OUR COMPETITORS IN IRON SHIPBUILDING.

By Captain Gambier, R.N.

No. II.

The Marine Engines constructed, and being constructed by the Orlandi, are of the largest and most recent type. The steamer Ortigia, of 4200 tons, attained a speed of 13½ knots with 1300 indicated horse-power. The design is a compound of high and low-pressure, with four cylinders. The Vega, torpedo boat, made $20\frac{9}{10}$ knots on her official trial at Spezia. The Birmania, before-mentioned, of 5000 tons, 1100-horse power, made 11½ knots. These are excellent results, and certainly entitle this firm to rank high as constructors of marine engines. From the design to the finish of the last nut all these engines are the exclusive work of the firm. They have also constructed several locomotive engines of the first-class, besides a variety of other machines, mills and crushing presses for olive oil, washing machines, and a variety of agricultural implements, in the construction of which the workmen acquire that technical skill which fits them to take in hand any other kind of engineering work. It will thus be seen that not alone in shipbuilding is a formidable competitor gaining ground against England, but in our particular speciality, namely, agricultural implements and tools of every kind. Nor must the fact be lost sight of that, up to the present, these Italian workshops have laboured under great disadvantages in procuring the raw material, and in having unskilled labour to deal with. These disadvantages are, however, rapidly disappearing, and it is not too much to say that the balance of advantage will soon be on their side in both respects. The Italian Government are fully alive to the importance of fostering and developing home industries, and repeat on this side of the Atlantic the example set by the United States. Strenuous efforts are being made to render Italy entirely independent of foreign aid, and with commendable and patriotic enterprise the Government have confided the construction of 17,000,000 francs worth of armour-plates to an Italian firm, whose works are at Terni. The Island of Elba supplies the iron—an ore of excellent quality, where it has been estimated that deposits of not less than 12,000,000 tons are still above the sea level. These ores are very rich, yielding an average of 58 per cent. of metal, and though containing certain quantities of sulphur, are found to make excellent pig iron, of good quality, by an admixture of the calcareous and manganiferous ores of Monte Argentario, the supply of which is inexhaustible, and can be cheaply worked. The output of the Elba mines has increased from 50,000 tons in 1871 to 403,000 in 1881, and to nearly double that amount in 1885. There are also other sites containing valuable ores in Italy; but these have not been thoroughly examined nor officially reported on. The net cost per ton in producing this iron has been from eight to nine francs—an average of about seven shillings. The freights to England were five and to the United States eight shillings per ton. The lignites in Italy are in very large deposits and of good quality for smelting purposes. At the present rate of consumption it is estimated they would last two centuries—sufficiently long for their purposes. It will thus be seen that in dealing with the capabilities of the San Rocco firm to turn out work of excellent quality everything shows that this firm may be the nucleus of a shipbuilding and machine making industry second to none in Europe. Some further details of this establishment may be interesting. As regards its actual work, we believe that this firm has been much criticised by English experts for the extreme care and labour bestowed on it, and it has been held that this excessive exactitude of measurement and this accurate planing of the edges of iron plates is so much time and money thrown away. The Orlandi, however, take a different view, and insist on having the rivet holes of their plates as mathematically exact as machinery and patience can make them. Their argument is, that at some time or other good workmanship will be found to stand where bad fails, and it is hardly too much to say that in this respect they put to blush many of our English manufacturers. To insure accuracy amongst the many admirable contrivances used by the Orlandi, is a truck running on rails, which brings the plates through which the holes for the rivets are to be bored directly and with mathematical precision under the drill, so that every hole is within the thousandth part of an inch of where it should be, whilst the drill acts automatically and independently of the man who moves the truck. Now in many of our yards it is still necessary to employ six, eight, ten, or twelve men, to pull and haul about, with clumsy and extemporised appliances of ropes and wedges, to bring the plate under the drill. Any one who has watched this operation knows the time that is wasted over this bungling kind of work, and frequently the drill is brought down out of the centre of the chalk mark, which is, indeed, not surprising when one considers the weight of the plate that has to be wriggled about to the fraction of an inch. But with the Orlandi truck all this is obviated, and mark the result. Orlandi's plates, when they come to be rivetted on the ship, lie with the rivet holes exactly in the right place; the rivets go easily into their place, and are immediately rivetted whilst still hot and malleable. The rivet holes bored on the other system do not fit, and every one accustomed to watch iron shipbuilding will have seen the frantic efforts of the rivetters to force the rivets through the holes which do not exactly correspond. It is true they do force them in, but the rivet is made to take a twist, and before the final hammering and rivetting has been accomplished is so much cooled that the work is necessarily imperfect. But the mischief does not end here. The vessel goes to sea, and under the severe strain of rolling with the enormous weight of the ship and her cargo, the maltreated rivet gives way; the head comes off, and the rivet falls out. The strain then comes on the next rivet, and if two or three of these rivets happen to be in a part where the form of the vessel brings an extra strain on the plate from its curvature, the plate will soon snap its other rivets and come off. There is not a shadow of doubt that many a missing ship has foundered from her plates coming off, and there is no more certain method of effecting this catastrophe than bad rivetting.

To continue some further details of the Orlando establishment, it may be mentioned that the iron foundry is capable of turning out castings of 25 to 35 tons weight. It is fitted with three revolving cranes—one of 20 tons, one of 15, and one of 8. In the workshops, the present machinery—which, however, is being greatly enlarged—is calculated to work up about 350 to 400 tons of material per month, giving employment to about 1200 to 1300 men per diem. There are upwards of seventy machines at work in these workshops, with three travelling cranes of 40, 10, and 5 tons respectively. The turning lathes are capable of turning the largest screw shafting. Amongst other work going on now in this workshop is a Government marine engine for a ship of nearly 8000 tons. The boiler shop is very capacious, and conveniently situated close to the jetty. It is a covered area of 1300 square yards. The carpenters' shops, which comprise some excellent cabinet work for the internal fittings of ships, together with the brass and copper foundries, are all on the same scale. All the workshops and the slips, are lighted with electricity. From the above details it will be seen that the dockyard of San Rocco should be able fairly to compete with any of our establishments in England or Scotland. Nothing is spared to make their enterprise successful in all respects, and during the years 1882, 1883, and 1884, no less than £27,000 was expended by the firm on plant and workshops, and this in the face of a dead loss of nearly £40,000 incurred by the failure of a company for whom they had built two large steamers. Amongst other works entirely developed out of their own resources must be mentioned the patent slips. They are worked in each case by 20-horse power engines operating on four hydraulic presses, which are arranged to work alternately, so that there is no cessation of pull at any one moment of the vessel coming up out of the water. Vessels of 2000 to 3000 tons can be hauled up in about three hours' time. For other repairs the well sheltered basin affords every facility, and here the firm have lately constructed a large revolving hydraulic crane capable of lifting 70 tons, so that the largest pieces of machinery or boilers of any dimension can be with safety deposited in the workshop.

Much attention has been turned in this establishment to the delicate and difficult art of building torpedo boats. Those constructed by the Orlandi may now be seen lying side by side in the Royal Arsenal of Spezia with similar boats built in England. It is impossible to award the palm of superiority to the latter, whilst on the measured mile the Italian boats have attained most speed. They are somewhat fuller in the run than the English boats, and have more accommodation inside. Their cost was considerably less, but the figures were not obtained. As a guide, however, in estimating the relative cost of building ironclads in England and Italy, it may be stated that the Lepanto, the colossal ironclad before alluded to, cost at the rate of 1f. per kilo of material employed, or about 4½d. per English pound. The Italian Government are now having the following vessels constructed by the Orlandi, viz, the Provana, Veniero, Vesuvio, and the Clio, Vega, and Rigel torpedo boats. These vessels will be completed ready for sea by the firm, who hitherto have only built the hulls for the Government. In addition to the above mentioned, the Orlandi have built and launched some of the largest and most successful steamers of the mercantile marine, which can bear comparison with anything turned out by the best firms on the Clyde. Whether the predilection for British workmanship is likely long to remain an *idée fixe* with British shipowners remains to be seen, but to buy vessels in the dearest market will be a severe strain on their patriotism in view of foreign freight bounties. Cheap and intelligent labour, sobriety, and minding their own business, are important factors in the development of any industry, and as the day is not far distant when Italy will be independent of foreign aid for the raw material, the dream of the Brothers Orlando that they will some day build steamers for British owners may not be so very chimerical. It is only insular prejudice which leads us to underrate the foreign workman, whereas a very considerable experience of workmen, the marvellously adaptive Japanese at Yeddo or Osaka; the clever, quick-witted Chinese artificer, in the Naval yard at Hong-Kong; the patient and thoroughgoing Russian in the Arsenal at Sebastopol, and the Tuscan at San Rocco in Leghorn, has led the writer to form an exactly converse opinion. And why should it be otherwise? What special claim have we to intelligence in all these handicrafts over and above our fellows? On the contrary, our surroundings, our detestable climate which drives men to the public-house for shelter, and many other causes, militate against that steady, sober, contentment, without which no good work of hand or brain can be accomplished. Nor is the growing tendency of the British workman to look on himself as entitled to come on the "public good" for support whenever he happens to be out of work, at all calculated to preserve for us the supremacy in manufactures which have hitherto been exclusively our own. The decrease in last year's iron and steel shipbuilding—150,000 tons—must seriously affect trade throughout the kingdom, and it is a national disaster that our own Colonies place their orders in America and Germany, paid for by money borrowed in England.

The Italian Government have recently placed very large contracts in the hands of Italians for the delivery of steel rails of Italian manufacture extending over the next ten years, and are besides actively developing the Royal Arsenals. In a short space of time Italy will be able to build as many ironclads as they and the rest of Europe are likely to require; and in this respect the arsenal and building yard of Spezia will eventually become of the highest importance, from the impregnability of its situation. It is doubtful if we have a single building yard of any importance safe from sudden and unexpected attack. It is true works are being tardily thrown up on the Clyde, and that Chatham, being far inland, may be considered safe; but in the absence of a fleet at Spithead, Portsmouth is practically defenceless; whilst the guns on Portsdown Hill and the neighbouring forts might thunder away in vain before being able to strike a rapidly moving vessel shelling the dockyard; and Devonport is no better. But this is entirely a side issue. There is, however, an aspect of the question of our allowing our competitors to get ahead of us that must not be lost sight of. Every segregation of human beings in the entire world, from the puniest State in the Pacific to the giant Empires of Europe and Asia, is banded together to exclude British manufactures by prohibitive tariffs; whilst, with hardly an exception, all countries are training thousands of workmen to produce what has hitherto been almost our monopoly. In a short time every European market for steel or iron must of necessity be closed against Great Britain. But there remains one outlet—an outlet which now lies ready to hand—the vast and undeveloped Chinese Empire. But even here we are likely to be forestalled by Germany.

An important Bill passed by the Italian Parliament just before the Christmas recess gives bounties to shipbuilding and navigation for a period of ten years. The chief features of this Bill are—(1) a bounty of 24s. per ton for iron and steel ships built and registered in Italy; (2) a bounty of 8s. per indicated horse-power on machinery, and of 2s. 5d. per cwt. on boilers; (3) a bounty of 10d. per ton weight of coal brought to Italy in Italian ships from ports lying outside the Straits of Gibraltar, provided the cargo is not less than three-fifths of the ship's burthen. A bounty on the navigation of 6½d. per net ton for every 1000 miles run from Italy to non-European ports lying beyond the Suez Canal and the Straits of Gibraltar. Further, the Italian coasting trade is reserved to the national flag, but foreign ships may be admitted on condition of reciprocity. The adoption of the above bounties, clearly opposed to the principles of free trade, will injure British shipping engaged in the coal trade, as well as the importation from England of machinery and marine engines.

That a policy of self-effacement, or rather of self-obliteration, should be one that recommends itself to a manufacturing nation, is incredible. That the redistribution of land which experts cannot make pay amongst men who scarce know a potato from a parsnip, is a universal panacea for the misery produced through the vast building yards and other manufactories standing silent and empty—is one of those malicious inventions which ruin nations. The cost of living in England is certainly not dearer than in many foreign countries, but the habits our working classes have engendered and rendered it so to them. There is an absence of thrift amongst us which tells painfully when the pinch of depression comes, and nothing can be more instructive than the dispute, amounting to a serious quarrel, going on now in one of our largest northern cities between the trades union managers and their subscribers. It is obvious that the savings of the men have been hitherto, and are still, looked on merely as a means to carry on the war against capital in supporting and aiding strikes. Thus a double evil is effected, for the savings are wasted which should have stood the men and their families in need when bad times overtook them, and business is driven from the country. However, this is a voice crying in the wilderness, for as long as there are officials and other functionaries making a good thing out of the working man's gullability, so long will this unfortunate state of affairs last.

PROFESSOR R. H. SMITH'S KINEMATIC DIAGRAMS.

