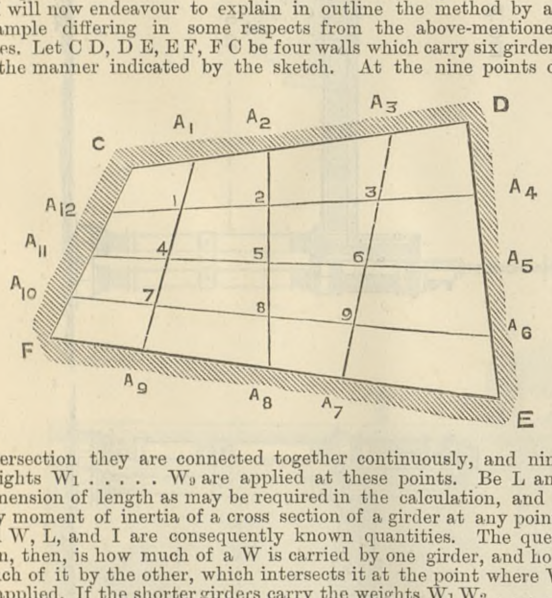
LETTERS TO THE EDITOR.

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

THE STRENGTH OF PLATFORMS.

SIR,—Your recent article on the strength of platforms induces me to refer to the calculation of strength of the gallery, New Town Hall, Reading—which appeared in your issue of July 1. That calculation was introduced into the description on account of its wider application, "and in using this expression" I had in my mind especially platforms of bridges and dock caissons, such as are used, for example, in the new dockyard, Portsmouth. These caissons may be looked upon as a series of horizontal girders supported at both ends and intersected by a series of vertical girders, which are supported only at one end, and which do the work of distributing and equalising the pressure upon the horizontal girders. Platforms of bridges—at least some—may be looked upon as a series of short parallel girders—cross girders—supported at both ends and intersected by a series of longitudinal girders of such length that their end supports have no material influence upon most of the cross girders, their influence being that of distributing a concentrated load among them. The structure above referred to consists of a number of short girders fixed at one end and free at the other, and intersected by one long distributing girder, also fixed at one end and free at the other. The theoretical treatment of these cases is in principle the same. The reason why it is not usually to be found in text-books is, probably, partly that their authors assume that students can find the general method themselves, partly that its full explanation requires examples, the calculation of which is generally very tedious.

I will now endeavour to explain in outline the method by an example differing in some respects from the above-mentioned cases. Let C D, D E, E F, F C be four walls which carry six girders in the manner indicated by the sketch. At the nine points of



intersection they are connected together continuously, and nine weights $W_1 \ldots\ldots W_9$ are applied at these points. Be L any dimension of length as may be required in the calculation, and I any moment of inertia of a cross section of a girder at any point. All W, L, and I are consequently known quantities. The question, then, is how much of a W is carried by one girder, and how much of it by the other, which intersects it at the point where W is applied. If the shorter girders carry the weights $W_1\, W_2 \ldots\ldots W_9$. then the longer girders will carry the weights $W_1 - w_1$, $W_2 - w_2 \ldots\ldots W_9 - w_9$. Here are nine unknown quantities, and inclusive of the twelve abutment pressures $A_1\, A_2 \ldots\ldots A_{12}$ there are twenty-one. Making up the necessary twenty-one equations we have first, six equations of the form :

$$A_1 + W_1 - w_1 + W_4 - w_4 + W_7 - w_7 + A_9 = 0$$

Secondly, the six equations of moments of the form :

$$\text{Funct.}\ [L\,(A_1\,;\ W_1 - w_1\,;\ W_4 - w_4\,;\ W_7 - w_7\,;\ A_9)] = 0\,;$$

and thirdly, we have eighteen statements of deflections, viz., three for each girder of the form :

$$\delta = \int \frac{M}{E\,I}\, x\, dx.$$

Two of these δ are always equal, and we have, therefore, nine more equations according to requirement. All the unknown quantities can now be determined.

If the girders are fixed in the walls, instead of resting on them freely, the twelve momenta at the supports appear as so many unknown quantities in the second series of six equations, and likewise in the third series of nine equations. On the other hand, twelve new equations are supplied by the condition that the change of angle at the supports is *nil*.—

$$\Delta\,\phi = \int \frac{M}{E\,I}\, d\,x = 0$$

It may be mentioned that in stating the products $\frac{M}{E\,I}\, x\, dx$ it is advisable to assume the girder to be held at any point—for example at one end—and to measure the x from the point whose deflection is to be calculated. The deflections obtained are then those measured from the tangent on the elastic curve at the assumed point, and these measurements have a simple relation to the deflections required, viz., those measured from the straight line drawn between the ends of the girder. For structures which are symmetrically arranged and symmetrically loaded the number of equations is considerably reduced.

From calculations of this sort which I have made it appears that when a series of short girders is intersected by a series of long ones, the latter do not help all the former in carrying the load which they would have to carry independently, but that they add to the load of some. This was also the case in the structure of the gallery referred to above. This effect may be neutralised by an artificial loading of the girders during their erection, but the determination of such loading on the principle of greatest expediency would be a very difficult matter.

Although the calculations indicated above are generally very lengthy and require great care, it seems impossible to avoid them, unless we are content to be completely in the dark as to the strains in such structures. To form an opinion about them by guessing I found to be utterly misleading. M. AM ENDE.

3, Westminster-chambers, S.W.
November 30th.

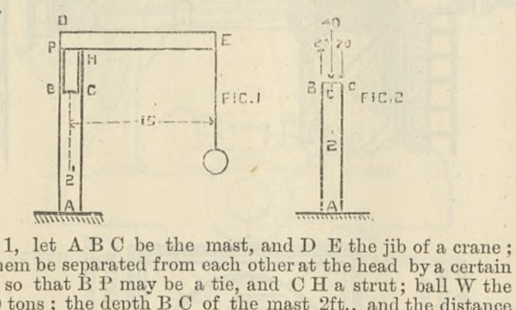
STRAINS ON CRANE POSTS.

SIR,—I did not notice till this evening that Mr. Major mentioned me in his letter to you on the above subject; as the passage has some peculiar merits I will quote it. "Shortly, Mr. Seguin removes the webs and argues behind their backs; what he does in practical and, if he wil. excuse me, workshop-like language, Mr. Tozer and "J. H. H." both do trigonometrically; and they, starting from the same error, naturally arrive at similar results." Now if Mr. Major means to accuse me of removing the webs and arguing behind their backs, my innocence is easily established, as I have not the slightest idea how to set about the job, and if he means that I have not taken into account the stresses in the webs of the crane he is mistaken, as the formulæ I gave involved the resultants of all the stresses in the post, the form of section of which merely determines the positions of these resultants. I did not show how to find these positions, as that was not the question at issue. If Mr. Major does not mean either of the above accusations, I would be much obliged if he would say what he does mean, as I am convinced still that the solutions given by Mr. Tozer and myself are quite right; indeed I gave reasons for each of the steps I took in my solution—if any of these are not satisfactory to Mr. Major he might be good enough to point out where he thinks them defective.

Coming back to his last letter, I would point out that he has attempted to prove that the effect of the weight suspended at the end of the arm is the same as that of an equal horizontal force applied to the post at a height equal to the length of the arm. Of course anyone who knows a little of mechanics can see that this is not the case. The mistake begins in supposing that it is possible to counteract the tendency of the weight W to break the post by any weight X, no matter what it may be. Even supposing it was possible, another error is introduced by neglecting the binding of the post due to the action of the strings pulling at different points in the post combined with the reaction of the ground. I think Mr. Major will see the truth of these remarks when he thinks about them. If not I will be glad to explain more clearly when I have more time than at present. J. H. H.

London, 16th November.

SIR,—If you will allow me, I will make a few more remarks in continuation and explanation of my letter on the above subject printed in your issue of 21st ultimo, as your correspondent "H. S." and one or two others seem to think I did not make myself sufficiently clear in that communication.



In Fig. 1, let A B C be the mast, and D E the jib of a crane; and let them be separated from each other at the head by a certain distance, so that B P may be a tie, and C H a strut; ball W the weight 40 tons; the depth B C of the mast 2ft., and the distance from the centre of gravity of the weight W to the neutral axis of the mast, 15ft.

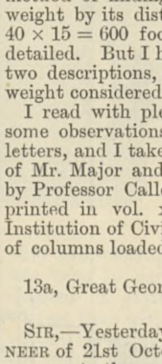
Mr. Pendred's safety valve theory will come into requisition at first, as the strain on B F equals $\frac{14}{2} \times 40 = 280$ tons in tension; and the strain on C H consequently equals $280 + 40 = 320$ tons in compression. Thus far we all seem pretty well agreed. These forces are equivalent to a couple having a bending moment of $280 \times 2 = 560$ foot-tons; plus the weight of 40 tons acting at the point C. What effect has this weight on the stresses in the mast? I think Mr. Pendred's safety valve theory now fails. It is well known that if a column is loaded excentrically, the action of the weight on the column may be reduced to a couple, and to the weight acting on its centre of gravity. Thus, in Fig. 2, if the weight W is supposed to act at the point C, the strains it exerts on the mast A B C at any section of the height A B may be found as follows :—

The couple produced by the excentricity of the weight W gives a bending moment equal to the depth B C of the section multiplied by $\frac{1}{2}$ W—that is, $2 \times 20 = 40$ foot-tons. There is also the strain caused by the direct action of the Weight W itself acting at G, the centre of gravity of the section. This means, of course, that it is compressing the section equally all over its entire surface. Summing all the strains, viz., 560 foot-tons bending moments due to the leverage of the jib, 40 foot-tons bending moments caused by the excentricity of the weight, and the compression due to the weight W equally distributed, the stresses on any section may be readily found if its moment of inertia and area are known. Of course, the weight W does not spread itself equally over the section immediately under the head, but there can be no doubt but that it practically does so very quickly, especially if the web between the back and front of the mast is of any considerable stiffness. A quicker method of finding the bending moments is by multiplying the weight by its distance from the neutral axis of the mast. Thus $40 \times 15 = 600$ foot-tons, and $560 + 40 = 600$ foot-tons, as before detailed. But I have purposely divided the bending moment into two descriptions, so as to show more clearly the action due to the weight considered by itself.

I read with pleasure the remarks of "H. S." with respect to some observations that Mr. Major made at the end of one of his letters, and I take this opportunity of recommending to the notice of Mr. Major and other engineering students the valuable papers by Professor Callcott Reilly entitled, "Studies on Iron Bridges," printed in vol. xxix. of the "Minutes of Proceedings" of the Institution of Civil Engineers. In one of these papers the subject of columns loaded excentrically is treated in great detail. ALFRED FYSON.

13a, Great George-street, Westminster.

SIR,—Yesterday I have received the last number of THE ENGINEER of 21st October. I have been much surprised by the nine answers to the query of Mr. Pendred. I think the single and best answer to his query to be another query, Do you know what is the neutral line you speak of? I have also found the diagrams of H. A. Hoy very extravagant. Has any one of the nine correspondents studied in Cooper's Hill College? I think not. Assuming the crane post to be massive and rectangular, I say the neutral line



cuts the back line of the crane post when the vertical of the centre of gravity falls in the section of the post, one-third of it from the front line, as you see in the section A; when the compression line falls parallel and coincides with the front line, the vertical line passes one-third from the back line. Other points could be easily drawn. I think not one of your correspondents is right. The strain of tension on the back cannot be equalled by that of compression in the breast; this one is always greater than the former, which disappears when the length of the vertical post is sufficient to bring the perpendicular line of gravity into the third of the section A. FREDERICO DE VASCONCELLOS.

Public Work Office, Frenchay, Madeira Island,
October 31st.

COLD-AIR MACHINES.

SIR,—Referring to a letter signed by Mr. J. W. de Galwey, published in your issue of the 25th November, I did not make the experiments therein referred to for the benefit of persons like himself, who appear to know all about the mechanical theory of heat, but for the benefit of those who have expressed doubts in your columns, within the last few months, that an expansion cylinder is really necessary for the production of cold in cold-air machines. Although your correspondent is mistaken in thinking that I am going to write a paper specially about these experiments—what I have been asked to prepare being rather an account of what has been practically accomplished in introducing cold-air machines—the experiments themselves are more interesting to many people than he thinks.

If air be compressed into a bottle provided with a stop-cock, as in Joule's original experiments, described in the *Phil. Mag.*, vol. xxvi, 1845, and the stop-cock be opened, then the bottle will become cold from the work done by the escaping air displacing the atmosphere—in fact, Joule measures the mechanical equivalent of heat by the method; but the air expelled from the bottle will not necessarily be cold—its temperature depending upon the friction of the molecules either in passing the orifice of the vessel or in coming to rest against the walls of the vessel into which it is expanding, or in coming to rest by collision with the molecules of the atmosphere into which it is being expelled. In my experiment I have no doubt a cooling effect was being produced behind the valve, but it was masked by the constant stream of air continually coming up to supply the place of that expanding.

I believe that in some circumstances a cooling effect may be produced by expanding compressed air into a room through a loaded valve, particularly when the reservoir containing the compressed air is very large and the orifice very wide through which the air is blowing; indeed, such an experiment was successfully made at Kenniel Ironworks in 1839 by Prof. Piazi Smith and Mr. Stirling, C.E. But there was no evidence whatever of such a cooling in my recent experiment, which in principle and results is very similar to a series of experiments made by Dr. Joule and Sir. Wm. Thomson jointly in 1854, by allowing compressed gases to escape through porous plugs into the atmosphere; in fact, the expanded air was a degree or two warmer than it was immediately before expansion, until the piston block was put on the rod, when in a short time the temperature dropped 50 deg. below freezing point.

I maintain, notwithstanding what your correspondent says, that this is a very pretty experiment, and a useful demonstration for a teacher of physics. I am much obliged for the information given by your correspondent about the cold-air machine fitted up for a Mr. Shaw near Cork, with the approximate date thereof, in which a Sturgeon's air compressor was used as a part of the apparatus; but I do not admit that it was the first cold-air machine in which water injection was not used, nor do I admit that Newton's specification of 1850, which I have been familiar with for years, nor any other of the hundred or so patents I have perused on the subject, describe the exact methods used by myself and, I may add, by other cold-air machine makers of the present day. The principles regulating the construction of cold-air machines were enunciated by Joule himself in his paper of 1845 above referred to, who in describing the oft quoted experiment of expanding compressed air from one bottle into another empty bottle, the one bottle becoming cold and the other equally hot, uses the words:—"But had the motion of the compressed air from one vessel into another been opposed in such a manner as to develope power at the outside of the jars, which might have been accomplished by means of a cylinder and piston, then loss of heat would have occurred, just as when the force was applied in lifting the atmosphere of the earth." J. J. COLEMAN.

45, West Nile-street, Glasgow,
November 28th.

EARLY STEAM NAVIGATION ON THE THAMES.

SIR,—I was pleased to see in THE ENGINEER, November 11th, the letter of Mr. Darton and his short account of Mr. George Dodd. I hardly think he is correct in saying that the Thames was the first steamer that ever performed a voyage on the high seas. I think the Comet was the first, as in 1813 Bell says: "I made her a jaunting boat all over the coasts of England, Ireland, and Scotland, to show the public the advantage of steamboat navigation ever sailing." With regard to Mr. Darton's other statement that the Thames, formerly the Glasgow, was the first passenger steamer that ran from London to Margate, I find on reference to a rare work—"Mémoire sur les Bateaux à Vapeux des Etats-Unis d'Amérique. Par M. Marestier. Paris, 1824"—that a list is there given of all the steamers which had been built in England up to that time. The tabular list was evidently prepared with care, and I should say was tolerably perfect. The following quotations may be of interest, by which it appears that Duke of Argyle or Thames was the first Margate steamer, the Glasgow appearing as a separate vessel. There is a note of correction, as to the dimensions of the Duke of Argyle or Thames, at the end of the volume, tending to show that the main entry in the body of the work is correct. In the year 1813, p. 176—Margery, 70 tons, 14-H.P.: Sur le Clyde de Leith à Londres; sur la Seine. Glasgow, 74 tons, 16-H.P.: Sur le Clyde; sur la Tamise en 1815. Duke of Argyle ou Thames, 74 tons, 14-H.P.: De Glascow à Greenock; De Londres à Margate. Passing over ten vessels, we come in 1814 to the Richmont, 60 tons, 10-H.P.: De Londres à Richmont. Then, passing six vessels, we come in 1816 to the Regent, 112 tons, 24-H.P.: De Londres à Margate—with the note that the vessel was burnt in 1817. She appears to have been the largest steamer built, as regards tonnage, up to that time in this country, but her horse-power had been considerably exceeded.

In conclusion, I beg to call the attention of those interested to the fine work I have mentioned. It is in French, and that is, I suppose, the reason it is so little known; but it seems strange that a 4to. work of 390 pp., with an atlas of seventeen plates, published in 1824, should, as far as I have seen, not be referred to in any English work on the subject—not even by Bennet Woodcroft in the "History of Steam Navigation." W. H. PROSSER.

Hampstead, November 23rd.

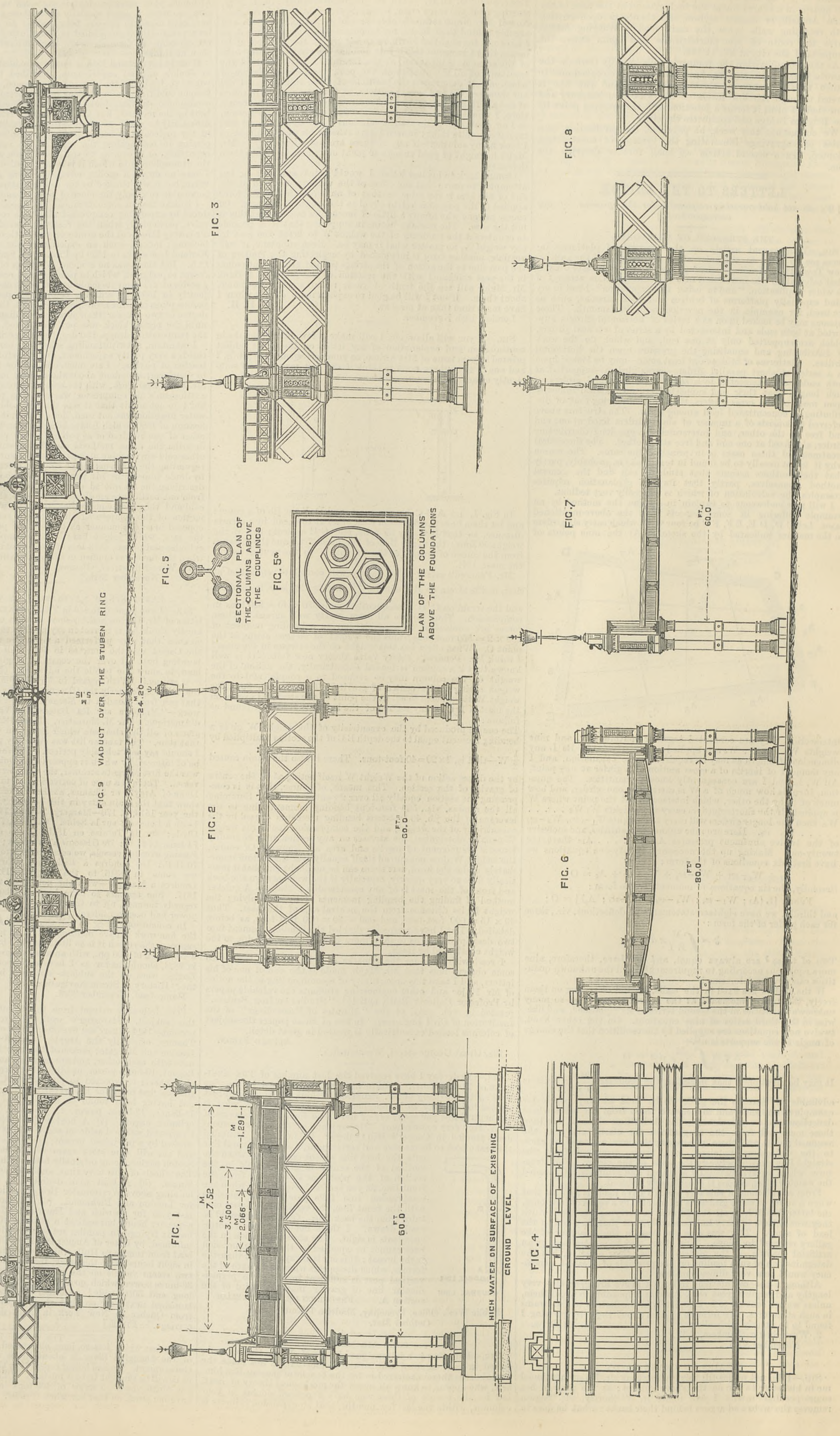
[The following extract from the *Scientific American* bears on this subject. Marestier's work is exceedingly scarce:—"At present—1814—there are five steamboats on the Thames. (1) The Thames, originally the Argyle, 14-horse power, plying between London and Margate; reckoned the best boat; the paddles alternate with each other, and are set at an angle of 45 deg. (2) The Regent, 10-horse power, paddles set square, with rims like an overshot wheel; is expected to ply between Chatham and Sheerness; she was first built for the wheel to work in the middle, but this, not having been found to answer, has been altered. (3) The Defiance, 12-horse power, to Margate, with double horizontal cylinder engine. (4) A boat which plied between London and Gravesend was laid aside on account of a lawsuit, as she was not worked by a privileged person; such a person has now taken her, and she will soon start again with a new 12 or 14-horse power Scotch engine, being originally fitted with a high-pressure engine. The wheels of this have rims, and the paddles swing like top butt hinges. (5) A boat with double keel, 6-horse power, is now building above Westminster Bridge; paddles upright; said to be for London and Richmond. (6) Mr. Maudslay built a small boat last year for Ipswich and Harwich; 16 miles done in two and a-quarter hours, but against a strong wind in three hours. This has six frying-pan paddles set square, without rims. I have been informed, by letter of August last from Gainsborough, of a steam-boat from thence to Hull, which performs the voyage—50 miles—in eight hours; and this week, from Canada, at present there are two steam vessels on the river St. Lawrence, one 48 the other 36-horse power, which go at 7 miles an hour, measure about 170ft. long and 30ft. wide! Another 48-horse power vessel will be launched next year on that river, so that one may go by steam from Quebec to New York in eight days, with a short land carriage."—ED. E.]

THE bar which has so long obstructed navigation at the mouth of the Shanghai River is about to be removed by the Chinese Government. We had better repeat "by the Chinese Government," or it will be thought to be a mistake. China has lately constructed her ninth vessel—a screw of 400 tons—and she does not want to have her stuck on that bar when it rains.

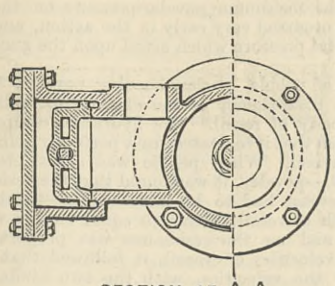
THE VIENNA CIRCULAR RAILWAY.

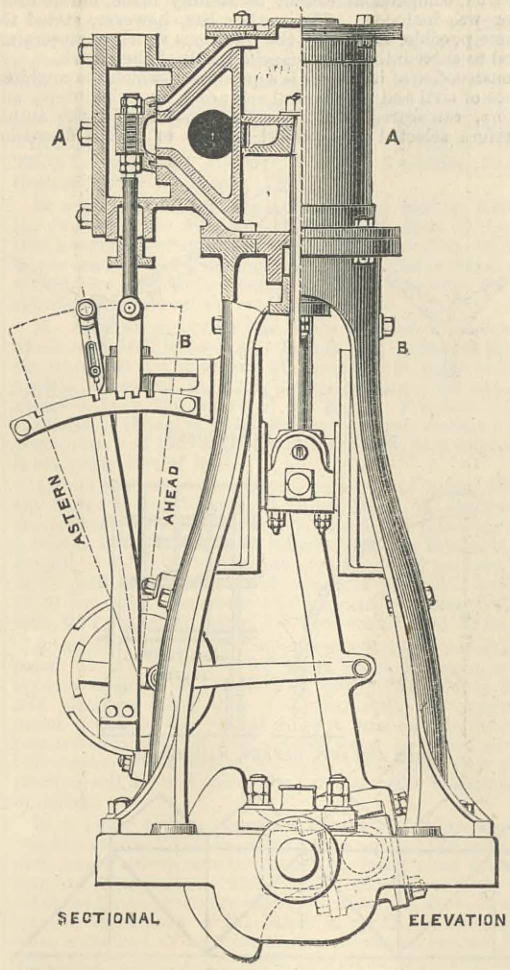
MR. J. FOGARTY, M.I.C.E., WESTMINSTER, ENGINEER.

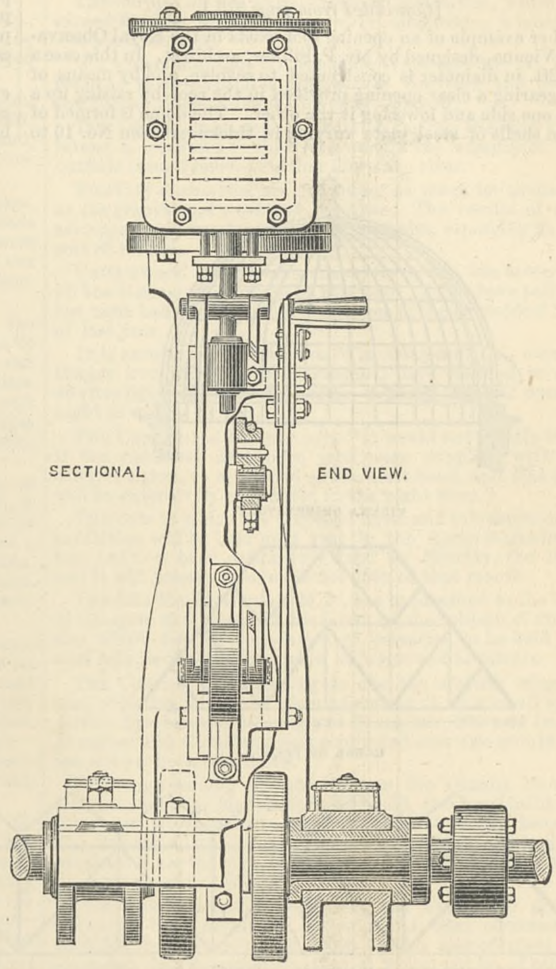
(For description see page 398.)



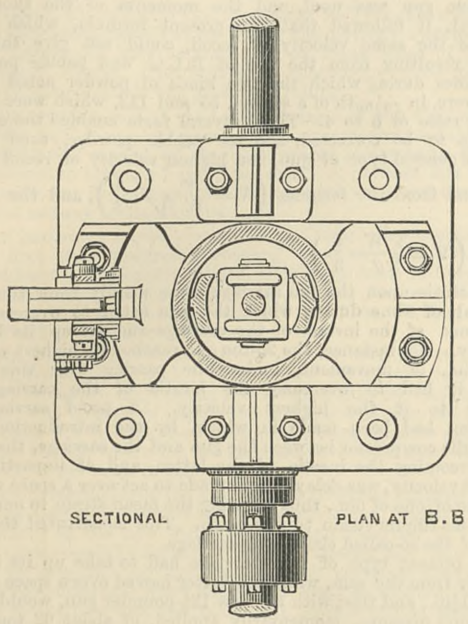
JOY'S VALVE GEAR.


SECTION AT A.A



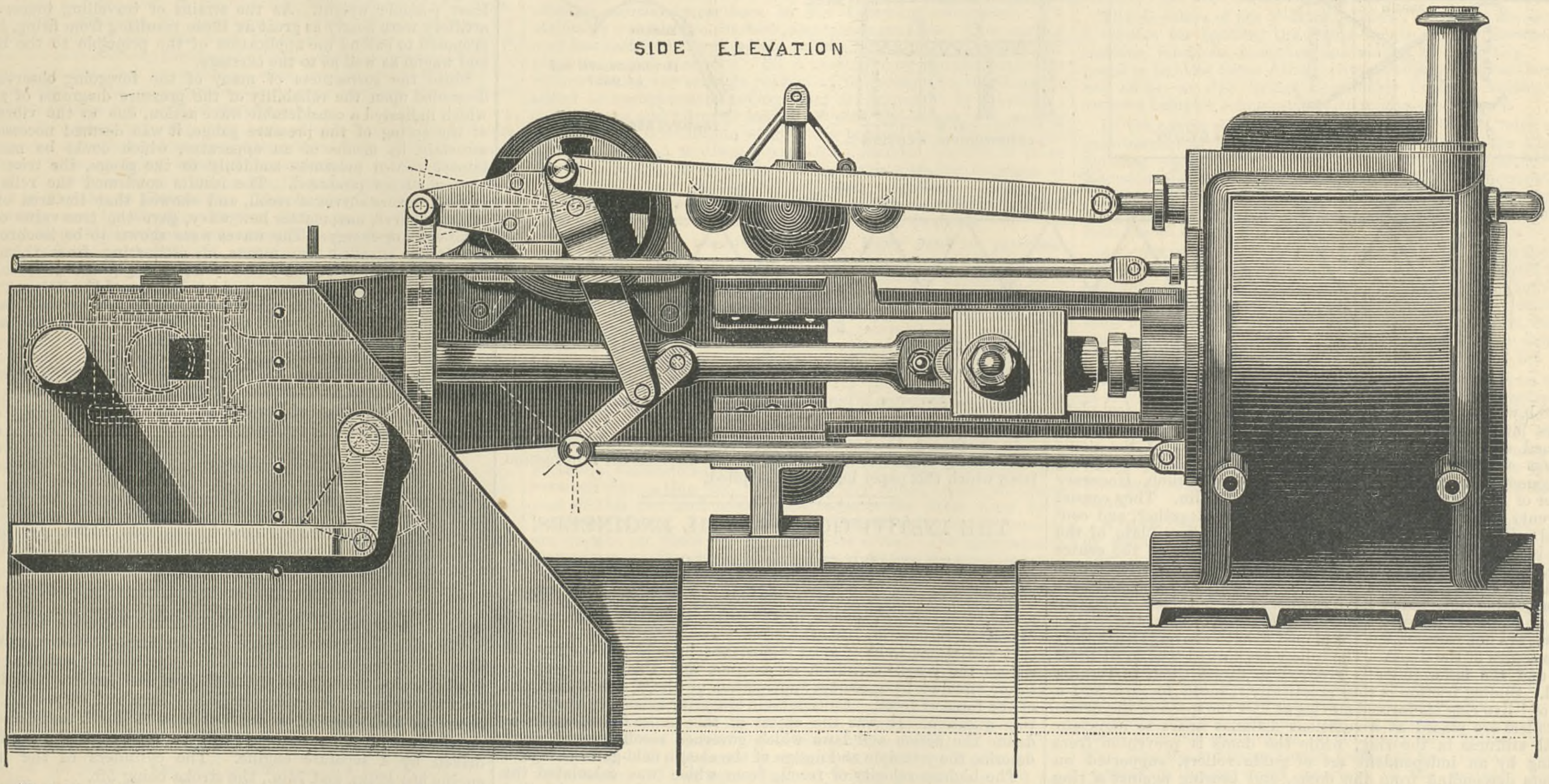


SECTIONAL END VIEW.

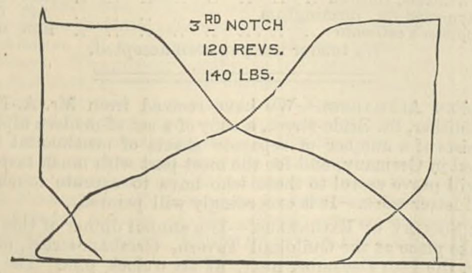

SECTIONAL PLAN AT B.B

SECTIONAL ELEVATION

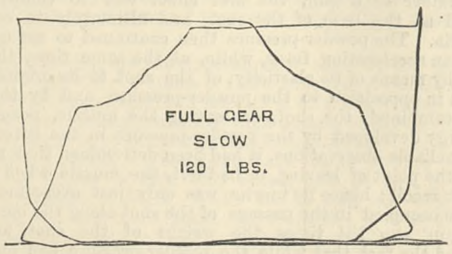
SIDE ELEVATION



WE illustrate above an excellent type of launch engine to indicate up to 40-horse power, fitted with Joy's patent valve gear, and constructed by Messrs. Worth and Mackenzie, Stockton-on-Tees. Mr. Joy, in his paper read before the Institute of Mechanical Engineers, described two forms of this gear, one in which the valve lever, being coupled direct to the connecting rod, has its fulcrum in a block which slides in a straight slot, and another form in which the valve lever is coupled to a secondary lever, one end of which is jointed to the connecting rod, and the other end to a vibrating link. In the latter form the



fulcrum of the valve lever moves in a slot curved to the radius of the valve rod; this motion is perfect for any degree of expansion in both fore and back gear, but in the first-named type, where simplicity is the object, there are two errors in the action, but these are so set against each other as practically to correct each other, and the result is that although the lead remains correct, the point of cut-off, though correct where usually required to be worked, is only approximately so for the remainder of the forward gear, and gives an unequal cut-off in the back gear. This approximate type has been adopted by the makers in the engine we illustrate on account of its greater simplicity, there being only five wearing parts as against eight in the link motion, and has been so carefully schemed out that at the usual working degrees of expansion the motion of the valve is more nearly correct than with the best designed link motion. The quadrant of the reversing handle is only notched for three degrees of expansion, viz., four, three, and two-tenths of the stroke, but for convenience in starting the handle can be held over to the end of the quadrant, giving an admission up to seven-tenths of the stroke. This arrangement is adopted to prevent the very rough-and-ready engine driver—to whom the management of



engines of this class is often entrusted—from working the engine at a later cut-off than four-tenths, thereby wasting coal.