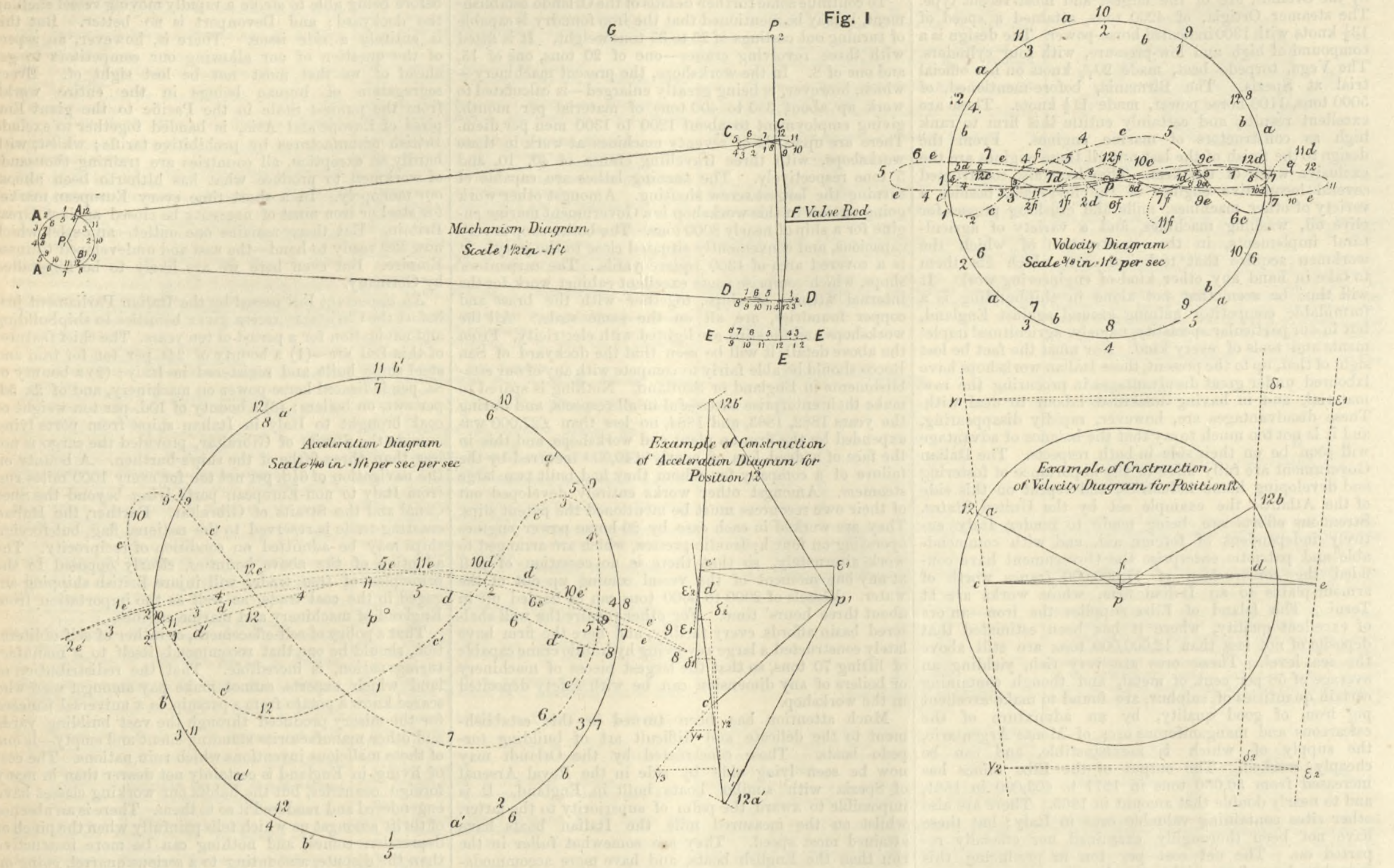
The following two examples have been selected from a considerable number of kinematic diagrams that have been worked out by Prof. Smith's new method. As these diagrams, if drawn to any readable scale, occupy considerable space, it is impossible to give here more than two, but these illustrations ought to be sufficient to enable any student to construct similar diagrams for any ordinarily occurring mechanism. Practice alone in this art, as in others, can give skill and facility. The draughtsman will find the working out of a few examples not only very interesting, but also extremely instructive. The principles of the method have already been explained in our issue of 31st July of last year. For a fuller exposition, and especially for the methods of overcoming difficulties that occur in dealing with particular mechanisms, the reader must be referred to the original paper itself, read before the Royal Society of Edinburgh at the beginning of last year, and printed in the volume of the proceedings of that institution just issued. The diagrams are reproduced here on about half the scale to which they were originally drawn, but the scales marked on the engravings are those of the engravings, not those of the original drawings.

Fig. 1 shows the set of diagrams for a Stephenson reversing link motion for a single slide valve with two excentrics. It is taken in mid gear. The dimensions and speed are stated on the diagram. The angular velocity of the crank shaft is taken as uniform.

P_1 is the crank shaft bearing. A is the forward and B is the backward excentric. The link C D is suspended at the point E by the suspension rod P_2 E, P_2 being a fixed point regulated in position for forward or backward gear by the rocking shaft G P_2.

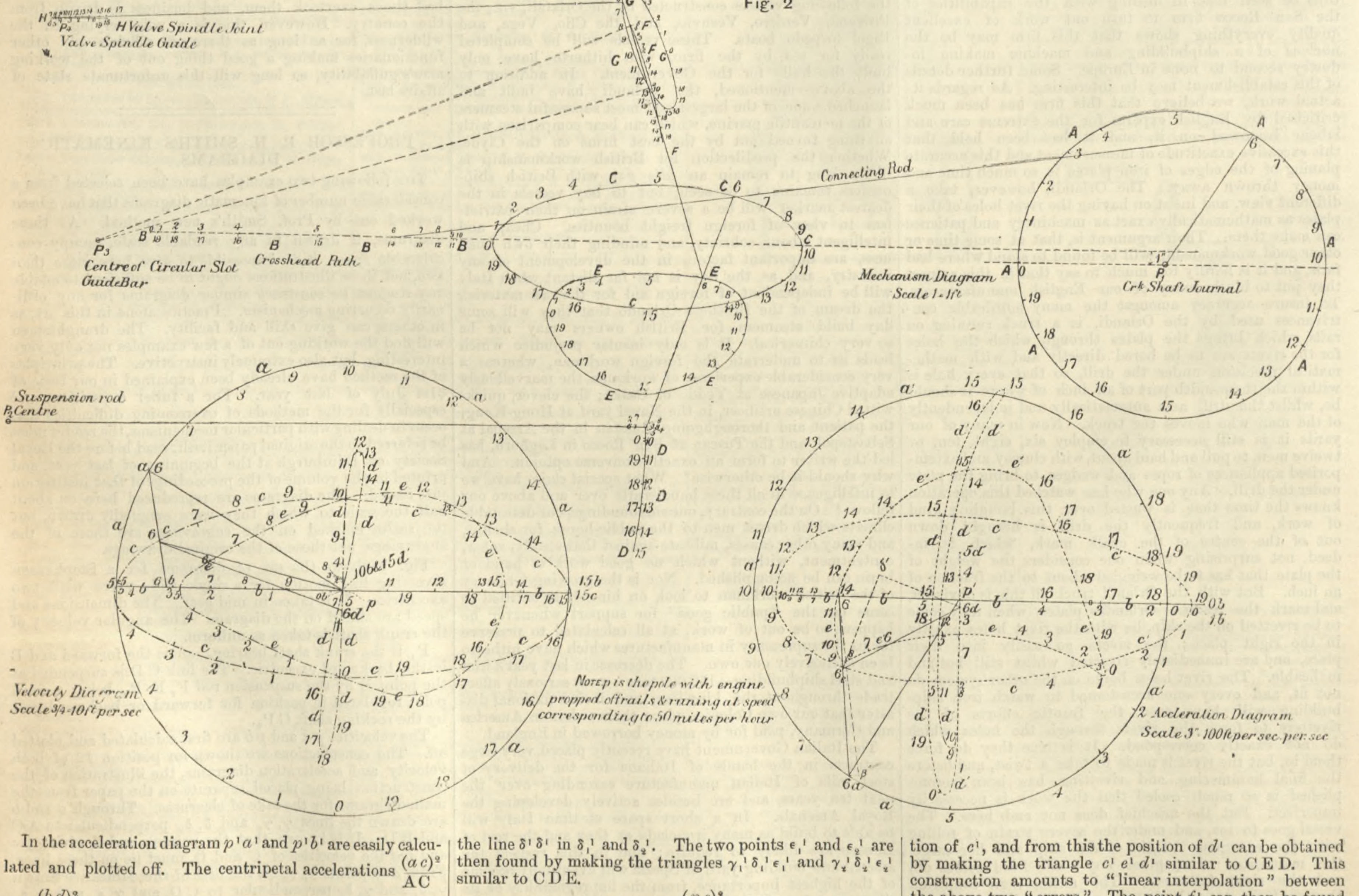
The velocities $p\,a$ and $p\,b$ are first calculated and plotted off. The constructions are shown for position 12 of both velocity and acceleration diagrams, the illustration of the construction being placed separate on the paper from the main diagrams for the sake of clearness. Through a and b are drawn the lines $\gamma_1\,\gamma_2$ and $\delta_1\,\delta_2$ perpendicular to A C and B D. It is known that the points c and d, giving $p\,c$ and $p\,d$ the velocities of C and D, must lie on these lines. From *any* points $\gamma_1\,\gamma_2$ on the first of these lines are drawn $\gamma_1\,\delta_1$ and $\gamma_2\,\delta_2$ perpendicular to C D, and $\gamma_1\,\epsilon_1$ and $\gamma_2\,\epsilon_2$ perpendicular to C E. Then $\delta_1\,\epsilon_1$ and $\delta_2\,\epsilon_2$ are drawn perpendicular to D E, and determining the intersections $\epsilon_1 \epsilon_2$; so that the triangles $\gamma_1 \delta_1 \epsilon_1$ and $\gamma_2 \delta_2 \epsilon_2$ are similar to C D E, and therefore the point e, giving $p\,e$ the velocity of E, must lie on the line $\epsilon_1 \epsilon_2$. But $p\,e$ is perpendicular to P_2 E. Therefore from p is drawn $p\,e$ perpendicular to P_2 E and intersecting $\epsilon_1 \epsilon_2$ in e. From e

Fig. I



thus found is constructed the triangle $e\,d\,c$, similar to E D C, with corresponding sides perpendicular. The point f is then found by making triangle $c\,d\,f$ similar to C D F. This completes the velocity diagram.

Fig. 2



In the acceleration diagram $p^1 a^1$ and $p^1 b^1$ are easily calculated and plotted off. The centripetal accelerations $\frac{(a\,c)^2}{\text{AC}}$ and $\frac{(b\,d)^2}{\text{BD}}$ are then calculated and plotted off from a^1 and b^1 parallel to C A and D B. These are extremely small. From the points so obtained are drawn lines $\gamma^1 \gamma^1$ and $\delta^1 \delta^1$ perpendicular to C A and D B. These are known to contain the points c^1 and d^1. On the first of these two lines are taken *any* two points $\gamma_1{}^1$ and $\gamma_2{}^1$, and from them is plotted parallel to D C the centripetal acceleration $\frac{(c\,d)^2}{\text{CD}}$ of D round C, which is calculated in the usual way. From the points so obtained are drawn lines perpendicular to D C to intersect the line $\delta^1 \delta^1$ in $\delta_1{}^1$ and $\delta_2{}^1$. The two points $\epsilon_1{}^1$ and $\epsilon_2{}^1$ are then found by making the triangles $\gamma_1{}^1 \delta_1{}^1 \epsilon_1{}^1$ and $\gamma_2{}^1 \delta_2{}^1 \epsilon_2{}^1$ similar to C D E.

The centripetal acceleration $\frac{(p\,e)^2}{P_2 E}$ of E round the fixed point P_2 is calculated and plotted off from p^1 parallel to E P_2. It is named in the diagram $p^1 \epsilon^1$. From ϵ^1 is drawn $\epsilon^1 e^1$ perpendicular to P_2 E and meeting the line $\epsilon_1{}^1 \epsilon_2{}^1$ in e^1. This is the correct position of e^1, giving $p^1 e^1$ the acceleration of E. The acceleration of C is now found by plotting from $\gamma_1{}^1$ and $\gamma_2{}^1$ in any parallel directions, the lengths $\gamma_1{}^1 \gamma_3$ and $\gamma_2{}^1 \gamma_4$ equal to the "errors" $\epsilon_1{}^1 e_1$ and $\epsilon_2{}^1 e_1$. The line drawn through $\gamma_3 \gamma_4$ intersects the line $\gamma_1{}^1 \gamma_2{}^1$ in the correct position of c^1, and from this the position of d^1 can be obtained by making the triangle $c^1 e^1 d^1$ similar to C E D. This construction amounts to "linear interpolation" between the above two "errors." The point f^1 can then be found directly by the construction of similar triangles.