An important feature of this valve gear is that it does not confine the designer to the length of the crank shaft bearings; this has been advantageously used in the case of this engine, the fore bearing being 8in. and the after 9in. long. In order that bearings so long may work to the best advantage it is necessary that the frame should be firm and rigid; this has been secured without sacrificing neatness of appearance, or without excessive weight, by making the section of the standard that of two segments of a hollow column, which are cast in one piece with the bottom cylinder cover; this framing is bored out for the motion bars and stuffing box, turned and faced to fit the bed-plate and cylinder at one setting, thus insuring absolute correctness. The cylinder is 9in. bore and the stroke 10in., the piston is of cast iron, with two outside rings of the same metal, and one inside ring of wrought iron; the slide valve is cast iron of the "Allan" pattern; the piston rod is of steel; the crosshead cast iron, fastened to the piston rod by an ingenious adaptation of jib and cottar—of which we give an enlarged detail—by means of which the piston rod can be withdrawn from the crosshead by simply changing the jib key from the upper to the lower side and driving the cottar above it; the crosshead is fitted with gun-metal bearings, the keep of wrought iron secured by ⅝in. bolts bent round the top half of the crosshead, so that the bolts only are exposed to tensile strain. The connecting is made in one piece with the pins, which work in the crosshead bearings; the crank pin end is an open fork, the lower brass reaches to the end of this fork and is bolted in its place by a steel bolt 1in. diameter; the wear is taken up by a tapered cottar—with nut and check nut—over the top brass. The crank shaft is made of steel, and is provided with a coupling, which allows a certain amount of flexibility in the crank shaft.

Another special feature in this design that will be appreciated by engineers is that every nut is accessible to a screw key, and there is not a single stud or tap bolt used throughout.

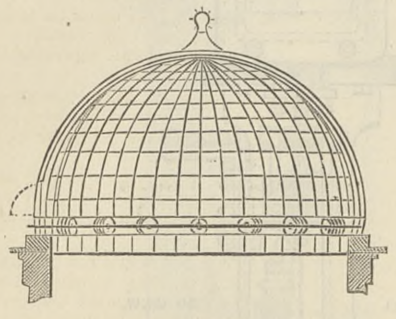
In our second set of engravings we illustrate the second and perfect form of this gear, where the errors of the former type are corrected throughout, resulting in a perfectly equal cut-off for both ends of the cylinders, for forward and backward going, and for all degrees of expansion. The present illustration shows its application to a road traction engine, built by Messrs. Charles Burrell and Sons, of Thetford. Diagrams from this engine are given above. In a similar form, but modified to meet the circumstances, the gear is applied to locomotive engines with inside and outside cylinders; to marine engines, rolling mill engines, &c., instances of which we propose to illustrate at a future time.

IRON ROOFS.

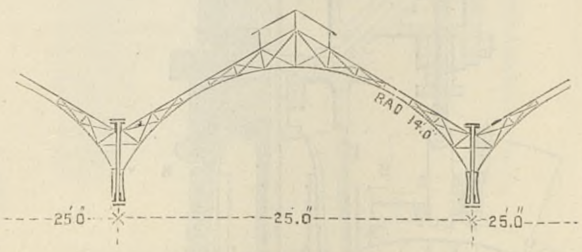
By Mr. A. T. Walmisley, C.E.

[*Concluded from page* 373.]

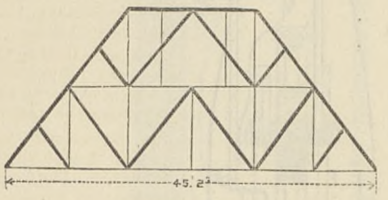
Another example of an opening roof exists in the Royal Observatory of Vienna, designed by Mr. F. Fillner, architect. In this case a dome 42ft. in diameter is constructed to revolve, and by means of special gearing a clear opening provided in the roof by raising up a shutter one side and lowering it the other. The dome is formed of two thin shells of steel plate varying in thickness from No. 16 to No. 18 b.w.g. rivetted on the inside and outside of light steel plate girders 9in. deep at the crown and 18in. at the base, which is stiffened sufficiently to bear the varying strains as the dome revolves without producing outward thrust. The revolving arrangements were designed by Mr. Howard Grubb, Honorary Master of Engineering in the University of Dublin. They consist of twenty sets of three rollers fastened rigidly together, and connected neither to the dome nor the walls. The foot-plate of the dome is made with a projecting rib, which travels on the centre roller, without bearing on the side rollers, and the side rollers travel on a special bed-plate secured to the wall, and provided with two projecting ribs, which serve as rails to carry them. The faces of these upper and lower projecting ribs, on which the rollers revolve, are not parallel, but are planed so as to converge accurately to the centre of the dome. The rollers are turned true to fit these ribs, and the inner roller is grooved to direct them in turning round. Sliding friction is thus practically reduced to zero, and a kind of "live ring" is formed moving at half the speed of the dome. The rollers are placed at a sufficient distance apart to maintain lateral stiffness in the ring, while the dome is prevented from slipping by an independent set of guide rollers, supported on brackets descending from the dome, and bearing against a ring made to slide true round the cast iron wall-plate. Any alteration of form in the dome can be provided for without interfering with the supporting system, by adjusting the lateral rollers, which always have a true circle to play against so long as the wall holds, and the construction of the dome commends itself as giving maximum stiffness with a minimum amount of material, in addition to the advantage of uniform temperatures when the dome is closed, due to variations outside.



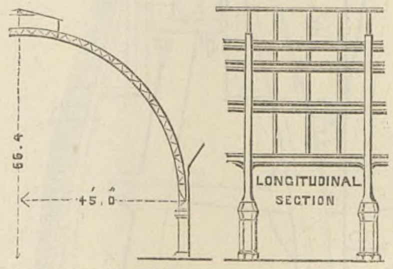
VIENNA OBSERVATORY



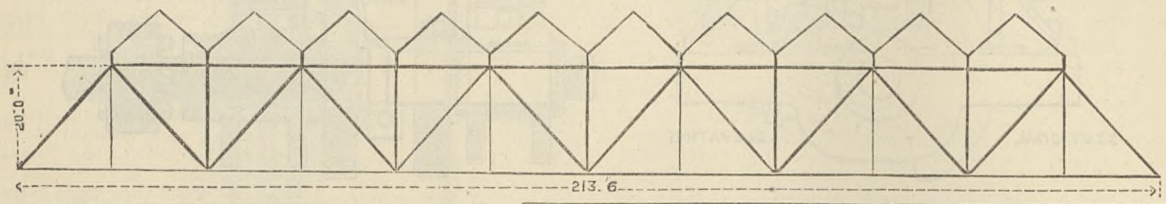
TUNBRIDGE WELLS GASWORKS.

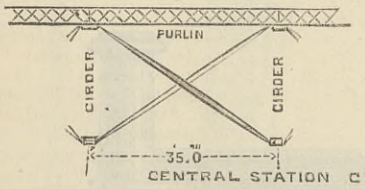


HOUSE OF PEERS.

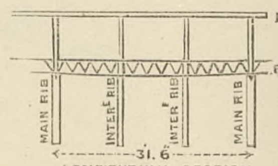


HIDE AND SKIN MARKET, MANCHESTER.

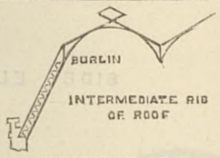




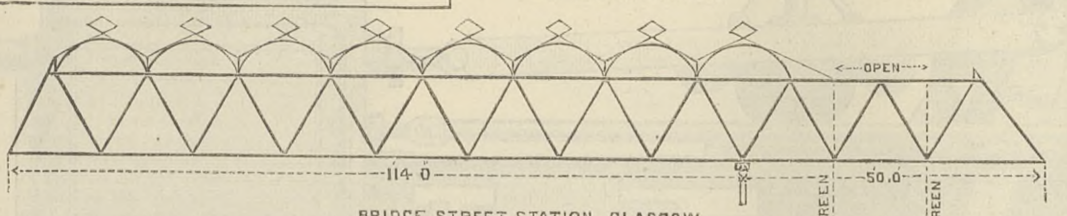
CENTRAL STATION GLASGOW



LONGITUDINAL SECTION



TRANSVERSE SECTION



BRIDGE STREET STATION GLASGOW

All iron exposed to the air is more or less sensitive to corrosion. Oiling is a much better protection from the effects of the weather or the action of steam than painting, but care is needed properly to clean off the black scale or oxide formed upon the iron by contact with the air immediately after leaving the rolls. In Holland great attention is paid to these details, the specifications of the engineers minutely describing how the iron is to be treated before the oil and paint are applied. After being properly cut, punched, or otherwise finished off in the shops, each piece before being fastened to any other piece is made quite free from rust and scales by immersion in a bath of dilute muriatic acid, and kept there as long as the inspecting engineer thinks proper. It is then lifted out by means of iron hooks and brushed with water, which removes all the black scale. Immediately afterwards it is immersed in a bath of fresh limewater, and then placed in a bath of boiling water, where it must remain till it is about as hot as the water. The water is renewed directly any traces of acid are discovered in the water bath. After being thus washed, the iron is removed from the hot water bath, and allowed to dry, but before becoming quite dry while still warm, it is besmeared abundantly with hot linseed oil, and then receives the first coat of paint. All rivet heads are similarly covered with hot linseed oil and painted over after the plates or other pieces are rivetted up. A second coat of paint is given to the iron before it is placed in contact with other pieces of different material, and while all parts are accessible to the painter's brush, care being taken that the pieces so painted are perfectly dry, and that the weather is not damp at the time the second coat of paint is applied. The paint used consists of lead or iron minium well mixed with boiled linseed oil. Iron minium consisting of iron oxide, with a small proportion of clay and water is cheaper, and more used than lead minium.

Too much importance must not be laid upon the cost quoted for different roofs, as they were erected at different times, and the price of material is constantly varying. Even with a uniform price for iron, comparisons cannot be usefully made, unless every particular was included. The author has, however, stated the price where possible, as one of the questions which engineers are compelled to enter into is the financial result of their work.

The construction of iron roofs is a question in which the combined experience of civil and mechanical engineers, manufacturers, and contractors, can scarcely fail to prove valuable, and the author has therefore selected this subject hoping to have a discussion which will fully redeem all the shortcomings of his remarks upon this important subject.

In conclusion, the author begs to acknowledge the courtesy with which many engineers have placed at his disposal the information from which this paper has been compiled.

THE INSTITUTION OF CIVIL ENGINEERS.

FORCES AND STRAINS OF RECOIL CONSIDERED WITH REFERENCE TO THE ELASTIC FIELD-GUN CARRIAGE.

At the meeting on Tuesday, the 22nd of November, Mr. Abernethy, F.R.S.E., President, in the chair, the paper read was by Mr. H. J. Butter, M. Inst. C.E.

It was stated to be of great importance in field-gun carriages to reduce the weight as much as possible, and this could only be safely effected by a correct appreciation of the action and extent of the force of recoil. Considerable obscurity existed in respect to this question. It was the object of this paper to endeavour to define the action and laws which governed recoil, as well as to describe the principle and design of the elastic field-gun carriage.

The highest velocity of recoil, from which was calculated the energy, had not hitherto been observed, as was the case with that of the shot, but had been calculated from the principle of the assumed equality of momenta of the shot and gun—*i.e.*, the product of the weight and highest velocity of the shot was divided by the weight of the gun $\left(V = \frac{v\,w}{W}\right)$ to obtain the highest velocity of the latter in recoil; this in itself failed to give the correct velocity.

It was generally stated that the highest pressure of recoil could not exceed the greatest powder pressure on the bottom of the bore; but this assertion was shown to be inconsistent with the true nature of recoil. When a powder charge was exploded in the chamber of a gun, the first effect was to compress the material at the base of the shot, and ultimately to overcome its inertia. The powder-pressure then continued to act upon the shot as an accelerating force, while, at the same time, the restitution, by means of its elasticity, of the shot to its original form, went on in opposition to the powder-pressure, and by these two actions combined, the shot, on leaving the muzzle, possessed all the energy developed by the powder-pressure in the bore. From several reliable observations, it had been determined that the shot was on the point of leaving, or had left, the muzzle when the gun began to recoil; hence its inertia was only just overcome during the time occupied in the passage of the shot along the bore. The 10in. gun was 134 times the weight of the shot, and this explained the fact that while the powder-pressure had only time to complete the first half of the action of impact upon the gun, it wholly completed the pressure of impact upon the small mass of the shot, and further acted upon it for a considerable interval, comparatively, as an accelerating force. It was clear, therefore, that while the powder-pressure acted equally upon the gun and the shot, it did not, for want of the requisite time, store up so much energy in the former as in the latter, being in fact only about one-hundredth part as much. The formula of the equality of momenta was thus shown to be insufficient to give the velocity of recoil, as it could only be true where the pressure of impact alone was concerned, and was completed alike in the two bodies.

The powder-pressure exhausted itself upon the gun in overcoming its elasticity longitudinally, since the inertia of the gun was barely overcome when the pressure ceased. Recoil was a purely dynamic effort, the resultant of all the powder-pressures combined, and could not be referred to any particular pressure, least of all to the maximum powder-pressure on the bottom of the bore, which occurred very early in the action, and was merely a part of the total pressure which acted upon the gun before recoil began.

The adoption of pebble, or slow-burning powder, first directed attention to the insufficiency of the existing formula for finding the highest velocity of recoil. The hydraulic compressor was so constant in action that it indicated, in a perfectly reliable manner, the energy of recoil. When pebble was substituted for quick-burning—R.L.G.—powder, it was found that the resistance of the hydraulic compressor had to be increased one-third to maintain the same length of recoil, although equal energy was imparted to the shot; and as the resistance was proportional to the squares of the velocities of recoil, it followed that the ratio of the squares of the velocities, with the two kinds of powder, should be as 3 to 4. An opportunity had occurred to record the actual velocities by observation, and these were found to be such as to give, when squared, this ratio. Since in each case the same gun was used, and the momenta of the shot were identical, it followed that the present formula, which would produce the same velocity of recoil, could not give the true recoils resulting from the use of R.L.G. and pebble powders. The times during which the two kinds of powder acted in the bore, were, in $\frac{1}{10000}$th of a second, 85 and 112, which were nearly in the ratio of 3 to 4. These several facts enabled the existing formula to be corrected, and for pebble powder, used in the present general type of gun, the highest velocity of recoil might be found from the formula $\left(V = \frac{v\,w}{W}\sqrt{\frac{4}{3}}\right)$, and the energy from $\left(V = \frac{V^2 W}{2g} \cdot \frac{4}{3}\right)$.

The strain upon the gun carriage arose mainly from the small interval of time during which the gun acted to overcome the resistance of the inertia of the carriage and set up its highest velocity. For instance, the 26-ton gun reached its highest velocity after 6in. of movement, and while passing over this small space it had to overcome the inertia of the carriage and impart to it the highest velocity. A proof carriage for this gun had been made in which, by the introduction of a hydraulic compressor between the gun and the carriage, the action of overcoming the inertia of the latter, and of imparting the highest velocity, was delayed, and made to act over a space of 36in. in place of one of 6in., thus reducing the mean strain to one-sixth, or the maximum strain to one-tenth. This constituted the principle of the so-called elastic gun-carriage.

The present type of field carriage had to take up its highest velocity from the gun, while the latter moved over a space of only about $1\frac{1}{2}$in., and this, with the new $12\frac{1}{2}$-pounder gun, would give a maximum pressure, momentarily applied, of about 92 tons; but by adopting the elastic principle this pressure might be reduced to $11\frac{1}{2}$ tons, and thus enable a carriage to be constructed of the least possible weight. As the strains of travelling incurred by artillery were nearly as great as those resulting from firing, it was proposed to extend the application of the principle to the limber and wagon as well as to the carriage.

Since the correctness of many of the foregoing observations depended upon the reliability of the pressure diagrams of recoil, which indicated a considerable wave action, due to the vibrations of the spring of the pressure gauge, it was deemed necessary to ascertain by means of an apparatus, which could be made to impart known pressures suddenly to the gauge, the true value of the curves produced. The results confirmed the reliability of the pressure curves of recoil, and showed that the area of any pressure curve, now matter how wavy, gave the true value of the total work or energy. The waves were shown to be isochronous, and thus afforded the means of estimating from them the highest velocity of recoil. This velocity might also be calculated from the total energy represented by the area of the curves.

Thus, three new methods had been established for ascertaining the highest velocity of recoil; applying them to the case of the 43-ton gun, they gave the following results :—

From the corrected formula $\left(V = \frac{v\,w}{W}\sqrt{\frac{4}{3}}\right)$ =	18·7ft.	per sec.
,, time waves of the curves	18·6	,,
,, areas of the curves of recoil	19·0	,,
Mean	18·8	,,

So remarkable a degree of uniformity might be taken as additional proof of the correctness of each result. The velocity, as calculated by the formula now in use, was 16·2ft. per second, giving an energy of recoil of only 465,550 foot-pounds, while the correct energy of recoil was 654,640 foot-pounds.

AN AMERICAN MARINE ENGINE.

We give this week on page 404 the first of two engravings, illustrating modern American marine engineering practice. We shall describe the engines of the City of Rio Janeiro fully in our next impression. American engineers have had very small experience in this class of work; but Messrs. Roach and Son have, on the whole, done well. It will be seen that the pumps are driven by a separate engine. The cylinders of the marine engine are $42\frac{1}{2}$in. and 74in., the stroke being 5ft.

TENDERS.

BARMOUTH WATERWORKS.

For the construction of a service reservoir and intake works at Ceilwart for the Barmouth Local Board. Thomas Roberts, Assoc. M. Inst. C.E., Portmadoc, engineer.

	£	s.	d.
J. Williams, Ceilwart, Barmouth	1202	0	0
John Williams, Frouslen, Barmouth	1198	0	0
S. P. Owen, Portmadoc	1069	0	0
G. Williams, Harlech	859	0	0
Frayne and Co., Birmingham	845	0	0
Engineer's estimate	1023	0	0

No tender has yet been accepted.

Modern Alphabets.—We have rceived from Mr. A. Fischer, the publisher, St. Bride-street, a copy of a set of modern alphabets. It consists of a number of separate sheets of ornamental letters, designed in Germany, and for the most part with much taste. The book will prove useful to those who have to execute much ornamental letter work. It is exceedingly will printed.

The Society of Engineers.—The annual dinner of this society will take place at the Guildhall Tavern, Gresham-street, on Wednesday, the 14th December next, at six o'clock p.m. The annual general meeting of the society will be held on Monday, the 12th December next, in the society's hall, 6, Westminster-chambers, for the purpose of electing the council and officers of the society for the ensuing year.

Sanitary Institute of Great Britain.—The announcement of the award of the prize of £200 offered by the Rev. E. Wyatt Edgell for an essay on the "Range of Hereditary Tendencies in Health and Disease," will be made by the adjudicators at the first ordinary meeting of the Institute, at 9, Conduit street, for the session 1881-82, which will be held on Wednesday, December 7th, at 7.45 p.m. The inaugural address will be delivered by Dr. Alfred Carpenter.

RAILWAY MATTERS.

THE *Times* learns from Chicago that the Canadian Pacific Railway Syndicate has closed a contract for the winter delivery of 65,000 tons of steel rails from England and Germany.

IN connection with Rhondda there is the railway to Swansea, and for the valley two distinct tramways, one from Llwynyfia to Treherbert, and the other taking the whole vale.

BEGINNING with January there will be two daily mail services between Lucerne and Milan by the St. Gothard Tunnel. The first mail will leave the former place at ten in the morning, and the journey will be performed in twenty-two hours.

AN accident occurred on the Taff Vale last week through the breakage of a coupling chain. A laden train ran back to pick up the detached, and came in contact with another. A good deal of damage was caused, estimated at £400, and two men injured.

MR. T. W. WORSDELL, assistant-locomotive superintendent of the London and North-Western Railway at Crewe, has been appointed locomotive superintendent-in-chief of the Great Eastern Railway. Mr. Worsdell will enter upon his duties at the end of this year.

MESSRS. RIDLEY AND CO., Newcastle-on-Tyne, have published a well illustrated pamphlet on Winby and Levick's system of tramway permanent way as employed on many miles of home and foreign tramways. The rails form continuous rolled girders, the groove being made in the process of rolling.

THE recent report of the traffic manager of the Ceylon Railway showed that during last year—one of exceptional trade depression—the profits earned by the Government railways in the colony amounted to between 7 and 8 per cent. A petition has been presented to the Legislative Council praying for the construction of a line of railway to Matakuliya.

AN important meeting was held at Cardiff on Saturday to take the first steps towards promoting a railway that by new lines, subsidiary, and connecting lines, should run from Milford by way of Llandovery, Brecon, Abergavenny, Lydney, Severn Valley, to the West of England, London, and Southampton. A large number of Welsh colliery proprietors were present.

ONE THOUSAND miles of railway are now open for traffic in New South Wales, of which 147 were opened during the current year. Four extensions, aggregating 225 miles, would be laid down next year. The increase of population in the colony since the passing of the Land Act in 1860 was 50 per cent., being greater than in the United States, where the increase had never been more than at the rate of 37 per cent. in ten years.

AT the invitation of the London and Brighton Railway Company a large party of gentlemen left Victoria for Brighton at 11.25 yesterday by the new Pulman train, and returned at 4.55. The train is successfully lighted by Faure batteries and Edison lamps, and the cars and the light called forth universal approval. We shall say something more about this train in another impression, only noting now that the train will leave Victoria daily at 11.30 and Brighton at 4.55.

MR. SIEMENS, of Messrs. Siemens and Halske, Berlin, is in America, and has been in consultation with Messrs. Gould, Sage, and Field, regarding the adaptation of his electrical motor to the requirements of the New York Elevated Railways. Mr. Sage is reported as favourably impressed with Mr. Siemens' representations, and intimates that experiments with the electric motor may be undertaken. An American contemporary remarks that "these facts open up a wide field of speculation."

ON Thursday last, the 24th inst., Major-General Hutchinson inspected a further extension to Cwmbwrla of the Swansea tramways. This extension, which it is proposed to work by steam, is about three-quarters of a mile in length, and on an average gradient of 1 in 20 rising to Cwmbwrla. The engines to be used, four in number, are by Hughes Engine Company, of Loughborough. Major-General Hutchinson was accompanied over the route by Mr. William Tweedie, A.M.I.C.E., representing Mr. Joseph Kincaid, M.I.C.E., engineer to the Swansea Tramways Company.

THE Allen (American) Paper Car Wheel Co. is now receiving, according to the *American Railway Review*, an invoice of 10,000 best quality steel tires, from the works of Fried Krupp, of Essen, Germany, and is increasing the capacity of its works at Pullman and Hudson as rapidly as the special tools required for their use can be built. The output of the Hudson work alone for the ten months ending November 1st of the present year has been 7729 wheels. The company expects to turn out from 20,000 to 25,000 wheels in the coming year, their orders being fully in keeping with their increased facilities.

IN his report on the accident which occurred on the 26th September, between Clady and Strabane Stations on the Finn Valley Railway, when the 8.10 p.m. mixed passenger and goods train from Stanorlar to Stabane came into collision with two bullocks, Major-General C. S. Hutchinson, R.E., says: "This accident directs attention to the danger to which passengers are subjected in mixed trains by the carriages being placed at the rear of the train. In the present case but for the couplings having given way between the last wagon and first carriage the consequences might have been most serious. If it is a necessity to run these mixed trains, the safest place for the carriages is certainly next the engine, otherwise any accident to a wagon which causes it to leave the rails imperils the safety of the carriages behind it."

THE surveying party under General Fielding, which started in June last on the survey exploration for determining the best route for the proposed Trans-Australian railway from Roma, Queensland, to Port Parker, in the Gulf of Carpentaria, has reached the latter end of the journey, and will probably return to Brisbane by the middle of this month. The results of the preliminary run through the country made by Mr. R. Watson, M.I.C.E., for the purposes of a report to the Queensland Government, was made in the first six months of this year, and the results were described in our impression for the 2nd September last. Queensland railways are 3ft. 6in. gauge, and before this great line is made it is to be hoped that some standard gauge for the whole of Australia will be arrived at by the several colonial Governments.

IN a country having a well-developed railway system the number of persons occupied with railway work is such as would form a large army. Thus—according to the *Deutsche Industrie Zeitung*—the number of officials and workmen on the German lines in the end of 1879 was 272,831, while the corresponding number for France the previous year was 182,983. For every 100,000 of the population, 611 in Germany and 493 in France were engaged on railways. The greater number in the former case is explained by the fact that, in relation to surface and population, Germany has a larger network of railways than France. For every 100 kilometres of line the *personnel* is in Germany about 834; in France 827; therefore nearly the same. Dividing the *personnel* into four groups, it appears, first, that the number of persons occupied with "general management" is in Germany about three times what it is in France per 100 kilometres of line, this being mainly due to the greater division of the railway system in Germany, where there are seventy-four railway lines with separate management, as against twenty-one in France. Next, a relatively less number of persons is engaged in Germany than in France in line service—second group—and in traffic and commercial service—third—whereas in train and workshop service—fourth—more persons are engaged in Germany. The traffic on the German lines is not, however, busier than on the French; but for the conveyance of the same number of persons, or the same quantity of goods, the same distance, a larger *personnel*—in this fourth group—is employed in Germany. The French statistics show, *inter alia*, that 68,865 persons who had been in the army, were engaged on French railways at the date specified; also 13,554 women. The former are pretty regularly distributed among all the four groups, and the latter are most largely engaged in line service.

NOTES AND MEMORANDA.

DURING the gales of the 14th ult. the recording anemometer at the Greenwich Observatory registered a wind pressure of 56 lb. per square foot, the highest ever recorded there.

AT the meeting of the Academie des Sciénces on the 14th ult., M. Berthelot read a second paper on electrolysis, in which he shows why the minimum electro-motive force should be employed in producing electrolytic decomposition in secondary batteries.

THE estimated population of the Australian colonies on December 31st, 1880, was as follows:—New South Wales, 739,385; Victoria, 860,067; South Australia, 267,573; Queensland, 226,077; Tasmania, 114,762; Western Australia, 29,019; New Zealand, 484,864. Total, 2,721,747.

BY experiments upon the absorption of radiant heat by gases, the *Journal of the Franklin Institute* says Herr E. Lechler finds that a layer of carbonic acid 917 millimetres—37in.—thick absorbs 90 per cent. of the luminous radiation. The carbonic acid of our atmosphere is therefore sufficient fully to account for the atmospheric absorption of the sun's rays.

M. ARMAND GAUTIER has made a series of analyses on the presence of lead in foods and liquids, and presented the results to the Academie des Sciénces. He finds lead in preserved fruits and vegetables packed in "tin" boxes contain a minute proportion absorbed from the solder of the boxes. Prepared sardines, and particularly the oil in which they are packed, contain a still larger proportion, and the longer the sardines have been kept the greater is the proportion of lead.

AMONG the notes of work done by students in the laboratory of the University of Virginia, in which Dr. J. W. Mallet, F.R.S., is the professor of chemistry and physics, is the following analysis of a clay, a seam of which of several inches in thickness overlies a deposit of calamine in Virginia:—Silica, 37·38 per cent.; alumina, 24·67 per cent.; peroxide of iron, 6·34 per cent.; oxide of zinc, 12·10 per cent.; magnesia, 0·27 per cent.; potassa, 0·47 per cent.; soda, 0·27 per cent.; water, 17·04 per cent.; total, 98·54.

A RECENT number of the *Comptes Rendus* contains a second paper on the electrolysis of water by M. Tommas, in which he opposes some of M. Berthelot's views. All metals except gold and platinum being able to combine with the oxygen of water under action of the voltaic current, are capable, he says, when positive electrodes, of decomposing water by action of a single—zinc copper or zinc carbon—element. He shows that the decomposition will occur if one of the two electrodes is aluminium, zinc, or carbon.

IN a letter to the *American Journal of Microscopy*, Mr. G. Fasoldt says:—"I have ruled plates up to 1,000,000 lines to the inch, one of which was purchased by the United States Government of Washington. These plates show lines truly and fairly ruled, as far as lenses are able to resolve, and above this point the *spectral* appearance of the bands in regular succeeding colours—when examined as an opaque object—shows, beyond doubt, that each band contains fairly ruled lines up to the 1,000,000 band.

M. FORQUIGNON, who has published an extensive series of researches upon malleable iron and the re-heating of steel, attaches special importance to the following conclusions: (1) Malleable iron always contains amorphous graphite; (2) a casting may lose carbon and yet remain brittle if the original quantity of graphite is not increased; (3) a casting may become malleable without losing any sensible portion of its carbon; (4) if silicium is added to manganesian castings they are improved by reheating; (5) hydrogen and nitrogen may unite with the carbon of a casting so as to make it malleable without the production of graphite; (6) the breaking load is always more than doubled, sometimes more than quadrupled, by annealing—it increases with the duration of the heating, very rapidly at first and then very slowly; (7) ductility generally increases with the resistance to breaking, but after a certain limit it has a slight tendency to diminish.

DYNAMO-electric machines are now being used in porcelain manufacture. The paste used for porcelain often contains ferruginous particles, which give the baked articles a colour, or a minutely spotted appearance, where a pure white may have been desired. In this way ceramic products may lose as much as 50 per cent. of their value. The attempt hitherto made to remove those traces of iron with magnets have met with poor success. Recently, however, at two important French works, the Faïencerie of Creil, and the establishment of MM. Pilivuyt and Co., of Mehun-sur-Yèvre, it was decided to set up powerful apparatus in which the electricity, instead of being supplied from batteries, was obtained by means of a small Gramme machine driven by a steam engine. The arrangement, which is said to work well, comprises a strong horizontal electro-magnet, with the poles very near each other, and between them a thin box. The paste, very liquid, enters the upper part of this box and is deflected towards the polar sides by a bent piece of zinc. As it flows down these sides the iron corpuscles are caught on them by the magnetic force. The apparatus is cleaned twice a day, by means of a jet of water, the magnet being demagnetised for the time. About 1 gramme of iron particles is stopped in the passage of 12 kilos. of paste, and 500 to 600 kilos. of paste may be passed through one apparatus in a day.

THE quantity of malt yielded by barley has recently been the subject of an article by Herr Thaussing in the *Allgemeine Zeitschrift für Bierbrauerei*. The author states that the result of his experience is that 100 parts by weight of good barley yield on an average 78 parts by weight of good dried malt; he calculates that 100 parts of air-dried barley retaining 14 per cent. of moisture, and, therefore, containing 86 per cent. of dry substance, lose during the processes of malting 9·3 per cent. by weight, as follows:—Extracted by steep water, 1·3 per cent.; evolved during germination, 5·0 per cent.; removal of rootlets, 3·0 per cent.; total, 9·3 per cent. Thaussing calculates the following to be the weight of 100 lb. of barley at different stages of its conversion into malt:—Weight when fully steeped, 141·1 lb.; weight of grain malt, 134·2 lb.; weight of malt rootlets, 3 lb.; weight of malt dry substance, 76·7 lb.; weight of screened malt, with $1\frac{1}{2}$ per cent. of moisture, 77·9 lb.; weight of store malt, with 5 to 8 per cent. of water, 82·9 lb. to 85 lb. He considers that a good result is obtained when the 100 lb. of barley yield from 78 to 79 per cent. of dry malt. With regard to volume, Thaussing estimates that 100 parts of barley yield just 100 parts of malt, but the *Brewers' Guardian* says that other authorities have held there is an increase in volume of from 1 to $2\frac{1}{2}$ per cent., whilst others assert there is a diminution in volume of nearly 1 per cent., especially in malting inferior barleys.

THE following are the dimensions of some of the large modern ships:—The City of Rome is 546ft. in length; the Great Eastern, 676; the Great Eastern in breadth is 82ft. 8in.; depth, 60ft., with a registered tonnage, excluding engine space, of 13,343. She has stowage for cargo to the extent of 6000 tons, and the capacity in her coal bunkers is 10,000. When loaded she draws 30ft. of water. The City of Rome is 52ft. 6in. broad, and 34-38ft. deep, with a gross tonnage of 8415. While she is thus 16ft. longer than the Servia and 6in. more beam, the Cunarder is actually 6ft. 9in. deeper, and is said to be able to carry a few tons more cargo. The Cunard Liner Gallia is 450ft. long and 46ft. broad, with a gross tonnage of 5000; the Arizona, 466ft. long and 46ft. broad, with a gross tonnage of 5500; the Orient, 460ft. long and 46ft. 6in. broad; the Parisian, 450ft. long; the Anchor Liner, Furnessia, is 445ft.; State of Nebraska, 395; Notting Hill, 420; Alaska, 525; Spartan, 370; Drummond Castle, 375; City of Calcutta, 400; Kansas—building—435; Austral—building—400; the Clyde, 385; and several of the White Star Liners about 400ft. long. One of the Cunard steamers, named the Aurania, now under construction in the yard of Messrs. James and George Thomson, is to be of somewhat unusual dimensions, some 485ft. long and 57ft. broad, with a tonnage of 7500; and another, the Pavonia, will carry 5500 tons.

MISCELLANEA.

MESSRS. NEWTON AND ESKELL, publishers, notify the removal of their offices to Gray's-inn-chambers, 20, High Holborn.

THE surplus of the Paris Electrical Exhibition, which is said to exceed £16,000, is to be expended in establishing a laboratory for electrical research.

WE understand that Mr. Radcliffe Ward and Mr. W. Wills have resigned their respective positions as Engineer and Secretary to the British Electric Light Company, Limited.