In proceeding with the construction of the motion paths of C and D in the mechanism diagram, use is made of the directions of the velocities of C and D, already found in the velocity diagram, these directions being those of the tangents to the motion-paths of C and D. The deflection from the tangents is estimated with the help of the acceleration diagram.

Fig. 2 is for Joy's valve gear, as arranged by Mr. F. W. Webb in the Crewe compound locomotives, shows the diagrams when the reversing lever is in full forward gear. The crank shaft bearing is at P_1, the crank-pin is A, and B is the cross head. From the intermediate joint, C, in the connecting-rod a link stretches to D, at which joint it is guided to move in a circular path by the suspension-link P_2D. From the joint E in the link C D, another link stretches to F, at which joint it is guided to move along a motionless circular slot, whose centre of curvature is at P_3. This circular slot is moved into different positions for forward, mid, and back gear. The valve-rod G H is driven from the joint G in the link E F produced. The end H of the valve-rod is guided in a straight line by the guide-surface P_4. The motion of H is the same as that of the valve.

In the velocity diagram, the construction is shown in full lines for position 6, the whole crank-pin circle being divided into twenty parts. $p\,a$ is drawn from the known speed of rotation, and $a\,b$ is drawn perpendicular to A B to meet the horizontal through p in b. Then $a\,b$ is divided in the same ratio as A B is divided in C in order to obtain the point c. From c is drawn a line perpendicular to C D and from p a line perpendicular to P_2D. The intersection of these two lines gives the point d of the diagram, and then $c\,d$ is divided in the same ratio as C D is in E to obtain the point e. From e is drawn a line perpendicular to E F, and from p a line perpendicular to P_3F. The intersection of these two gives f, and then $e\,f$ is produced to g in the ratio $\frac{EG}{EF}$. From g thus found a line is drawn perpendicular to G H to meet in h the horizontal line through p, *i.e.*, the line through p parallel to the guide surface P_4. This last part is not drawn in on Plate IV. in order to avoid confusion with the small scale of the engraving. In the acceleration diagram $p^1\,a^1$ is the centripetal acceleration of A in its uniform circular motion. $a^1\,\beta^1$ is equal to $\frac{(a\,b)^2}{AB}$ and parallel to B A and $\beta^1\,b^1$, perpendicular to B A, meets the horizontal through p^1 in b^1. Then $a^1\,b^1$ is divided in c^1 similarly to A B in C. Then $c^1\,\delta^1$ is made equal to $\frac{(c\,d)^2}{CD}$ and parallel to D C, and from δ^1 a line is drawn perpendicular to C D. Also from p^1 is drawn a line parallel to $D\,P_2$ and equal to $\frac{(p\,d)^2}{P_2\,D}$ and from its extremity a line is drawn perpendicular to P_2 D. This meets the line drawn from δ^1 in the point d^1 which is thus determined. The line $c^1\,d^1$ is then divided in e^1 similarly to C D in E. The points $f^1\,g^1\,h^1$ are then found by repetitions of precisely the same process as has just been described, but these are left out in our plate in order to leave the rest clearer.

BRAKES AT THE INVENTIONS EXHIBITION.

THE AUTOMATIC FRICTION BRAKE (HEBERLEIN SYSTEM).

Three important systems of automatic railway brakes were shown at the Inventions Exhibition last year, and obtained gold medals, namely, the Westinghouse Air Brake, the Gresham Vacuum Brake, and the Automatic Friction Brake. Descriptions of the first and second will be found in our impressions for Aug. 21st and Oct. 16th, 1885. This week we illustrate the third and last. This is by no means to be confounded with the original Heberlein brake, as tested some years ago in this country. Indeed, there is only a general resemblance between the two.

The principle involved in making a running train apply its own brakes is very old. As far back as 1853 at all events, a brake was devised in which one axle of every carriage in the train was fitted with a roller, on which a chain was wound up when a clutch was brought into gear. This chain was coupled to two sets of brake blocks—that is four blocks for the four wheels of the coach. The clutches were thrown into gear when a continuous cord, running the length of the train, was pulled The brakes could also be put on by shutting off steam and applying the tender brake. Then as the carriages pushed against each other and drove the buffers home, levers from the ends of the buffer rods threw the clutches into gear. This was, however, a very crude and unsatisfactory arrangement, and the invention came to nothing. Several patents for brakes of this kind were taken out, and the original Heberlein brake attained some popularity on the Continent. The Clark brake and the Clark and Webb brake followed. The automatic friction brake is without the disadvantages which have hitherto attended the use of chain brakes, the objections to the system having been got over by very ingenious methods, which deserve attention and explanation.

It will be found on examination that there is one fundamental principle underlying all successful automatic brakes, which is that a constant effort shall be exerted to keep the brakes off, and that they shall go on as soon as this effort is suspended. Take, for example, the Westinghouse brake; in it a constant pressure of air must be maintained in the pipes under the train, or the brakes will go on. In the automatic vacuum brake a constant vacuum must be maintained, or the brakes will go on. In the automatic friction brake it is necessary that a cord shall always be kept tight throughout the length of the train, to prevent the brakes from applying themselves. The result in each case is the same—if the train parts, the pipe or cord gives way, and the brakes go on. In the simple, or non-automatic brakes, the positive effort has to be made to put the blocks against the wheels. Thus, in the original Heberlein brake and the Clark brake a cord has to be *pulled* when the train is to be stopped; in the brake which we illustrate the cord has to be *released*. This is a most important difference, and by the adoption of this system a very bad brake has been converted into a very good one.

Before going on to describe the automatic friction brake, it may be well to dispose of certain objections which may be urged against it. The first of these is that it is impossible to use the cord on a long train so as to apply all the brakes. This was only true so long as the cord had to be pulled; it has no existence when the cord has only to be slackened out. A second objection is that the chains putting the brakes on are liable to be broken by the sudden shock or "chuck" caused by the blocks coming home before the momentum is taken out of the rotating wheels. This is guarded against in two ways—first by using a chain of very peculiar construction, and secondly by taking care that the friction wheels shall not be forced home too hard. A third objection is that flat places wear on the friction wheels. As a matter of fact, a great deal of trouble was at one time caused in this way, the wheels wearing into all sorts of shapes. After a good deal of experimenting, it was found that steel friction wheels working against soft cast iron axle drums will run for many years without loss of shape. The result of the adoption of the various improvements to which we have alluded is that the automatic friction brake now plays an important part abroad, where it has been adopted on all the Prussian Government subsidiary lines, and is also in use on the following railways and light railways:—Jura-Berne-Lucerne; Swedish States; Bahia and San Francisco; Gefle-dala; Harz-Mountain; Saronno-Como; La Sarthe; Kiel-Flensburg; Saxon States; Orel-Witepsk; La Guaira and Caraccas; Brunswick; Java; Oldenburg; Puerto-Cabello and Valencia; Mecklenburg Southern; Arezzo Fossato. In this country this brake can be seen in use on the Colne Valley Railway.

The brake blocks are applied to the wheels by the apparatus shown in Fig. 4 of our supplement. The friction roller b, mounted in a frame d, which hangs from supports g, fixed to the under-frame of the vehicle, can be lowered by means of the rod h into contact with the drum a, which is keyed on to and therefore revolves with the axle of the vehicle. The roller b is thus caused to revolve, owing to the friction between it and the revolving axle drum a, and consequently to wind up on its shaft the transmission chain e, which is so constructed as to wind clear of itself at each revolution, and thus transmit the force in a constant ratio to the brake chain f by turning the multiplying roller c, to the shaft of which the latter chain is attached. To the opposite end of this chain f the brake rod itself is attached, and by its action the brake blocks are caused to press against the wheel tires. The chain is of the watch fusee type, but as will be seen from the end view—Fig. 4—each link is so made that it winds up a little to the left of the preceding link, so that the links can never ride on one another. On the frame d being again raised by means of the lifting gear in connection with the rod h, either by hand or by tightening the brake cord, the friction roller is drawn out of contact with the axle drum, and the action of a counterweight unwinds the chain and releases the brake blocks. Fig. 6 shows the small apparatus used for light rolling stock, the multiplying roller c and chain e being dispensed with, and a roller with double friction surfaces employed, with a corresponding axle drum, and with a forked brake chain, constructed on the same principle as the transmission chain e of Fig. 4, but winding up in the centre of the shaft.

The brake cord plays a very important part. It is a small, strong, flexible rope, and the way in which it is passed over pulleys attached to the lifting rods, by which the brakes are kept off, is shown by Figs. 10 and 12.

The brake is applied from the foot-plate by a very elegant device, illustrated by Fig. 14. This is one of the most ingenious friction clutches ever made. It has always been an objection to chain brakes that their action cannot be graduated, and it is sufficiently evident that, were the train rope suddenly released, all the brakes would go hard on at once. To prevent this the friction clutch reel is used. A cast iron drum, having at one end a conical internal surface, and divided into two parts c and d by a partition, in the edge of which are four slits $i\,i$, runs loose upon a spindle b, which is supported on a cast iron frame a, and has mounted on it at one end a crank handle and at the other a cone, fitted with a ratchet A. On the crank handle being turned, a screw thread on the spindle draws the cone into contact with the drum, thus forming a friction clutch, by the action of which the drum is made to revolve, the cord is wound up, and the friction brake apparatus is lifted out of contact with the axle drum, and so maintained by the cone being held by the ratchet and a click attached to the frame a. When the cones are again separated by the screw being turned in the opposite direction by the crank handle, the reel drum is again free to run loose upon the spindle, thus slackening the brake cord and permitting the brake apparatus to drop into action.

The handle can be so used as to allow the reel drum to revolve backwards as fast or as slow as may be wished, so as to keep the train cord at any desired degree of tension, thus only allowing the necessary number of brake blocks to come into play. In this way the brake is used with perfect success in running down long banks. To use the brake reel the engine driver, after the engine has been coupled to the train, and the train brake cord attached by means of the coupling hooks—Fig. 7—to the portion of cord fastened to the reel, proceeds to wind up any surplus cord on the left-hand or larger division of the reel c, and then passes the cord through one of the slits in the partition on to the smaller division d, thus obtaining greater leverage for tightening the cord and taking off the brakes with a minimum of bodily exertion. The end of the cord on the last carriage should, if with carriages on the American system, be hooked into the slip catch, Fig. 8, fixed on the platform rail, any passenger being thus able to apply all the brakes in case of emergency by simply turning over the weighted handle of the catch, upon which the cord will be slipped.

By means of the apparatus which we have described, the following conditions are fulfilled:—(1) When the system is employed as a continuous brake the engine-driver not only has the power at any moment of instantly applying all the brakes in the train by one simple movement of the brake-reel handle, but he has also a perfect *control* over the amount of brake-power to be given, and can thus regulate at pleasure the speed of the train. (2) It is also in the power of each guard to apply, in any emergency, the whole of the brakes; and the same power can be given, if thought desirable, to every passenger. (3) In case of any accident, the rupture of a coupling is instantly followed by the snapping of the brake-cord, when the whole of the brakes drop automatically into action. (4) Each brake is available separately as a far more rapidly-applied and efficient hand-brake than the ordinary screw-brake, which can therefore be dispensed with—the friction system thus comparing most favourably with all systems with which supplementary screw-brakes have to be fitted. (5) Vehicles not fitted with brakes, or belonging to other railways, can be coupled into the trains without in any manner interfering with the working of the brakes, since the continuous connection, and consequent control, can be maintained by passing spare lengths of brake-cord over any such vehicles. (6) Since each apparatus forms of itself a perfectly independent brake, any injury to one in no way affects any of the others in the train. (7) The friction-brake system offers the greatest possible security against dangers resulting from neglect on the part of any employés when making-up the train, because unless the continuous brake-cord is duly coupled up the train cannot leave the platform, as the engine-driver is unable to take off the brakes; so that it follows that no train can be in motion at all without its brake-power being at command. (8) The friction-brake system is specially suitable for goods trains, either continuously from the engine, or else worked in groups with a brakesman for each group only.

The question of braking the driving wheels of the locomotive, and thus making use of its great weight as a retarding force, has for many years been warmly disputed, but may now be said to be practically decided in the affirmative by the consensus of opinion of the leading railway engineers of all countries. It is, however, still an open question as to the advisability, or otherwise, of connecting the engine brake with the automatic train-brakes, so as to make it also self-acting in case of danger. Should any accident occur in the front portion of a long train at high speed, it must, doubtless, be unadvisable to apply any excess of brake power in front of the disabled vehicle, since it would cause the danger to be increased by the running up of the vehicles behind. In the system under notice, therefore, the engine drivers' driving wheel brake is invariably treated as an independent emergency brake, under his sole control; the tender-brake, on the contrary—should there be a tender—coming under the continuous control of the driver and guards, and also acting automatically in case of accident.