THE *Citizen* states that the Port of London Sanitary Committee intend to represent to the Government the urgency of the sewer outfalls being removed further down the river.

THE City authorities are expending as much for asphalte paving as for granite and wood put together. The results of experience are apparently much in favour of asphalte, especially in respect of cost of repairs.

FAILURE and loss, in some cases very heavy, has attended nearly all the German exhibitions of this year. A few have paid expenses, but none had anything like the success of the Dusseldorf Exhibition of last year.

IT is announced that Messrs. Wm. Gray and Co., owners of the largest iron shipyard at Hartlepool, have decided to adopt the electric light, so as to enable them to carry on their operations by night as well as by day.

THE Cape Ann *Advertiser* says "it would not greatly surprise us if the mackerel fleet next year were supplied with powerful calcium lights, to be carried at the mast-head, and that the fishery will be extensively prosecuted in the night time."

THE date at which the proposed naval and submarine engineering exhibition will be held next year in the Agricultural-hall, Islington, has now been definitively fixed for Monday, the 10th April, and it will remain open until the 20th of that month.

THE late Mr. McDonald, M.P., has bequeathed to the University of Glasgow the whole of his books on the subject of mining, and also £1000 for the foundation of bursaries, to be held by young men who have actually worked underground as miners.

THE Chinese are beginning to like the electric telegraph after long objecting to it, and then tolerating it on a small scale in the private line between Mosung and Shanghai. The new line between Shanghai and Chinkiang was completed over two months ago, and has not yet been torn down.

THE long-standing dispute between the Denaby Main Colliery Company and the Manchester, Sheffield, and Lincolnshire Railway Company, with regard to canal dues, has at length been decided. The Railway Commissioners, in their judgment, declare that the canal rates are too high, and that the Denaby Company is entitled to remedy and to costs.

THE New Zealand Government has abandoned the Harbour works at New Plymouth. Power had been obtained to raise £200,000 for this work, and £5000 besides cost of plant had been expended, but it was shown that it would not be of colonial, but only local value, especially as the work would have to be of great extent to get even 12ft. at spring tides.

THE directors of the Midland Railway Company are considering a scheme for lighting the entire length of the Erewash Valley stations, junctions, branches, and sidings by electricity. It is proposed to light as far as Alfreton by one engine, fixed at Chesterfield, and as far as Pye Bridge by another fixed at Nottingham, the stations being at comparatively short distances apart.

IN the course of the month now closed 22 vessels, with an aggregate tonnage of 31,170, have been launched from the Clyde shipbuilding yards as compared with 14 vessels of 26,300 tons in November, 1880. The work of the eleven months consists of 215 vessels of 290,039 tons, against 206 vessels of 213,130 tons in the same period of last year. A large number of new contracts have been placed during the month.

A CONTEMPORARY says that a banquet in a steam boiler was lately given by a German manufacturer in the Duchy of Baden to celebrate the completion of one of the largest steam boilers in the world. Inside the boiler a scaffolding was erected containing a table for thirty guests, while racks for the cookery and wines were arranged along the sides. The only defect was the entrance, as the guests had to slip in through a 3ft. opening in the lid.

THE Dover Harbour Board have decided to construct a new quay at Dover to provide the additional accommodation required for the new mail packets which are being constructed for the London, Chatham, and Dover Railway Company. The boats, which will take the place of some of the smaller vessels now running between Dover and Calais, are expected to begin running in May, 1882. The quay will most likely be formed opposite the Lord Warden Hotel.

A CATALOGUE of hydraulic machinery, *i.e.*, machinery operated by water under high pressure, has been published by the East Ferry-road Engineering Works Company, illustrative and descriptive of dock gates, bridges, cranes, lifts, pumps, capstans, suspended weighing machines, and machinery for use in docks, railway stations, warehouses, &c. It is compiled by Mr. C. R. Parkes and is prefaced by useful notes on water as a source and transmitter of power.

ACCORDING to news by recent mail, the new harbour works at Madras had been seriously damaged, and the cranes at the ends of the northern and southern piers were swept away. The top row of blocks, for about 2500ft. from the end of each pier, was carried away, and the extremities of the piers have settled down about 2ft. The steam hopper barges Salisbury and Hobart, which were engaged in laying down moorings in the harbour, foundered. Their European captain and about fourteen natives were drowned.

A MOST important judgment was given this week by Mr. Justice Fry, who found that Messrs. Chadwick, Adamson, and Collier had issued a prospectus of the Blochairn Iron Company that was inaccurate in several important particulars. Mr. William Smith, steel merchant, of Sheffield, who had invested £5000 on the faith of the prospectus and other representations, sued for damages, and the judge has decided in the plaintiff's favour, awarding him £5000 and £750 for interest. This action will lead to others which have been threatened against other firms.

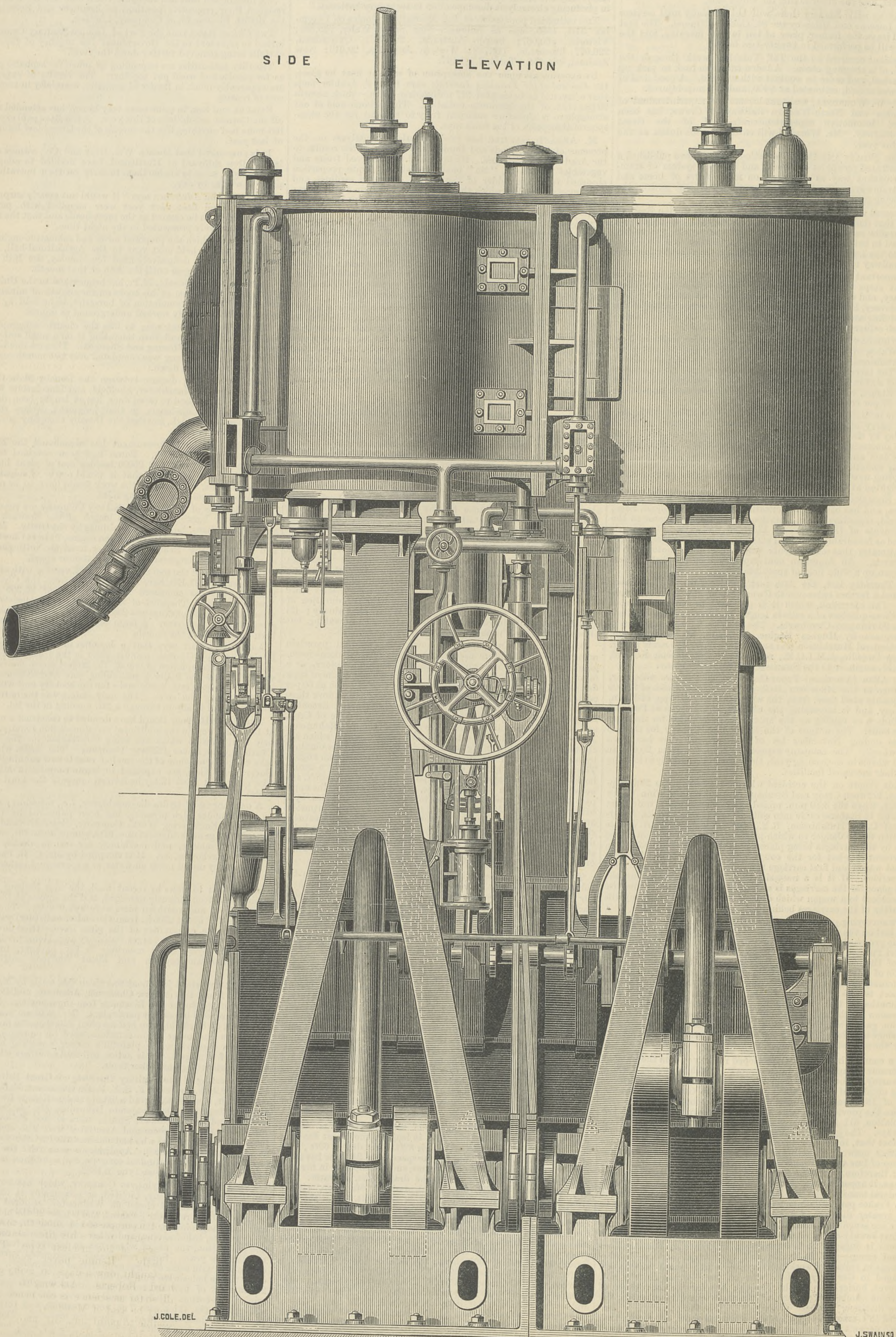
AT a meeting of the Sanitary Institute of Great Britain, held November 24th, Professor F. S. B. F. De Chaumont, M.D., F.R.S., in the chair, the secretary read a list of the donations to library since last meeting, and Dr. Benjamin Browning, Mr. A. Roberts, of Sydney, and Dr. W. Robert Smith, were elected Fellows of the Institute. Four Members and Associates were also elected, and four Associates enrolled who had obtained the Institute's certificate as inspectors of nuisances. Applications were read for ballot at next meeting. The autumnal congress and exhibition is arranged to be held at Newcastle-on-Tyne in 1882.

THE Stowmarket Explosives Company, which has now become the Explosives Company, Limited, or presumably it has, as the share subscription list closed on Wednesday, acquired 150 acres of land at Pembrey, near Swansea, and a lease of the old harbour and docks adjoining for the purpose of extending the manufacture of dynamite, lithofracteur, and other nitro-glycerine compounds, and gun-cotton, the use of which has so largely increased within the last few years. Some remarkable experiments were recently carried out with some of these explosives at Stowmarket. Amongst other things holes were punched through steel discs $\frac{1}{2}$in. thick with 20 grammes of new dynamite, and others with 20 grammes of mining gun-cotton. Holes of small size were also punched through steel plates $\frac{5}{8}$in. thick with 7 oz. new dynamite, and through steel plates $\frac{15}{16}$in. thick with 14 oz. of the same material. The effect on tough wrought iron would probably be slightly less; but some of these experiments suggest punching plates with fulminate of silver or other such severe explosives, instead of by machine.

COMPOUND ENGINES OF THE S.S. CITY OF RIO JANEIRO.

MESSRS. JOHN ROACH AND SON, NEW YORK, ENGINEERS.

(*For description see page* 402.)



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-Street.*

PUBLISHER'S NOTICE.

*** *With this week's number is issued as a Supplement, No. CXXIV. of* THE ENGINEER *Portfolio of Working Drawings, representing a Goods Engine Tender for the Lancashire and Yorkshire Railway. 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.*

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

J. S. J.—*You will find a chart of the heavens published every week in* Knowledge, *a weekly paper, price 2d., published by Wyman, Great Queen-street.*

C. H. J.—*You can obtain the information you require in the "Transactions" of the Institution of Mechanical Engineers. Write to the Secretary,* 10, *Victoria-chambers, Westminster.*

P. K. (Derby).—*We really cannot undertake to calculate the strength of the platform of which you enclose a tracing, and which is obviously a purely ideal structure. Read Mr. Max am Ende's letter in another page.*

J. M. (Barbadoes).—*The buffers are not attached to the bogies, but to the carriages, which are coupled up in the ordinary way, just like four or six-wheeled coaches. The bogies will take care of themselves if they are properly made.*

J. S. (Stourbridge).—*Our reply to "Enquirer" will answer your question to a great extent. If you still cannot calculate the strength of your girder, write again. The price of the book to which you refer is about 35s. You can obtain it through any bookseller.*

W. H. (Warrington).—*It is quite practicable to superheat the steam, but how you can do it to the most advantage we cannot tell unless you give us further particulars. Thus, it may or may not be possible to take the steam pipe through a boiler flue, or you may have to put up a separate furnace with a coil of piping in it. We can only give a general answer to a general question.*

ENQUIRER.—*The rule is, to the sectional area of the bottom flange add one-fourth of the sectional area of the web, calculated on the total depth, both in inches, and multiply the sum by the depth in inches and by 7, and divide by the span in feet, the quotient is the breaking weight in tons at the middle. By this rule the strength of your girder is 28 tons, or for distributed load 56 tons. By the well-known rule* $S = \frac{W L}{8 D}$, *where* S *is the strain on top and bottom flange at centre in tons per inch,* W *distributed load,* D *effective depth of girder in feet and fractions of a foot, the strain on the bottom of your girder 30ft. long and 16in. deep, with 56 tons load, is 126 tons, and dividing this by 7·75, the area of the bottom flange, &c., we have 16·5 tons per inch as the strain, showing that Mr. Clark's is a safe rule. If, however, we neglect the web of the girder, the strain becomes 24 tons on the inch, which is more than girder iron will stand.*

CALVER'S WAVE SCREEN.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers kindly inform me whether Captain Calver's Wave Screen was ever tried, and if so, on what scale, and with what results?

RAREY.

THE NEW TAY BRIDGE.

(*To the Editor of The Engineer.*)

SIR,—Our attention has been drawn to the concluding paragraph of your description of the new Tay Bridge, which appears in your number of the 25th inst., viz. :—"The contract for the erection of the new bridge, which has been placed with Messrs. Wm. Arrol and Co., of Glasgow, involves an expenditure of £700,000, which is understood largely to exceed the estimate under the Act of Parliament obtained last session for the reconstruction of the bridge." As this statement is quite erroneous, we must request you to contradict it in your next issue, the fact being that the new Tay viaduct has been let at about £40,000 under the Parliamentary estimate.

BARLOW AND SONS.

2, Old Palace Yard, Westminster, November 30th.

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred be supplied direct from the office, on the following terms (paid in advance):—*

Half-yearly (including double numbers) .. .. .. £0 14*s.* 6*d.*
Yearly (including two double numbers) .. .. .. £1 9*s.* 0*d.*

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

Cloth Cases for binding THE ENGINEER *Volume, Price 2s. 6d each.*

Many Volumes of THE ENGINEER *can be had price 18s. each*

Foreign Subscriptions for Thin Paper Copies will, until further notice be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office Order.—Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Egypt, France, Germany, Gibraltar, Italy, Japan, Malta, Natal, Netherlands, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, China *via* Southampton, Cyprus, £1 16s. India, £2 0s.6d.

Remittance by Bill in London.—Austria, Buenos Ayres, and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Mauritius, £2 5s.

ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings; for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by stamps in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, December 6th, at 8 p.m.: Paper to be discussed, "The Conservancy of Rivers; the Fen District of England," by Mr. William Henry Wheeler, M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, December 5th, at 7.30 p.m.: on the "Arrangement, Construction and Machinery of Breweries," by Mr. W. Barns Kinsey, the leading features of which are as follows:—General principles which should govern the arrangement of the buildings and machinery of breweries. Wells and water. The machinery used in the operation of brewing, which may be divided into six sections:—(1) Pumping; (2) Grinding; (3) Mashing; (4) Boiling; (5) Cooling; (6) Fermenting and Cleansing.

SOCIETY OF ARTS.—Monday, December 5th, at 8 p.m.: Cantor Lectures. "Some of the Industrial Uses of the Calcium Compounds," by Thomas Bolas, F.C.S. Lecture III.—Sulphate of lime and its occurrence in nature. Gypsum and alabaster. Plaster of Paris, its preparations and uses. Physical and chemical aspects of the setting of plaster. Accelerating and retarding influences. Scientific principles involved in some of the applications of plaster. Moulding, stereotyping, and other processes. Wednesday, December 7th, at 8 p.m.: Fourth ordinary meeting, "The American System of Heating Towns by Steam," by Capt. Douglas Galton, C.B., F.R.S. C. W. Siemens, D.C.L., LL.D., F.R.S., will preside.

THE ENGINEER.

DECEMBER 2, 1881.

FUEL ENGINES.

HEAT engines which do not use steam alone as a working fluid may for convenience be termed "fuel engines." They are not necessarily hot-air engines or gas engines. They may employ as a working fluid either gas or air, or a mixture of gas and air or steam. Very little is as yet known about them, but it is not improbable that they may yet play an important part in doing the world's work. They are intended to avoid or overcome difficulties which stand in the way of the extended adoption of gas and hot-air engines properly so called. A gas engine, for example, is not self-sufficing. It cannot be worked in districts where there is no gas. The hot-air engine, on the other hand, operates at such high temperatures and low pressures that its sphere of usefulness is, like its life, extremely limited. The fuel engine may be regarded as both a hot-air and a gas engine in one, or a hot-air and steam engine in one; and if the principles on which it operates admit of extended practical application, a better motor of moderate power than anything yet in the market may perhaps be produced.

The first attempts to make a fuel engine are of comparatively old date. They contemplated the combination of the hot-air with the steam engine. The fuel was burned under pressure in a close furnace, and all the products of combustion were passed direct into the water in a boiler. Steam was generated, and mixing with the heated gases flowed into the cylinder and worked the engine; such an engine is illustrated in THE ENGINEER for April 7th, 1865. There was no waste of heat up the chimney, and it is not difficult to show, if it were necessary, that the fuel was used to the best possible advantage. A like scheme was tried on a large scale some seventeen or eighteen years ago on board the John Faron, a United States river steamer. The invention failed because it was found to be impossible to keep ashes out of the boiler, which quickly filled it. Mr. Edgar P. Watson, an American engineer, commenting on the invention, wrote in 1867:—"All that is required to make this great improvement practicable is some simple and effectual plan for preventing the ashes from going into the boiler, or for readily blowing them out after they are introduced." To get over the difficulty at that time seemed impossible. We know now that it ought to be very easy to produce, let us say, a petroleum engine which would solve the problem. One pound of petroleum oil is competent theoretically to evaporate 28 lb. of water. We shall assume that used in the following way it will evaporate 20 lb.:—The oil is to be pumped in spray into a close chamber; the spraying will be effected by the action of a jet of air. In this chamber, lined with fire-brick, the petroleum will be ignited, and the products of combustion will then be passed directly into the water in a boiler, through which they will bubble up. They will probably not give up all their heat to the water, but they will then superheat the steam with which they will be mixed; the mingled hot gas and steam will then be employed in the usual way to work an engine. About 24 lb. of air will be required to effect the complete combustion of 1 lb. of petroleum oil. This at atmospheric pressure will occupy a space of 315 cubic feet. If we assume the working-pressure to be 60 lb. absolute, it will occupy a space of 79 cubic feet in round numbers after compression; and the work expended in compressing it will be 1,080,000 foot-pounds. If 1 lb. of petroleum is burned per hour under the conditions stated, a little more than half of one horse-power will be required to compress the air for combustion, and so on in proportion for larger engines. We have assumed that 20 lb. of water will be evaporated by each pound of oil burned; the volume of the steam resulting would be 140 cubic feet. The temperature of the products of combustion, which will consist principally of nitrogen, carbonic anhydride, and steam resulting from the combination of the hydrogen of the fuel with the oxygen of the air, will enter the water at a very high temperature. They cannot, however, leave the boiler much hotter than the steam which accompanies them, the sensible heat of the gas being rendered latent in that steam. The temperature of 60 lb. steam is 292·7 deg.; but it may be taken for granted that some superheating will occur, and we shall probably not be far wrong if we assume that the final temperature of the composite working fluid entering the cylinder will be 350 deg. At this temperature the products of combustion will probably have a volume of about 120 cubic feet. We cannot give a precise figure here, because the volume will depend on the composition of the fluid and the quantity of steam which may be in it; but the larger proportion will be nitrogen, which expands as air does. To sum up then, we shall have as the result of the combustion of one pound of petroleum oil, 140 cubic feet of steam and 120 cubic feet of gas—we neglect the steam produced by the combustion of the hydrogen—or together, 260 cubic feet of working fluid with a pressure of 60 lb. on the square inch. If this were permitted to flow under a piston 1ft. in area, fitted to a sufficiently long cylinder, it would lift that piston through a height of 520ft., retaining at the end of the operation a pressure of 30 lb. on the square inch, or 15 lb. above the atmosphere. The average load on the piston might be 7200 lb., the average pressure being 50 lb. on the square inch, and 7200 × 520 = 3,744,000 foot-pounds. If the piston took an hour to travel the 520ft., then it would do work equivalent to 1·88-horse power, from which must be deducted, say, 0·53-horse power expended in compressing the air for combustion, leaving 1·33 effective horse-power, and deducting ·33 H.P. for friction, &c., we should have 1-horse power net for the combustion of one pound of petroleum oil. Taking the oil to be practically as efficient as 3 lb. of coal, this represents 1-horse power for 3 lb. of coal—a result utterly impossible of attainment with a non-condensing steam engine of 2-horse power cutting off 60 lb. steam at half stroke. With large petroleum engines greater economy could be realised. It will be seen that we have here a very economical heat engine working within moderate limits of temperature, and therefore under much more favourable conditions than a hot-air engine. The objection that a boiler must be used would probably be got over by injecting water in the form of spray among the hot gas to cool it down, being itself vaporised in the process. Here then is a fuel engine which appears worthy of consideration. We may add that, so far as we are aware, there is no patent involved in the scheme.

Another form of fuel engine may be called a hot-air and gas engine combined. Fuel is burned, or rather distilled, in a close furnace. Coke is used by preference. Into this furnace the air necessary to effect partial combustion is pumped under pressure. Each atom of the carbon obtains one atom of oxygen, and the result is a large production of CO, the carbonic oxide leaving the furnace at a comparatively high temperature, and mixed with nitrogen, next enters a chamber or prolongation at the foot or end of the working cylinder. Here it is supplied with more air, and at once burning to CO_2 developes intense heat, and is augmented in volume. It is not necessary to occupy space by giving calculations to show exactly what takes place. The advantage secured over the ordinary hot air engine is perfect combustion, a high working pressure, and cleanliness; that is to say, nothing but gas is permitted to pass from the furnace to the working cylinder, dust and grit being nearly excluded. The heat has not to be transmitted through the metal of the cylinder to the air to be expanded, and it is possible to keep the working part of the cylinder cooled down by a water jacket. We have here in one sense a gas engine working with carbonic oxide instead of carburetted hydrogen or coal gas. It does not work explosively, and is, of course, self-sufficing. Engines constructed on this principle, by Mr. Buckett, of Southwark, have been in use for some time driving sirens and fog-horns for the Trinity House, and are said to be quite satisfactory in their operation. The advantages which they possess over the ordinary low-pressure hot-air engine sl ould be sufficiently obvious. There are other methods of constructing fuel engines which will, perhaps, suggest themselves to our readers. Concerning one involving a curious principle and very full of promise, we are not at liberty to speak as yet. Our readers may, however, rest assured that attention turned to this class of engine ought to produce good commercial results. It is by no means certain that the coal gas engine will have it all its own way. The demand for engines of moderate power which will not need boilers is rapidly growing. What M. Faure's battery and its adaptations may do for us remains to be seen; but it is unlikely that they will prevent money being made out of a good fuel engine, and there is certainly no physical obstacle, so far as can be seen, to producing this.

SCIENCE AND ENGINEERING.

WHAT has science done for engineering? Before the question can be answered we must know what is meant by the words "science" and "engineering." The first then is here supposed to mean a knowledge of the laws of nature, and of mathematics; the latter is supposed to mean the practice of the art of construction. Neither definition is absolutely complete. Both are complete for our present purpose. The question with which we began may be put into this form—what have men who are only natural philosophers done to promote that species of progress which takes its origin in and draws its life from the development of the mechanical arts? According to one school of thinkers—everything. According to another—nothing. At first sight it may appear that an article on such a text as we have chosen cannot fail to lack interest. It must, it may be said, deal with abstract questions which concern practical folks not at all. Now, this is not the case. The education of the rising generation of engineers is deeply concerned in the problem; and we know that not a few parents and guardians, to say nothing of certain young men themselves, are very deeply interested in all that refers to the professional education of engineers. If science has hitherto done much for engineering, then it is probable that it will do yet more in time to come. If, on the contrary, engineers have got on very well without a great deal of mathematics or natural philosophy, why then it may be waste of time to study such matters too deeply. In this country we have had hitherto not too much science taught. On the continent of Europe, and especially in France and Germany, science and mathematics have been taught, there is some reason to think to excess. Which system has given the best results?

We fear that it cannot be denied that pure science has up to the present, always followed the engineer instead of preceding him. Natural philosophy owes more to the engineer than the engineer does to it. The men who have really materially improved the world were, for the most part, those whose information was very limited, even judged by the standard of the day in which they lived; and quite insignificant as compared with modern standards. George Stephenson could not have passed a modern examination for a county surveyorship to save his life. James Watt's natural philosophy was of the crudest type. Trevithick the elder knew little. Rennie never even heard of elementary truths, taught now-a-days to every schoolboy and girl. Richard Roberts, Arkwright, Cartright, Crompton were all, so far as science is concerned, ignorant men. The same may be said of Maudslay and John Penn. It is next to impossible to point out any man who was a pioneer engineer and did great things who was also a man of science. A hundred instances could be given in which science has followed instead of leading; but her following has usually been productive of good. The defect, it is said, in her career is that she lacks the power of originating. She will compile or develope, but not originate. It is well that this point should be made quite clear, for there is growing up amongst us a class of thinkers and close observers who assert that a highly scientific training is fatal to mental development. That, in a word, it puts men's thoughts into grooves and prevents mental excursions into unexplored fields of invention and discovery. We neither assent to nor dispute this proposition, because we are not quite clear what is meant by the words "highly scientific training." There is no doubt much force in the argument that Stephenson could make railways and locomotives without the aid of any scientific training. George Stephenson may be cited as a type. But the question admits of being reduced to narrow limits suitable for convenient discussion. Instead of wandering over the whole range of the arts, and asking what pure science has done for them, let us confine our attention to one or two distinct subjects. Take, for example, the steam engine, and let us ask what abstract science has done to make that engine what it is? We fear that the answer must be, nothing at all.

Some time after Watt's death the theory of the steam engine was carefully investigated on both a mathematical and a physical basis. This investigation did not in any way modify results. It in no way promoted economy. That was effected by men who did not know anything about either natural philosophy or mathematics. The compound engine, for example, was not invented by a mathematician, nor yet by a natural philosopher, but by a man so ignorant that he thought that for every pound pressure per square inch in his boiler he could expand steam once, and yet have a terminal pressure equal to that of the atmosphere. Thus, if he carried 20 lb. in his boiler he could, he said, expand that steam twenty-fold, and yet it would not fall below 15 lb. on the square inch. The link motion was not invented by a mathematician; but very shortly after its invention, and thenceforth for ever, mathematicians found in it a fruitful and beautiful subject for investigation. But no professional mathematician, so far as we are aware, ever succeeded in devising a practical valve gear now in use, and better than the link motion. So far as mathematicians and men of pure science were concerned, the steam engine might have gone on for ever burning 5 lb. or 6 lb. of coal per horse-power per hour. They could not, or did not tell the world how to make better boilers or more economical engines. The only assertion they put forward on the subject was wrong. They deduced from their reasonings that the more steam was expanded the less would be the fuel required, and when their advice was put into practice the engineers came to grief, and had to find out for themselves that steam did not behave like a permanent gas; that if it was expanded more than about eight times, more was lost than was gained, and that it was impossible to make an efficient superheater which would also be permanent. Not one single real improvement has been made in the steam engine by the man of pure science or the mathematician. For example, Rankine did nothing for it; Carnot's theorem has not even modified its construction. It is in a sense wholly unscientific men who have given us marine engines which require 75 per cent. less fuel than those of a few years ago. Leaving the steam engine, we may turn to other industries. Take the manufacture of Bessemer steel. Besssemer, when he invented the process of blowing air through iron, was not a man of science. The scientific men looked on and despised him. When he first succeeded, they accepted his process as final and praised him. When it was found that the process would not work, they scorned him—they did not help him. The process was finally made a success, but no thanks to the chemist or the mathematician. David Mushet; common sense; invention; and spiegleisen did what was wanted. It is fair to say that science, as represented by Messrs. Thomas, Gilchrist, Snelus, and Reilly, has devised the basic process. But it must also be added that those who devised it and those who have made it such a success as it is, are all intensely practically men as well as men of theory. In cotton spinning pure science has done next to nothing, and the same may be said of weaving, coal-mining, glass-making, and very many other industries that have made England what she is. The evidence is overwhelming that a scientific training, properly so-called, has not been essential to the success of the engineer; and that science has invented nothing and discovered nothing of importance to him. Are we to assume that the young engineer is to be brought up without scientific training? Certainly not. It may be said that those great men whose names we have cited, and who have done so much in the past, did it in spite of their want of scientific training, and not because of it. No doubt they would have avoided many mistakes and saved much money if they had known more and had less to find out day by day. Besides, it must be remembered that every young man who wants to make money as an engineer is not a George Stephenson. Men of small originality must avail themselves of all the help they can get from those who have gone before them, and they cannot dispense with scientific training and fit themselves to earn their bread at the same time.

There is such a thing in this world as practical science. It is to be found working hard among manufacturing chemists; perhaps it will one day find its way into engineering schools and the training of engineers. Abstract science is in itself a very good thing, and those who have a life of elegant leisure before them will find in it much to comfort, amuse, and elevate. But the young man who must earn his bread is well disposed to regard abstract science as a useless infliction, and not without reason. The proper course to pursue is, we think, obvious. In engineering schools and colleges let the student see from the first moment that his training consists of two kinds—giving him mental tools, and teaching him how to use them. When he can solve a quadratic he has obtained a tool, but he will be sure to let this tool rust unless he is shown what practical use to make of it. Much of the scientific training of the present day is carried on as though a man makes lathes and planing machines and files and drills. Young men, would-be mechanical engineers, come to him and remain with him for a time, and when they leave they carry away with them some of his wares, but how to use these wares they know not. A man with a good shaping machine is given a bar to true up. He blunders about helplessly, and at last with much trouble he gets it into shape with hammer and chisel and file. College training has hitherto given similar results. Men learn certain facts; to apply these facts to a useful purpose is beyond their power. We meet engineers now and then who have the calculus at their fingers' ends, and yet cannot read a diagram or understand the lesson it has to teach. Some years ago a wrangler, after elaborately investigating the performance of a peculiar screw propeller, asked us in confidence to explain to him how it was a screw propeller made a ship go through the water at all. We could cite an instance where a firm was ruined because one of the partners, a German, would insist on making the dimensions of every part of a special machine just what they ought to be by calculation. Thus ⅝in. bolts being too strong he had them all put in the lathe and turned down to ·590in. Other things done in the same way—result bankruptcy. Again, a large bridge was specified for. The calculations were all given in the specification. The dimensions of the bars were all given in hundredths of an inch. Of course no one would tender, because no one can buy in the open market bars rolled to the hundredth of an inch. It may be said that all this is science gone mad. We fear that a great many young engineers may be found fresh from college affected in this way. There was a great practical lesson involved in Mr. Squeers' system of teaching at Dotheboys Hall—"Spell winder," said Mr. Squeers. "W-i-n-d-e-r—winder," replied the boy. "So it is," said Squeers; "now go and clean it." Let young students be taught to apply at once in practice what they learn. Nothing will more vividly impress the value of the training they are getting on their minds. But the practice will exert a yet more beneficial influence on the mind of the teacher. *If he be compelled to find a use for all that he teaches, he will be careful to teach nothing that is not useful.* No man can find a use for the scientific training of an engineer but an engineer; and so it will be found that engineers will ultimately teach engineers even in colleges. This is just as it should be. Engineers, men of considerable practical experience as well as sound theoretical attainments, are beginning to take their proper places as professors in our colleges. The highest results may be expected from this, and it may yet be found that science will make up for lost time and lead where she has hitherto followed.

PUDDLERS' WAGES.

THAT early period in a time of trade revival when prices have not yet got up level with demand is a trying one for wages sliding scales and boards of industrial arbitration. The current period in the trade revival through which we are now passing is no exception to the rule. Preparing for a revision of the sliding scale in the iron trade of the North of England which terminates next May, the ironworkers held a meeting on Saturday last in Stockton. Enthusiasts amongst them, comparing to-day's steady rise in the tide with the crest of revival waves in "times past," would have no wages scales which should keep them from getting now what they got then; while others maintained that "the price for puddling should never go beneath 8s. per week, and should range from that to 12s." It is, however, satisfactory that the Unionist leaders who are officially associated with the working out of the scales in association with the arbitration boards do not encourage these utterances. The operatives' secretary of the northern board would have his men bear in mind that the present 7s. per ton for puddling is 3d. instead of the ordinary 6d. per ton below the Staffordshire price; and that the existing sliding scale is 3d. per ton above that of 1871, and 1s. 6d. above that of 1874. Yet more satisfactory is it that at a set meeting in Wednesbury, on the same day, of the operative members of the Staffordshire board, a formal rebuke was administered to the puddlers at the Bewsey Forge of the Pearson and Knowles Coal and Iron Company, Limited, of Warrington. There the puddlers have struck work for an allowance of 3d. per ton. Their official fellows we note by our Staffordshire letter declare their conduct to be "a blow aimed at arbitration," express their "unqualified disapproval" of it, and "recommend puddlers in want of employment to apply at once to the company for situations."

THE GREAT EASTERN.

AN American exchange tells us that the idea of purchasing the Great Eastern, with a view of altering her very materially, such as razing her so that she will draw much less water, and at the same time reduce her carrying capacity, which is considered to be too great for the present requirements of profitable trade, is seriously entertained in the United States. It is contemplated, should she be purchased, to remove all her present motive power, and substitute for it a pair of compound engines, driving in its stead twin screws, which would give her an average speed of from ten to twelve knots per hour. She would be fitted as a general freighter and particularly as a cattle boat, for which she would be well adapted in her changed dimensions. It is believed that her outer bottom is in good condition, while her interior, and above the water-line, is in first-class order. The main question, our contemporary remarks, upon which her purchase hinges, is as to whether she can be brought under an American register, so that she can fly the American flag. This question will be submitted to the Treasury Department in a few days; the would-be purchasers believing that the change of register can be effected, especially as the character of the vessel is to be entirely changed. It is to be hoped that some use may be found for this great ship, and the proposed scheme sounds well. With refrigerators on board, she might carry enormous quantities of fresh meat.