Our supplement illustrates very clearly the way in which this brake is used under different conditions:—Fig. 1 is a passenger locomotive, with engine and tender brakes, and with friction brake-reel and cord for the continuous control of the tender and train brakes. The engine brake is worked by hand separately as a special emergency brake only. Fig. 2: Goods locomotive, with driver's emergency engine brake. Fig. 3: Tank engine, with brake-reel and cord for the control of the continuous brakes. Fig. 4: Friction brake apparatus for ordinary rolling-stock—a, axle-drum; b, friction roller; c, multiplying roller; d, frame; e, transmission chain; f, brake chain and rod; g, support; h, lifting-rod connection. Fig. 5: Guard's van and passenger carriage, showing the mode of working the brakes with the brake-reel in the van—see Fig. 9—or of applying the brakes, in any emergency, from the brakesman's seat on the carriage by slipping the hook on the lifting-rod, and thus severing the continuous connection—see Fig. 12. Fig. 6; Friction brake apparatus for light railways, &c.—a, axle-drum; b, friction roller; c, apparatus frame, with chain roller; d, support; e, brake chain and rod; f, lifting rod connection. Fig. 7: Cord hooks, showing the method of coupling together the continuous brake cord, as well as of fastening the cord by a knot jammed in the conical head of the hook. Fig. 8: Slip for letting go the cord on the last vehicle of a train so as to apply the brakes in any emergency. Fig. 9: Guards' van brake-reel, to enable the guard to work the cord and control the brakes, if required, as well as the engine driver. Fig. 10: Lifting-rod support with bell-crank lever and lifting rod. Fig. 11: Friction brake as applied to an eight-wheeled bogie vehicle. Fig. 12: Lifting pulley and rod, showing slip arrangement for brakesman in cases of sudden emergency, and also handle and ring for working as a hand brake. Fig. 13: Portable cord-guide support, to be carried in the van and used when several strange vehicles, without fittings, are coupled in between the train and engine. Fig. 14: Engine driver's friction reel for the continuous control of the brakes—a, cast iron frame; b, shaft; c, d, drum, in two divisions, of different diameters; e, f, cone, with ratchet and click; g, crank handle; h, stop for limiting reverse movement of crank handle. Fig 15: Passenger train and engine with engine hand brake and continuous tender and train brake, and with a wagon, without any fittings, coupled in between train and engine. Fig. 16: Mixed train, showing use of temporary cord support—Fig. 13—for enabling the cord to be worked over several goods wagons. Fig. 17: Goods wagons, coupled in brake groups, each under the control of one brakesman. Fig. 18: Steam tramway train and engine.

So much prejudice has been raised in this country against the chain brake system, owing to its notorious failures on the London and North-Western Railway, that we feel in a manner bound to justify ourselves for devoting so much space to the brake we have just described. We therefore give some extracts from statements made by independent engineers, which speak for themselves. Mr. James Livesey, engineer-in-chief of the La Guayra and Caracas line, writes:—"For a distance of nearly twenty miles there is a continuous gradient of 1 in 27, with a succession of curves and reverse curves of 130ft. radius from one end of the line to the other. To convey an idea of the aerial character of the railway at certain points, it may be stated that the line is there carried along a mere ledge cut into the face of the perpendicular rock, some 3000ft. high, and that a biscuit dropped from the train would fall 1800ft. before touching the ground. On such a railway it requires a steady hand and strong nerve to conduct the trains, and both drivers and guards must be provided with means to meet all emergencies. The greater proportion of the traffic being up, the engines are all heavily laden. Each wagon carries, as a rule, from 10 to 14 tons, and is provided with two powerful brakes, a hand screw brake, and an automatic continuous brake, the apparatus being so arranged that both the engine-driver and guard have command over the train; and any passenger may in an instant put on the brakes throughout the train. If by accident a carriage or wagon should break adrift, not only is the brake on that wagon instantly applied automatically by the very fact of its breaking away, but the brakes are applied throughout the train, which is then brought to a standstill. The engines weigh 33 tons each, and are capable of drawing up a weight of 80 tons, exclusive of their own weight. The concession for the line having been granted in 1880, the work was commenced in January, 1882, and was expeditiously executed by Messrs. Perry and Co." The brakes referred to are those just described. The screw brakes were fitted as a reserve until the men became accustomed to the Heberlein gear, but rolling stock recently ordered for this line and others in South America is without screw brakes.

Probably one of the most important features about a goods train brake is that it enables guards to be dispensed with, and thus reduces working expenses. On this subject we give the following statement, dated Elberfield, March 20th, 1885:—"The groups of brake wagons fitted with the newest form of Heberlein brakes for the service of our Hochdahl-Erkrath line, with an incline of 1 in 30, have answered until now extremely well. The first group is in regular service since December, 1883, and the second one since October, 1884, each group consisting of three wagons, the brakes of which are controlled by one man. A saving in brakesmen has so far been effected, that those stationed at Hochdahl, who, on certain days with much traffic, were not sufficient for the heavy goods trains, and had to be supplemented by extra brakesmen, can now, since the introduction of brake groups, manage the duty without assistance, or, at any rate, do not require it to the same extent. We also hereby certify that the Remscheid passenger trains which were fitted in 1878 with Heberlein brakes, under the immediate and sole control of the engine-driver by means of a brake-reel, perform their daily service without any extra brakesmen, and without any difficulty whatever, as well on the Hochdahl-Erkrath incline, as also on the Ronsdorf-Rittershausen line, which is full of curves, and has an incline of 1 in 40." (Signed) "BRANDHOFF."

Heavy votes have been passed for the construction of an immense network of subsidiary or branch lines of the Royal Prussian State Railways. A paper on these lines was read before the Society for the Promotion of Railway Science, in March, 1884, by M. Stambke, Chief of the Technical Department in the Ministry of Public Works, in which the following passage occurs:—"As is well known, the question of subsidiary lines has of late years, when planning new railways, been brought forward more prominently than that of main lines. As regards the Prussian State Railways, for instance, in the projects of law proposed on May 15th, 1882, May 21st, 1883, and now again quite recently, the lines proposed to be built consist almost entirely of such subsidiary lines. According to the 'Railway Archives,' of March 1884, No. 2, the sum of 273,992,390 marks has been granted by the Prussian Chambers since 1879 for building or subsidising new railways, and of this sum 225,522,690 marks are for 2962·7 kilometres of subsidiary lines, and only 48,469,700 marks for 373·9 kilometres of main lines.* In addition to the above a number of lines which were originally constructed as main lines are now worked, under the law of June 12th, 1878, as subsidiary lines, so that at the present time all the Royal Directions have subsidiary lines under their supervision, of which some are in traffic and others are being constructed, whilst others are being surveyed. On such lines, in order to save the expense of special brakesmen, the trains are fitted up with a continuous brake. As the trains on subsidiary railways are generally mixed ones, and as the goods' wagons coupled in between the engine and the passenger carriages interfere with the working of the brakes by the engine driver,† the Heberlein brake, being the only system which could be employed, has been selected as the normal brake." With reference to the above, the following rolling stock has already been fitted on the Heberlein system for the Royal Prussian States Railways:—368 engines, 169 vans, 1034 carriages and wagons.

This concludes our notice of the railway brake systems exhibited last year at South Kensington. For obvious reasons we have instituted no comparisons between them and expressed no opinions concerning their relative merits. They one and all embody very ingenious ideas, and are the outcome of experience collected with much expenditure of time, patience, and money. We have done our best to place them impartially before our readers, and in all cases we have taken every care to arrive at the truth by personal investigation, and to put forward no statements made by inventors or exhibitors that did not appear to be founded on fact. Inventors will do well, we think, to draw a lesson from the history of the Westinghouse, the vacuum, and the chain brake, namely, that they can spend their talents, their time, and their money on no more hopeless task than the invention of a brake intended to take the place of any one of the three. They probably represent finality as much as does the locomotive engine itself.

* Further sums of 49,484,000 and 57,742,000 marks have been granted for 1885 and 1886 for the construction of additional subsidiary railways.

† This necessarily refers only to the air-pipe connections of the other system of compressed air brakes (Carpenter system) adopted by the Prussian Government for the express trains on the main lines, and with which the coupling in of any one vehicle without the air pipes at once renders all the brakes in rear of it useless.

THEATRICAL MECHANISM AT THE LYCEUM THEATRE.

THE mechanical engineering of the stage has been recognised in the columns of THE ENGINEER on several occasions. In February, 1884, we published an illustrated description of the machinery used in the Paris Opera House, and later we illustrated the new aquatic circus in Paris, and we now propose to give an account of a visit behind the scenes of the Lyceum Theatre during the performance of "Faust." In our account of the Paris Opera we mentioned the very conservative nature of the theatrical machinist's craft, which, perhaps, has been handed down from father to son, each having to produce more astounding and marvellous effects with increasing difficulty, owing to the cumbrous machinery that is usually employed. These remarks cannot fairly be applied to the modern stage as illustrated by the Lyceum under Mr. Irving's management, who, assisted with a most efficient stage manager, Mr. H. J. Loveday, and an army of well-drilled stage workmen, has defied the rule of precedents, and takes advantage of all kind of mechanical devices most successfully.

Some of our readers may be unacquainted with the proportions and technical arrangements of the stage, which we will briefly describe, with special reference to the Lyceum. The width of the proscenium arch is 33ft. 5in., and from this for a distance of 40ft. is the stage proper, the apparent distance being greatly increased by the inclination given to the floor, which is about ½in. to the foot. The total height was formerly 48ft., but on account of the very large quantity of scenery which has to be changed during the production of "Faust," and which, failing other stowage space, has to be suspended, it was found necessary to specially raise the roof of the theatre 12ft., thus making the total available height inside 60ft. The scenery employed is nearly all "built up," instead of painted on the flat, to give a perspective appearance—that is to say, constructed of moulded cardboard coloured to imitate stone or brick; this, although a great improvement on the usual plan of painted canvas scenes stretched on what are termed "frames," would be much heavier to move if the friction were not overcome by the use of small india-rubber covered wheels. The "wings," or side scenes, are held in place by braces, iron supports covered with leather to prevent noise, jammed against the framework, and secured to the floor by a stage screw. This small matter occupies the attention of a man whose sole duty is to attend to, perhaps, six braces, and to fix and remove the stage screw at the word of command.

The lighting is obtained from gas, the side lights, which are removable, being produced from gas battens, vertical pipes containing a number of argand burners, the top lights being similarly produced by horizontal battens with batswing burners. It is usual to have two sets of pipes so that two qualities of lighting can be produced, and the chance of a total extinction obviated. The batten lights can be enveloped from below by a framework of calico, known as a medium, the colour of the light being changed by rotating the framework and presenting a medium of the desired shade. Besides these lights, it is necessary to have some ready means of illumination which can be quickly set up in any desired spot. The plan adopted at the Lyceum is to use portable gas brackets mounted on heavy vertical stands, with arrangements for coloured mediums, and connected with the nearest union by means of a leather hose; any leakage between the gas tap, which is let in flush with the stage, and the hose is prevented by a simple water joint, care being taken always to keep sufficient head of water to overcome the pressure of the gas. This very old device appears to answer admirably, and besides being easy to connect up, draws attention to the shortness of water by the noise of the gas bubbling through. India-rubber has for some time been discarded on account of the difficulty in keeping it gas-tight; well-oiled leather appears to last well, and is not easily damaged. So far we have only considered the gas lighting, but as the spectacular effects of the Brocken scene require the combined display of twenty-five lime lights, the arrangements for their production must of necessity be on a large scale. The oxygen and hydrogen gases are stored in large vertical cylinders in what might be termed the stage basement, the necessary pressure being produced by partly filling the cylinders with water from the main. Separate pipes are led to all parts of the stage, so that to produce the light it is only necessary to connect the limelight burners to the two pressure mains; the advantage of this plan will be readily understood by those who have had experience of the old-fashioned gas bags or the still more cumbersome gas cylinders which are used in America for a similar purpose. We must confess to a slight feeling of disappointment when we were told that the electric light was not used at the Lyceum, having been much impressed by the extremely vivid lightning, which appeared somewhat tame, when it was explained that the flashes were not electrical but produced by a special powder burnt in a lycopodium pot, which was found to give a better effect than nature. A fifty cell Grove battery is used on several occasions; in the first scene, to illuminate the book which Faust signs, and also to produce the sparks which come from Mephistopheles' sword when he wards off that of Valentine who is fighting the duel with Faust. This effect is easily produced by the two performers each wearing a metal sole to one of their boots, which is electrically connected to their swords by means of an insulated wire, contact being made by stepping on two metallic plates, to which the two wires from the battery are joined. The 90 volt intermittent current which is generated, however, caused an unpleasant shock to Valentine at the first performance when he inadvertently grasped an uninsulated portion of the sword hilt. Steam takes a very important part in the play; by its aid Mephistopheles is apparently evolved from the brazier in the study scene, and throughout the piece disappearances of his satanic majesty are assisted by the same agent. The first question we asked was, How do you get rid of the noise, as the vapour appears to spring up silently and mysterious from the stage floor? On being led below we found the appliances to consist as follows:—A gas heated boiler supplies steam at 60 lb. per square inch pressure, which is led by 1in. pipes to a valve near the point of escape, from which the pipe is enlarged to 4in., and on it funnel-shaped openings, also provided with taps, look upwards. This effect, as well as every other stage device, is controlled by the prompter by means of a "pull" or signal string, to which a small weight is attached. On the prepare-for-steam signal the stop-cock is opened, the contents of the small pipe are allowed to expand into the larger one, and, on the second pull, other assistants open the several cocks which control the admission to the stage. Nothing can be simpler or more effective, yet the easy method of overcoming the noise was only arrived at after many experiments. The appearance of fire spurting from the ground where the enchanted wine has been dropped is produced by a funnel-shaped gaspipe, covered with paper, held immediately under a grating on the stage. The prompter turns up the gas, which is kept lighted, by means of a bye-pass, and the particles of burning paper give a realistic appearance to the flame.