LITERATURE.

The Elements of Plane Geometry, for the use of Schools and Colleges. By RICHARD P. WRIGHT, Teacher of Mathematics in University College School, London; with a Preface by T. ARCHER HURST, F.R.S., &c., late Professor of Mathematics in University College. Fourth edition. Longmans and Co. 1881.

"FOR several years the conviction appears to have been steadily gaining ground, that the admitted imperfections in the teaching of geometry in English schools and colleges are in a great measure traceable to the fact that England, unlike almost every other nation, still adheres to a text-book written upwards of 2000 years ago." This, which forms the opening sentence of the preface to the work before us, expresses very distinctly the object with which that work was undertaken. To expel the Greek geometer from the throne he has so long occupied in our schools and universities; to substitute "geometry" for "Euclid;" this, and nothing less, is the ambitious programme of our educational revolutionists. Now the real difficulties of every revolution only make their appearance when the first success has been achieved, and the conspirators find themselves face to face with the inevitable question, What next? We believe that the contemplated revolution in our method of teaching geometry will prove no exception to the general rule. Euclid may be deposed, but whom are we to put in his place? We may safely predict that there will be no lack of candidates for the vacant throne. Several have already appeared, to be followed, doubtless, by a numerous host of rivals. Now however much these manuals may differ in form or substance, there is one quality which we must imperatively demand of all, and that is, perfect exactitude, both in reasoning and expression. Failure in either of these particulars must be looked upon as absolutely fatal to any aspirant for that position in our educational system hitherto occupied by Euclid. This, however, by the way. Our present business is rather with the charges brought against our old friend than with the demerits of those who are striving to supplant him. The most important of these charges appear to be—prolixity, artificiality, and unsuggestiveness. That some, if not all, of these objections are well founded, few persons will be bold enough to deny. Of course there is one answer always at hand, namely, that these so-called faults only become such when we apply Euclid's work to a purpose for which it was never intended; but this answer, however it might serve to defend Euclid as a writer, does not at all meet the question now raised, which is precisely whether we do wisely in thrusting into the hands of boys utterly unable to appreciate its beauties, a work which is manifestly intended as a mental exercise for the enjoyment of the advanced mathematician? Our own feeling is that some change is imperatively called for, though we cannot join in the hue and cry which is being raised to expel Euclid altogether from our schools, until it be conclusively shown that by no modification or re-arrangement can it be made to satisfy the requirements of a modern text-book. Of one thing we are convinced—namely, that in spite of all that has been advanced to his disparagement, Euclid supplies a mental discipline for which it will be very hard to find a satisfactory substitute.

Of the various manuals which have lately appeared with this object, the most complete in design and execution is the work before us. The demonstrations are remarkably clear and the arrangement admirable, which, it must be confessed, is more than can be said of Euclid's First Book, where the natural sequence of the propositions is disturbed by his too rigid exclusion of all hypothetical constructions, whilst inconsistently enough, many of his principal definitions are purely hypothetical. For example, how do we know that any figure bounded by one line can have the property he asserts of the circle, or that a four-sided figure can exist having all its sides equal and its angles right angles? We are glad to see that Mr. Wright has recognised "superposition" as a thoroughly legitimate test of equality to be used without scruple whenever it suits our purpose, and not as a mere makeshift when other methods fail us. By this means the fourth and twenty-sixth propositions of Euclid's First Book can be demonstrated at the same time, and likewise the fourth and sixth propositions of his Sixth Book. In some cases we think our author has deviated from Euclid's method without gaining any advantage either in clearness or brevity; as, for instance, in his treatment of the corollary to the thirty-second proposition.

Passing on to the chapter on parallels, we regret that Mr. Wright has not made some attempt to get rid of the old definition of parallel straight lines—a definition at once useless and unscientific. When we say that "straight lines in the same plane which being produced ever so far do not meet are parallel," we are really asserting that two straight lines in the same plane which constantly approach each other must intersect at some finite distance. Now this is not true if stated of lines in general, and it ought to be shown to be a distinctive property of straight lines. The theory of parallels has always been the great difficulty of elementary geometry, and we are convinced that it will never be placed on a satisfactory basis till we distinctly recognise parallelism as only a particular case of intersection. But a discussion of this question would carry us far beyond our limits.

The equivalence of rectilinear figures is treated, as in Euclid, without the aid of proportion. In the chapter on proportion, which is intended to supersede the Fifth and Sixth Books of Euclid, will be found much that is interesting and ingenious, especially in the treatment of incommensurables. Whether a beginner will find it easier to master than the fifth definition of Euclid's Fifth Book, on which Euclid bases his whole theory of proportion, is more than we will venture to assert; but it is at least a very meritorious attempt to find some substitute for that, which we seem by common consent to have abandoned.

On the whole, then, we are disposed to think that Mr. Wright has achieved no inconsiderable measure of success in the task he has undertaken. The few blemishes which we have ventured to point out—or, at least, what have appeared to us as such—will doubtless disappear in future editions; and if the day be indeed arrived when we shall be compelled to part with our old text-book in obedience to modern requirements, we know of no other in our language which can put forward so good a claim to be substituted for it.

THE CALF ROCK LIGHTHOUSE.—During the storm of Saturday night last a portion of the lighthouse, with its lighting apparatus, on the Calf Rock, Bantry Bay, was destroyed.

THE FOUNDATIONS OF MECHANICS.

By Walter R. Browne, M.A.

No. III.

33. *Definition of Matter.*—The definitions of force and motion do not enable us to proceed at once to the first principles of the subject, for we have seen that motion implies something which moves, and I may be asked to define this something. The general name given to this something is *matter*, and we may therefore begin by saying that matter is that which is moved by force: but this is not really a definition, although given as such by some writers; it is merely a substitution of the name "matter" for the general word "something." We go on to inquire whether any definition, whether as a term or a thing, can be given of matter.

34. The writers on mechanics treat this question in ways which vary considerably. Some, as Moseley and Maxwell, attempt no account of it, and simply proceed to speak of matter, or of bodies, as things with which their readers are familiar. Others, as Whewell, define body or matter as "the most general name which we give to everything which is the object of our senses." This explanation, though suited perhaps to metaphysics, is not of the character required for dynamics. Rankine—"Applied Mechanics, Introduction"—defines matter as "that which fills space;" but he omits to state whether this means that which really fills space, or that which apparently fills space—a very important difference. Moreover this definition touches a much-vexed question, which there is no necessity to solve for the purposes of mechanics. Thomson and Tait—ch. 2—observe: "We cannot, of course, give a definition of *matter* which will satisfy the metaphysician; but the naturalist may be content to know matter as *that which can be perceived by the senses*, or as *that which can be acted upon by, or can exert, force.*" The former of these definitions, like Whewell's, is a metaphysical rather than a physical one; and moreover, seems open to the objection that what is directly perceived by the senses—*e.g.*, warmth, light, sweetness, pain—is not matter, but an effect of some condition of matter. The latter seems at first sight the same as that suggested in the last paragraph; but we immediately see that it includes something else, and that something of the greatest importance; for it says that matter can not only be acted upon, but can act; can not only be moved, but also cause motion. It does not, of course, imply that there is one kind of matter that acts and another that is acted upon; one kind which causes motion, and another which is moved. The whole of mechanics is built on the assumption—explicitly stated, in fact, in Newton's third law of motion—that matter both acts and is acted upon. Hence, looking forward to the fundamental principles of the science and the mode in which they are proved, I propose to formulate the definition of matter, *as a term in mechanics*, as follows:—*Matter consists of a collection of centres of force distributed in space, and acting upon each other according to laws, which do not vary with time, but do vary with distance.**

35. This definition is of matter in general; but in practice we are always treating of some definite portions of matter, and we require names to express these portions, according to their size and other properties. The names usually employed are the following, beginning with the most elementary.

36. (1) The centre of force itself is called an ultimate atom, or a physical point. Like a geometrical point, it has no assignable parts or magnitude, and cannot therefore be compressed, extended, or divided. It is, in fact, a geometrical point, conceived as having also the properties of exerting and receiving forces, and of being movable through space, whilst retaining its constitution unaltered. The word "point" is, perhaps, the simplest and shortest which can be applied to it, but in this treatise I shall continue, for greater clearness, to use the word "centre."

37. (2) A collection of points or centres, acting on each other, and so intimately and closely bound up together that no known process or natural force can separate them, is called an atom or a molecule. I shall here follow Clerk-Maxwell in using the latter term.

38. (3) A collection of points, simply considered as so small that for the purposes of any particular investigation, or for those of elementary mechanics in general, it may be considered as concentrated in a single central point, is called a particle. This word is used merely to imply that all questions of size, rotation, constitution, &c., are for the present left out of account.

39. (4) A collection of points of any size or shape whatever, which for the purpose of any investigation is treated together as a whole, is called a body.

40. On the foregoing definitions the following remarks may be made.

41. (*a*) The definition of matter, as stated, is only its definition as a term of mechanics, and only relates to it as it is concerned with force. It does not assert or deny that matter may have other properties; *e.g.*, the properties which distinguish the different chemical elements *may be* special properties of so many different kinds of matter. If, however, chemical properties should eventually be resolved into manifestations of force, this distinction would cease; and thus, what is now the definition of matter as a *term* may eventually prove to be also its sufficient definition as a *thing*.

42. (*b*) The definition covers all those properties usually classed as general properties of matter. Extension on this view is recognised as a property, not of the centres of force themselves, but of the space in which they are distributed; as it is of all space. Hardness, colour, temperature, penetrability, &c., are all now recognised as properties depending merely upon force.

43. (*c*) At the same time the definition does not absolutely commit us to the statement that the centres of force are in the strict sense infinitely small. All I insist is that no assignable magnitude can be allowed to them. If anyone prefers the conception of a magnitude which, though less than any assignable magnitude, is yet not infinitely small, he is not precluded from it.

44. (*d*) The definition does not preclude the existence of different *kinds* of matter. Thus there may be two kinds—A and B—such that all centres belonging to kind A act on each other according to one and the same law, but act on those of kind B according to a different law, or even do not act on them at all. For example, the fact that the velocity of light is the same within and without a crystal appears to show that the attraction of gravitation does not exist between the molecules of the ether and the molecules of the crystal; on the other hand, the fact that the molecules of the crystal are thrown into agitation by the radiant heat of the sun—which is an undulation in the ether—seems to prove that *some* action takes place between the two sets of molecules. Assuming this, we should say that the molecules of the earth and of the ether belonged to different kinds of matter. But elementary mechanics does not consider the motions of the ether, and therefore for the purposes of this treatise we may consider all matter as of one kind; in other words, that the centres of force are all alike, and all act on each other by like laws.

45. (*e*) As already mentioned, some writers, such as Maxwell, avoid the use of the word "matter" altogether, and prefer to speak of a "body," in all cases understanding thereby a portion of matter of any size and form; and in the article of The Engineer already referred to, and also in a paper by Dr. Lodge—*Phil. Mag.*, 1879—this practice is formally approved and adopted. For many purposes there is no harm in this course; but when we are trying to give a rational account of the principles of the science, with a view to their application in practice, it appears to me open to grave objection. For the general result of the application of force to a finite body is to produce three different effects:—(1) a translation of the whole body in some direction; (2) a rotation of the whole body about some axis; (3) a strain or internal displacement of the different parts of the body. Now to consider all these three effects together forms the office of the highest and most difficult branch of mechanics; and therefore for elementary purposes it is essential to consider them separately, beginning with the simplest—that of translation. But if we take as our typical case that of a finite body of any size, we can only treat the case of translation separately by making two assumptions. First, to get rid of rotation, we must assume that the direction of the force passes exactly through the centre of gravity of the body. This assumption is realised, at least approximately, in many cases of practice, but by no means in all. Secondly, to get rid of internal strains, we must assume that, whatever be the external force, the body preserves the arrangement of its parts absolutely unaltered, which is expressed by saying that the body is rigid. This is an assumption which is a very large one indeed, inasmuch as it amounts to saying that the internal forces of the body are infinite; and it is needless to add that it is *never* realised in practice. Thus, the extension of a steel bar becomes a very visible quantity long before it breaks; or again, the commonest of all engineering problems, that of the strength of a beam or girder, cannot be approached at all without assuming that it *has* changed its form under the load. Now, to make this vast and radically false assumption the very basis of our dealings with the science, appears to me a course fraught with danger; it is almost certain to produce confusion, if not in the mind of the teacher, at least in the minds of the taught. On the other hand, by beginning with the simple element, or centre of force, and considering first the action of one centre of force on another, we get rid of the need of both assumptions; for the force must pass through the centre of the body acted on, since it is nothing but a centre; and there can be no strain of its internal parts, since it has no internal parts. In this arrangement, I only follow what is surely an accepted rule in the teaching of science, namely, to begin with a single case, and with the simplest elements, and thence to rise gradually to compounds, and to complicated arrangements.

46. (*f*) What has just been said is not, of course, to be read as objecting to the legitimate use of the hypothesis of rigidity. When the principles and lower branches of the subject have been mastered, it is perfectly open to make this approximate hypothesis for the purpose of attacking some of the higher problems, which are more easily mastered thereby; and, in fact, this process forms a separate branch of the subject, under the name of rigid dynamics. But the first and lowest branch of analytical dynamics is called dynamics of a particle; and this branch goes throughout on practically the same assumption as that here advocated—namely, that the body considered has no parts to produce rotation or strain. The only objection to the use of the word "particle," instead of "centre," or "physical point," is that it leaves out of sight the fact that the body considered, besides being acted upon, is itself in all cases a source of action; and this fact seems to me so important that, in a treatise such as the present, it is well, even in our terminology, to keep it constantly in view.

47. (*g*) This is perhaps the place to mention an objection to the conception of matter as consisting of force-centres, which has been brought by no less an authority than Prof. Clerk-Maxwell. He observes—"Theory of Heat," p. 86—that such a conception takes no account, and can take no account, of the property of inertia, which is essential to the idea of matter. To this the reply, on the definitions here laid down, is easy. No doubt the idea of inertia does not flow directly from the definition of force; but it does flow at once from that definition, combined with a general principle which nobody will dispute—namely, that any effect which we can see and measure—and therefore any motion, amongst other effects—must be *finite*, and not infinite. Hence, since we define forces as the cause of motion, and since we know them only through the motions they cause, it follows that any forces we can investigate must produce only finite motions in the bodies, or centres, to which they are applied; in other words, any known body under the action of any known force will only be caused to move over finite distances in finite times. And that is precisely the fact which is expressed by the term inertia.

48. (*h*) It remains to answer the objection that I have no right to assume that the forces connected with matter are central forces at all. To this I reply that the conception of central forces is of course only one among many possible conceptions as to the action of forces, with which the student becomes perfectly familiar in his progress through mechanics. But the assumption that all the forces of nature are central forces is justified by the fact that all the natural phenomena, which have as yet been explained on mechanical principles, have been explained on that hypothesis. To cite only one instance, the widest generalisation yet made as to the mechanics of the universe, namely, that known as the Conservation of Energy, has been proved only on the supposition that all the forces concerned are central forces. If anyone doubts this, he may be referred to the mathematical demonstration of the principle in any work on dynamics; or to explicit declarations such as that of Maxwell, "Theory of Heat," p. 93, or of Clausius, at the end of his demonstration of the principle, "Mechanical Theory of Heat," p. 16. The latter is as follows:—"The assumption lying at the root of the foregoing analysis, viz., that central forces are the only ones acting, is of course only one among all the assumptions mathematically possible as to the forces; but it forms a case of peculiar importance, inasmuch as all the forces which occur in nature may apparently be classed as central forces."

49. (*i*) To some minds the definition here given of matter will be an offence, owing to an *à priori* impression that the action of two centres on one another across empty space cannot possibly exist. To this I can only reply as follows:—(1) *A priori* impressions have in all ages been the worst foes of science, and she has met and conquered too many to stop her course for any of them now. (2) This special conviction is probably not even a frequent, much less a general one; to many minds the idea of action across empty space, or action at a distance, presents no greater difficulties than any other mode of action. (3) I have elsewhere shown—*Phil. Mag.*, January, 1881—that various simple phenomena cannot be explained, except on the hypothesis that action at a distance exists; and also that* the ordinary assertion of Newton's having disbelieved its existence is erroneous. (4) The definition does not absolutely preclude such minds from holding that the actions of matter are caused by the contact of some unknown description of extramundane particles, in any case where they can show that all the facts are reconcileable with that hypothesis. It seems clear, however, that for a very long time to come it will only be possible to represent mechanical facts to a student by telling him that the forces act *as if they were* central forces; and while that is so the present definition will at least be the most convenient.

50. We have thus arrived, so far, at the following definitions:—(1) Mechanics is the science of motion, rest, and force. (2) Motion is an ultimate conception, which cannot be further defined, but is recognised by change of position with reference to something assumed to be fixed: all motion that can be recognised is therefore relative. (3) A force is a cause of motion. (4) Matter, or that which is moved by force, consists of a collection of centres of force distributed in space, and acting on each other according to laws which do not vary with time, but do vary with distance.

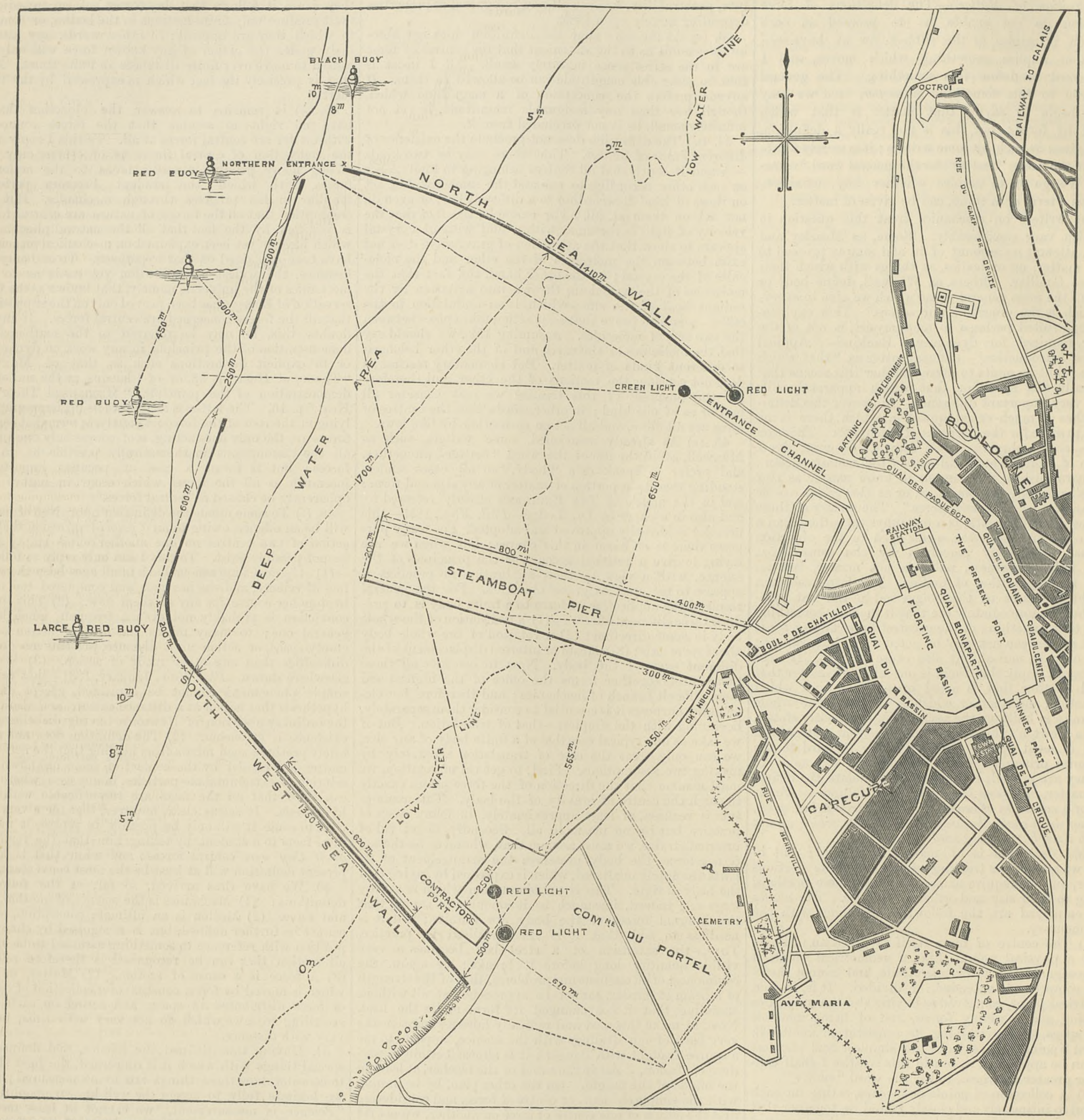
51. Having thus defined the science, and defined the special things with which it is concerned, the next step is to consider how these things are to be measured; for if we hesitate fully to accept the well-known apophthegm, "Science is measurement," we cannot at least feel any doubt as to its converse, "No measurement, no science."

52. The mode in which motion, force, &c., are practically measured is known to all; and there is no difficulty in showing how this mode is deduced from our definitions. We must begin by pointing out that there are three fundamental elements of all sciences, on the measurement of which measurements of every other kind are eventually founded. These are time, space, and weight. For the purposes of this inquiry I shall assume that these, as things, are perfectly well known, and shall not attempt to define them, if even such definition were possible. I need only in passing state that, like all ordinary men, I look upon them as things, and not, like a few bewildered metaphysicians, as abstractions, sequences, or what not. Passing on to consider how these are measured, we find in practice that the only possible mode is to adopt some one definite standard, kept at a definite place, which the inhabitants of a State agree to regard as a final appeal and measure on each of these subjects. Thus, in England the standard of time is the rate of a particular clock, the standard of space is the distance between two marks on a particular bar of metal, and the standard of weight is the weight of a particular mass of metal—all of which may be seen and used at Greenwich Observatory. It is, of course, essential that these standards should themselves be permanent and unalterable, and to ensure this they are frequently checked by various natural standards; *e.g.*, in the case of time, for which the artificial standard is most liable to variation, it is checked by daily transit observations of sidereal time. Into these questions, however, we need not enter. Assuming that, by means of these artificial standards, we have the power of measuring with considerable exactness space, time, and weight, we have to inquire how we can apply these measurements to the purposes of mechanics; in other words, to the measurement of motion, force, and matter.

* It may be well to say something of the terms which occur in this definition. "Collection," "distributed," "space," "laws," are all ordinary and well-understood words, which need not detain us. The laws in this case are laws the mathematical expression of which is not a function of time, so that, other things remaining the same, the force acting is always the same from one moment to another. On the other hand, the mathematical expression of these laws is a function of the distance between the two centres considered, so that as this distance varies the force acting also varies. Lastly, the conception of a "centre of force" is one which becomes familiar to every student of analytical dynamics. It is that of a point in space movable or fixed, from which, as a centre, force is exerted in all directions upon all other points which have the capacity of being acted upon by it; in contradistinction to a point which does not act on others at all, or only on points in certain positions, *e.g.*, along a particular line, or on a particular surface.

* This, I find, has already been pointed out by Sir E. Beckett, "Origin of the Laws of Nature."

BOULOGNE HARBOUR WORKS.



BOULOGNE AND ITS NEW DEEP WATER HARBOUR.

Recently the Prince of Wales laid the first stone of the new docks at Folkestone, and on the other side of the Channel the French authorities have not omitted to persevere in the construction of a harbour which will aid in greatly improving the means of communication between England and France. Of the various routes between London and Paris, those by Calais and Boulogne-sur-Mer are the quickest and have the shortest sea passages, whilst those farther south include more sea travelling, but are less expensive. The Boulogne route has been rising fast in public favour of late, and is much patronised by royalty. It is between six and seven miles longer than the sea trip from Dover to Calais, but the South-Eastern Railway Company, by putting on larger boats, takes its passengers across in about the same time; this, however, can only be done by means of a tidal service, and not a service at fixed hours like that between Dover and Calais. An advantage again on the other side is that Boulogne is fifty minutes' railway journey nearer Paris.

Although the South-Eastern Railway carries continental passengers *viâ* Dover as well as *viâ* Folkestone, the London, Chatham, and Dover Railway Company takes a proportion of the traffic by the former route; hence the South-Eastern Company has a strong inducement to make the Folkestone and Boulogne passenger service, which is entirely in its own hands, as comfortable and as popular as possible.

Boulogne is a cathedral city of about 40,000 inhabitants, of whom nearly 2000 are English and 1000 Italians. It is picturesquely built upon hilly ground, at the mouth of the non-navigable little river La Liane. On approaching from England, among its prominent features which come early into view, are its cathedral near a hill top, its bathing establishment near the beach, and its two lighthouses at the entrance to the port. The entrance channel between these is 70 metres wide between the two jetties; the south-west jetty is 700 metres long, and the other one 519 metres. The channel leads to the present port, which has 1500 metres of utilisable quay walls; the inner port, shown in our large map, is 200 metres by 110. The floating basin, constructed in 1859 and 1868, has 1043 metres of quay walls. The chief dock, already mentioned, has an area of 17 acres, including its walls and quays, and will accommodate seventy vessels of 1000 tons each; its mean depth is 16ft. 9in.; at ordinary spring tides there are 29ft. 8in. of water in the port, and at neap tides 23ft. 7in. At ordinary spring ebb 3ft. 10in., at the neap tide ebb 9ft. 1in. At the highest known tide 31ft., at the lowest known ebb 1ft. 8in. The masonry of the entrance to the dock is 328ft. 1in. long by 69ft. wide. The English passenger steamships from Folkestone, London, and Goole, make regular use of the present main harbour, and have each a separate landing station. When off the harbour the Folkestone boats are known by their white funnels, the London steamships by their black ones, and the Goole boats by their funnels annually painted in black and white, and further indicated by a red cross. Judged by its customs dues, Boulogne-sur-Mer is the third maritime port of France; when judged by tonnage, it ranks fourth, the other three being Marseilles, Bordeaux, and Havre. It has no water communication with the interior; this is a great drawback, and the completion of the great harbour works hereinafter to be described, involves, sooner or later, the making of a canal to unite Boulogne with the great water system of France. The resources of the port cannot be fully developed so long as there is no option but that of incurring the cost of railway transit to the interior.

Boulogne is plentifully supplied with hotels, which is a point of interest to those who intend to break the journey there to avoid too much fatigue, and to sleep off the effects of sea-sickness. Those who stay all night at Boulogne discover that the drainage of the town is emptied into the harbour, and that the wind blowing over this residuum at low water impregnates the neighbourhood with anything but a sweet smelling savour.

In a technical journal it would be out of place to more than indicate the rich vein of historical associations connected with Boulogne-sur-Mer. Suffice it to say that Boulogne is supposed by some critics to have been the port whence Julius Cæsar set sail to invade Britain. Be that as it may, he made it his military head-quarters on the other side of the Channel. The Emperor Caligula, in the year 40 B.C., collected a large army at Boulogne with the same intention; he subsequently abandoned the enterprise, but left a memorial in the shape of the Tour d'Odre, which fell down in 1644; the foundations are still visible. About A.D. 450, the Roman power in Northern France was broken up, and in 606 the first cathedral was built in Boulogne The whole district was ravaged by Edward III. in 1346, and at various subsequent times has been the scene of fighting, and peacemaking, and fraternisation between the English and the French; and in the neighbourhood, between Guînes and Ardres was "The Field of the Cloth of Gold." Some of the fêtes and religious ordinances are of strong interest to English visitors; Frith's picture of the venerable archbishop at the end of a procession blessing the little children, represents an annual ceremony in Boulogne; another ceremony of high antiquity is that of "Blessing the Sea," for the sea once bore in a boat upon its bosom to Boulogne a miraculous image of the Virgin and Child. This is the origin of the Virgin and Child in a boat, so commonly seen about London in the hands of Italian image vendors.

As regards steam navigation between England and Boulogne, the first English steam packet which entered the port of Boulogne was the Rob Roy of 59 tons burden. She started from Dover on the 22nd of May, 1822, Folkestone harbour not being then in existence. She brought six passengers. The packet service between Boulogne and Folkestone was established on the first of August, 1843.

As regards the port, the French National Convention in 1797 reported on its great natural advantages, and Napoleon I. visited it the following year, with an eye to the invasion of England, nor did he give up the project till seven years afterwards. If he could land an army on the British Islands he counted on the support of the Irish, who then, as now, hated the English system of land tenure; but Bonaparte entered into no direct political relations with them, because—so he said at St. Helena—none of the Irish who called upon him on the subject were gentlemen, but persons who did not inspire confidence. The first pile of the present entrance to the port was driven in 1830, and as already stated, the packet service between Boulogne and Folkestone was opened in 1843.

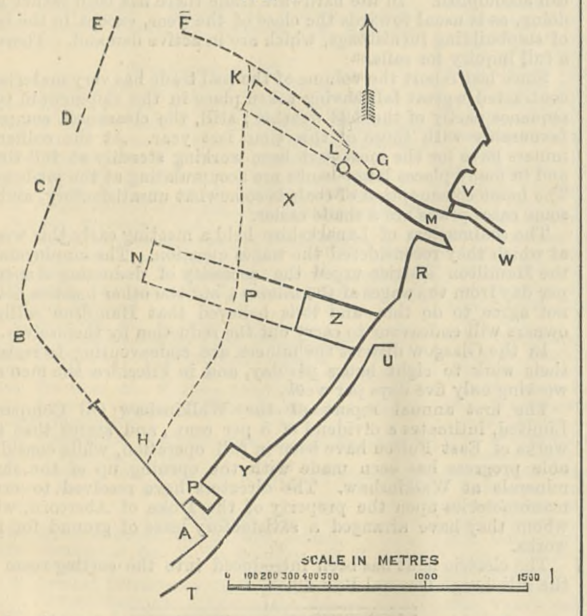
The plans for the new harbour now in course of construction at Boulogne were passed by a unanimous vote of the Chamber of Deputies on the 14th May, 1878, and approved by the Senate on the 3rd of June in the same year. The first stone was laid on the 9th of September, 1878, at the Châtillon, or eastern part of the works, but the work of construction was not seriously begun until some months later.

The French method of carrying out such schemes as that of the new Boulogne harbour is this :—The Government engineers estimate what the cost of any such work should be, and their estimate is usually an exceedingly liberal one, so that a rebate from the amount can be tendered by the various contractors. The cost of the whole of the deep-water harbour works, including minor details not shown in the accompanying plan, Fig. 1, was thus put down at 17 millions of francs, which is rather more than £700,000. No contractor could be found to undertake it on the terms ; the risk was considered to be too great. The work was therefore let out in pieces, and the first contract of three millions of francs is already pretty well completed. It was entered into by Messrs. Varinot and Caville, celebrated French contractors, who have already executed large works at Calais and Dunkirk. As will be seen from the plan, that which they have so far executed at Boulogne, denoted by the lines in Fig. 1 not dotted, includes scarcely any deep water work. Tenders for other portions of the works will shortly be advertised for by the Government, and this, according to French law, must be done for one month. Contractors of any nation may compete.

The cliffs, which have been largely cut away by Messrs. Varinot and Caville to fill in the jetties, consist chiefly of blue clay, with layers of stone here and there. The stone thus obtained has also, of course, been used in the construction ; in fact, no other stone has been required. Eventually it will probably be necessary to bring stone from Marquise, eight miles from Boulogne by rail, where even marble can be obtained. Good stone can also be had at Wimille.

The only deep water work at present executed is the foundations of the western wall. The whole harbour is not expected to be completed in less than fifteen years.

FIG. 1.



In the accompanying diagram, Fig. 1, representing the new harbour, T U, is the line of the cliffs in process of being cut away to obtain earth and stone. At R the outskirts of a plebeian section of the City of Boulogne stretch down to the sea beach, and between R and W are docks and buildings connected with the present harbour. The heavy lines connected with the harbour in this plan represent the portions of the works finished under the contract just expiring ; the heavy dotted lines represent the portions to be executed, which are for the most part in deep water. The light dotted line H K is the average line of low-water mark, shown in detail on the larger map. M is the channel entrance to the present harbour. The circles near L and G represent the small lighthouses at the entrance. V is the *Etablissement des Bains*, such a prominent building in approaching Boulogne from the sea, and above that, in Fig. 1, is a little of the outline of the coast, stretching northwards. The portion of the sea wall A, exclusive of the shore angle of it, is 640 metres ; it is composed of rough stones and pieces of rock, faced with masonry ; the total length of A B C when completed will be 2150 metres, ending at C in a pier head. Between C, D is one of the two harbour entrances, 250 metres in width. An isolated mole D E, 500 metres long, will be built up to the height of 8 metres from the bottom of the sea. Between E and F is the other harbour entrance 150 metres in width. The remaining portion of the sea wall F G is 1410 metres in length.

In the middle of the harbour will be the great traverse N, P, Z, of which the portion Z is already completed under the present contract. This traverse is 1200 metres long on its northern, and 1100 metres long on its southern side ; its width is 200 metres. It is intended to allow steamships of the largest size to come alongside in all states of the tide, and on this traverse may possibly be the maritime railway terminus, and all the usual Custom House, railway, and other offices. Dredgers will preserve a minimum depth of five metres of water between the traverse and the harbour entrances. P is a little port already finished, and used by the contractors in the construction of the works.