We drew attention, in our description of the opera of "l'Africaine," to the immense weights which have to be moved, and gave details of the shipwreck scene, in which a mass of timber framing and superstructure weighing seven tons, and having an area of 2000 square feet, had to be brought on the stage in the interval between the acts and shifted sideways a distance of 22ft. This and the subsequent lowering a distance of 6ft. to represent the sinking of the ship, although a triumph in its way, does not compare with what is nightly undertaken at the Lyceum. It is true no such ponderous weight has to be moved in a mass, although the total weight of scenery which has to be planted on the stage both in the representation of the St. Lorenz Platz and the subsequent cathedral scene is probably much greater. On the Continent long waits between the acts are the rule, but at the Lyceum the curtain rises after twelve minutes' interval, so that in order to lose no time the different heavy parts of the scene which represent the statuary, archway, market cross, &c., have to be kept ready slung in the flies, and are immediately lowered by signal on to the framework, which is quickly fitted together. There is no noise or bustle on the drop curtain descending, the scene-shifters, who all wear india-rubber shoes, fall into their respective places much like men-of-war's-men at station drill, all doing their allotted work at the word of command, which is given by signs. In this scene a very curious effect is produced which has puzzled many professionals, in that on the curtain rising the stained-glass windows of the cathedral appear to be illuminated, and later on the whole side of the church becomes transparent, discovering Marguerite at prayer, also the priests and congregation at mass before the high altar. To produce this two scenes are painted, one on opaque linen, and in front one on very fine gauze; the stained-glass windows are made of silk, and are let into the opaque cloth which, on being drawn up, leaves the semi-transparent gauze only. The whole of this scene is supposed to take place at night, so that it is necessary to fully illuminate the interior of the cathedral and leave the outside street in partial darkness; this is ingeniously accomplished by lowering a curtain from above which shuts off all the outside light, the curtain being removed when the exterior of the structure is again revealed. The scene on the summit of the Brocken is perhaps the most impressive in the piece. It has been described as a study in black and white and grey: "a mass of time-worn rocks on one hand, two weather-beaten pines on the other, between them a snowy valley, the distance a mystery of vaporous cloud, through and across which the lightning plays." After this description the reality appears rather prosaic. The rocks are of moulded cardboard, and are deftly built into one another so as to overlie a timber framework which rises at about an angle of 20 deg. from the front of the stage. On this the trees 20ft. high, also of moulded work, are easily planted, and on the spectators' right a timber framework, which, when expanded like an open parallel rule, forms a substantial foundation for the huge rock on which Mephisto stands. The peculiar lighting of this scene, imitating that from frequent lightning flashes, is produced by gas flares and groups of Argand burners turned up and down at frequent intervals; the lightning, if openly displayed, would be too vivid, so the effect is produced behind a suitably painted transparent screen hung before the background; other screens represent the moon with storm-driven clouds. The finale of the mountain on fire is perhaps the easiest part of the act, and is due to some twenty-five lime-lights with red glass slides blazing through every portion of the background and focussed on to numerous steam orifices; the tableaux is also assisted by a shower of gold tinsil distributed from the bridges above by men carrying baskets and walking to-and-fro. Two hundred and fifty persons take part in this scene which necessitates great care that the framework should be strong enough to bear their weight in motion as they climb over the rocks. This is successfully accomplished, yet the whole superstructure is cleared away, and the bare stage prepared for the dungeon scene in less than ten minutes from the fall of the curtain. Stage thunder has always been a subject of ridicule, but some novelty has been introduced at the Lyceum in that the 6in., 8in., and 9in. cannon balls, besides rolling a considerable distance down an inclined shoot, are first of all placed in several hoppers from which they fall about 8ft. on to a 1in. boiler-plate when released by slides either singly or, as in the final crash, a ton at a time. It is curious to note the prejudice against iron existing amongst theatrical machinists; out of all the hoisting drums used at the theatre we only found two with iron barrels and gear; the old form of wooden wheel and axle prevails, and the same remark applies to the ropes, which we were informed constantly have to be renewed, whereas if made of steel wire they would be far more durable; a wire rope is used in the last act to support a Jacob's ladder arrangement of T-iron, and was pointed out to us as a veritable curiosity on account of its small diameter and guaranteed strength. One other point we think is worthy the attention of stage managers—that is, the introduction of hydraulic power to lower the heavy curtain and drop, which might be easily accomplished by the prompter; as yet, however, we believe the Hydraulic Power Company has not succeeded in inducing any theatrical proprietor to try the experiment, which, if successful, would render the services of the six men who attend the curtain available for some other work.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty: William J. Maudling, engineer, to the President, additional, for temporary service at the Admiralty; David J. Bennett, engineer, to the Indus, additional, for temporary service as Admiralty overseer on the Clyde; and Joseph H. W. H. Ellis, to the Vernon, additional, for temporary service at torpedo store; Charles W. Thorne, engineer, to the Algerine; John Hale, staff engineer, to the Tourmaline; William S. Coope, chief engineer, to the Royalist.

ROYAL INSTITUTION.—Dr. Lodge is about to give a course of two lectures on fuel and smoke, considered with reference to the scientific principles underlying the use of the one and the avoidance of the other. They are to be delivered on the following days, at three o'clock. Lecture 1, Saturday, April 10th: The requirements of perfect combustion; The three stages of a coal fire: distillation gas burning, and coke burning; Products of combustion and of incombustion; Coal-tar products; Customary methods of supplying air to houses; Principles involved in any proper system of warming and ventilation; Defects, real and imaginary, of gas fires; Objections to solid fuel in any form as involving attention, labour, and dirt; Principles involved in proper stoking; Reasons why gaseous fuel may be expected to become more generally used. Lecture 2, Saturday, April 17th, 1886: Principles involved in the management of furnaces; Various kinds of "smoke consumers;" Various kinds of gas producers; Gas producers and furnaces combined; Minton's oven for pottery; Siemens' regenerative furnace; The use of powdered fuel; Principles involved in the deposition of soot; Effect of crude coal burning on pictures, buildings, vegetation; Effect of smoke on water vapour; Formation of offensive fogs; Defensive system of treatment.

RAILWAY MATTERS.

THE total length of the Norwegian railways at present is 1100 miles.

THE Scotch railways are joining with those of England in the opposition to Mr. Mundella's Railway and Canal Traffic Bill. The principle it embodies of giving power to the Board of Trade to fix rates compulsorily is severely condemned by all in any way connected with the railway interest.

THE North Metropolitan Tramways Company notifies its intention of applying to Parliament in the present session, by petition, for leave to insert in its No. 1 Bill, now pending in the House of Commons, a clause or clauses authorising the company to use electricity as a power for moving carriages on portions of its existing or authorised tramways in West Ham, East Ham, and Leyton.

A REPORT by Major-General Hutchinson on the collision which occurred on the 8th February, at Ings Junction, near Wakefield—Kirkgate—station, on the Lancashire and Yorkshire Railway, has been issued by the Board of Trade. After describing the circumstances, the report concludes :—"Had his train been fitted with a good continuous brake, which the driver could have himself applied, he would very probably have been able to stop his train short of the junction crossing," whereat the collision occurred.

MR. THOMAS RAY, chief goods manager of the London and North-Western Railway, died at the North-Western Hotel, Crewe, on Wednesday, under melancholy circumstances. He was travelling in the Manchester express to London, and when nearing Crewe his fellow passengers observed him to fall forward, apparently in a fit. When the train arrived at Crewe he was moved into the Railway Company's Hotel and attended by Drs. Atkinson and Athill, but he gradually sank and died, the cause of death being apoplexy. He had been in the company's service forty-three years.

DERAILMENTS continue to be the chief of the frequent accidents on American railways. The accidents on American lines are classed as to their number and causes as follows by the *Railroad Gazette*:—Collision: Rear, 20; butting, 10; crossing, 5. Derailments: Broken rail, 6; broken frog, 2; broken bridge, 1; spreading of rails, 4; broken wheel, 1; broken axle, 3; broken truck, 1; cattle, 2; land slide, 2; wash-out, 1; snow or ice, 18; misplaced switch, 7; rail removed for repairs, 1; malicious obstruction, 1; unexplained, 4. Other accidents: Boiler explosion, 2; broken parallel-rod, 1; caving of tunnel, 1; car burned while running, 1. Total number of accidents, 94. Five collisions were caused by misplaced switches, four by snow, two by mistakes or misunderstanding of orders, two by failure to use signals, one by fog, and only one by a train breaking in two.

THE most frequent cause of railway accidents is the failure of axles. Besides the 773 accidents on our railways reported last year as causing personal injury, there were 1252 cases reported involving no personal injury. Of the 500 persons killed and 914 injured, ninety-six of the killed and 693 of the injured were passengers. Of these injuries the chief causes were as follows:—Twenty-five persons were killed and forty-nine injured by falling between carriages and platforms; seventeen killed and 470 injured by falling on to platforms, ballast, &c.; thirty-five were killed and eleven injured while passing over the line at stations. Besides these, who were all actually passengers, fifty-eight persons were killed and twenty-one injured while passing over railways at level crossings, 250 persons were killed and 126 injured while trespassing, and to this number must be added fifty-five persons who committed suicide on railways.

THE third main division of the report on the railway accidents in the United Kingdom in 1885 deals with accidents to servants, whether of companies or contractors, caused by the travelling of trains or other vehicles on railways. Here we find 438 killed, and 2036 injured, while the causes of injury are too numerous to be mentioned in detail. The most fatal risk to which the servants are subjected is working on the permanent way, sidings, &c., whereby 107 were killed and 126 injured, while walking, crossing, or standing on the line on duty caused 79 deaths and 108 injuries. Altogether, what with passengers, others of the public, and servants, the total number of persons killed during the year 1885 was 957, against 1134 of the year before, and of injured 3467 persons, against 4100 in 1884. It is satisfactory to note that not only the totals but almost all the items have materially decreased from the year before.

THE total length of the Austro-Hungarian railways in 1885 was 21,980 kilos., against 20,818 in 1884, showing an increase of 1162 kilos., equal to 5·6 per cent. During the same period the traffic had decreased to the extent of 4·8 per cent. for passengers, 1 per cent. for goods, and the return per kilo. had fallen off by 5 per cent. The gross receipts show an increase of only 0·3 per cent., those for passengers and luggage an advance of 2·7 per cent., whereas the goods traffic declined 0·4 per cent. The reduced rates for goods traffic introduced on many lines was accompanied by a simultaneous decline of the traffic in merchandise and other goods, and both circumstances naturally contributed to a reduction of the gross receipts. The average receipts per kilo. were less than in 1884, a year already distinguished by low average returns. They amounted to 12,223 florins in 1882, 12,268 florins in 1883, 11,718 florins in 1884, and to only 11,135 florins in 1885, and have, consequently, fallen off by nearly 9 per cent. since 1882.

A REMARKABLE instance of the effect of competition by sea and land which at present exists has been brought to our notice within the last few days. The *Railway News* says a contract has just been entered into between the agents of Italian railways for the delivery at Venice of coal shipped at Cardiff and Swansea, free of all charges, at 20s. per ton. This is exactly the price at which the same coal is delivered to the Metropolitan Railway Company in London, the competition between sea-going ships being so severe that the freight is little more than nominal. Another illustration of the effect of competition by sea with our own railways is afforded by the fact that the quantity of coal brought by coasting vessels into London from Welsh ports has increased to such an extent as seriously to curtail the quantity carried by the Great Western to London. For the two months of the current year the decrease in coal carried to London on the Great Western was over 20,000 tons as compared with 1884. There is sea competition also with other ports as well as with London. At the meeting of the Great Western Company Sir Daniel Gooch stated that coal was conveyed from Cardiff to London at 4s. per ton, or equal to a railway fare of one farthing per ton per mile—a rate with which the railway companies could not profitably compete.