At X, and to the east of the dotted line K, it is contemplated, subject to future modifications, to construct a port for the use of ships and fishing vessels, for the herring fishery is a chief element in the trade of Boulogne ; in this port it is intended to preserve a minimum of five metres depth of water at low tides. Between this port at X and the shore will, it is suggested, be a floating dock completely surrounded by warehouses, building slips, repairing sheds, and it will be bounded by a quay wall more than 2000 metres in length, with lines of rails in immediate proximity. In the rear of this floating dock will be the present Bassin de la Liane, which will be converted into a large interior dock, at the entrance of a contemplated canal, intended to place Boulogne in connection with the canal system of the rest of France.

The part of this plan of more immediate interest to travellers is that included between the dotted lines at K and L, and about which the public have hitherto heard little or nothing. As in any case the deep-water harbour works are not likely to be finished in less than fifteen years, the South-Eastern Railway Company desires that its boats should long before that time have the power of entering Boulogne harbour at all times, thus obtaining the power, so far as the French side of the Channel is concerned, of establishing a service at fixed hours, instead of at periods varying according to tidal conditions. At present Calais has the advantage in this respect. Accordingly arrangements have been entered into between the French Government and the South-Eastern Railway Company, whereby the former undertakes to dredge the shallow sandy area K L, to permit the entrance of steamboats at all hours, and the latter, being commercially interested, agrees to pay a portion of the expenses. The work has just been begun by Messrs. Volker and Bos, Dutch contractors, whose dredgers act by suction on the system already carried out at Dunkirk, and not in the ordinary way. It is expected that within three years from this date the work will be finished, and a regular service established, for the large new steamships now running draw but 7ft. 6in of water in anything like ordinary weather. As the work between A and B progresses, that between K and L is facilitated, because the breakwater gives shelter from the south-west and westerly winds, thereby reducing the liability of the filling up of any dredged channel at K L with sand.

FIG. 2.

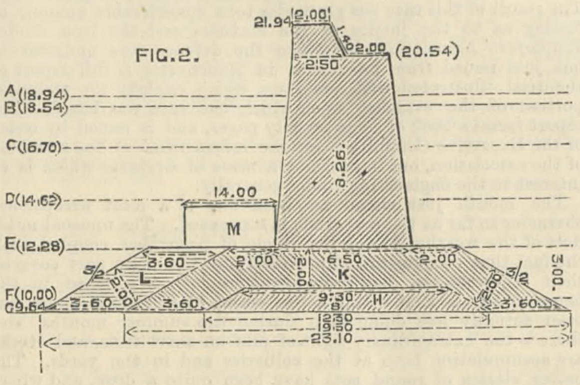
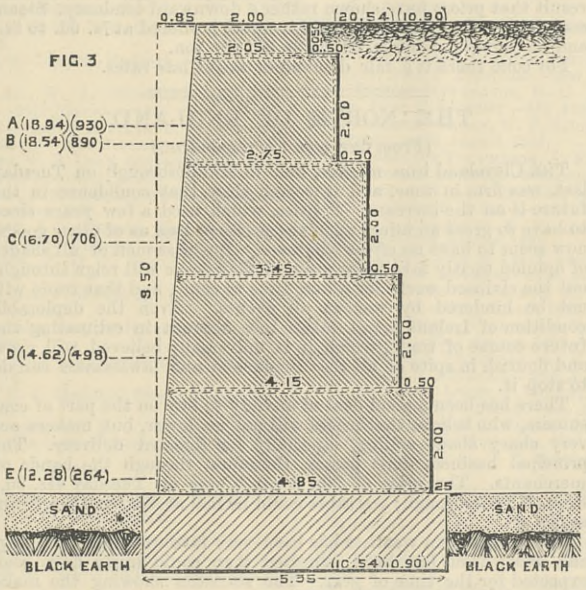


Fig. 2 represents the sea-wall of the new harbour, and Fig. 3 the masonry bounding the pier or traverse. The masonry will vary in thickness according to the depth of the water. The isolated part of the western wall of the harbour will be 6 metres wide at the summit. The traverse or steam packet pier will be 430 yards long by 218 yards broad, with a minimum depth alongside of 26ft. of water, secured by dredging or other means. M and L, Fig. 2, are of artificial blocks, 4 metres long, 2 wide, and 1·75 thick, consisting of rectangular stones cemented together. K consists of natural blocks of stone, weighing from

FIG. 3



1000 to 10,000 kilos., and H consists of natural blocks, weighing from 200 to 1000 kilos. Generally speaking the lightest blocks are laid in the centre of the work and the heaviest on the side of the wall nearest to the open sea. About 1000 Italians are engaged in the work. They form a little colony just outside Boulogne, and at present live amicably with their French neighbours. The French are so prosperous and comfortable that they do not care to do very rough work on limited pay.

The two new steamships—the Louise Dagmar and the Albert Victor—placed recently by the South-Eastern Railway Company upon their service between Folkestone and Boulogne, are 50ft. longer and 5ft. wider than those formerly in daily use. One of these, the Victoria, is still running, but is to be replaced soon by a larger boat. The new boats, built by Messrs. Samuda and engined by Messrs. Penn and Co., are calculated to run 18 knots an hour, and they do the trip regularly in an hour and a-half. They are about five minutes longer in steaming to Boulogne than in making the passage in the opposite direction, because of the strong adverse currents to the south-easterly trip. As already stated the passage by Boulogne is about six miles longer than that by Calais, but by the larger boats it can be run in the same time. In rough weather the large boats have a still greater advantage than in smooth water over the small boats in point of speed. The percentage of passengers who escape sea-sickness by means of the greater steadiness of the larger boats, and the quicker passage, must be considerable, because in crossing in the smaller boats many a passenger has had the experience of having fought off sea-sickness till within fifteen minutes of land. The Louise Dagmar and the Albert Victor are each 250ft. long and 29ft. beam ; $359\frac{1}{10}$ tons burden, and 18 knots an hour speed. They draw 8½ft. water, and are licensed to carry 543 passengers. The captains are instructed that in fine weather they may enter Boulogne harbour, when the water therein is not less than 10½ft. deep. According to statistics compiled by the Great Northern Railway of France, the total number of passengers from England by all steamships landed at Boulogne during April, May, June, was 39,023 in 1881, as compared with 32,246 during the same three months last year ; an increase of 6777. The numbers landed at Calais during the same three months in 1881, were 53,877 against 51,860 last year; an increase of 2017. In considering the relative numbers by the two routes of travellers whose destination is Paris, it must be remembered that much Belgian and German traffic from England passes through Calais. The distance by rail from Boulogne to Paris is 254 kilos. The fares for that distance are 31f. 25c. first-class ; 23f. 45c. second-class ; and 17f. 20c. third-class. The distance by rail from Calais to Paris is 297 kilos. ; fares 36f. 55c., 27f. 40c., and 20f. 10c., according to class.

The present duration of the through tidal service between London and Paris is 8½ hours, which can be exceeded on special occasions. Recently, for instance, the Prince and Princess of Wales returned to London, accompanied by Mr. Myles Fenton and others, in a few minutes less than 8 hours, including half-an-hour at Folkestone for breakfast. A calm sea favoured the water portion of the journey. When the service at fixed hours can be established, it will be of great advantage to the Post-office, complaints about delays in the delivery of letters being now not unfrequent. By considerable exertion, and no little extra expense to the Government, over sorting and other items, the French mail now leaves London twenty minutes earlier than was once the case. On Fridays it is invariably late, because the Indian mail *viâ* Brindisi cannot possibly be made up by the appointed time.

GOODS ENGINE TENDER, LANCASHIRE AND YORKSHIRE RAILWAY.

With our impression for April the 1st we published a working drawing of a goods engine for the Lancashire and Yorkshire Railway. We this week publish a sectional elevation and plan of the tender for this engine. This tender is constructed under a patent, taken out by Mr. J. Sharp, of the locomotive department of the Manchester, Sheffield, and Lincoln Railway, No. 3358, 1879. The principal peculiarity consists in placing the filling holes at each side of the foot-plate forward, so that the stoker has not to go to the rear end of the tender. The tender is also fitted with a weather board, in the middle of which is constructed a cupboard, for tools, &c., as shown. Under the tender forward are fitted the air-brake sacks. The dimensions are so fully given that further description is not necessary. This is a excellent type of tender, giving much satisfaction.

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

(*From our own Correspondent.*)

There was quite as good a tone upon the Birmingham and Wolverhampton Exchange to-day and yesterday as prevailed last week. The minimum prices for hoops for home consumption were £7 per ton at the works ; but export sorts were slightly less. Common bars reached a minimum of £6 10s. to £6 15s. There were various quotations from this figure up to £7 10s., which is the standard for marked bars. Strips for wrought iron tube-making sold well. Gas strip could not be bought at less than £6 15s.; bedstead strip, £7 ; and thin gauges for best bedstead work from £8 10s. to £9.

Boiler-plate quotations were without alteration upon the basis of £8 10s. as the minimum up to £9 10s. and £10. For sheets, quotations were unchanged upon last week, at £8 to £8 10s. for singles, £9 10s. for doubles, and £11 for latens.

Agents of hematite firms reported this afternoon that great sales were still being made to the Sheffield and other South Yorkshire steel houses, to the west coast steel makers, and also that the United States were buying well. The Carnforth Company's representative stated that during the past three weeks or so his firm had contracted for between 20,000 and 30,000 tons. Hence he declined to quote anything less than 75s., which was an advance of 5s. per ton on three weeks ago. At such a price, however, the brand was altogether out of the market. The general quotation for hematites was 2s. 6d. below this figure. Staffordshire part-mine pigs were quoted at 47s. 6d., and cinder sorts at 42s. 6d. as a minimum.

It was announced in Wolverhampton that next quarter yet another sample of crude iron will be offered upon our local exchanges. The pigs are to come from Melton Mowbray, in Leicestershire, where the Holwell Iron Company has this week put into blast the first one of the half-dozen furnaces which it purposes erecting upon the most modern principles. Their height will be 100ft., and they will be 20ft. in the bosh; Whitwell's patent stoves will be used, and the boilers will be of steel. It is hoped that two more furnaces will have been started in the ensuing three months. The description of pig which the company is intending to produce is something of the Derbyshire quality, but will command, the makers hope, more money by half-a-crown per ton.

The Pearson and Knowles Coal and Iron Company, Limited, of Warrington, has applied in South Staffordshire for puddlers to take the place of others now on strike at the Bewsey Forge. The explanation of the dispute is that at the Durham Forge, belonging to the same company, and at other works in Warrington, the puddlers are supplied with pottery mine for fettling purposes, and are paid at the rate of 7s. 9d. per ton. At the Bewsey Forge, however, the puddlers have hitherto been supplied with one-half mine and one-half calcined cinder for puddling purposes, and have been paid at the rate of 8s. per ton, the extra 3d. being allowed in consideration of the use of the calcined cinder. Now the company have ceased to supply calcined cinder, and most reasonably, have in return asked the men to forego the claim to the additional 3d. per ton hitherto paid for the use of such cinder. The men have refused, and hence the strike. The application of the Staffordshire men was considered at a meeting of the members of the operative section of the South Staffordshire Mill and Forge Wages Board at Wednesbury on Saturday. The following was the resolution come to :—"That we publicly express our unqualified disapproval of the action taken by the Bewsey Forge puddlers, who have elected to come out on strike instead of agreeing with their employers to submit the matter in dispute between them to a properly constituted trade tribunal. It being our opinion that the action taken by the Bewsey Forge puddlers is a blow aimed at the Board of Arbitration existing in connection with the iron trade, we declare such conduct to be unworthy of the growing intelligence of the ironworkers ; and, further, approving as we do of the action taken by the Pearson and Knowles Coal and Iron Company, and knowing that the terms offered by them are fair and just, we recommend puddlers in want of employment to apply at once to the company for situations."

The draft award for a mines drainage rate for underground works in the Old Hill district, to remain in force for the ensuing year, has now been issued by the arbitrators under the Acts. The maximum rates are 3d. per ton on fire-clay and limestone, and 6d. on coal, slack, ironstone, and minerals. But in the case of nine colliery occupiers graduation has been allowed.

The strike in the earthenware trades of the Potteries, of which I spoke the week before last, is still continuing ; but the men are in great straits, and seem to be anxious for a settlement. Much help was expected from the American potters, but as yet only £40 has been received. The large Etruria Works of Messrs. Wedgwood and Sons were opened on Monday, and most of the hands, with the exception of the printers, returned to work on a slight advance. The men are now regretting the loss of the Board of Arbitration, which broke up in the spring, mainly through their neglect.

Dudley has been the first town in the South Staffordshire district to follow the example of Birmingham in the adoption of the electric light. On Tuesday last the Town Council closed with an offer from Messrs. Hammond and Co., of London, to light the Market-place with six electric lamps for twelve months, at a total cost of £180. This is £14 higher than the cost of the present fifty-five gas lamps ; but the electric light will be on every evening throughout the year, whereas the lamps were lighted only eight months. It is somewhat singular that a few minutes before the offer was closed with, the Council had accepted the gift of four large gas-lamps from the Dudley Gas Company.

The trustees of the Earl of Dudley's mines won their case against the Dudley Corporation in the Westminster Court of Appeal on Saturday last. The corporation in laying down sewage mains had to pass over some of his lordship's mines, and claimed, under the Public Health Act, that the mining should be so conducted as not to interfere with the work of the Corporation. The power of the Corporation was called in question by the trustees, although their wishes were complied with; and the case has been in arbitration for some time. The final decision is that the Corporation have the "right of suppport," but that the mine-owner must receive compensation for hindrance to work. The claim of the trustees that mine-owners in such cases were liable to compensation for percolation from the sewers into the mines was negatived. £1100 has already been paid to his lordship as compensation for support, in accordance with the judgment of lower courts; and Saturday's decision secures to him another £1500.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE heavy trades are unchanged from last week. Iron is still in exceptional demand, and most of the firms and companies in this district are very actively employed, and they are taking orders somewhat reluctantly in the face of a rising market. The Parkgate Iron Company, Limited, has issued its interim report, in which it states that an improvement has recently taken place in "the demand for both pig and finished iron, but the prices still remain very low." The directors, however, "look forward to a steady improvement in the iron trade." The company has now the whole of its six blast furnaces at work, and preparations are being made to start twenty more puddling furnaces in the old rail mill forge. The re-opening of these furnaces, which have been standing about six years, will necessitate the employment of about 130 additional hands. The directors have determined to pay an interim dividend of £5 per cent. Four of the company's shares—£100, £65 paid up—fetched at Sheffield on Tuesday £5 premium.

South Yorkshire makers of pig iron advanced on Wednesday from 43s. to 44s. a ton; special makes of South Yorkshire irons for manufacturing purposes, 44s. to 45s.; sheets, No. 1, have advanced 12s. per ton; boiler sheets are realising £14 to £14 12s. 6d. per ton; webs are selling freely at £5 11s. 6d.; Bessemer blooms are fetching £7 12s. 6d.; Bessemer ingots have run to £5 10s. This was the closing price of Monday. On Tuesday they were £5 12s. 6d., and on Wednesday £5 15s. 6d.

A large order has been secured for steel rails, at £6 7s. 6d. for ordinary sections, and 10s. per ton extra for "curved."

Another heavy order has been booked for light ship plates at £9. Foreign Bessemer ingots, on the fortnight's transactions, show an advance of 10s. per ton, and this makes a rise of £1 per ton on the two months.

Fresh disputes in the coal trade are reported. At Barnsley Messrs. Frith, Parrott, and Pickard have addressed miners' meetings, where resolutions have been passed demanding advances of wages "proportionate to the improvement in trade and prices placed upon coal." One resolution was to the effect that if the owners did not give an advance in wages the men would join in restricting the output of coal, either by working shorter hours or sending out a less number of tons of coal per man per day, "as we are convinced long hours, over-production of coal, and non-unionism have tended greatly to reduce wages and keep them low, as found at the present time."

For three days the Do Well pit belonging to the Staveley Company was idle. A stoppage of wages was made in the case of the pony drivers, who struck work in consequence. Work has now been resumed. The men are moving for an advance of wages.

The fortune left by the late Mr. Laycock, M.P. for North Lincolnshire, has been divided as follows:—The widow's portion is £9000 a year; her son, the heir, who is now a boy at Eton, has £32,000 a year; the only daughter has a bequest of £10,000. An uncle of the young lady, it is reported, has named her his heiress to the sum of £200,000. All these riches, or nearly all, are the outcome of coal; and the local miners in Nottinghamshire and this district, I am told, are using them as arguments for more wages.

The blast furnaces of Messrs. Wm. Cooke and Co., Limited, have, I hear, been taken by a local firm with the intention of working them vigorously.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—It is somewhat difficult just at present to describe precisely the condition of the iron market here. There is still very little business doing in pig iron, so far as new orders are concerned, but the general activity throughout the chief iron branches of industry, it is felt, must lead to considerable buying before long to cover the actual requirements of consumers, and makers, who have mostly plenty of work in hand for the present, are consequently very firm. On the other hand, iron is being offered in the market at under makers' prices, and the belief appears to be entertained amongst consumers that any further material upward movement in values will be checked by increased production. Inquiries, therefore, which are almost entirely for forward delivery, are only being made on the basis of present prices, and makers who ask for premiums on extended deliveries into next year find very few buyers ready to place out orders on those terms.

Lancashire makers of pig iron are kept fully employed with deliveries under contract, and there is a tendency towards increased stiffness in prices, notwithstanding that very few new orders are at present coming in. For forge iron especially, upon which the demand turns rather than upon foundry, makers are very stiff, and they are now asking the same price for No. 4 as for No. 3, the quotation for both forge and foundry iron delivered equal to Manchester being this week 49s. per ton, less 2½ per cent.

In outside brands prices during the week have been irregular, particularly as regards Lincolnshire and Derbyshire irons. In these brands there has been of late a little easing down as compared with the high prices which makers were asking when they had filled up their books about a couple of months back. At the more reasonable figures which have lately been quoted a moderate amount of business has been done, and during the week fair transactions have taken place in Lincolnshire iron on the basis of 48s. 6d. to 49s., less 2½, delivered equal to Manchester, with good Derbyshire brands quoted at 50s. to 51s. per ton, less 2½. These figures, however, are now being undersold by second-hand holders, and Lincolnshire iron has been offered at quite 1s. to 1s. 6d. per ton under the figures above quoted. Middlesbrough iron delivered equal to Manchester is quoted at 50s. 3d. per ton net cash, but any transactions in north country iron are for the most part limited to small occasional purchases for special purposes.

The finished iron trade continues in a sound, healthy position. The forges throughout the district are all well employed, and the chief makers in the Manchester, Bolton, and Warrington districts have orders in hand to keep them going for some time to come. The inquiry still coming in is also considerable, both on home accounts and for exports, and with regard to the foreign inquiries, one satisfactory feature is their very general character. From India, Australia, South America, and the United States there are good inquiries, whilst buyers are now endeavouring to place Danube orders for next spring, but these makers do not care to entertain. Prices generally are firm at late rates. Some Wigan district bars have been offered during the week at £6 7s. 6d., but the average quotations are still £6 10s. to £6 12s. 6d. and £6 15s., with hoops at £7 to £7 5s., and sheets at £8 10s. to £8 15s. per ton delivered into the Manchester district.

In the engineering branches of industry trade generally continues to mend steadily. In both the heavy and light trades there is an improvement so far as engineers are concerned, which, although the prices taken are still low, lead up to orders which are gradually filling the various shops with work.

Tool makers engaged in work for marine engineers and shipbuilders are very busy. There is also a good deal doing in locomotive tools, whilst for the general class of tools there is a considerable demand, both for home use and shipment; and this branch of trade may be said to be active throughout. Locomotive builders in this district are also tolerably well employed.

The principal boiler makers report a considerable amount of work in hand, which in some cases is keeping them constantly on overtime to complete orders.

I understand that a company has just been floated, with a nominal capital of £100,000, to take over the ironworks erected some time back at Wigan by Mr. Thomas Gedlow, and to work that gentleman's patent rocking furnaces. The Gedlow Iron and Coal Company is the name by which the new company will be known.

Of the thirteen claims which have been heard during the year under the Employers Liability Act, the most important was the case of the "Widow of William Owens *v.* Messrs. Maudslay, Sons, and Field," decided last month in the Southwark County-court, when damages to the amount of £182 were awarded by the jury. The result of this case has given rise to a considerable amount of feeling as to the justice of the decision, and the Iron Trades Employers' Association, by whom the defence was undertaken, has just issued from its offices in Manchester a full report of the trial, illustrated with diagrams which explain the technical portion of the evidence upon which the case was based. The report forms a book of some seventy pages, and is issued by order of the Executive Committee for the information of the members of the association, but it contains a mass of evidence which is of interest to the engineering trades generally.

The month just closed has been one of a most exceptional character so far as the coal trade is concerned. The unusual mildness of the weather during the whole of November, coupled with the fact that consumers had previously for the most part covered their requirements, has brought about such a collapse in the house coal trade that within a few weeks of Christmas there has been actually less doing than during the summer months, and there is the extraordinary sight of pits on short time, and stocks are accumulating both at the collieries and in the yards. The better classes of round coal have been quite a drug, and where sales have been pushed concessions have been necessary, but the colliery proprietors generally are holding for late rates, and although the market is unquestionably easier, quoted rates are without change. The absence of demand for house-fire consumption has, of course, also thrown more of the common classes of round coal upon the market, but for these there is still a tolerably good demand for iron-making and steam purposes, and engine classes of fuel also move off tolerably well. The average prices at the pit mouth remain at about 10s. for best coal, 8s. to 8s. 6d. for seconds, 6s. 6d. to 7s. for common coal, 4s. 9d. to 5s. for burgy, 3s. 9d. to 4s. 3d. for good slack.

The shipping trade continues only dull, and the depression in the home trade has caused a pressure to sell for shipment with the result that prices have shown rather a downward tendency. Steam coal delivered at the high level Liverpool is offered at 7s. 6d. to 8s., and at Garston about 7s. 9d. to 8s. 3d. per ton.

For coke there is a fair demand at about late rates.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market, held in Middlesbrough on Tuesday last, was firm in tone, and it seems clear that confidence in the future is on the increase. Politics, which used a few years since to have so great an affect upon the prices of iron as of other goods, now seem to have no effect whatever. Business men of all shades of opinion tacitly take it for granted that peace will reign throughout the civilised world for a long time to come, and that trade will not be hindered by war at all events. Even the deplorable condition of Ireland is not taken into account in estimating the future course of trade, which it is universally believed will grow and flourish in spite of all that Fenianism and lawlessness can do to stop it.

There has been a good deal of anxiety to buy on the part of consumers, who believe that prices will not go lower, but makers are very chary about selling, especially for forward delivery. The principal business done passes, therefore, through the hands of merchants. The price of No. 3 g.m.b. was on Tuesday 41s. 9d., f.o.b. Middlesbrough; warrants could be had at 42s., and forge iron at 40s. 9d.

The recent open weather has been very favourable for shipping, and more iron has been exported than could fairly have been expected for the time of year. The statistics showing the make for November, and the stocks at the end thereof, will be published during the week, and it is expected they will show a considerable diminution of the quantity held. Connal's stocks continue to decline, there being 1592 tons less than last week, leaving a total of 174,882 tons. Ironfounders complain that there is a lull in the demand for their specialities, and that they still cannot make any profit. The manufactured iron trade is brisk, the weight of new orders booked being still considerably in excess of what is run off week by week. Plates have advanced 5s. per ton, and bars and angles are certain to follow. The following may be taken as the present market prices, viz.:—Ship plates, £6 15s.; angles, £6 2s. 6d.; bars, £6 5s.; puddle bars, £4 2s. 6d., all delivered Middlesbrough, less 2½ per cent.

The steel trade continues very active, with a tendency to higher prices.

The coal trade partakes of the general firmness, an average rise of 6d. per ton having taken place for manufacturing, and 1s. per ton for household qualities.

Purple ore is rather weaker in price, owing to second-hand holders being forced to sell. The price for favourite brands delivered Middlesbrough is about 18s. per ton.

The shipbuilders are having a fine time of it. Everything at the moment seems to be in their favour—cheap material, moderate labour, plenty of orders, good prices, and it may be added, plenty of shipwrecks to pave the way for new work. The French are buying shipbuilding iron rather largely, and all their orders seem to be placed in Cleveland. The iron which has been delivered to and worked by them from that locality has, so far, given great satisfaction.

Messrs. Westgarth and Co., who recently purchased the East Yorkshire Ironworks at Middlesbrough, have already commenced operations, and are about to build a pair of engines and a boiler. The Tees-side Iron and Engineering Company is also actively pushing on its preparations for starting its bar and angle mills, and are buying the materials they will require for this purpose.

Mr. Wm. Pearson, now general manager of Abbot and Co.'s works at Gateshead, is going shortly to leave that position and become the London representative of the Tees-side Company.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE favourable nature of the bank return had a good effect upon the Glasgow iron market towards the close of last week. For some days previously the prices were slackening, but they then took an upward turn, which has been on the whole pretty well maintained this week. The speculative business done in warrants has been principally confined to transactions between some of the larger operators, the outside public taking very little interest at present in the market. The demand for makers' iron for home consumption is large and steady. There has, however, been less inquiry from abroad, and particularly on American account. The shipments of pig iron for the past week have been comparatively small, chiefly on account of the severe weather, amounting to only 7131 tons as compared with 11,153 in the preceding week and 8062 in the corresponding week of 1880. The falling off in the foreign demand has had the effect of sending more pig iron into store, upwards of 3000 tons having been placed this week in Messrs. Connal and Co.'s stores, which now contain fully 620,000 tons.

Business was done in the warrant on Friday morning at from 51s. eight days and 51s. 1½d. one month to 50s. 10d. cash, and in the afternoon at 50s. 9d. to 50s. 6d., again recovering to 50s. 10d. at the close. On Monday the market recovered considerably, business being done at 50s. 10d. to 51s. 1d. cash and 51s. to 51s. 4d. one month, while the quotations in the afternoon were from 51s. to 51s. 3½d. cash and 51s. 2½d. to 51s. 6d. one month. Tuesday's market was strong, with a fair business up to 51s. 6d. cash. On Wednesday the market was firm, with a good business up to 51s. 9d. cash and 52s. one month. The market was also strong on Thursday, at 51s. 5d. to 51s. 9d. cash, and 51s. 11d. one month.

The large demand for makers' iron for home consumption has kept the prices steady, and the quotations are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1. 59s. 6d.; No. 3, 52s.; Coltness, 60s. and 53s.; Langloan, 61s. 6d. and 53s. 6d.; Summerlee, 59s. 6d. and 51s. 6d.; Calder, 59s. and 52s. 6d.; Carnbroe, 53s. and 50s. 6d.; Clyde, 52s. and 49s.; Monkland, Quarter and Govan, ditto ditto; Shotts at Leith, 60s. and 53s.; Carron at Grangemouth, 53s. 6d. (specially selected, 56s.) and 52s. 6d.; Kinneil at Bo'ness, 50s. 6d. and 49s. 6d.; Glengarnock at Ardrossan, 53s. and 50s. 6d.; Eglinton, 52s. and 48s.; Dalmellington, 52s. and 48s. 6d.

Up to the present date the shipments of pig iron from Scotch ports amount for the year to 528,600 tons, as compared with 618,346 tons at the same time last year. The imports of Middlesbrough and Cleveland iron have been larger than last year, showing a present increase of 36,695 tons.

The imports of Spanish ore have of late been smaller than usual, and arrivals have been much impeded by the tempestuous weather at sea. The same state of matters has also told upon the export trade in iron manufactures, the consignments of machinery, rails, &c., during the past week have been smaller than usual.

There is a gratifying continuance of activity in the manufactured iron trade; prices of malleable iron, which were advanced 5s. per ton last week, are reported to be well maintained. The foundries are very busy, and additional contracts are in the market for locomotives. The cast iron pipe makers are likewise fairly active, and the manufacturers of tubes have more work than they can accomplish. In the hardware trade there has been rather less doing, as is usual towards the close of the year, except in the case of shipbuilding furnishings, which are in active demand. There is a full inquiry for rails.

Since last report the volume of the coal trade has very materially contracted, a great fall having taken place in the shipment in consequence partly of the bad weather; still, the clearances compare favourably with those of this time last year. At the collieries miners have for the most part been working steadily at full time, and in many places large banks are accumulating at the pit-heads. The home consumption of coals is somewhat unsatisfactory, and in some cases prices are a shade easier.

The coalmasters of Lanarkshire held a meeting early this week, at which they reconsidered the wages question. The employers of the Hamilton district urged the necessity of deducting sixpence per day from the wages of the miners; but the other masters could not agree to do this, and it is believed that Hamilton colliery owners will endeavour to carry out the reduction by themselves.

In the Glasgow district the miners are endeavouring to restrict their work to eight hours per day, and in Fifeshire the men are working only five days per week.

The first annual report of the Walkinshaw Oil Company, Limited, intimates a dividend of 5 per cent., and states that the works of East Fulton have been in full operation, while considerable progress has been made with the opening up of the shale minerals at Walkinshaw. The directors have resolved to erect manufactories upon the property of the Duke of Abercorn, with whom they have arranged a satisfactory lease of ground for the works.

The electric light has been introduced into the sorting room in the Edinburgh General Post-office.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

As I anticipated and stated in this column, the end of the recess will show that Wales is going in for most spirited railway and dock enterprise. I do not remember so many substantial enterprises on foot. First in importance is the Cardiff Dock. This is to abandon the proposed sea wall for reclaiming the Cardiff Flats, the cut or junction joining Roath Dock, and railways to connect, and instead to construct another sea wall, an extensive dock, and a cut or junction lock, and make and maintain four railways in connection. This completed, will give to Cardiff all the dock accommodation it can require, even at a much greater output of coal than now exists.

Then there is the Newport Dock Company and negotiations with Sir George Elliott. The company first offered the Great Western Company to carry out extensions, and this being refused, overtures were made to the Alexandra Dock Company. Now the offer has been made to Sir George Elliott, who proffers certain terms for one-half, as follows:—£40 for first preferential; £12 for the second; and £12 10s. for the original shares. Then there are the various railways, the Great Western for a new line into Merthyr; Taff Vale for a line, and Rhymney for another.

What with railway enterprises and the satisfactory state of the staple trades, Wales now enjoys a much more prosperous condition than it has known for some years. Both the iron and coal trades are marked by a steadiness and hopefulness that can but be regarded as satisfactory to owners and buyers. There is a fair even track pursued, with none of the old and deceptive bounds, and if one day a tendency is given in the coal trade towards a lowering price, it is soon seen to be caused by exceptional incidents, and firmness is regained. Last week, for instance, there was an accumulation of coal at the docks, on account of the tempestuous weather, and buyers were talking freely of falling prices, which I need not add were not realised. Prices remain very firm, and may be expected to improve. Increased docks and additional railways will lead on to larger outputs, but not I think to any more backward movement in price for best varieties.

The total coal exports last week were about 120,000 tons.

The formal opening of a new tramway at Cardiff took place last week, connecting Iplollands and Lower Grange Tom.

Some more engineering work is opening out at Pontypridd, as it is the intention to embark there in an extensive course of sewerage.

A good deal of interest has been shown during the week in the Board of Trade enquiry at Cardiff into the abandonment of the s.s. Matthew Curtis. The result has been the suspension of the master's certificate. The vessel was stranded on the African coast, and on the approach of natives they were fired upon and the vessel abandoned. The evidence brought to bear was in a measure to prove that the natives were very amicably disposed towards the English.

Serious damage to shipping and hindrance to trade have resulted from the late storms. Vessels were driven in all directions upon the Welsh coast, or forced back into Penarth roads. I am glad to see that the French coal trade is improving. Larger freights than ordinary are being paid so as to insure quick deliveries, and a fair winter trade is secured.

Blaenavon is to have a new series of coke ovens of the Coppée patent. This will place Dowlais, Rhymney, and Blaenavon in the same category. Rhymney is in full activity, and the new mill for blooms works well. £370,000 are to be raised for fresh and hopeful additions. Swansea is well occupied with patent fuel; 3000 tons were despatched last week, and in coal and metal the port is well placed. Large rail orders are under negotiation, and in tinplate more business has been done, though the make is not steady. Makers are somewhat incommoded, too, by the rise of tin bars, which necessitate a corresponding advance.

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 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.

22nd November, 1881.

5091. Generating Heat, H. Defty, Middlesbrough.
5092. Looms, J. Holding, Wheelton.
5093. Traverse Motions, T. White, jun., Headingley.
5094. Brake Blocks, I. A. Timmis, London.
5095. Bricks, &c., W. R. Lake.—(*W. W. Potts, U.S.*)
5096. Electrical Commutators, W. R. Lake.—(*F. Blake, Weston, U.S.*)
5097. Folding Bedstead, &c., A. J. Boult.—(*O. Guinchard, Geneva.*)
5098. Heating Apparatus, T. F. Harvey, Dowlais.
5099. Harvesting Machines, W. P. Thompson.—(*C. H. McCormick, Chicago, U.S.*)
5100. Rotary Engines, J. Patten, San Francisco, U.S.
5101. Heels for Boots, &c., A. Steenberg.—(*A. H. Christensen and G. Lund, Denmark.*)
5102. Lead, &c., Holders, J. H. Johnson.—(*J. Reckendorfer, New York, U.S.*)
5103. Distilling Water, E. Wimshurst, London.
5104. Electric Batteries, A. M. Clark.—(*G. Fournier, France.*)
5105. Taps, W. Rose, Halesowen.
5106. Velocipedes, W. E. Price and W. D. Overton, Hampton Wick.
5107. Horseshoes, E. Kimber.—(*L. Bellamy, Canada.*)
5108. Cutting Paper, E. Edwards.—(*H. Gamichon, Paris.*)

23rd November, 1881.

5109. Vacuum Brake, J. Gresham, Salford.
5110. Motive Power, R. Hallewell, Blackburn.
5111. Water Fittings, J. R. Hargreaves, Haslingden.
5112. Filter Blocks, C. Abel.—(*F. Kleeman, Germany.*)
5113. Velocipedes, W. T. Eades, Birmingham.
5114. Jacquard Machines, A. Place, Macclesfield.
5115. Looms, R. S., E., and R. Collinge, Oldham.
5116. Incandescent Burners, H. J. Haddan.—(*W. M. Jackson, Providence, U.S.*)
5117. Metrical Carburetters, H. J. Haddan.—(*W. M. Jackson, Providence, U.S.*)
5118. Roads, &c., H. J. Haddan.—(*J. Salvat, France.*)
5119. Comb Cleaner, H. J. Haddan.—(*H. Ullrich, Leipzig, Saxony.*)
5120. Scarves, &c., A. Lemay, London.
5121. Folding Chairs, L. Field, Birmingham.
5122. Iron, &c., J. C. Bromfield, Brighton.
5123. Vacuum Brakes, J. A. F. Aspinall, Inchicore.
5124. Tip Vans, &c., E. Hora, London.
5125. Screw Spanners, H. Waters, sen., and A. Vickerstaff, Birmingham.
5126. Hermetical Voltaic Pile, R. H. Brandon.—(*C. A. Nyström, Paris.*)
5127. Setting, &c., Printing Types, S. Pitt.—(*H. A. Burr, New York, U.S.*)

24th November, 1881.

5128. Heels of Boots, &c., W. Reid, Bristol.
5129. Umbrellas, &c., R. H. Brandon.—(*J. P. d'Aragon, Paris.*)
5130. Optical Instrument, R. F. Woodford, Norwood.
5131. Sewing Machines, J Imray.—(*A. Boisard, Paris.*)
132. Temples for Looms, W. R. Lake.—(*La Société de Tassigny Frères et Cie., Reims.*)
5133. Printing, A. J. Boult.—(*J. Mössmer, Vienna.*)
5134. Spinning Wool, &c., W. T. Emmott.—(*E. Appenzeller, Mulhouze, Germany.*)
5135. Spinning Machinery, F. Ripley and T. H. Brigg, Bradford.
5136. Stays, &c., D. Davies, London.
5137. Pumping Apparatus, A. M. Clark.—(*C. W. Cooper, Brooklyn, U.S.*)
5138. Tram-car Brakes, H. Betteley, London.
5139. Tricycles, &c., F. Beauchamp, Edmonton.
5140. Signalling Apparatus, H. C. Brown and H. A. C. Saunders, London.
5141. Hatching Eggs, C. E. Hearson, London.
5142. Warming, &c., Apparatus, L. A. Groth.—(*C. Ostlund, Stockholm.*)
5143. Fire-arms, T. W. and H. Webley, Birmingham.
5144. Blasting Rock, &c., E. Edwards.—(*E. Wickersheimer and L. Pech, France.*)
5145. Artificial Parchment, &c., C. Weygang, South Hornsey

25th November, 1881.

5146. Penholder, W. Hampton, Busby, and W. H. Gray, Partick.
5147. Lamps, J. Darling, Glasgow.
5148. Perambulators, &c., T. Steen, Ripley.
5149. Velocipedes, W. H. J. Grout, London.
5150. Vessels, J. Imray.—(*W. Kowalevsky, Moscow.*)
5151. Solitaires, &c., A. B. Furlong, London.
5152. Bobbins, &c., J. H. and L. Wilson, Cornholme.
5153. Slipways, J. Thompson, Newcastle-on-Tyne, and G. Cooper, Penarth.
5154. Bottle, &c., Stoppers, H. Barrett, London.
5155. Mineral Substances, T. H. Cobley, Dunstable.
5156. Rotary Engines, A. Brossard, Swansea.
5157. Tool, J. McClure, Belfast.
5158. Indicating Apparatus, A. Turner, Worcester.
5159. Galvanic Batteries, R. E. B. Crompton and D. G. Fitz-Gerald, London.
5160. Coal-cutting, J. R. Bower, Moor Allerton, A. Pflaum, Potternewton, and J. T. Tannett, Leeds.
5161. Ribbed Hose, &c., W. Raven, Leicester.
5162. Ventilating Buildings, F. Lönholdt, London.

26th November, 1881.

5163. Two-wheeled Carriages, J. M. Stuart, London.
5164. Lawn-tennis Poles, E. Haskell, London.
5165. Dislodging Apparatus, T. H. D. Voss, London.
5166. Sewing Machines, H. J. Haddan.—(*D'A. Porter and T. H. White, Cleveland, U.S.*)
5167. Woollen Fabrics, H. A. Bonneville.—(*A. L. Pollet, Roubaix, France.*)
5168. Screw Buttons, E. A. Brydges.—(*B. Fischer, Stuttgart.*)
5169. Speed Regulator, W. W. Girdwood, London.
5170. Drawing, &c., Frames, R. Andrews, Bessbrook.
5171. Brewing, A. Kinder, London.
5172. Water-closets, C. Pieper.—(*R. Henneburg and A. Herzberg, Berlin.*)
5173. Engines, W. A. Barlow.—(*G. Ritz and A. Nebele, Gmünd, Germany.*)
5174. Washing, &c., Fabrics, L. Webster, Dewsbury.
5175. Speed Recorder, D. Young, London.
5176. Steam Boilers, J. Harrison, Jarrow-on-Tyne.
5177. Reproducing Views, B. C. Le Moussu, London.
5178. Engines, J. Shaw, Hightown.

28th November, 1881

5179. Rendering Harmless Fire-damp, &c., D. R. Jenkins and G. Treharne, Aberavon.
5180. Washing Machines, T. Bradford, Manchester.
5181. Artificial Light, R. Simmonds, Glasgow.
5182. Boilers, W. Mather, Newark-on-Trent, C. Cousins, Lincoln, and H. Wurr, London.
5183. Purifying Water, P. Spence, Manchester.
5184. Knobs, E. W. Buller, Birmingham.
5185. Lamps, E. G. Brewer.—(*A. G. Waterhouse, U.S.*)
5186. Sewing Machines, M. H. Pearson, Leeds.
5187. Looms, R. and R. Vickers, Burnley.
5188. Looms, J. Bullough, Accrington.
5189. Potteryware, J. Roberton, Glasgow.
5190. Securing Knobs, &c., G. Harper, London.
5191. Heating Appliances, A. C. Henderson.—(*C. G. Masson-Roigueau, Paris.*)
5192. Gun Barrels, W. C. Stiff, Birmingham.
5193. Pulleys, &c., W. H. Price, Wrexham.
5194. Pen, F. Wirth.—(*E. Spindler, Chemnitz.*)
5195. Gas Regulators, J. Ungar, London.
5196. Cocks and Valves, D. R. Ashton, Clapton, and J. N. Sperryn, Brixton.
5197. Malleable Iron, W. R. Lake.—(*G. Beales, U.S.*)
5198. Electric Currents, C. H. W. Biggs and W. W. Beaumont, London.
5199. Disinfecting Composition, A. M. Clark.—(*P. Schlosser, Paris.*)
5200. Gas-burners, W. Snelgrove, Melksham.

Inventions Protected for Six Months on deposit of Complete Specifications.

5116. Incandescent Burners, H. J. Haddan, Kensington, London.—A communication from W. M. Jackson, Providence, U.S.—*23rd November*, 1881.
5117. Metrical Carburetters, H. J. Haddan, Kensington, London.—A communication from W. M. Jackson, Providence, U.S.—*23rd November*, 1881.
5127. Setting, &c., Printing Types, S. Pitt, Sutton.—A communication from H. A. Burr, New York, U.S. —*23rd November*, 1881.
5137. Pumping Apparatus, A. M. Clark, Chancery-lane, London.—A communication from C. W. Cooper, Brooklyn, U.S.—*24th November*, 1881.

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

4366. Propellers, F. A. Whelan, Walterton-road, Paddington, London.—*29th October*, 1878.
4755. Treating Copper Ores, T. H. Cobley, Dunstable. —*22nd November*, 1878.
4761. Heating Apparatus, R. R. Gibbs, Liverpool.—*22nd November*, 1878.
5018. Elastic Compound, J. Burbridge, Tottenham.—*7th December*, 1878.
5116. Drain Ploughs, R. Knights, Harleston.—*13th December*, 1878.
4778. Ornamental Pile Fabrics, J. S. Templeton, Glasgow.—*23rd November*, 1878.
4773. Dating Stamps, G. K. Cooke, Fleet-street, London.—*23rd November*, 1878.
4787. Bending Corrugated Metal, C. F. Elliott and J. Bayley, Liverpool,—*25th November*, 1878.
4804. Manure, I. Brown, Edinburgh.—*26th November*, 1878.
4847. Electric Lamps, F. J. Cheesbrough, Water-street, Liverpool.—*28th November*, 1878.
4856. Fabrics, E. A. Lheureux, Boulevard St. Denis, Paris.—*28th November*, 1878.
4876. Weavers' Harness, W. R. Lake, Southampton-buildings, London.—*29th November*, 1878.
5006. Tramways, H. Ciotti, Bois Colombes, Paris.—*6th December*, 1878.
4794. Safety Fuse, A. Lanyon, Redruth.—*25th November*, 1878.
4814. Tramways, &c., W. L. Thompson and C. C. Rogers, London.—*26th November*, 1878.
4852. Producing Luminous Effects, J. N. Aronson, Bedford-row, London.—*26th November*, 1878.
4900. Water-meters, W. R. Lake, Southampton-buildings, London.—*30th November*, 1878.
4913. Water-closets, S. S. Hellyer, Newcastle-street, London.—*2nd December*, 1878.
4940. Table Cutlery, J. N. Mappin, Mansion House-buildings, London.—*3rd December*, 1878.
4818. Sliding Tables, F. H. F. Engel, Hamburg.—*26th November*, 1878.
4826. Children's Chair, J. W. Benn, City-road, London.—*27th November*, 1878.
4839. Stopping Bottles, &c., D. Rylands, Ardsley.—*27th November*, 1878.
4849. Valve Seats, H. J. Haddan, Strand, London.—*28th November*, 1878.
4858. Suspenders, H. J. Haddan, Strand, London.—*28th November*, 1878.
4854. Filtering Apparatus, P. A. Maignen, Great Tower-street, London.—*28.th November*, 1878.

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

3999. Grate-backs, G. L. Shorland, Stretford-road, Manchester.—*21st November*, 1874.
4175. Carbonates of Soda, L. Mond, Northwick.—*4th December*, 1874.
4094. Extracting Apparatus, G. W. Risien, Water-street, Liverpool.—*30th November*, 1874.
4012. Safety Apparatus, H. A. Davis, Appleby-road, Dalston.—*24th November*, 1874.
4174. Reaping, &c., Machines, R. Hornsby, J. E. Phillips, J. Innocent, and G. T. Rutter, Grantham. —*4th December*, 1874.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 16th December, 1881.

3155. Fog Signals, A. Kelday, London.—*20th July*, 1881.
3159. Shaving Apparatus, L. A. Groth, London.—Com. from A. C. T. Adam.—*26th July*, 1881.
3163. Vacuum Apparatus, F. H. F. Engel, Germany. —A communication from Niederberger and Co.—*20th July*, 1881.
3166. Electric Lamps, W. Morgan-Brown, London.—Com. from G. P. Harding.—*20th July*, 1881.
3167. Perforating Cheques, &c., R. Donkin, London. —*20th July*, 1881.
3170. Cooling, &c., Air, R. R. Gibbs, Liverpool.—*21st July*, 1881.
3172. Sounding Machines, &c., T. Bassnett, Liverpool. —*21st July*, 1881.
3180. Tricycles, J. G. Smith, Russell-street, Eccles.—*21st July*, 1881.
3186. Speed Governors, M. Havelock, Newcastle-upon-Tyne.—*21st July*, 1881.
3187. Electric Lamps, W. R. Lake, London.—Com. from J. V. Nichols.—*21st July*, 1881.
3189. Electric Lamps, W. R. Lake, London.—A communication from H. S. Maxim.—*21st July*, 1881.
3191. Rubber-faced Metal Type, G. K. Cooke, London.—*22nd July*, 1881.
3192. Rolling Leather, E. Wilson, Exeter.—*22nd July*, 1881.
3194. Scissors, G. G. M. Hardingham, London.—*22nd July*, 1881.
3199. Combination Carriage, J. N. Rowe, Rockland, U.S.—*22nd July*, 1881.
3200. Driving Mechanism for Tricycles, A. Burdess, Coventry.—*22nd July*, 1881.
3210. Lighting, &c., Lamps, W. H. Stokes, Birmingham.—*22nd July*, 1881.
3212. Velocipedes, G. Singer, Coventry.—*22nd July*, 1881.
3215. Centrifugal Machines, J. H. Johnson, London. —A communication from La Société dite Raffinierie de St. Ouen.—*22nd July*, 1881.
3255. Waterproof Sleeping Beds, B. Genn, Ely.—*26th July*, 1881
3286. Disinfecting Agent, R. E. Goolden and A. Mackay, Southwark.—*27th July*, 1881.
3298. Sewing Machine, D. Mills, Philadelphia, U.S.—*28th July*, 1881.
3299. Floating Cranes, W. Hunter, Bow-road, London.—*28th July*, 1881.
3399. Intermittent Siphons, A. T. Bean, Cannon-row, London.—*5th August*, 1881.
3491. Flat-headed Nails, G. Klug, Glasgow.—A communication from C. Meier.—*12th August*, 1881.
4202. Electric Lamps, J. W. Swan, Newcastle-on-Tyne.—*29th September*, 1881.
4218. Mineral Pyrites, &c., J. R. Francis, Swansea.—Com. from H. Wurtz.—*30th September*, 1881.
4241. Bone Black, A. W. L. Reddie, London.—A communication from R. A. Chesebrough.—*30th September*, 1881.
4249. Umbrellas, J. Minière, Paris.—*1st October*, 1881.
4284. Distilling Shale, &c., G. T. Beilby, Mid-Calder. —*3rd October*, 1881.
4298. Securing Bolts, W. R. Lake, London.—A communication from G. B. Taylor, J. Wood, and B. S. Clark.—*4th October*, 1881.
4392. Knitting Machinery, S. Fingland, Hawick.—*10th October*, 1881.
4442. Securing Handles, &c., C. Ezard, Manchester. —*12th October*, 1881.
4480. Umbrellas, &c., W. P. Thompson, London.—Com. from M. J. Ganilh.—*14th October*, 1881.
4544. Manufacture of Hyponitric Anhydride, E. Turpin, Paris.—*18th October*, 1881.
4607. Magneto-electric Machines, H. F. Joel, Dalston.—*21st October*, 1881.
4683. Railway, &c., Wagons, R. Hudson, Gildersome. —*26th October*, 1881.
4711. Figured Fabrics, J. Makin and J. E. Johnson-Ferguson, Bolton.—*27th October*, 1881.
4713. Figured Fabrics, J. Makin and J. E. Johnson-Ferguson, Bolton.—*27th October*, 1881.
4797. Telephonic Cables, C. L. Gore, New York, U.S.—*2nd November*, 1881.
4949. Uncoupling Apparatus, C. F. C. Morris and F. H. Bennett. London.—*11th November*, 1881.

Last day for filing opposition, 20th December, 1881.

3148. Steam Engines, W. R. Lake, London.—A communication from D. Renshaw and H. T. Litchfield. —*19th July*, 1881.
3217. Catches for Bracelets, E. P. Wells, London.—*23rd July*, 1881.
3220. Looms, C. T. Bradbury, Buckton, and R. H. Harrison, Dukinfield.—*23rd July*, 1881.
3227. Changeable Lasts, J. Fieldhouse, Keighley.—*23rd July*, 1881.
3259. Funnels, C. D. Abel, London.—A communication from O. Petzold.—*26th July*, 1881.
3261. Glazing Apparatus, T. W. Helliwell, Brighouse. —*26th July*, 1881.
3271. Glasses, &c., A. McLaren, London.—*26th July*, 1881.
3284. Separating Glycerine, F. J. O'Farrell, Dublin. —*27th July*, 1881.
3294. Musical Instrument, W. F. Schmoele and A. Mols, Antwerp.—*27th July*, 1881.
3296. Connectors, &c., E. P. Alexander, London.—Com. from A. J. Violette.—*28th July*, 1881.
3302. Furnaces, C. Pieper, Gneisenau-strasse.—Com. from A. Faber.—*28th July*, 1881.
3305. Displaying Electric Light, Sir C. T. Bright, London.—*28th July*, 1881.
3315. Submerged Propellers, P. Amati, Nice, France. —*30th July*, 1881.
3362. Electric Lamps, J. Hopkinson, London.—*3rd August*, 1881.
3371. Velocipedes, F. Wirth, Frankfort-on-the-Maine. —Com. from P. Praechter.—*3rd August*, 1881.
3379. Drying Apparatus, E. G. Brewer, London.—Com. from F. Stormer.—*4th August*, 1881.
3386. Electric Organ, W. F. Schmoele and A. Mols, Antwerp.—*4th August*, 1881.
3410. Fireproof Documents, J. R. Meihé, London.—Com. from L. Frobeen.—*6th August*, 1881.
3453. Engine, H. A. Bonneville, London.—A communication from F. Roland.—*9th August*, 1881.
3544. Slag Apparatus, E. F. Jones, Middlesbrough-on-Tees.—*16th August*, 1881.
3584. Sulphur, &c., W. Clark, London.—Com. from C. Girard and J. A. Pabst.—*17th August*, 1881.
3600. Taking-off Apparatus, H. T. L. Wilkinson, Clerkenwell.—*18th August*, 1881.
3666. Steam Pipes, W. D. and S. Priestman, Kingston-upon-Hull.—*23rd August*, 1881.
3732. Chemical Processes, A. M. Clark, London.—Com. from A. Michaud.—*26th August*, 1881.
3858. Diffusing Light, J. Wetter, New Wandsworth. —Com. from W. Wheeler.—*5th August*, 1881.
3958. Starch Sugar, P. Jensen, London.—Com. from F. Soxhlet.—*13th September*, 1881.
4125. Combing Wool, J. F. Harrison, Bradford.—*24th September*, 1881.
4171. Portable Hydraulic Cranes, C. R. Parkes, Millwall.—*27th September*, 1881.
4186. German Yeast, G. W. von Nawrocki, Berlin.—Com. from C. Paulmann.—*28th September*, 1881.
4197. Umbrellas, J. Minière, Paris.—*29th September*, 1881.
4257. Gas-heating Stoves, J. Wadsworth, Manchester. —*1st October*, 1881.
4268. Traction Engines, W. Wilkinson, Wigan.—*1st October*, 1881.
4332. Mortise Locks, E. de Pass, London.—Com. from A. H. Elliott.—*5th October*, 1881.
4334. Street Lamps, A. W. Calvert, Leeds.—*5th October*, 1881.
4342. Gas Stoves, T. Fletcher, Warrington.—*6th October*, 1881.
4366. Brake Apparatus, G. Westinghouse, jun., King's Cross, London.—*7th October*, 1881.
4439. Electric Lamps, J. Jameson, Newcastle-on-Tyne.—*12th October*, 1881.
4456. Furnaces, W. Black, South Shields, and T. Larkin, East Jarrow.—*13th October*, 1881.
4458. Vacuum Pumps, W. H. Akester, Glasgow.—*13th October*, 1881.
4462. Pumping Machinery, J. Gill, Edinburgh.—*13th October*, 1881.
4472. Electric Meter, C. V. Boys, Wing, near Oakham.—*13th October*, 1881.
4515. Cold Air Apparatus, J. Sturgeon, Liverpool, and J. W. de V. Galwey, Warrington.—*17th October*, 1881.
4526. Stoves, P. Everitt, Great Ryburgh, and A. Barnard, Norwich.—*17th October*, 1881.
4531. Colouring Matters, J. A. Dixon, Glasgow.—Com. from C. Kœnig.—*18th October*, 1881.
4552. Dynamo Machines, P. Jensen, London.—Com. from T. A. Edison.—*18th October*, 1881.
4556. Axle Bearings, P. M. Justice, London.—A communication from L. Bastet.—*18th October*, 1881.
4562. Sawing Rails, J. H. Kitson, Leeds.—*19th October*, 1881.
4576. Meters, E. G. Brewer, London.—A communicaten from T. A. Edison.—*19th October*, 1881.
4578. Self-feeding Stoves, W. A. Barlow, London.—Com. from F. Lonholdt.—*19th October*, 1881.
4615. Fastener for Waist Belts, L. Dee, Golden-square, London.—*21st October*, 1881.
4616. Drying Apparatus, M. E. G. Finch-Hatton, Haverholme Priory, and R. Thorpe, Evedon.—*21st October*, 1881.
4673. Mixing Machinery, J. Melvin, Glasgow.—*25th October*, 1881.
4676. Wire Ropes, J. Hodson, St. Helens.—*25th October*, 1881.
4686. Knitted Fabrics, J. Imray, London.—A communication from O. Viett.—*26th October*, 1881.
4720. Freezing Apparatus, J. Chambers, New Zealand.—*28th October*, 1881.
4733. Carriages in Twist Lace Machines, J. R. Hancock and W. Smith, Nottingham.—*29th October*, 1881.
4760. Facilitating the Removal of Yeast, P. Smith, Sevenoaks.—*31st October*, 1881.
4776. Cartridge Cases, G. Kynoch, Witton, near Birmingham.—*1st November*, 1881.
5004. Securing Tubes, W. R. Lake, London.—Com. from J. A. Reed.—*15th November*, 1881.
5116. Incandescent Burners, H. J. Haddan, London. —Com. from W. M. Jackson.—*23rd November*, 1881.
5117. Metrical Carbureters, H. J. Haddan, London. —Com. from W. M. Jackson.—*23rd November*, 1881.
5127. Setting, &c., Type, S. Pitt, Sutton.—A communication from H. A. Burr.—*23rd November*, 1881.
5137. Pumping Liquids, A. M. Clark, London.—Com. from C. W. Cooper.—*24th November*, 1881.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 25th November*, 1881.)

2340. Screw Propellers, T. Turton and G. Allibon, Liverpool.—*27th May*, 1881.
2354. Pump, &c., for Petroleum Lamps, B. B. Schneider, Orange, U.S.—*28th May*, 1881.
2359. Filtering Apparatus, J. F. N. Macay, Chancery lane, London.—*28th May*, 1881.
2363. Cleaning Milk Vessels, S. J. Pocock, Vauxhall —*30th May*, 1881.
2367. Water Meters, J. C. Dennert and G. G. Lind, Altona.—*30th May*, 1881.
2368. Hand Carts, A. Specht, Hamburg.—*30th May*, 1881.
2372. Actuating Signals, B. C. Scott, Regent's Park, London.—*30th May*, 1881.
2392. Harrow, J. McKinley, Coleman-street, London. —*31st May*, 1881.
2403. Paint, &c., D. Brown, Falmouth, and R. Mitchell, Combe Hill, near Devoran.—*31st May*, 1881.
2408. Forcing Water, &c., A. Clark, Lancaster-gate, London.—*31st May*, 1881.
2431. Railway Signalling Apparatus, T. M. Ford, London.—*2nd June*, 1881.
2434. Looms, G. H. Smith, Manchester.—*2nd June*, 1881.
2453. Roadways, J. Herd, Birmingham.—*3rd June*, 1881.
2456. Axle-boxes, &c., J. Bottomley, Manchester.—*4th June*, 1881.
2509. Roses of Watering Cans, J. Ludlow, Birmingham.—*9th June*, 1881.
2512. Bottle Wrappers, H. J. Haddan, Strand, London.—*9th June*, 1881.
2514. Hatchway Doors, H. J. Haddan, Strand, London.—*9th June*, 1881.
2805. Dead-eyes, &c., H. J. Haddan, Strand, London. —*27th June*, 1881.
2963. Cooling Apparatus, J. T. King, Clayton-square, Liverpool.—*6th July*, 1881.
2998. Pile, &c., A. L. Murphy, Philadelphia, U.S.—*7th July*, 1881.
3619. Purification of Coal Gas, C. C. Walker, Lilleshall, and W. T. Walker, Highgate.—*19th August*, 1881.
3911. Reflectors, J. Wetter, New Wandsworth.—*9th September*, 1881.

(*List of Letters Patent which passed the Great Seal on the 29th November*, 1881.)

528. Sawing Stone, &c., P. Gay, Boulevard St. Denis, Paris.—*7th February*, 1881.
2099. Self-stopping Beaming Machines, S. Cook, sen., Bury.—*13th May*, 1881.
2366. Sewing Machine Covers, F. H. F. Engel, Hamburg.—*30th May*, 1881.
2377. Finings, E. J. T. Digby, Hammersmith, London.—*31st May*, 1881.
2383. Grinding, &c., Surfaces, F. McDonald Robertson, Croydon, and R. R. Gubbins, New Cross.—*31st May*, 1881.
2396. Wire Bed Bottoms, H. Orth, Washington, U.S. —*31st May*, 1881.
2402. Electric Lamps, G. Hawkes, London, and R. Bowman, Ipswich.—*31st May*, 1881.
2406. Ventilators, W. Chrystal, Commercial-road, London.—*31st May*, 1881.
2411. Transmitting Motive Power, J. Aylward, Birmingham.—*1st June*, 1881.
2414. Milanaise, J. A. Sparling, Highgate, London.—*1st June*, 1881.
2421. Musical Instruments, W. E. Evans and R. W. Jarrett, London.—*1st June*, 1881
2429. Hammering Metals, H. Mainwaring, Manchester—*2nd June*, 1881.
2438. Cleaning Cotton Seed, G. Welburn, Grovehill. —*2nd June*, 1881.
2448. Treating Cereal, E. Martin and R. Benns, London—*3rd June*, 1881.
2477. Belt Clasp, A. M. Clark, Chancery-lane, London.—*7th June*, 1881.
2483. Feeding Apparatus, A. C. Henderson, Holborn, London.—*8th June*, 1881.
2511. Horse-rakes, J. Huxtable, Brayford.—*9th June*, 1881.
2513. Bottle Wrappers, H. J. Haddan, Strand, London.—*9th June*, 1881.
2516. Jacquard Machine, J. Brentnall, Mansfield.—*9th June*, 1881.
2531. Breech-loading Small-arms, E. James, Birmingham.—*10th June*, 1881.
2532. Electric Cables, G. E. Gouraud, Lombard-street, London.—*10th June*, 1881.
2534. Section Knives, T. Heiffor, Paradise-square, Sheffield.—*10th June*, 1881.
2545. Frames, F. Wirth, Frankfort-on-the-Main.—*11th June*, 1881.
2555. Water Taps, A. Harvey, Glasgow.—*13th June*, 1881.
2565. Tricycles, E. J. Lewis, Reading.—*13th June*, 1881.
2567. Regulating Apparatus, E. P. Alexander, London.—*13th June*, 1881.
2623. Facilitating Apparatus, I. Bell, F. G. M. Stoney and W. E. Rich, London.—*16th June*, 1881.
2669. Gas Retorts, G. Anderson, Great George-street, London.—*18th June*, 1881.
2683. Tubes, W. E. Everitt, Birmingham.—*18th June*, 1881.
2693. Combing Flax, J. C. Mewburn, Fleet-street, London.—*20th June*, 1881.
2699. Pressing Machines, W. Lorenz, Germany.—*20th June*, 1881.
2709. Copper Caps, W. Lorenz, Germany.—*21st June*, 1881.
2717. Steam Boilers, H. H. Lake, Southampton-buildings, London.—*21st June*, 1881.
2722. Sewing Machines, W. R. Lake, Southampton-buildings, London.—*21st June*, 1881.
2725. Forming Moulds, F. Ley, Derby.—*21st June* 1881.
2739. Distributing Apparatus, H. E. Newton, London.—*22nd June*, 1881.
2773. Spinning Machinery, A. M. Clark, Chancery-lane, London.—*24th June*, 1881.
2783. Kilns, T. Carder, Chudleigh.—*25th June*, 1881.
2792. Carriages, A. E. Dalzell, Pall Mall, London.—*25th June*, 1881.
2821. Supplying Air to Lamps, C. W. Torr, Birmingham.—*28th June*, 1881.
2889. Combination Bed, C. W. Torr, Birmingham.—*2nd July*, 1881.
3035. Metallic Fabric, G. W. von Nawrocki, Berlin. —*11th July*, 1881.
3125. Boilers, W. Allan, Sunderland.—*18th July*, 1881.
3127. Silk-dressing Machinery, A. Greenwood, Leeds. —*18th July*, 1881.
3250. Steam Cooking Apparatus, D. Grove, Berlin.—*25th July*, 1881.
3256. Pumps, H. H. Lake, Southampton-buildings, London.—*26th July*, 1881.
3262. Textile Fabrics, J. Knowles, Mosley-street, Manchester.—*26th July*, 1881.
3275. Engines, R. Ord, Devizes.—*26th July*, 1881.
3301. Lighting Gas, E. B. Burr, Walthamstow.—*28th July*, 1881.
3384. Indicators, J. C. Mewburn, Fleet-street, London.—*4th August*, 1881.
3407. Churns, N. Stewart, Hayward's Heath.—*6th August*, 1881.
3483. Electric Conductors, E. G. Brewer, Chancery-lane, London.—*11th August*, 1881.
3504. Polychromatic Printing, J. R. Meihé, Laurence Pountney-hill, London.—*12th August*, 1881.
3553. Dyeing, G. Jagenburg, Rydboholm.—*16th August*, 1881.
3594. Targets, H. J. Haddan, Kensington, London.—*18th August*, 1881.
3595. Pianofortes, C. Collard, Oval-road, Camden Town, London.—*18th August*, 1881.
3599. Lamps, C. Lever, Bowden.—*18th August*, 1881.

3602. TREATING FRUITS, A. J. M. Bolanachi, Wes Dulwich.—18th August, 1881.
3620. DRESSING ENAMELLED BRICKS, &c., J. Craig, Kilmarnock.—19th August, 1881.
3636. SILK REELS, C. W. Maconchy, Templeogue.—20th August, 1881.
3691. AERIAL NAVIGATION, A. L. Blackman, Southampton-buildings, London.—24th August, 1881.
3826. DUST PANS, E. L. and M. A. Dietz, Oakland, U.S. —2nd September, 1881.
3839. FIRE-G RATES, C. D. Abel, Southampton-buildings, London.—3rd Septem ber, 1881.
3864. NITRO-CELLULOSE, S. Pitt, Sutton.—6th September, 1881.
3876. SEWING MACHINES, W. R. Lake, Southampton-buildings, London.—7th September, 1881.
4004. CASES for PENCILS, W. R. Lake, Southampton-buildings, London.—16th September, 1881.
4019. GENERATING DYNAMIC ELECTRICITY, G. E. Dering, Lockleys.—17th September, 1881.
4041. GLASS BOTTLES, H. Codd, King William-street, London.—19th September, 1881.
4046. CONDENSING HEAT, H. Defty and C. C. Braithwaite, London—20th September, 1881.
4075. WOODEN BOXES, J. Womersley, Norwich.—21st September, 1881.
4110. FIRE-ARMS, H. H. Lake, Southampton-buildings, London.—23rd September, 1881.
4168. GOVERNING APPARATUS, W. P. Thompson, High Holborn, London.—27th September, 1881.

List of Specifications published during the week ending November 26th, 1881.

1669, 10d.; 1689, 4d.; 1692, 6d.; 1719, 6d.; 1728, 1s.; 1766, 6d.; 1772, 6d.; 1773, 6d.; 1774, 2d.; 1777, 2d.; 1779, 2d.; 1782, 2d.; 1783, 6d.; 1784, 2d.; 1786, 4d.; 1787, 1s. 4d.; 1788, 4d.; 1789, 6d.; 1793, 4d.; 1794, 4d.; 1795, 10d.; 1799, 6d.; 1800, 6d.; 1801, 2d.; 1802, 10d.; 1803, 10d.; 1804, 4d.; 1805, 8d.; 1806, 6d.; 1807, 6d.; 1809, 8d.; 1810, 6d.; 1811, 4d.; 1813, 2d.; 1814, 1s.; 1815, 6d.; 1816, 6d.; 1818, 6d.; 1819, 2d.; 1820, 4d.; 1821, 4d.; 1822, 2d.; 1823, 6d.; 1825, 6d.; 1826, 4d.; 1827, 6d., 1828, 4d.; 1829, 4d.; 1830, 2d.; 1831, 2d.; 1832, 2d.; 1834, 6d.; 1835, 6d.; 1837, 6d.; 1838, 2d.; 1839, 2d.; 1840, 6d.; 1841, 2d.; 1842, 6d.; 1843, 2d.; 1846, 1s. 2d.; 1847, 4d.; 1848, 6d.; 1849, 2d.; 1850, 6d.; 1851, 6d.; 1852, 2d.; 1853, 8d.; 1854, 6d.; 1855, 6d.; 1856, 6d.; 1858, 6d.; 1859, 4d.; 1860, 6d.; 1861, 4d.; 1865, 6d.; 1866, 2d.; 1867, 2d.; 1869, 2d.; 1870, 6d.; 1871, 8d.; 1872, 6d.; 1873, 6d.; 1874, 2d.; 1878, 6d.; 1885, 6d.; 1888, 6d.; 1891, 6d.; 1893, 4d.; 1898, 6d.; 1911, 2d.; 1929, 6d.; 1931, 2d.; 1964, 6d.; 1994, 6d.; 2016, 4d.; 2017, 2d.; 2235, 2d.; 2312, 4d.; 2663, 6d.; 3061, 6d.; 3565, 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.