A SOMEWHAT novel design for a convertible sleeping and day car is described by the *Railroad Gazette*, introduced by Mr. W. K. Tubman, of Baltimore, Md. The main feature is a series of compartments, formed by removable partitions, along one side of a car with an aisle along the other, and removable yielding berths athwart the car supported upon springs. Curtains separate the berth sections. The berth supports attach to the plates instead of to the roof; the beds are of a single thickness of flexible woven wire, and both the supports and bed bottoms are, at the same time, made taut, to prevent swinging, by a single ratchet and pawl. The whole being integral can quickly be unfastened, folded, and stored in a space beneath the windows, under the floor or in a locker at the end of the car. Folding chairs are used. The bed frames are composed of hollow metallic rods ½in. in diameter, covered with woven wire and supported by four coiled springs. The mattress is 3in. thick, a netting surrounds each bed, and is attached to the tube supports inclosing springs. The tubes turn down upon the bed frame when the berths are folded up and stowed away under the floor. The folding chairs used by day are stowed away at night in a similar manner. The greater room for dressing and the absence of any partitions by day appear to be the most salient advantages conferred by this style of car. The inventor claims that the method of suspending the berths will give a particularly easy motion favourable to sleep.

NOTES AND MEMORANDA.

THE *Times'* obituary of March 23rd included advertisement notices of 81 deaths, of which number 44 represent a total of 3133 years, or an average of 78 years each.

HERR A. BLUEMCKE has published determinations of the specific heat of soda solutions containing more than 50 per cent., as possessing a practical value in connection with Honigmann's soda process. The specific heat increases with the concentration until it reaches a maximum at a 73 per cent. solution; thence it decreases.

THE *Colonies and India* says:—"Great satisfaction is felt by the press throughout Western Australia at the satisfactory condition of the colony's finances for the past year, the revenue exceeding the expenditure by nearly £90,000. The Public Works Department is advertising for tenders for a large number of extensive public works in various parts of the colony, and the prospects of the colony never looked brighter than at present." Engineers ought to find a field in Australia that would employ many.

A RECENT number of the "Journal" of the Russian Physico-Chemical Society contains an elaborate paper, by K. Kraewitch, on the relation between the elasticity and density of the air in a rarified condition. His experiments on the velocity of sound show that, at a temperature of 17·5 deg. Cent., the velocity decreased from 330 m. at a pressure of 761 mm., to 171 m. at a pressure of 2·6 mm. At a pressure of 280 mm. the velocity is about the same as the mean air pressure, but it diminishes rapidly below 280 mm. He concluded that gases below this pressure do not obey the Boyle-Mariotte law.

IN a note read by M. Sarrau at the Paris Academy of Sciences, on the compressibility of fluids, the author shows that the formula—

$$p = \frac{R\,T}{v - a} - \frac{K}{T\,(v + \beta)^2}$$

proposed by M. Clausius for carbonic acid, in which p = the pressure, v = volume, and T = absolute temperature, is applicable to other gases. He also stated that for these gases he had deduced the elements approaching the critical point before the experiments of MM. Wroblewski and Olszewski.

A CURIOUS phenomenon has been observed by M. Blondlot, and communicated to the French Academy of Sciences. A disc of platinum and a disc of copper, 0·03 metre in diameter, were fixed vertically in front of each other by help of two platinum stands. The discs were three or four millimetres apart, and both were placed inside a bell jar of porcelain, open below. The apparatus was then heated red-hot for three hours by means of a gas furnace, and although there was no electric current, it was found that the face of the platinum disc was blackened with a deposit containing copper and platinum. In short, the copper had crossed from the copper plate to the platinum one. M. Blondlot, by repeating the experiment in different gas, found that the nitrogen of the air was the agent in this transport of matter. The nitrogen combines with the copper, and lodges on the platinum, either incorporating itself with the latter or decomposing in contact with it under the influence of its high temperature.

FROM a large number of determinations of the electro-motive force of the currents yielded by zinc-copper and lead-platinum couples in various simple saline solutions, B. C. Damien—*Ann. Chim. Phys.*—finds that the electro-motive force as a rule decreases with the time the couple is immersed. In the case, however, of the zinc-copper couple in solutions of the chlorides, the electro-motive force at first slowly increases. The electro-motive force of the current yielded by a zinc-copper couple in a solution of magnesium sulphate is very constant, scarcely varying 0·017 volt during twelve months, and is not appreciably affected by changes either of the strength of the solution or of temperature. By introducing an exterior resistance of 20,000 ohms, the current becomes practically invariable, even when the couple is kept in circuit. The author proposes to employ this couple for the generation of currents of standard strength. The zinc-copper couple yields currents whose electro-motive force is almost identical for members of any class of salts containing a given acid, but varies greatly with a change of acid. Amalgamation of the zinc slightly increases the electro-motive force at first, but it decreases more rapidly than is the case when unamalgamated zinc is employed. The current obtained from a platinum and amalgamated zinc couple in dilute sulphuric acid has its maximum electro-motive force when its solution contains 30 per cent. of acid.

THE following is suggested in the *Electrician* as a perfectly fair arc lamp carbon test:—Take a dynamo machine, with its full complement of lamps, and trim the lamps with the same make of carbons; note the speed of the dynamo carefully, and during the test measure the current at frequent intervals with an ammeter; see that all the lamps burn freely, without hissing, and yet not with arcs so long as to flame. Measure the electro-motive force around each arc with a voltmeter. Burn the lamps until all the carbons are consumed, or burn them, say, for four hours, and then measure the length of carbons consumed, and calculate the total time that they would burn, taking the average result. In testing another make of carbon pursue the same course. You will now be able to note the difference between various grades of carbons. Some carbons will be soft, and will consume so rapidly as to make them uneconomical; others will be of such high resistance that the machine will not run its full complement of lamps with good long arcs, without increasing its speed. In such a case a lamp or two could be cut out of the circuit until the arcs are normal, and this would show the degree of economy of the first carbons over the others. It is not infrequently the custom to mix several different brands of carbons on the same circuit of lamps, and then judge of the results entirely by the length of time each carbon burns. Nothing could be further from a real test. A carbon which would burn nine hours would frequently be less economical than a carbon burning eight hours; as generally the latter carbon would enable you to burn, say, two more lamps on a thirty-light circuit than the former. Calculating the rental receipts from these two lamps, it would be found that they would more than make up the difference due to more rapid consumption of the eight-hour carbons.

A NEW sweetening agent has been produced from coal-tar. It is known to chemists as "benzoyl sulphuric imide," but it is proposed to name it "saccharine." The discoverer is Dr. Fahlberg, a German chemist in America, and its preparation and properties were recently described by Mr. Ivan Levinstein at a meeting of the Manchester Section of the Society of Chemical Industry. Saccharine presents the appearance of a white powder, and crystallises from its aqueous solution in thick short prisms, which are with difficulty soluble in cold water, but more easily in warm. Alcohol, ether, glucose, glycerol, &c., are good solvents of saccharine. It melts at 200 deg. Cent., with partial decomposition; its taste in diluted solutions is intensely sweet, so much so that one part will give a very sweet taste to 10,000 parts of water. Saccharine forms salts, all of which possess a powerful saccharine taste; it is endowed with moderately strong antiseptic properties, and is not decomposed in the human system, but eliminated from the body without undergoing any change. It is about 230 times sweeter than the best cane or beetroot sugar. The use of saccharine will therefore be not merely as a probable substitute for sugar, but it may even be applied to medicinal purposes where sugar is not permissible. One part of saccharine added to 1000 parts of glucose forms a mixture quite as sweet as ordinary cane sugar. The present price is 50s. per pound; but although very high, this is not prohibitory, as its sweetening power is so great; but it is very probable the cost of its manufacture will soon be very considerably reduced. The *Brewers' Guardian* says: "This new compound will be of great interest to brewers, for not only is it perfectly wholesome, but it possesses, in addition to its intensely sweet taste, decided antiseptic properties, and therefore may be usefully, safely, and advantageously added to beer."

MISCELLANEA.

MESSRS. KINCAIRD & CO., engineers, Greenock, have contracted to supply, at a cost of between £2000 and £3000, dock gates for the San Fernando Dock Company.

MESSRS. A. SMITH AND STEVENS have recently connected their hydraulic balance lift at Lloyd's Rooms, Royal Exchange, with the Hydraulic Power Company's mains. This lift is now making about forty journeys per hour, and is probably carrying more passengers than any other lift in London, the estimated number being over 1000 per day.

OPERATIONS which have been proceeding for some time at the Marquis of Lothian's Newbattle Colliery, with the object of developing the workings, are now almost completed. The present output is about 1000 tons daily, and it is expected that it will be considerably increased. About 700 men are engaged in this colliery, into which the electric light has just been introduced.

IN accordance with the recommendation of Sir John Coode, tenders have been accepted for the extension of the eastern breakwater in Cleveland Bay, Queensland, 300ft. instead of 1500ft., as at first projected. Messrs. Brand and Dryboro, the lowest tenderers for the former contract, were the successful tenderers in the latter instance. This will greatly advantage Cleveland.

MESSRS. SCHAFFER AND BUDENBERG, of Manchester, are supplying the whole of the injectors for feeding the boilers in connection with the engines at the Colonial and Indian Exhibition. A portion of these will be of the ordinary type, but amongst them will be four of a new type, which Messrs. Schaffer and Budenberg have termed their "perfect re-starting injectors," which will each deliver 450 gals. per hour.

EFFORTS which proved futile a couple of years back are again being made in the West Lancashire district to establish a sliding scale for the regulation of miners' wages. The employers and the men appear to be now dealing with the question in a very conciliatory manner, and with an evident desire to arrive at some settled arrangement, which, it is to be hoped, will have good results upon the future relations of capital and labour in this important colliery district.

MR. WATERHOUSE, accountant to the North of England Board of Arbitration, has just issued his report for the months of January and February. The average net realised price of plates, bars, angles, and rails was £4 14s. 9·64d. per ton, being a reduction of 2½d. per ton when compared with the previous two months. The output was 44,518 tons, being an increase of 1500 tons. In January and February, 1885, the output was 62,460 tons, and in the corresponding period of 1884 it was 90,616 tons. This enormous falling-off is principally in the item of plates.

WATERWORKS are about to be established at Abbots Langley, Herts, and Messrs. Le Grand and Sutcliff, of Bunhill-row, London, have been instructed by the company to sink one of their Artesian tube wells 150ft. deep, and of sufficient size to be capable of yielding 100,000 gallons per day of ten hours. As in the case of the Wallingford Waterworks, the well for which was also sunk by Messrs. Le Grand and Sutcliff, the site of the Abbots Langley pumping station will be contiguous to the gasworks at Hunton Bridge, and the pumps will be worked by a pair of gas engines.

AT the Edinburgh International Exhibition, which is to be opened in May and continue till October, the manufacturers of Sheffield are to be worthily represented. An Exhibitors' Committee has been formed, and many of the most skilled artisans of the town have responded to the invitation to exhibit, with the result that in many departments there will be a capital show of Sheffield's high-class work. A good position—what the committee consider the most prominent and best position in the artisan section of the Exhibition—has been secured for the Sheffield workmen. It is intended to have examples of old Sheffield work placed side by side with the specimens of skill made by modern artisans.

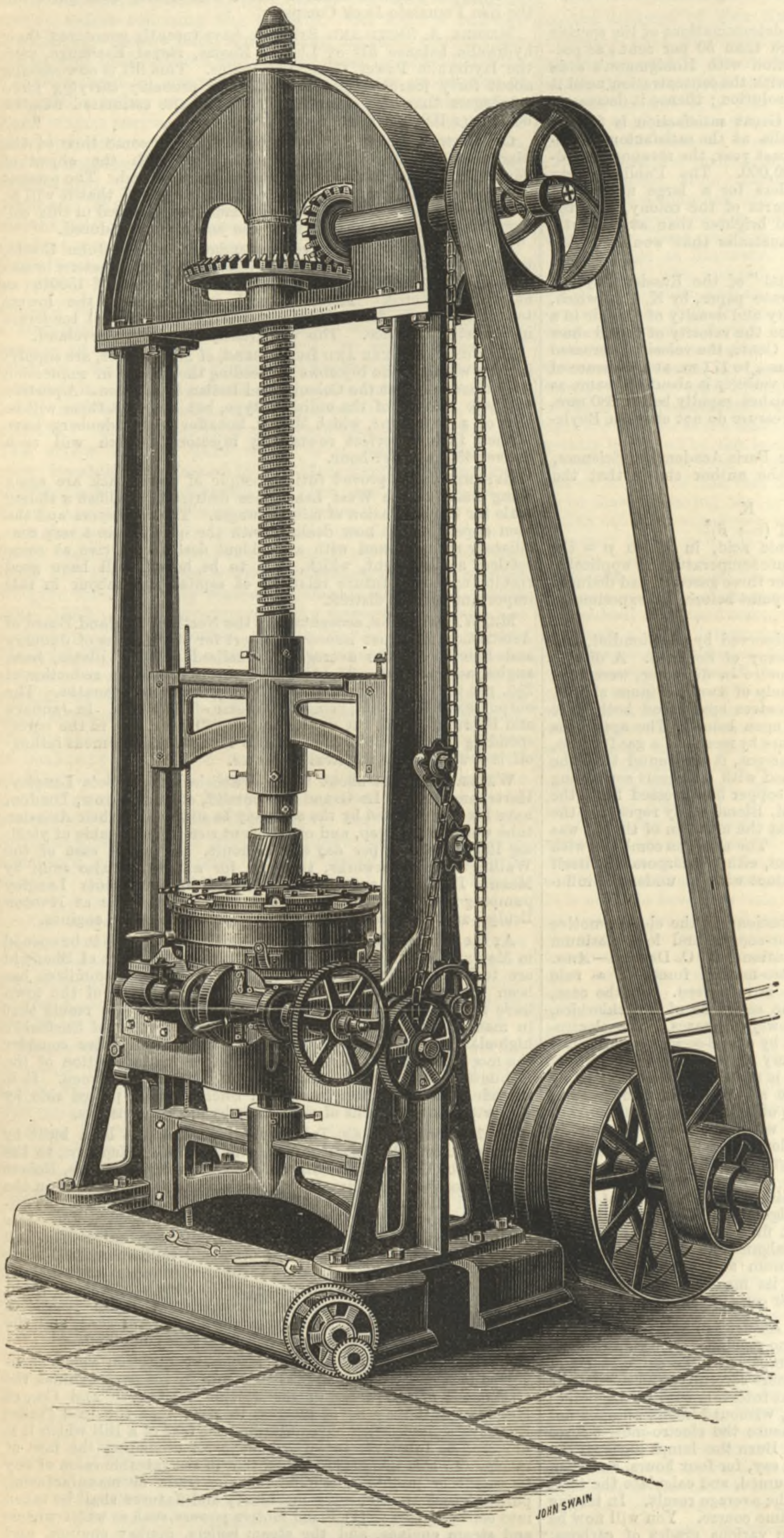
ON 28th inst. the s.s. Talisman, which has just been built by Messrs. R. and W. Hawthorn, Leslie, and Co., Hepburn, to the order of the Ocean Steamship Co., and engined by Messrs. Robert Stephenson and Co., Newcastle, had a very successful trial on the measured mile at Hartley. The dimensions of the vessel are as follows:—Length, 320ft.; breadth, 36ft.; and depth, 27ft. 9in. Her engines are of the Holt's tandem design, having cylinders 27in. and 58in. diameter, with a stroke of 5ft., and indicating 1265-horse power. Steam of 80 lb. pressure is supplied from one large double-ended steel boiler, of a total weight of 75 tons, and this is fitted with Fox's patent corrugated furnaces. A mean result of 12½ knots was attained at full speed during several runs, and the engines worked most smoothly, and were easily handled.

WITH regard to the rating of machinery question which is involved in the important appeal case now in progress against the assessment of the works of Sir Joseph Whitworth and Co., of Manchester, it may be of interest to state that the Iron Trades Employers' Association have published the text of a Bill which it is proposed to introduce into Parliament for amending the law of rating. In this Bill it is proposed that in the rateable value of any tenement or premises occupied for any trade or manufacturing purposes only the following machinery and fixtures shall be taken into consideration:—(1) Fixed motive powers, such as water-wheels and steam engines, and the steam boilers, donkey engines, and other fixed appurtenances of the said motive powers. (2) Fixed power machinery, such as the shafts, wheels, drums, and their fixed appurtenances which transmit the action of the motive powers to the other machinery fixed and loose. (3) Pipes for steam, gas, and water. Save as above provided, no machinery, whether attached to the tenement or premises or not, is to be taken into consideration in estimating the rateable value.

THE discussion session of the Manchester Association of Engineers was brought to a close on Saturday last, when Mr. T. L. Daltry read a paper on "Certain Motions used in Weaving." The paper was confined to a description of the various drop-box motions in use, with a narrative of the progress which had been made by different inventors, and in conclusion Mr. Daltry briefly referred to an invention he had himself recently patented. The problem of a good drop-box motion, he said, was no easy one to solve; his aim had been to devise a motion that would run at practically any speed—160 picks, for instance—and slip from one box to any other of four boxes. This, after considerable trouble, he had worked out mainly by the introduction of excentrics, and he claimed that one great merit of his invention was the narrowness of the space which it occupied, whilst with the excentric motion, however high the speed, it did not bang the boxes, but lifted and lowered them quite gently. The chair at the meeting was occupied by the president, Mr. W. H. Bailey, and a vote of thanks to Mr. Daltry, moved by Mr. Thos. Ashbury, C.E., and seconded by Mr. Jas. Walthen, brought the proceedings to a close.

THE plans and proposal of Mr. W. H. Radford, C.E., of Nottingham, for the drainage of Newhaven have been accepted. Eighteen competitive plans were sent in. The scheme retains those sewers which are in good condition, and utilises the remainder for surface water only. New well ventilated and flushed sewers will be placed in those streets where they are required. The sewage from the town on the west of the river will be conveyed by a main outfall to a point away from the town and near the mouth of the river, where it will impound in a concrete storage tank during high tide. The sewage will then be run into the mouth of the tidal river at half ebb, so as to take advantage of the powerful seaward current, and the last remnant of the sewage will have entered the river while there is still one and a-half hours of the ebb tide left to wash it far out to sea. On the east of the river the present sewers and outfall at the mouth of the river will be utilised; but the sewage will be prevented from backing up the sewers by a tank, and the sewers will be well ventilated and flushed. Provision is made to connect this outfall at some future time with the main outfall on the west by means of a syphon under the river.

THE MESSER ROLL CORRUGATOR.



THE MESSER CORRUGATOR.

The above illustration represents a machine for grooving rolls, and described in the *Age of Steel* as the "Messer corrugator for corrugating mill rolls," casual mention of which was made in their columns a short time ago. A brief description will enable the reader to understand its working. "The roller to be cut is held firmly by both ends, and travels straight up and down through an opening in the tool head, which, rotating simultaneously determines the degree of spiral. This rotation is accomplished by means of a worm operating on a large worm wheel, which forms the outside of the base of the tool-head. The degree of rotation of the worm shaft being governed by a set of change gears, which can be combined similar to those used in screw-cutting on a lathe, the broad base of the tool-head is graduated as an index plate with a sufficient number of circles, properly divided, to enable any practicable distributions of corrugations per inch of circumference, thus making it certain that at the completion of the roll there will be no extra wide or narrow corrugations. The tool-head can be compared in a general way with a large universal combination chuck with eight jaws; each of these jaws carries a tool. One motion of a lever moves all the tools forward to the work on the down stroke of the roll, while a reverse motion of same draws them back on the up stroke to prevent wear or breaking. Besides this universal motion, each tool can be given an independent adjustment if desirable. The tools used are of ordinary tool steel, and as easily made as a chaser for cutting threads in a lathe. The setting of the tools on the tool-head requires no special skill or experience, the arrangement being such that once put in the tool post it is bound to find its proper place. After making the starting cut on the roll, the tools need no further care until the roll is finished. As each tool is required to cut only one-eighth of the face or circumference of the roll, the wear, and consequent grinding of tools so common to chilled ironwork, are dispensed with, and a smooth, uniformly cut roll is the result. It is well known that on machines only using one tool it becomes necessary to grind and reset them several times before a roll is finished. Grinding takes time, and proper resetting is a delicate operation.

On machines where the roll is held by one end only, and operated upon by a single tool, there is naturally a strong tendency to spring away from the cut. In this machine the roller being held at both ends, the manufacturers overcome the spring or torsion of the gudgeons. Furthermore, there being eight tools spaced diametrically opposite one another, each serves as a support to the other, thus relieving each from an unnatural and injurious strain. Besides being used as a corrugator, this machine is very efficient as a means for scraping off old rolls before grinding, which makes a marked saving in emery wheels. The most prominent merit of this corrugator is the quantity of work which can be accomplished with it. Six rolls can be cut per day by a good man on rolls not coarser than sixteen per inch, and the workmanship be correct. Nevertheless, the manufacturers guarantee only four 9 by 18 rolls, twenty corrugations, as an average ten hours' work. Some corrugations, of course, will admit of a larger output and some—for example, two per inch less—depending somewhat on the operator. The manufacturers do not claim that the Messer corrugator is cheaper than others now in general use, but they do claim that its increased first cost is more than counter-balanced by the superiority of its merits. The Messer corrugator, though in constant practical use for over a year, has only lately been placed on the market, and has received a very flattering reception from the very best firms in the country. Messrs. Hill, Clarke, and Co., of St. Louis, are the makers."

A CRUISER FOR SPAIN.

It may be remembered by many of our readers that towards the end of last summer the Spanish Government issued invitations to some of the largest ship constructors in Europe to submit designs and tenders to build two third-class cruisers of 1000 tons displacement and one first-class cruiser of 4300 tons. Unlike the English naval constructors, the Spanish ones preferred to trust to private enterprise and competition rather than to their own skill exclusively. By this means they placed themselves in the happy position of critics instead of acting the martyr-like part of the criticised. The principal necessary conditions were clearly and fully laid down, and the competing constructors were left to produce the highest results in coal endurance, speed, and protection at the most reasonable price. A committee consisting of some of the most eminent naval officers and naval architects in Spain has been sitting for some months past, and has at length decided that Messrs. J. and G. Thomson have produced a design and tender which in all respects is the most satisfactory. This eminent firm has associated itself with high-speed steamers for many years past, and is second to none in success in this interesting but risky business. It is only necessary to say that they are builders of the Servia, Aurania, America, Columba, Scout, &c., to justify one in saying that the Spanish Government have a sufficient guarantee that whatever can be done to produce the highest possible speed will be done by these constructors. We find by reference to the programme of conditions, and to information recently to hand from Madrid, that the design of Messrs. Thomson is of the following particulars and dimensions:—

Length between perpendiculars	300ft.
Breadth, moulded	50ft.
Depth, moulded	31ft. 6in.
Displacement	4300 tons.
Speed under natural draught..	$18\frac{1}{4}$ knots.
" forced "	$20\frac{1}{2}$ knots.
I.H.P. of engines..	11,000.
Draught of water..	20ft.
Coal capacity..	1100 tons.
Distance can steam at cruising speed..	12,000 knots.
Complement of men and officers	300.

Armament:—4 12-ton guns of Hontarios type; 6 5in. guns of Hontarios type; 8 6-prs. rapid firing; 8 Nordenfelt machine gun; 5 torpedo tubes; 10 torpedoes.

A complete protective deck will be constructed from end to end of vessel. This deck is 6ft. below water-line at side, and rounds up to the water-line at the middle. This deck is $4\frac{3}{4}$in. thick on sloped part in way of machinery and magazines, and 3in. thick on flat part. Before and abaft these spaces the deck is reduced 1in. in thickness. The vessel is very completely sub-divided in the greatest practicable number of compartments. In the vicinity of the water-line above the protective deck the whole space is cut up by bunker bulkheads and cofferdams, so that when the ship is fully laden it will take a considerable amount of destruction of the thin plating to render the vessel in anything like a critical condition as to buoyancy or stability.