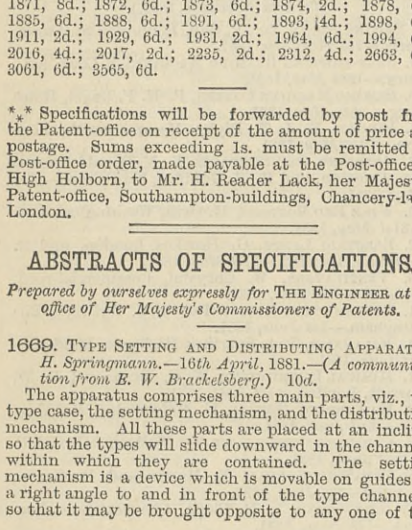
ABSTRACTS OF SPECIFICATIONS.

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

1669. TYPE SETTING AND DISTRIBUTING APPARATUS, *H. Springmann.—16th April*, 1881.—(*A communication from E. W. Brackelsberg.*) 10d.

The apparatus comprises three main parts, viz., the type case, the setting mechanism, and the distributing mechanism. All these parts are placed at an incline, so that the types will slide downward in the channels within which they are contained. The setting mechanism is a device which is movable on guides at a right angle to and in front of the type channels, so that it may be brought opposite to any one of the channels for the purpose of ejecting a type into the composing case which is fixed to it. The distributing mechanism comprises principally a distributing race for the reception of the line or lines to be decomposed, and the parts serving to correct the position of the mechanism, and to eject the front type from the distributing race into the corresponding type channel.

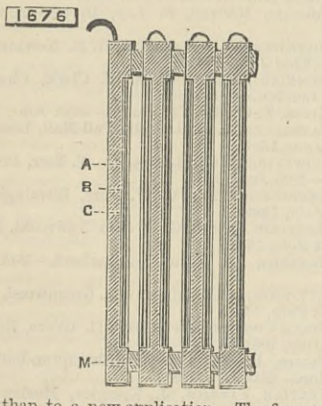
1669



1676. IMPROVEMENTS IN SECONDARY ELECTRIC OR GALVANIC BATTERIES, *J. H. Johnson.—16th April*, 1881.—(*A communication from C. A. Faure.*) 6d.

The patent refers more to the manner of securing the layers of the active substance in the secondary battery than to a new application. The figure shows the form now adopted—A showing the lead plate, B the minium, C the felt; M is a strip of india-rubber to make a good joint so as to make a series of cells.

1676



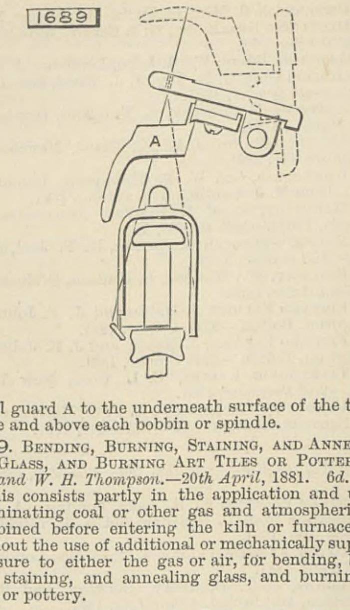
1692. DISTANCE REGISTER FOR CONVEYANCES, *W. Thompson and A. Morten.—19th April*, 1881. 6d.

This consists, First, in the distance registering portion of the apparatus, of the combination of a sprocket or a chain gear, kept taut by riding rollers actuated by a cam gear and levers fixed to the axle-tree with an indicating band and dial, an endless band or chain, or a wheel with figures marked thereon, together with subsidiary apparatus; Secondly, in the distance, stamping, printing, or perforating portion of the apparatus, of the combination of a sprocket or chain gear, kept taut by riding rollers, and actuated by a cam gear and levers fixed to the axle-tree with an issuing and receiving, stamping, perforating, or printing rollers and push levers.

1689. SPINNING AND TWISTING FRAMES, *J. Erskine.—19th April*, 1881. 4d.

This relates to the application and use of a centrifugal guard A to the underneath surface of the thread plate and above each bobbin or spindle.

1689



1719. BENDING, BURNING, STAINING, AND ANNEALING GLASS, AND BURNING ART TILES OR POTTERY, *D. and W. H. Thompson.—20th April*, 1881. 6d.

This consists partly in the application and use of illuminating coal or other gas and atmospheric air, combined before entering the kiln or furnace, and without the use of additional or mechanically supplied pressure to either the gas or air, for bending, burning, staining, and annealing glass, and burning art tiles or pottery.

1728. MANUFACTURE OF BASES OF ARTIFICIAL TEETH, *A. M. Clark.—20th April*, 1881.—(*A communication from J. Duchesne.*) 1s.

This consists essentially in an apparatus for the manufacture of bases for artificial teeth of celluloid, india-rubber, or other plastic material of the construction and arrangement of the flask made in two parts, fitted together with a tongue and groove joint, and arranged in such manner as to permit of producing articles of the same or different colours or materials.

1766. REEL FITTINGS FOR FISHING-RODS, &c., *W. Hardy.—23rd April*, 1881. 6d.

This consists, First, in reel fittings for fishing-rods, comprising a slide guide or double slot for the back of the reel to slide in, provided with a snap action bolt to let the reel in or out at will; Secondly, in the arrangements of the rod section joints, consisting in locking the joints by a hook arrangement wound spirally round the rod.

1772. BOBBINS AND TUBES OF SPINNING MACHINERY, *J. H. and L. Wilson.—25th April*, 1881. 6d.

This consists in strengthening and protecting the bobbins and tubes used in preparing spinning and doubling machinery by the application thereto of their metallic ferules, hoops, and shields.

1773. CONTROLLING THE ACCURACY OF SIGHTING AND AIM IN RIFLE DRILL OR PRACTICE, *R. Morris.—25th April*, 1881. 6d.

This consists, First, in providing an easily attachable and detachable inner barrel to one rifle for enabling very small cartridges to be fired thereby; and Secondly, in providing a screen or target to be placed at a short distance from the men marked with bull's-eyes, and with division lines for indicating the points at which the bullets should pass through with correct sighting and aiming.

1774. DRIVING GEAR OF TRICYCLES, *T. Townsend.—25th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to improvements in driving gear of tricycles by which equal driving power may be transmitted to both the main wheels of such machines, either backwards or forwards, in such a manner that either of the wheels may run faster or slower than the other, in order to give greater facility in turning corners.

1777. JOINTS OF PIPES OR TUBES, *R. Punch.—25th April*, 1881.—(*Not proceeded with.*) 2d.

This relates to a contrivance for connecting two concentric lengths of a system of pipes or tubes by screwing their ends into an apparatus in the same manner as into ferules in ordinary use for such purposes.

1779. SHAPING WOOD, *T. Morgan.—25th April*, 1881. —(*A communication from E. Bahn.*)—(*Not proceeded with.*) 2d.

The object of the invention is a machine for shaping roughly-cut pieces of wood to finely profiled pillars, balusters, &c.

1782. HOT AIR OR CARBONIC ACID ENGINES, *P. Jensen.—25th April*, 1881.—(*A communication from M. Honigmann.*)—(*Not proceeded with.*) 2d.

The leading features of the engine are, the employment of high-pressure, say, four to ten atmospheres; the heating of compressed air by direct influence of this air on the glowing fuel, that is, by direct combustion under pressure, the action of the hot high-pressure gases of combustion mainly by expansive force on the acting piston and the proportioning of the acting piston area to about three times that of the air compressor piston, which corresponds to a temperature of about 600 deg. Cent. (1112 deg. Fah.)

1783. IMPROVEMENTS IN DEVICES FOR MEASURING THE ELECTRIC CURRENTS, &c., *E. G. Brewer.—25th April*, 1881.—(*A communication from T. A. Edison.*) 6d.

This invention is an improvement on patent No. 4391, 27th October, 1881, to which the name "Webermeter" was given, and consists in a device for obviating a rise or fall of temperature in the cells of the apparatus, which would decrease or increase their resistance. To obviate this a metallic resistance, say, of copper, is placed in the shunt circuit, which increases when the temperature rises, while the resistance of the cell diminishes. The resistance, therefore, must be proportioned to that of the cell; for instance, if the latter contains a 20 per cent. solution of sulphate of copper, the copper wire resistance must be three times as great as that of the cell in order that the balance may be maintained between the cells, and the effects of a rise or fall of temperature rendered nugatory.

1784. GRINDING RAGS, &c., *W. Knowles.—25th April*, 1881.—(*Not proceeded with.*) 2d.

The slot in the bracket of rag-grinding and carding machines is curved or formed at the same radius as the swift, so that if the rollers are raised or lowered they do not leave the swift.

1786. PRODUCTION OF SOLID FAT ACIDS FROM OILS OR OLEIC ACID, &c., *F. Wirth.—25th April*, 1881.—(*A communication from A. Müller-Jacobs.*) 4d.

This consists, First, in the transformation of oleic acid, erucа acid, as also of the glycerides thereof into solid fat acids by the reaction of sulphuric acid thereon at low temperatures, and by the decomposition of the sulpho-acid compound produced by means of boiling water; Secondly, to the application of the fat acids to the manufacture of candles; Thirdly, the use of the liquid fat acids for the manufacture of soap and of Turkish red mordants.

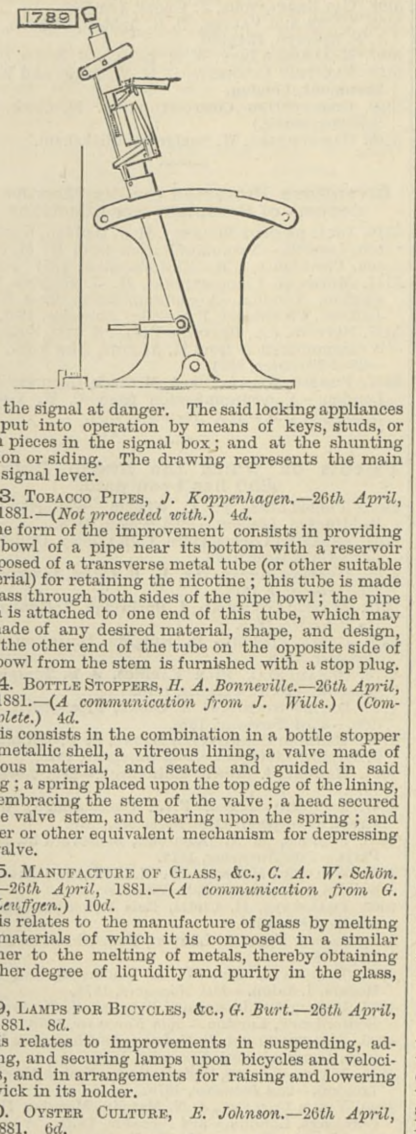
1788. FURNACES FOR BURNING PYRITES, *J. Mason.—26th April*, 1881.—(*Not proceeded with.*) 4d.

This relates to improvements on patent No. 3196, dated 4th August, 1880, and consists partly in means for the more regular feeding and the avoidance of dust.

1789. BLOCK SIGNALS FOR RAILWAYS, *J. W. Fletcher.—26th April*, 1881. 6d.

The lever in the signal box which works the signal, and the lever at the shunting station or siding which actuates the points, are each fitted with locking apparatus of any desired kind capable of being operated by an elastic current. The said locking appliances are so arranged that when the signal lever is free to be moved the point lever is locked in close position, and that when the points are free to be moved the signal lever is locked in position to maintain the signal at danger. The said locking appliances are put into operation by means of keys, studs, or push pieces in the signal box; and at the shunting station or siding. The drawing represents the main line signal lever.

1789



1793. TOBACCO PIPES, *J. Koppenhagen.—26th April*, 1881.—(*Not proceeded with.*) 4d.

One form of the improvement consists in providing the bowl of a pipe near its bottom with a reservoir composed of a transverse metal tube (or other suitable material) for retaining the nicotine; this tube is made to pass through both sides of the pipe bowl; the pipe stem is attached to one end of this tube, which may be made of any desired material, shape, and design, and the other end of the tube on the opposite side of the bowl from the stem is furnished with a stop plug.

1794. BOTTLE STOPPERS, *H. A. Bonneville.—26th April*, 1881.—(*A communication from J. Wills.*) (*Complete.*) 4d.

This consists in the combination in a bottle stopper of a metallic shell, a vitreous lining, a valve made of vitreous material, and seated and guided in said lining; a spring placed upon the top edge of the lining, and embracing the stem of the valve; a head secured to the valve stem, and bearing upon the spring; and a lever or other equivalent mechanism for depressing the valve.

1795. MANUFACTURE OF GLASS, &c., *C. A. W. Schön.—26th April*, 1881.—(*A communication from G. Leuffgen.*) 10d.

This relates to the manufacture of glass by melting the materials of which it is composed in a similar manner to the melting of metals, thereby obtaining a higher degree of liquidity and purity in the glass, &c.

1799. LAMPS FOR BICYCLES, &c., *G. Burt.—26th April*, 1881. 8d.

This relates to improvements in suspending, adjusting, and securing lamps upon bicycles and velocipedes, and in arrangements for raising and lowering the wick in its holder.

1800. OYSTER CULTURE, *E. Johnson.—26th April*, 1881. 6d.

This consists in receiving the spat deposit in covered trays or chambers and there retaining it until sufficiently matured and fit for turning out on the open ground.

1801. PREVENTING RADIATION OF HEAT FROM PIPE AND OTHER SURFACES, *R. Stewart.—26th April*, 1881.—(*Not proceeded with.*) 2d.

The covering as applied to pipes is formed in halves or other sectional parts, and consists essentially of an inner sheet which is placed next to the pipe to be covered, and is made of asbestos, millboard, or other suitable non-conducting sheet material; on the outside of this sheet is fixed one or more longitudinal or other strips or chaplets of tin, wood, or cardboard, and these strips are also fixed to an outer part casing of tin, sheet iron, cardboard, or other suitable smooth and sufficiently strong sheet material; the space intermediate between this outer casing and the inner asbestos millboard casing is fitted with silicate, cotton, or other suitable bad conductor of heat.

1803. PRODUCTION AND USE OF NEW TYPES, &c., *L. Weiss.—26th April*, 1881. 10d.

This relates to the employment of types consisting of grouped letters, or characters and figures.

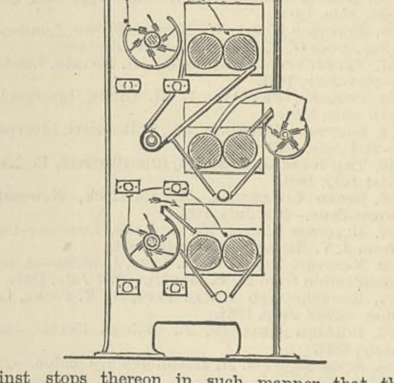
1804. COMPOUND FOR CULTIVATING PLANTS WITHOUT SOIL, *J. Imray.—26th April*, 1881.—(*A communication from A. F. Poullain-Dumesnil.*) 4d.

This relates to the use of a compound consisting of moss mixed with manure for the cultivation of plants.

1805. GRINDING, GRANULATING, OR CRUSHING GRAIN, &c., *H. Seck.* 8d.

This consists in arranging the levers carrying the crushing or grinding rollers, in combination with adjusting spindles and springs pressing the levers against stops thereon in such manner that the spindles adjust the position of the levers and rollers independently of the action of the springs, the tension of which is also adjusted independently of the position of the rollers. The drawing shows a cross section of the mill.

1805



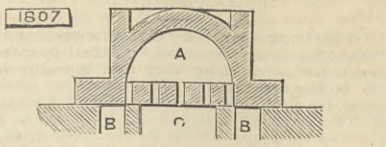
1806. PREPARING AND WELDING TOGETHER LENGTHS OF METAL PIPE, *A. M. Clark.—26th April*, 1881.—(*A communication from H. von Hartz and O. Fix.*) 6d.

This consists in simultaneously cutting off and scarfing or bevelling the male or entering end by rolling a bevel channel around the tube on a mandril, and holding down the metal on each side of the bevel channel to prevent enlargement of the cut ends, then in a second operation cutting and expanding the female end simultaneously by rolling a bevel channel around the tube on a mandril, and allowing the metal on each side of the bevel cut to spread or move freely to permit the cut ends to be expanded by the rolling action of the roll to a diameter large enough to receive the male end.

1807. SLIDE VALVES FOR STEAM ENGINES, *A. M. Clark.—26th April*, 1881.—(*A communication from W. S. Hughes, J. Gregory, and C. J. Howe.*) 6d.

This consists in the combination of a slide valve having exhaust cavity A, and valve seat having ports B, B, C, and the valve face so extended that the exhaust cavity is partially cut off during the movement of the valve.

1807



1809. IMPROVEMENTS IN AND RELATING TO TELEGRAPHIC CABLES OR CONDUCTORS, *W. L. Lake.—26th April*, 1881.—(*A communication from P. C. Delaney.*) 8d.

The object of this invention is to obtain a good insulator for telegraphic cables, which are led through tubes either under or above ground. To effect this the inventor surrounds the wires, which have been drawn through a tube, with dry pulverised talc, which he causes to be blown into sections of the tubes as laid by means of a fan; when the section is almost full it is rammed tight. By another method the inventor surrounds his cable by an outer and inner tube forming two chambers, in the inner of which the conductors are placed, being properly insulated, whilst hot air, hot water, or steam is made to circulate through the outer chamber; or the order may be reversed, and the hot air made to traverse the inner tube, the conductors being laid in the outer one.

1810. COMBINATION GARMENT FOR MECHANICS, &c., *W. R. Lake.—26th April*, 1881.—(*A communication from A. Peschel.*) 6d.

This consists essentially in the combination of an apron bearing a "bib" with a pair of trousers.

1811. TREATING VEGETABLE TEXTILE MATERIALS TO FACILITATE THE DYEING OF THE SAME, *W. R. Lake.—26th April*, 1881.—(*A communication from A. F. J. Bang and C. V. Clolus.*) 4d.

This consists essentially in the transformation of the cellulose of the vegetable materials into a slightly nitrogenised product, capable of being dyed directly by means of colours or dies, which contain nitrogen or azone, such as aniline, soluble indigo, litmus, and the like, or of being employed as a mixture with wool or silk to be afterwards worked up and dyed together with these materials, and to be then utilised in the manufacture of velvets, ribbons, and other fabrics, and for any purposes to which wool and silk are applied.

1813. BRAKE AND SPEED INDICATOR FOR BICYCLES, &c., *H. S. H. Shaw.—27th April*, 1881.—(*Not proceeded with.*) 2d.

According to one modification a rotating weight which moves outwards, and overcomes the resistance of a spring as the speed of the vehicle increases, and shows the velocity by the size of the circle which the weight apparently forms by reason of the retention of impressions on the retina, the circle may be measured by the point at which it appears to cut a properly graduated spiral curve.

1814. BUTTON HOLE SEWING MACHINES, *W. Morgan-Brown.—27th April*, 1881.—(*A communication from J. Reece.*) 1s.

This consists in a button hole sewing machine of the following instrumentalities, viz., a bed plate upon which the material is held; a framework; a reciprocating needle bar, its two needles, one to penetrate the fabrics the other to pass over the edge to be overstitched; and the loop spreader; a looper carrier; and hooked looper, and means to move said framework longitudinally upon said bed plate, and to operate the said spreader and looper carrier and reciprocate the needle bar, whereby the needles descend and the looper engages the loop of the perforating needle below the material and draws it through the loop of the over edge needle, and holds it while the needles are drawn up above the material, and until after the next descent of the needle bar, when the loop of the perforating needle is drawn through its previous loop.

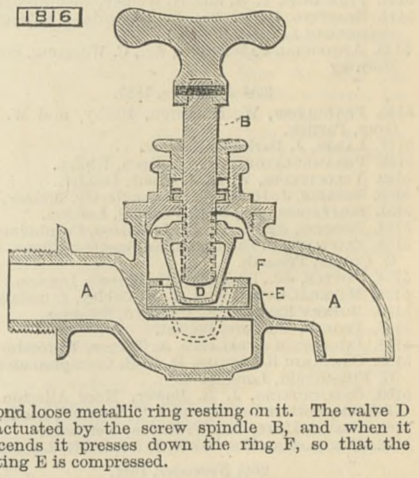
1815. MOULDING WATER-CLOSET CISTERNS, *H. and W. Sutcliffe.—27th April*, 1881. 6d.

A bed-plate is employed supporting a block or core to form the inside of the cistern. The outer portions of the mould are formed so as to leave the required thickness of metal for the cistern, and may be hinged or have holes left for removing same by means of bars after casting.

1816. VALVES AND TAPS, *T. G. Messenger.—27th April*, 1881. 6d.

The valve body A is formed with a cylindrical chamber into which the valve seating E is introduced, and consists of a loose ring of india-rubber with a second loose metallic ring resting on it. The valve D is actuated by the screw spindle B, and when it descends it presses down the ring F, so that the seating E is compressed.

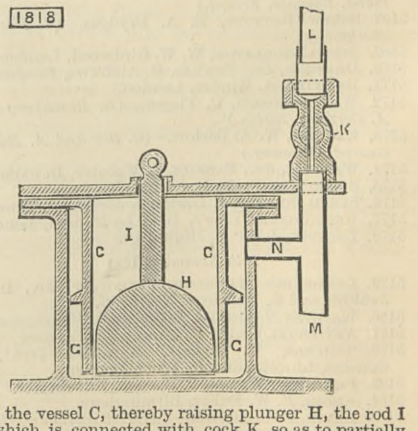
1816



1818. REGULATING FLOW OR PRESSURE OF GASES, &c., *F. W. Clark.—27th April*, 1881. 6d.

The gas entering at L and passing through cock K to outlet M will by means of branch N act upon the surface of mercury contained in space G, forcing it into the vessel C, thereby raising plunger H, the rod I of which is connected with cock K, so as to partially close the same. When the weight falls the cock is again opened.

1818



1819. FURNACE FIRE-BARS, *R. Macpherson.—27th April*, 1881.—*(Not proceeded with.)* 2d.

The apertures in the bars for the air to pass through are made alternate; for example, supposing there are three passages on each side of the bar, there would then be six or more apertures through the bars, according to length.

1820. PREPARATION OF MAGNESIA FOR SEPARATION OF AMMONIA FROM EXCREMENTITIOUS MATTERS, &c., *S. Pitt.—27th April*, 1881.—*(A communication from T. Schloesing.)* 4d.

This consists partly in the manufacture of magnesia by submitting fragments or pellets of lime to the action of a magnesian solution, so that by diffusion the lime is replaced by magnesia throughout the fragment or pellet, whilst the fragment or pellet retains its form, permitting the free access of the magnesian solution.

1821. LOOMS, *F. S. Witham.—27th April*, 1881. 4d.

This consists of an adjustable slay or batten, so constructed in the reed space as to be capable of adjustment to the various widths of cloth required to be woven in the same loom.

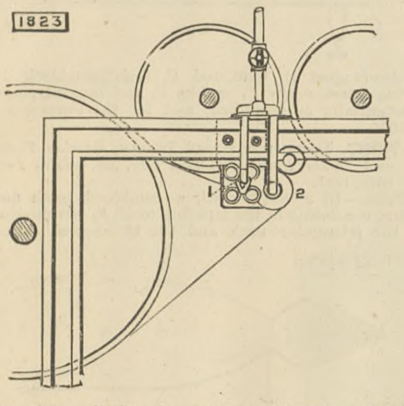
1822. PRODUCING INLAID DESIGNS UPON SURFACES, *E. Ormerod and R. J. and A. Edwards.—27th April*, 1881.—*(Not proceeded with.)* 2d.

The design is cut into a suitable material, and the recesses thus formed are filled in with a mixture of a metallic sulphide and sulphur.

1823. PRINTING MACHINES, *E. F. Kelly.—27th April*, 1881. 6d.

The object of the invention is to obviate the necessity of frequently removing the travelling "set-off sheets" owing to their becoming moistened and besmeared with ink as they are carried round by the

1823



impression cylinder in contact with the printed sheets, and it consists in the use of two drying cylinders 1 and 2 heated by steam, and round which the set-off sheets are caused to pass, both sides being acted upon, whereby they are thoroughly dried.

1825. PADDING COLOURS ON TO CALICO, &c., *G. W. Clayton.—27th April*, 1881. 6d.

This consists specially in the use of a plain metal roller or rollers whereby the ordinary engraved "pin-pad" or "slash roller," the top bowl or roller and lapping, and the blanket ordinarily employed, are dispensed with.

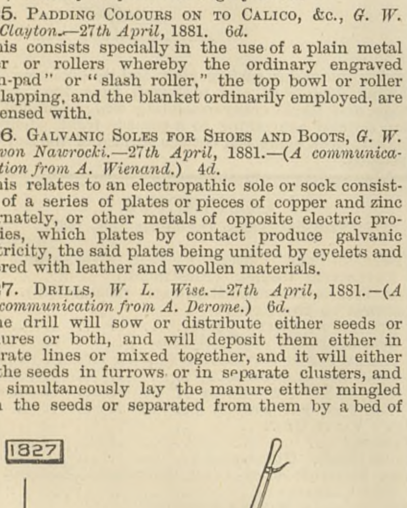
1826. GALVANIC SOLES FOR SHOES AND BOOTS, *G. W. von Nawrocki.—27th April*, 1881.—*(A communication from A. Wienand.)* 4d.

This relates to an electropathic sole or sock consisting of a series of plates or pieces of copper and zinc alternately, or other metals of opposite electric properties, which plates by contact produce galvanic electricity, the said plates being united by eyelets and covered with leather and woollen materials.

1827. DRILLS, *W. L. Wise.—27th April*, 1881.—*(A communication from A. Derome.)* 6d.

The drill will sow or distribute either seeds or manures or both, and will deposit them either in separate lines or mixed together, and it will either lay the seeds in furrows or in separate clusters, and will simultaneously lay the manure either mingled with the seeds or separated from them by a bed of

1827



earth or by the side of them. The manure is contained in hopper A, and the seed in hopper B, both of which communicate with trough C in which a stirrer revolves. This trough is divided into compartments, into some of which the manure falls while the seed falls into others. The cylinder L has recesses to take the manure and seed from trough C and deliver them to the open hopper V, from which they fall into telescopic distributing tubes X and Y.

1828. MANUFACTURE OF GUNPOWDER, *E. A. Brydges.—27th April*, 1881.—*(A communication from A. Mayr.)* 4d.

This relates to the process for the production of gunpowder cakes, as well as for the production of perforated cubes or parallelopipeds.

1829. MANUFACTURE OF NAILS, *J. L. Heward.—27th April*, 1881. 4d.

This consists in the method of arranging and putting together of the rolls in segments for convenience in renewing the working surfaces of the excentrically-shaped divisions or segments.

1830. MANUFACTURE OF NAILS, *J. L. Heward.—27th April*, 1881.—*(Not proceeded with.)* 2d.

This relates to improvements on patent No. 2711, dated 14th October, 1880, and refers to the arrangement of the dies.

1831. REGULATING THE HEAT OF CARBONACEOUS SUBSTANCES USED FOR ENRICHING COAL GAS, *W. R. Lake.—27th April*, 1881.—*(A communication from L. Tredholm.)*—*(Not proceeded with.)* 2d.

This relates to providing the apparatus with single and effective devices, whereby the heat imparted to the vessel containing the naphthaline or other substance used may be automatically regulated or controlled.

1832. BRAKE APPARATUS FOR RAILWAY TRAINS, *G. L. Joy.—28th April*, 1881.—*(Not proceeded with.)* 2d.

This relates to that class of brakes operated by the speed of the engine being retarded, and consists principally in the application of an automatic device for throwing the pull bars operating the brakes out of gear when motion ceases, and puts them in gear ready for action when the train is running.

1834. REFLECTORS, *H. J. Haddan.—28th April*, 1881. *(A communication from C. F. Brush.)* 6d.

This consists of a reflector having a concave face, such as would have been formed by bending a flat sheet, so that it would have in cross section the form of a parabola.

1837. COKE OVENS, *H. Simon.—28th April*, 1881.—*(A communication from A. Hussener.)* 6d.

This consists, First, in conducting the purified gases distilled off from the contents of the ovens into the flues in the side walls of the ovens in order there to enter into combustion with a heated air supply; Secondly, causing the heated air from the cooling flues in the bed of the ovens to ascend in vertical flues between the fireplaces of the ovens, and to enter through passages regulated by slides or valves into the spaces above and below the firegrate and the flues into which the combustible gases pass, in order to enter in combustion therewith.

1838. HORSE AND CATTLE FOOD, *E. J. T. Digby.—28th April*, 1881. 2d.

This consists of gentian, carraway, and salt, of each 20 lb.; finugrick and cocoa husks, of each 25 lb.; linseed meal and Indian meal, of each 1 cwt.; and of locust beans 4 cwt.

1839. MUSICAL APPARATUS APPLICABLE TO KETTLES, &c., *M. A. Wise.—28th April*, 1881.—*(Not proceeded with.)* 2d.

This relates to the employment of reeds, whistles, or other analogous sound-producing appliances.

1840. MANUFACTURE OF SWEETMEATS, *S. P. Wilding.—28th April*, 1881.—*(A communication from H. Zimmermann, Thiele, and Holzhause.)* 6d.

This consists essentially of an open box of any suitable material to contain the confection or material in a condition ready for forming into shape. To the bottom of this box is fastened a perforated form plate suitable for producing the required shape of sweetmeat, and such as is at present used for the purpose by hand.

1841. HARMONICONS, *M. A. Weir.—28th April*, 1881.—*(Not proceeded with.)* 2d.

The apparatus is designed so as to drop shot upon the various plates in the proper succession required by the tune or air it is wished to perform, in place of delivering the blows by hand as at present practised.

1842. EXTRACTING BY VOLATILE SOLVENTS SOLUBLE MATTER FROM SUBSTANCES, &c., *E. B. Hart.—28th April*, 1881. 6d.

This consists essentially in boiling and washing the substance under treatment on a filter-bed, by evaporating a solvent and allowing it to ascend as vapour through the filter-bed, so that it will as condensed be retained and boiled in the substance on the bed, so long as the pressure below is not balanced by the pressure above, and that when the pressures above and below are balanced the solvent will fall, carrying with it what it has dissolved.

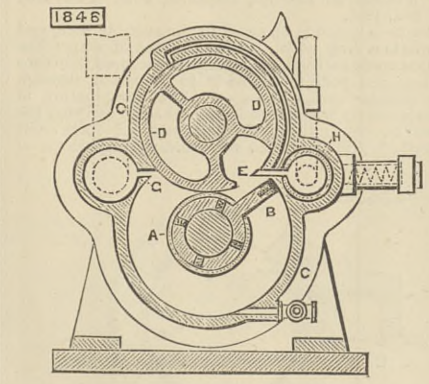
1843. RYMER FOR WOOD, &c., *G. W. von Nawrocki.—28th April*, 1881.—*(A communication from the Werkzeug und Maschinenfabrick Oerlikon.)*—*(Not proceeded with.)* 2d.

The instrument consists of two halves or parts, which at the lower end are united by hinge pin, and form a hollow space or tube; on the upper end they are held together by a key or handle. One or both halves are formed with notches constituting a longitudinal slot fitted with a steel cutter blade, something like a plane iron, which may be fastened by means of screws having a narrow slot for the shavings.

1846. ROTARY ENGINES, *J. Swalwell.—28th April*, 1881. 1s. 2d.

This relates to engines with an axis passing concentrically through a cylindrical casing and carrying a radial piston, and in which an abutment, together with the piston, serves, during the greater part of the revolution, to separate off two chambers in the casing

1846



one from the other. A is the axis and B the piston contained in case C, the abutment D, which is in the form of a roller, being contained in a side compartment of the case. The axis A and that of the abutment are geared together so as to revolve at equal speeds in opposite directions. There is a recess in abutment D to receive the piston as it passes round. E is the steam inlet and G the outlet. The entrance of steam is regulated by valve H, to which a rocking motion is imparted.

1847. EXTRACTING COPPER FROM ITS ORES, *W. W. Hughes.—28th April*, 1881. 4d.

This consists, First in a series of desulphurating furnaces for producing copper from ores by a continuous operation; Secondly, providing the furnaces with inclined tuyeres, by which blast is forced into the molten contents of the furnace, and the same kept in rapid rotation or circulation.

1848. EXTINGUISHING FIRES, &c., *J. K. J. Foster.—28th April*, 1881. 6d.

This relates to improvements on patent No. 4181, dated 19th October, 1878, and consists principally in the combination of three cylinders, provided with their respective appurtenances by means of three pipes combined with a three-way cock and two pipes, the pipes being provided with valves.

1849. TREATMENT OF COFFEE, &c., *A. Gough.—28th April*, 1881. 2d.

This consists, First, in malting the coffee before roasting; and, Secondly, in the combination or admixture with malted and roasted coffee berries of malted grain for the decoction of a beverage.

1850. IMPREGNATING WATER WITH CARBONIC ACID GAS, *J. K. J. Foster.—28th April*, 1881. 6d.

This consists of an apparatus constituting an attachment to a water service pipe or engine hose constructed of two cylinders connected by pipes controlled by a cock and valves.

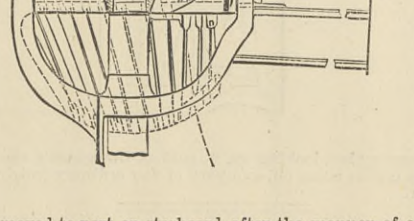
1851. CARVING FORKS, *W. B. Hatfield.—29th April*, 1881. 6d.

This consists in the construction of carving forks with guards, the said guards being raised or lowered by rotating them on their shanks or axles.

1853. PROPELLING AND STEERING APPARATUS FOR SHIPS OR VESSELS, *J. I. Thorneycroft.—29th April*, 1881. 8d.

This consists essentially in apparatus for propelling and steering ships or vessels, wherein a propeller has behind it in line with its boss a rearward body having a gradually increasing diameter or width for a short distance, and afterwards a gradually diminishing diameter or width to its rearward end, making the said body in two or more lengths, and mounting the rearward part of the same on pivots or axes so that it can

1853

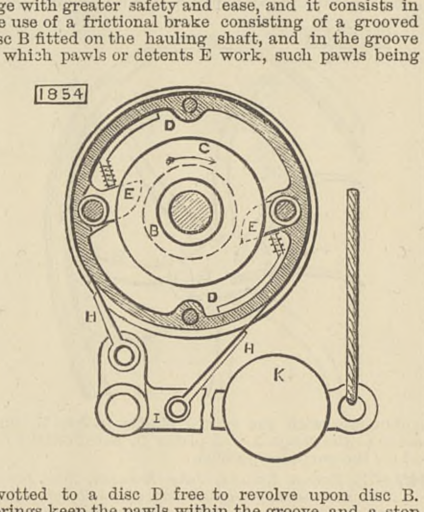


be moved to port or starboard after the manner of a rudder. The drawing shows a central vertical longitudinal sectional elevation of the stern portion of a vessel provided with the steering and propelling apparatus.

1854. LIFTS AND HOISTS, *J. M. Day, W. R. Green, and H. C. Walker.—29th April*, 1881. 6d.

This relates to means for raising and lowering the cage with greater safety and ease, and it consists in the use of a frictional brake consisting of a grooved disc B fitted on the hauling shaft, and in the groove of which pawls or detents E work, such pawls being

1854



pivotted to a disc D free to revolve upon disc B. Springs keep the pawls within the groove, and a stop is provided for each to bear upon when in gear. Encircling disc D is an ordinary brake strap H, one end of which is secured to a fixed point and the other to a lever I carrying a counterweight K. At the end of lever I is a cord, whereby the lever can be raised and the brake released.

1855. PREPARING, SPINNING, AND DOUBLING COTTON, WOOL, &c., *R. Clegg and J. Taylor.—29th April*, 1881. 6d.

This consists in the use of a tube or bush placed within a frame or flyer, so as to revolve around an axis inclined to an axis of the said frame or flyer, for the purpose of imparting to the yarn additional twist to that given by the said frame or flyer.

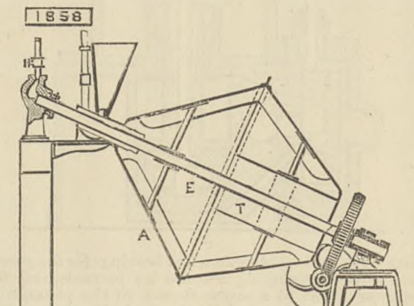
1856. CONSTRUCTION OF RAILWAYS, &c., *A. W. L. Reddie.—29th April*, 1881.—*(A communication from J. Hunebelle.)* 6d.

This relates to a composite rail consisting of two parts, the rail proper and the base-plate or chair, these parts being so constructed as to fit closely the one within the other.

1858. DRYING, CLEANING, AND DRESSING GRAIN, SEEDS, &c., *E. Keighley—29th April*, 1881. 6d.

In bearings in a suitable frame is fitted in a diagonal position a shaft E made hollow and partly perforated; on the shaft is secured a conical cylinder A, having the top part left open, whereby to put in the material to be operated upon; the inside of the cylinder is fitted with a series of plates for the purpose of lifting and turning over the grain, seed, or other

1858



material operated on, by which means the substances are lightened up, so as to give free action to a current of air which is forced by means of a fan or blower (or steam or other vapour may be injected); the blast of air may be either heated or cold; over the shaft, and in the bottom part of the conical cylinder, is fitted a steam drying cylinder T, or a coil of steam pipes may be employed.

1859. BRICK-MAKING MACHINERY, *T. C. Fawcett.—29th April*, 1881. 4d.

This consists, First, in the employment of stationary or reciprocating knives used in combination with a revolving, reciprocating, or stationary mould large enough to contain material for the formation of two or more bricks; Secondly, in the employment of a stationary knife used in combination with a rectangular mould.

1860. TRICYCLES, &c., *J. Harrington.—29th April*, 1881. 6d.

This consists, First, in the employment of a friction gear to communicate motion from the crank driving axle to the driving wheels of tricycles and other velocipedes; Secondly, arranging the intermediate friction wheel or wheels on one or on each side of a right line drawn through the crank driving axle and the axles of the driving wheels.

1861. MANUFACTURE OF THICKENING AND ADHESIVE MATERIALS OR "DRESS" COMPOSITIONS, *G. W. von Nawrocki.—29th April*, 1881.—*(A communication from E. R. Portheim.)* 4d.

This consists in the manufacture of thickening and adhesive materials and "dress" compositions by means of solutions of animal or vegetable protein substances prepared with caustic alkali, and by addition of means for preventing coagulation.

1865. LIME KILNS, &c., *E. Crosland.—29th April*, 1881. 6d.

This relates to the construction of lime kilns, applicable also for calcining cement, ore, or other material, according to which gas from a producer admitted by lateral apertures in an overhanging shoulder of the kiln burns in the body of the material treated along with air rising from below, and the products of combustion ascend through the material above, drying and heating it as it descends to the zone of combustion.

1866. LETTING OFF THE WARP IN LOOMS, *J. Heap.—30th April*, 1881.—*(Not proceeded with.)* 2d.

This relates to an arrangement of rollers for nipping and holding the warp.

1867. MULES, *J. Haughton, J. Roberts, and J. Buckley.—30th April*, 1881.—*(Not proceeded with.)* 2d.

This relates to mechanism for regulating the winding of the threads in a mule by diminishing the speed of the spindles in proportion as the diameter of the cops increases, and so as to build up the cops in a more perfect manner than has hitherto been practicable.

1869. ELASTIC COTTON FOR UPHOLSTERY, *G. G. de L. Byron.—30th April*, 1881.—*(Not proceeded with.)* 2d.

This relates principally to a chemical treatment and drying process.

1870. SEPARATING AND SORTING GRAIN, SEEDS, &c., *S. Handscombe and C. Dellar.—30th April*, 1881., 6d.

This consists partly in the method of rotating the indented separator and perforated screens by frictional contact with rollers at each end thereof.

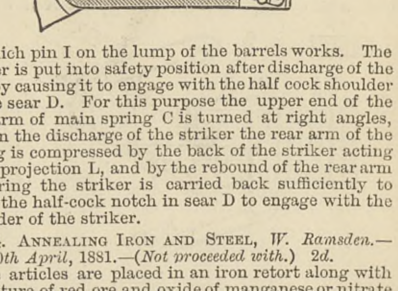
1871. VELOCIPEDES, *A. G. Meeze and N. Salomon.—30th April*, 1881. 8d.

Instead of transmitting motion from the treadle shaft to the driving wheels by means of chains or gearing as usual, discs or their equivalent are attached to the axles of the driving wheels and to the treadle axle, and they are connected together by sets of link rods, so arranged that at least one end of each set will always be in a position to pull upon the disc of the driving wheel, and thereby, as the treadle shaft is being rotated, transmit that motion to its wheel. A second improvement relates to means for laterally contracting the velocipede.

1872. BREECH-LOADING SMALL-ARMS, *H. Walker.—30th April*, 1881. 6d.

This relates to drop-down fire-arms, and consists in cocking and discharging arrangements, and in safety apparatus to prevent accidental discharge. The striker A works in a recess under tang B, and in it is a slot in which the free ends of the main spring C work. The rear part of the slot forms a shoulder, with which the half or full cock notch in the sear D engages. The latter is under tang B, and turns on centre X, being acted upon by spring E to cause the notches to engage the shoulder of the striker. Behind the main spring is the compressing and cocking lever F, the upper arm of which works in the slot of the striker; jointed to lower arm of lever F is a rod G, having a depression

1872



in which pin I on the lump of the barrels works. The striker is put into safety position after discharge of the gun by causing it to engage with the half cock shoulder in the sear D. For this purpose the upper end of the rear arm of main spring C is turned at right angles, and on the discharge of the striker the rear arm of the spring is compressed by the back of the striker acting upon projection L, and by the rebound of the rear arm of spring the striker is carried back sufficiently to cause the half-cock notch in sear D to engage with the shoulder of the striker.

1874. ANNEALING IRON AND STEEL, *W. Ramsden.—30th April*, 1881.—*(Not proceeded with.)* 2d.

The articles are placed in an iron retort along with a mixture of red ore and oxide of manganese or nitrate of potash, or other material which gives off oxygen gas at a low temperature. The retort is then closed, having a small aperture to carry off the carbonic oxide formed.

1878. FINISHING WOVEN FABRICS, *M. McCallum.—2nd May*, 1881. 6d.

This relates principally to improvements in the holding devices or clips.

1888. MUSIC STOOLS, &c., *A. W. L. Reddie.—2nd May*, 1881.—*(A communication from M. H. Wilson.)* 6d.

This consists essentially in the combination in a stool of two standards, which may be secured together side by side, their adjacent faces or sides being made to conform to each other to form a single column for supporting a single seat, and which may be readily separated when desired to support each a seat.

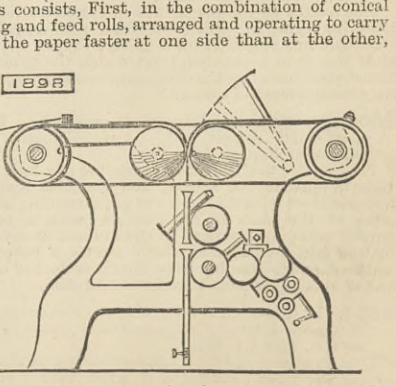
1891. RAILWAYS, *A. J. H. Smythe.—2nd May*, 1881 6d.

This consists in the combination with a Vignoles or flat-bottomed rail of a rolled metal grooved bed-plate supporting the rail in an inclined position, of a fang bolt with a clip gripping the inside flange of the rail, and of dog spikes fastening the rail, the bed-plate, and the sleeper together on the outside of the rail.

1898. FOLDING PAPER, &c., *J. H. Johnson.—3rd May*, 1881.—*(A communication from W. C. Cross.)* 6d.

This consists, First, in the combination of conical folding and feed rolls, arranged and operating to carry along the paper faster at one side than at the other,

1898



thereby partially turning the sheet, so that when the fold is completed what were the front and rear edges will have become the side edges of the sheet; Secondly, in the combination of a vibratory tucker blade and conical folding rolls arranged and operating to carry along the paper faster at one side than at the other. Other improvements are described.

1893. Absorbing and Rendering Available for Manufacture the Sulphuric and Sulphurous Acid Contained in Furnace Gases, &c., *C. D. Abel.—2nd May,* 1881.—(*A communication from Dr. K. Schnabel.*) 4d.

This relates principally to the process of absorbing and rendering innocuous sulphurous acid fume contained in furnace gases, and gases or vapours resulting from manufactures, by converting the same into sulphite of zinc by means of zinc oxide or carbonates or sulphates of zinc.

1911. Food for Cattle, *A. E. Brooke-Hunt.—3rd May,* 1881. 2d.

This relates to cakes consisting of seaweeds in admixture with meal or with other matter suitable for use as food for cattle.

929. Alarm Signal Apparatus for Railway Trains, *Compte P. A. de Sparre.—4th May,* 1881. 6d.

This consists in the fitting on the roof of railway carriages of an apparatus composed of a windmill or set of vanes or sails which is put into operation by the current of air due to the motion of the train, so as to give an alarm as soon as the windmill or vanes or sails are exposed to the action of the said current by mechanism actuated by a cord.

1931. Treating Textile Fabrics for Sanitary Purposes, *H. J. Haddan.—4th May,* 1881.—(*A communication from J. Tisselin.*) 2d.

This consists in the application of tar to textile material of any kind and in any shape, either in their fibrous state or as tissues, unmade or made up into articles of clothing or upholstery, by dipping the said materials in a solution of tar.

1964. Manufacture of Door Knobs, &c., *A. and R. F. Heath.—5th May,* 1881. 6d.

This consists in making the said knobs of two shells, the shell which constitutes the back or principal part of the knob having nearly the figure of the neck of the knob, and somewhat more than one-half of the body; and the other or front shell having nearly the figure of the remaining portion of the body of the knob, the said shells being connected together.

1994. Lathes, &c., *G. B. Sherwin.—7th May,* 1881. 6d.

This consists partly in forming or fixing an arm bracket or bed on the fast headstock of the lathe at right angles to the axis of the lathe, the said fixed arm, bracket, or bed, carrying a sliding bed extending beyond the periphery of the face plate for supporting a slide rest carrying a cutting or turning tool, and providing with the ordinary self-acting or hand feed motions, whether the surface of the bracket, arm, or fixed bed on which the sliding bed works be horizontal or vertical.

2016. Engraving on Glass or Glassy Surfaces, *J. H. Johnson.—9th May,* 1881.—(*A communication from S. H. Crocker.*) 4d.

This consists in the process of engraving on glass or glassy surfaces by drawing thereon with a hot pen, or with any other heated drawing instrument which melts and maintains fluid an ink capable of resisting the subsequent action of fluoric acid or its equivalent.

2017. Soda, *E. Solvay.—9th May,* 1881. 2d.

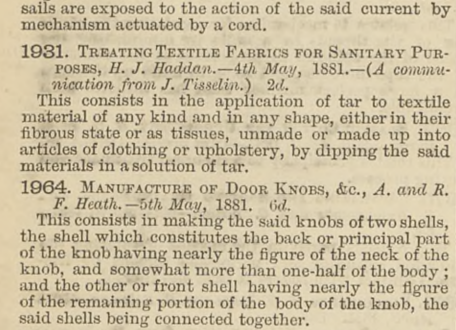
This consists in the process of mixing soda in the ammonia process with the bicarbonate of soda previously to the introduction of the said bicarbonate of soda into the decomposing apparatus.

2235. Utilisation of Ores in the Manufacture of Iron and Steel, *J. H. Sanders.—21st May,* 1881.—(*A communication from E. Samuel.*) 2d.

This consists in the process or method of providing for the utilisation of finely divided iron ores by mixing them with small pieces or particles of iron or steel, and consolidating the mixture into workable masses or lumps by means of moisture previous to their reduction in a blast or other suitable furnace.

2312. Metallic Pipe Joint for Fire Engines, &c., *E. Cooman and P. Dallard.—26th May,* 1881. 6d.

B is the tube to receive the hose or pipe, and is provided with a flange D with ears E, between which



works a claw K to fit over a claw H on the other half of the joint. The inner periphery of each pipe has a recessed channel, and holds a rubber or leather washer O.

2663. Rope Compresser, *W. McGlashan.—18th June,* 1881. 6d.

This relates to a rope compresser, wherein the compression upon the rope is obtained from a movable wedge or wedges, or inclined surface or surfaces, and a fixed inclined plane or surface or fixed inclined planes or surfaces.

3061. Pencil Cases, *W. E. Wiley.—13th July,* 1881. 6d.

This consists of a method of fastening or holding in position the lead or marking material by making a partial turn of the tube holding the lead or marking material.

3388. Continuous Underground Pipes, *C. Detrick.—4th August,* 1881.—(*Complete.*) 8d.

This relates to the formation of continuous seamless pipes from plastic materials.

3421. Making Cigarettes, *W. R. Lake.—8th August,* 1881.—(*A communication from J. Cowan and G. H. Frost.*)—(*Complete.*) 1s. 2d.

This relates to various novel features of construction in machines for making cigarettes.

3477. Type Distributing Machines, *H. J. Haddan.—11th August,* 1881.—(*A communication from T. Reeve.*)—(*Complete.*) 1s.

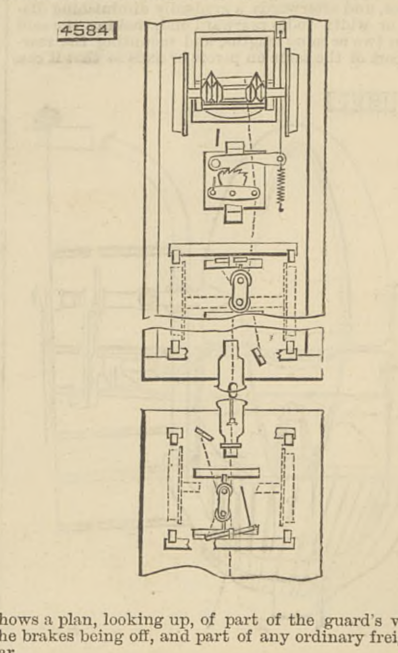
This relates to improvements in machines for distributing type, in which the dead matter, column after column, is placed on a galley, thence fed line after line into a channel, from which the types are transferred one after the other into cases arranged on the circumference of a cone.

3565. Fasteners for Gloves, Gaiters, &c., *W. R. Lake.—16th August,* 1881.—(*A communication from A. Hopfen.*)—(*Complete.*) 6d.

This relates to a fastening consisting of a base plate to be applied to the article, and provided upon its upper surface with the guides or guide running lengthwise of the plate in combination with a button carrier which is arranged to slide in and is retained by the said guides, and which carries a button or buttons, and is adapted to be caught or locked at the end of its closing movement by mechanism.

4584. Railway Brakes, *W. P. Thompson.—9th November,* 1880.—(*A communication from C. F. Sim and W. Spider.*) 6d.

This consists of a brake mechanism operated either by hand or power, composed of a rod passing beyond and under draw bar, and connected by a chain or rope with a hand brake or fixed point, and a rod passing out beyond other end of car, and connected by a rope or chain with end of brake lever, each of these chains or ropes passing over a separate sheave, both of which are carried in a sliding hanging frame. The drawing



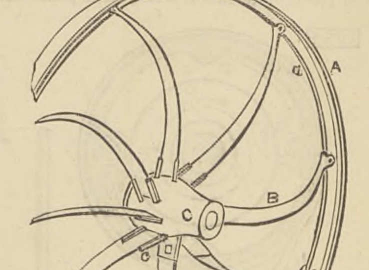
shows a plan, looking up, of part of the guard's van, the brakes being off, and part of any ordinary freight car.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

147,775. Carriage Wheel, *Thomas A. Miller, Grenola, Kans.—Filed July 16th,* 1881.

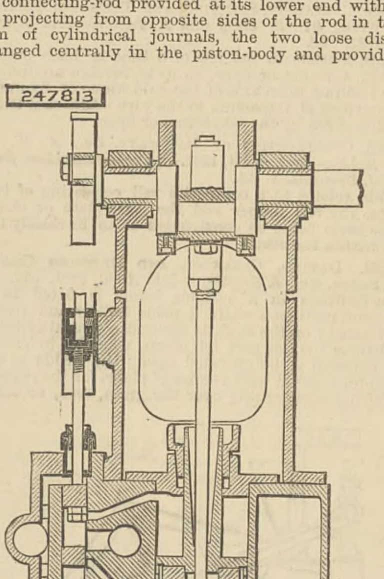
Claim.—In a spring wheel, the rim A, having flange A, and the hub C, having plates D, with flanges C, in



combination with the curved elastic spokes E, connected to the flange A, and plates D, substantially as and for the purpose specified.

247,813. Steam Engine, *John Ericsson, New York, N.Y., assignor of one-half to Cornelius H. Delamater and G. H. Robinson, same place.—Filed July 1st,* 1881.

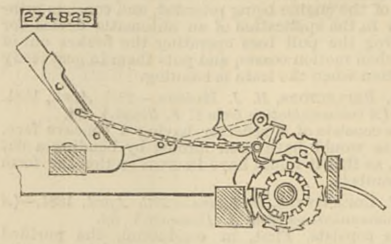
Claim.—(1) In a reciprocating engine, the combination, with the piston constructed with a central bore in its under portion and provided with an upright hollow rod or trunk in communication with the bore in the piston to form a receptacle for a lubricant, of the connecting-rod provided at its lower end with a pin projecting from opposite sides of the rod in the form of cylindrical journals, the two loose discs arranged centrally in the piston-body and provided



with slots and semi-cylindrical bearings for the reception of the connecting-rod and its journals, and the follower fitted to a screw thread in the piston and capable of rotating independent of the lower disc for holding and adjusting the parts in position, all substantially as described. (2) A connection between the valve stem and its connecting-rod of a steam engine and a guide for the said stem, consisting of the combination of a packed piston formed or secured on the valve-stem, a joint-pin connecting the said rod with the said piston, and a stationary cylinder in which the said piston works, and which forms an oil reservoir, substantially as herein described.

247,825. Horse Hayrake, *Reuben Hoffhein, York, Pa.—Filed March 1st,* 1881.

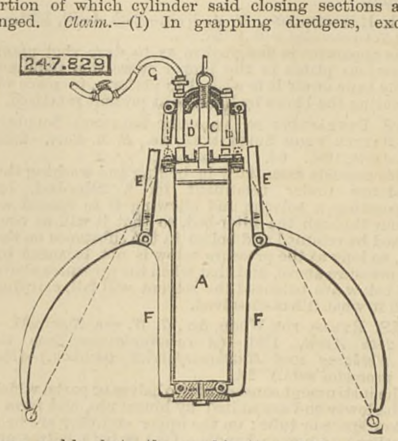
Claim.—(1) The axle-box, tooth-holder, and the rake-head holder, all cast in a single piece, adapted to conform to the sides of the rake head, as shown and described. (2) The broad concave-faced tooth on the centre wheel, combined with the pawl having corresponding projection, whereby the rake is held up while passing from the movement in elevation to the movement in descent. (3) The double-ended cam G, with notches corresponding with the teeth of the centre wheel D. (4) The centre wheel D, combined with a double-ended revolving cam, substantially as set forth. (5) The double-ended cam G and the centre wheel D, combined with the series of gear wheels intermediate between said centre wheel and the adjacent ends of the main axle. (6) The double-ended revolving cam G, provided with a transverse loop-rod, combined with a travelling ring and its flexible connection, whereby the cam may be at any time brought into engagement. (7) In a horse hayrake, the combination of a continually revolving axle cut in two parts at or near the centre of the rake, the two parts being connected at their inner ends to the lifting wheel by a



train of gear wheels, so that each part of the axle can turn independently of each other when the rake is turning round and act in conjunction when lifting the teeth, while the outer ends are rigidly connected to the supporting wheel, and a lifting device under the control of the operator, that will lift the teeth to pass over the windrow and reset them gradually by the draught of the team, thereby preventing the teeth from falling to the ground. (8) In a horse hayrake, the combination of a revolving axle, a centre lifting wheel, and a device to raise the teeth and reset them automatically, as described. (9) In a horse hayrake, a lifting and resetting device by which the teeth are raised to discharge the gathered load and gradually reset automatically to gather a fresh load. (10) A horserake having a revolving axle, a centre ratchet or gear wheel mounted upon or driven by said axle, and a hinged rake-head, combined with a revolving double-ended pawl provided with gear teeth and mounted on said rake-head, so that it may be caused to engage with said ratchet at will, whereby the rake may be automatically lifted from the ground and lowered again by positive power derived from the continuous motion of said axle.

247,829. Dredging, Excavating, and Grappling Machine, *Frank G. Johnson, Brooklyn, N.Y.—Filed February 14th,* 1881.

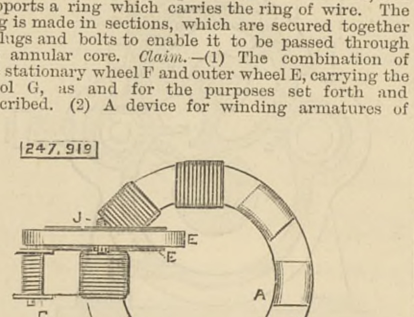
Brief.—The closing sections are operated through arms connected thereto and to sliding head-plates of the piston-rod of the operating cylinder, to the lower portion of which cylinder said closing sections are hinged. *Claim.*—(1) In grappling dredgers, exca-



vators, and buckets, the combination of the carrying arms F F, cylinder A, the working or closing arms E E, sliding head-plates, and piston-rod C, substantially as and for the purpose set forth. (2) In grappling dredgers, excavators, and buckets, the combination of the hollow sliding tube D^1, the flexible tube G, sliding rods D^1 D, sliding head-plates, piston-rod C, working arms E E, and cylinder A, substantially in the manner and for the purposes described.

247,919. Device for Winding the Armatures of Electric Machines, *Robert A. Johnston and William H. Bulcroft, Cleveland, Ohio.—Filed May 2nd,* 1881.

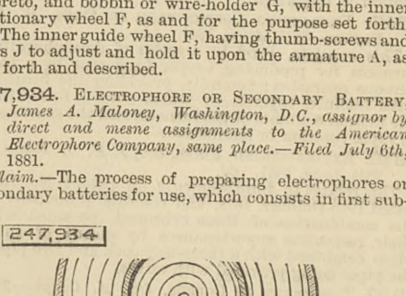
Brief.—A guide is clamped to the annular core, and supports a ring which carries the ring of wire. The ring is made in sections, which are secured together by lugs and bolts to enable it to be passed through the annular core. *Claim.*—(1) The combination of the stationary wheel F and outer wheel E, carrying the spool G, as and for the purposes set forth and described. (2) A device for winding armatures of



electric machines, consisting of a divided wheel E turning upon a stationary wheel or guide F attached to an annular armature, as and for the purposes set forth and described. (3) The combination of the sectional wheel E, having a screw X, spring Y attached thereto, and bobbin or wire-holder G, with the inner stationary wheel F, as and for the purpose set forth. (4) The inner guide wheel F, having thumb-screws and lugs J to adjust and hold it upon the armature A, as set forth and described.

247,934. Electrophore or Secondary Battery, *James A. Maloney, Washington, D.C., assignor by direct and mesne assignments to the American Electrophore Company, same place.—Filed July 6th,* 1881.

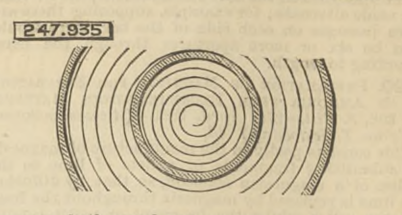
Claim.—The process of preparing electrophores or secondary batteries for use, which consists in first sub-



merging the metal coils in acidulated water, and then placing the device in an electric circuit for the purpose of polarising the leaden coils or plates, and, Secondly, in subsequently replacing the acidulated water with water without acid for the purpose of conducting the current to the respective polarised plates, substantially and for the purpose set forth.

247,935. Electrophore or Secondary Battery, *James A. Maloney and Franz Bürger, Washington, D.C., assignors, by direct and mesne assignments, to the American Electrophore Company, same place.—Filed July 20th,* 1881.

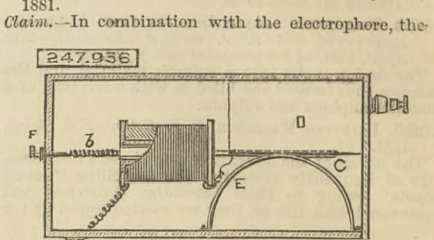
Claim.—An electrophore or secondary battery substantially as described, consisting of an exterior non-conducting vessel containing a central porous cup, two coils of the same metal coated with red lead, one arranged within the porous cup and one without the



porous cup, both vessel and porous cup being filled with acidulated water, for the purpose specified.

247,936. Regulator for Electrophores or Secondary Batteries, *James A. Maloney and Franz Bürger, Washington, D.C., assignors, by direct and mesne assignments, to the American Electrophore Company, same place.—Filed July 23rd,* 1881.

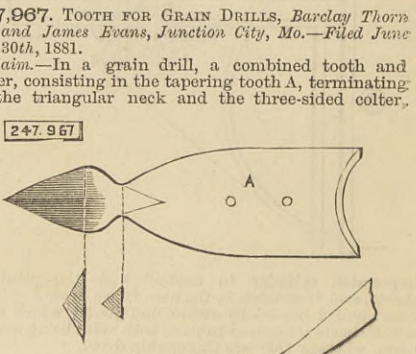
Claim.—In combination with the electrophore, the



electro-magnet B, wire rod C, resistance-block D, spring E, set screw F, spring B, and binding posts, substantially as described, and for the purpose set forth.

247,967. Tooth for Grain Drills, *Barclay Thorn and James Evans, Junction City, Mo.—Filed June 30th,* 1881.

Claim.—In a grain drill, a combined tooth and colter, consisting in the tapering tooth A, terminating in the triangular neck and the three-sided colter,



having its under surface plain and its upper surface sloping downward and backward from the central ridge, and its laterally-extending wings rounded at the rear and converging to a point in front, whereby the said neck alone will cut the surface of the soil, as specified.

CONTENTS.

The Engineer, December 2nd, 1881.

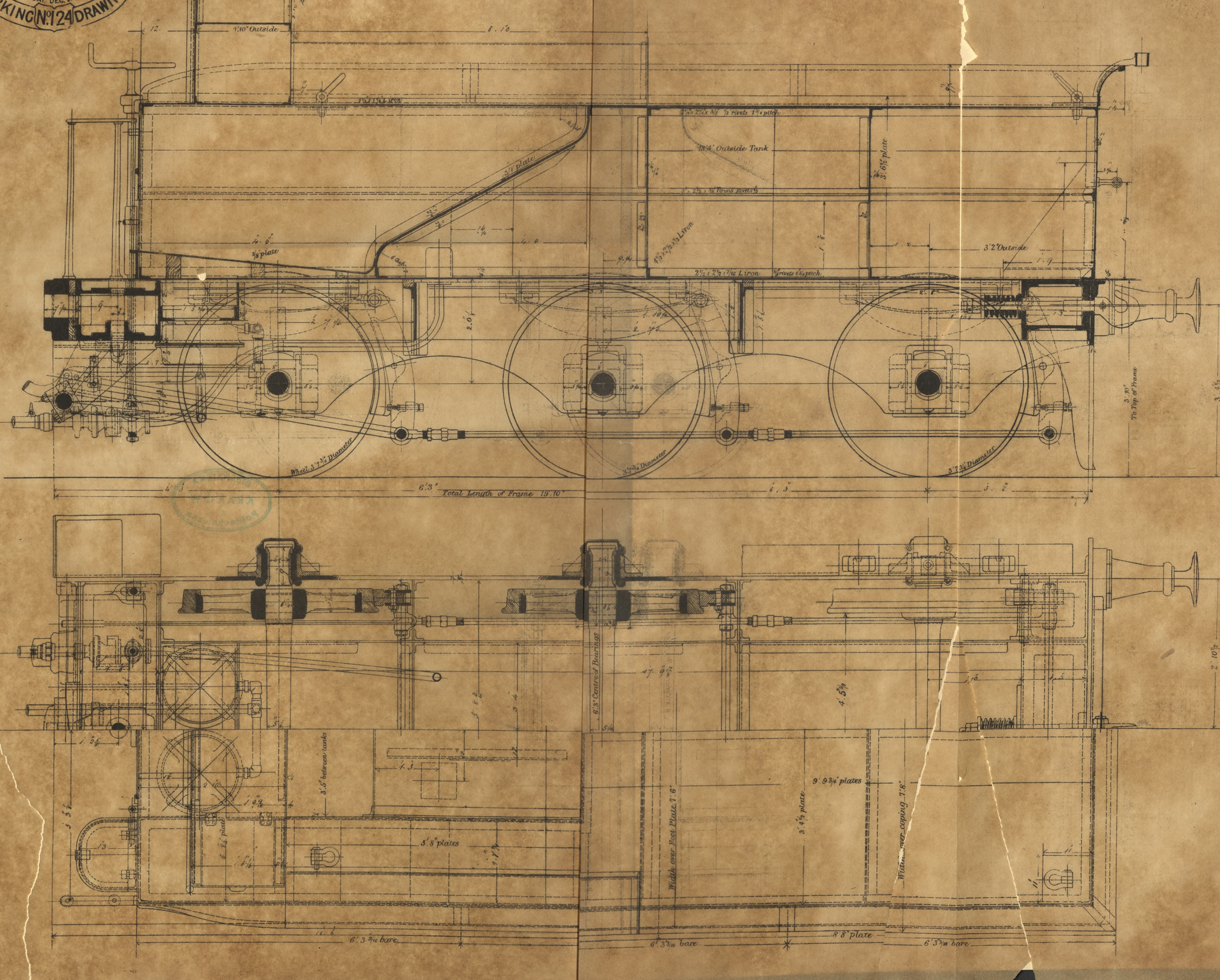
South Kensington Museum.—Visitors during the week ending Nov. 26th, 1881 :—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9218; mercantile marine, building materials, and other collections, 3081. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1486.

PORTFOLIO OF WORKING DRAWINGS
SUPPLEMENT TO THE ENGINEER
FRIDAY, DEC. 2. 1881.
No. 124

GOODS ENGINE TENDER, LANCASHIRE & [illegible]RKSHIRE RAILWAY.

Constructed from the designs of Mr. Barton Wri[illegible], Locomotive Superintendent,

BY THE VULCAN FOUNDRY Co., NEWTON-LE-WILLOWS.



GOODS ENGINE TENDER, LANCASHIRE & …RKSHIRE RAILWAY.

Constructed from the designs of Mr. Barton Wrig… Locomotive Superintendent,

By The Vulcan Foundry Co. Newton-le-Willows.

PORTFOLIO OF WORKING DRAWINGS No. 124
SUPPLEMENT TO THE ENGINEER
FRIDAY DEC. 2 1881