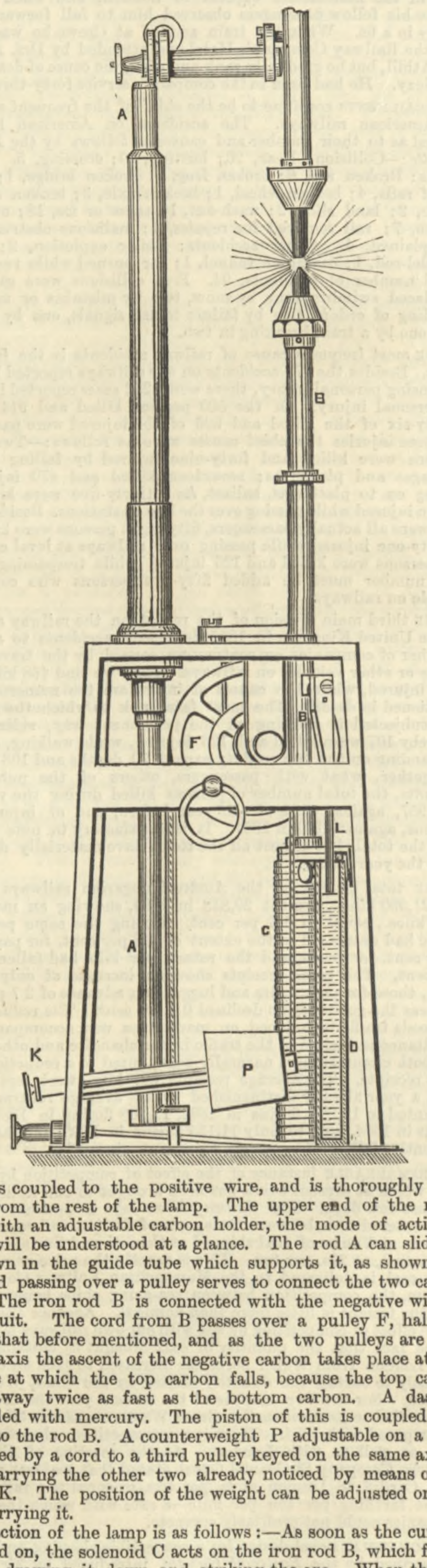
The above outline description will enable any one familiar with the subject to say that this vessel, for her size, is very formidable. In the descriptions of the belted cruiser or improved Mersey type we have already published, it will be found that the speed of these vessels is to be 18 knots, their armament is two 18-ton and ten 6in. guns, their protection is a partial belt of 10in. side armour, $5\frac{1}{2}$ft. wide, surmounted by a deck 2in. thick. These vessels are 300ft. long by 56ft. wide, and are of 5000 tons displacement. We place these facts in juxtaposition to the description of the Spanish cruiser not to disparage the former so much as to show that when matters of ship designing were left to private enterprise the result is not inferior to that which is obtained by the united wisdom of the naval officers and naval constructors of our own Admiralty.

We may remark that this is the second high-speed warship entrusted by the Spanish Government to Messrs. Thomson.

THE JASPAR ARC LAMP.

Among the most satisfactory lamps at the Antwerp Exhibition of last year must be included the Jaspar, which, although by no means a pretty lamp to look at, burns with perfect steadiness, and is very simple in construction.

The lamp is made in two patterns, one for suspension, while the other, which we illustrate, is intended to be supported on a stand. It is of the Archereau type improved. Our engraving shows the lamp when the carbons are nearly burned out. The



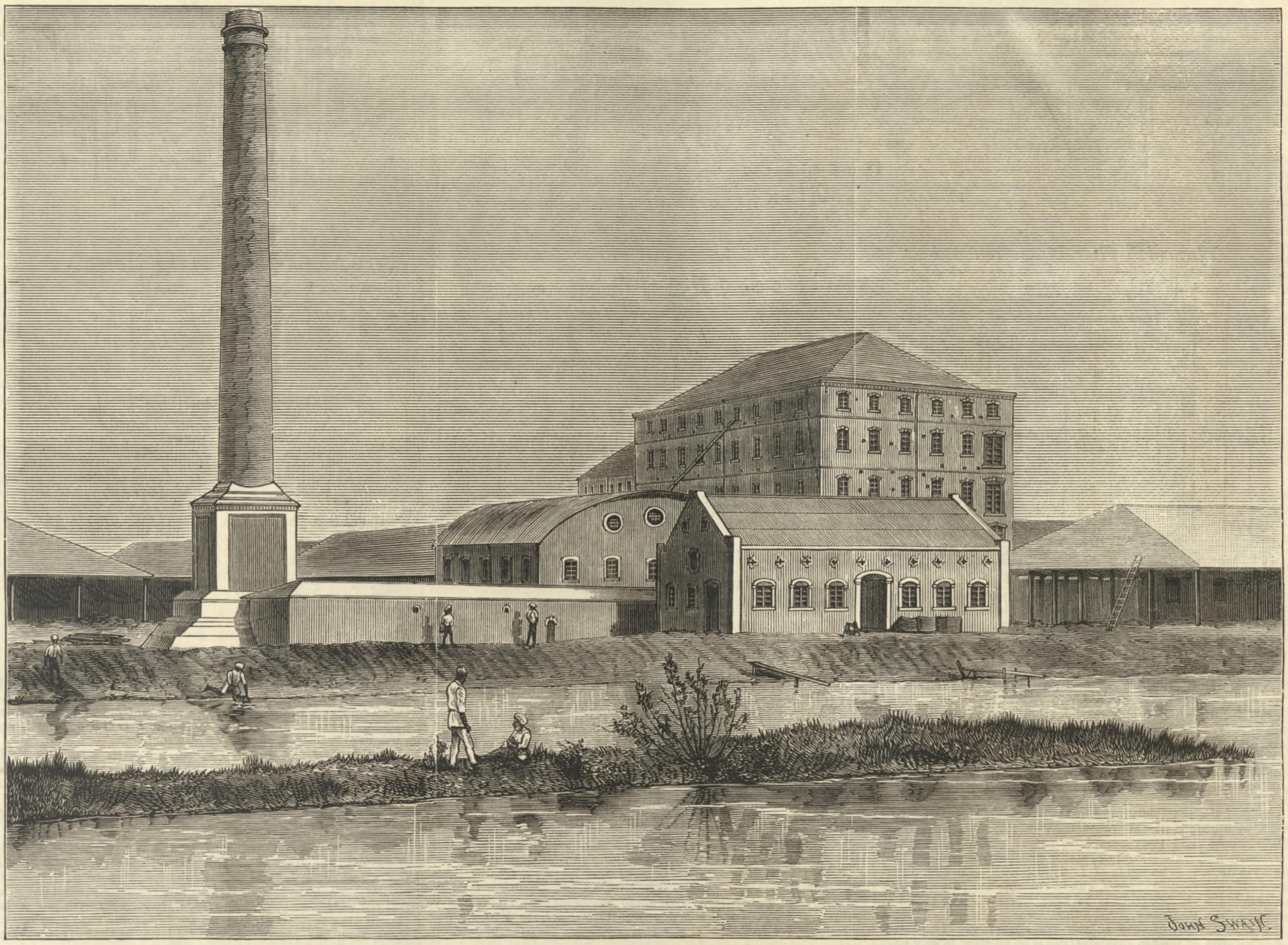
rod A is coupled to the positive wire, and is thoroughly insulated from the rest of the lamp. The upper end of the rod is fitted with an adjustable carbon holder, the mode of action of which will be understood at a glance. The rod A can slide up and down in the guide tube which supports it, as shown. A fine cord passing over a pulley serves to connect the two carbon rods. The iron rod B is connected with the negative wire of the circuit. The cord from B passes over a pulley F, half the size of that before mentioned, and as the two pulleys are fixed on one axis the ascent of the negative carbon takes place at half the rate at which the top carbon falls, because the top carbon burns away twice as fast as the bottom carbon. A dashpot D is filled with mercury. The piston of this is coupled by a link L to the rod B. A counterweight P adjustable on a lever is coupled by a cord to a third pulley keyed on the same axis as those carrying the other two already noticed by means of the button K. The position of the weight can be adjusted on the lever carrying it.

The action of the lamp is as follows:—As soon as the current is turned on, the solenoid C acts on the iron rod B, which forms its core, drawing it down and striking the arc. When the arc becomes too long the action of the current becomes weakened, and the carbons so urged by the weight of the rod A approach each other. The current then becomes stronger in the solenoid, and the further advance of the carbons is prevented. The counterweight F pulls against A, and as it can be adjusted for any current, the same regulator can be used on different currents through a wide range. The dashpot prevents the carbons from jumping. At first sight it would appear that the distance between the carbons would augment as they became burned away. This is prevented by the varying action of the counterweight P.

It will be seen that this lamp is entirely dependent for its efficiency on the mercury dashpot, and there is no provision for working it in series. The lamp we illustrate is intended to run alone with a current of 25 ampères. The lamp can, it is claimed, be worked successfully in multiple arc. It is certainly extremely simple, but it will not commend itself to English electricians, who have set their faces against the use of dash-pots in any form, whether filled with glycerine or any other liquid.

RICE MILL AT RANGOON.

ERECTED FOR MESSRS. MOHR BROTHERS AND CO., BY DOUGLAS AND GRANT, ENGINEERS, KIRKCALDY, SCOTLAND.

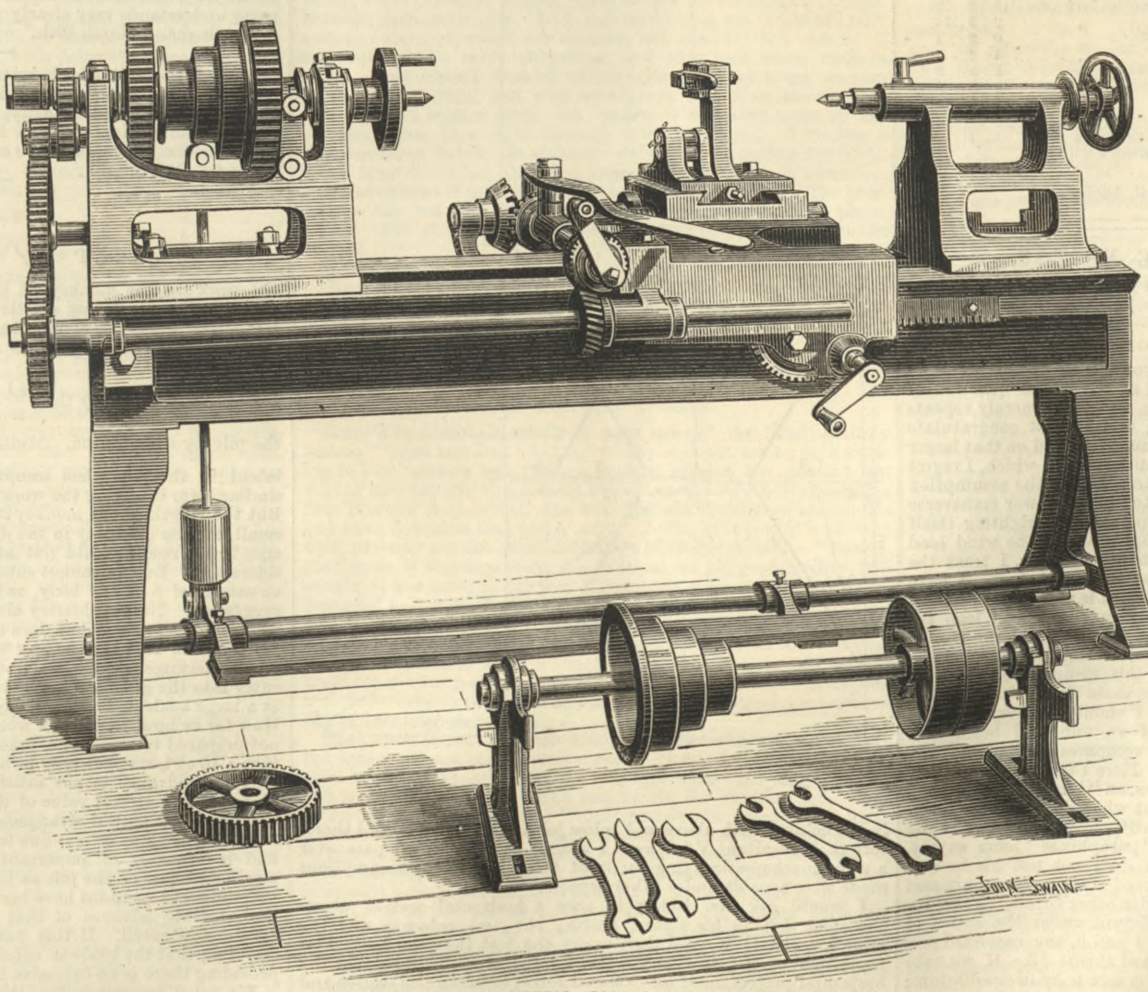


RICE MILL AT RANGOON.

This mill, which, we understand, is the largest rice mill in the East, has been in operation for the last two years. It is capable of turning out 400 tons of Straits quality white rice in twenty-four hours. The brickbuilding was executed by a local firm. The columns, girders, and iron roofing, together with the engines and boilers, and the whole internal machinery of the mill, were supplied by Messrs. Douglas and Grant. This firm has been known for many years as the most extensive makers of this class of work. The engines are compound surface condensing, and develope 700 indicated horse-power. The boilers, five in number, are fitted with paddy husk burning apparatus, which supersedes the use of coal as fuel. Messrs. Douglas and Grant are at present erecting a large rice mill in the French settlement of Saigon.

DYNAMO WINDING MACHINES.

This machine for winding the wire on dynamo armatures is designed so as to wind the wire tightly and evenly on the armatures ; the machine is arranged with friction-feed for wire, hand-reversing motion to feed-slide, and pedal-stop motion to spindle. The whole of the machine is under the command of one attendant, who does not require to move from his place, the stopping, reversing, &c., being under easy control. The machine will no doubt be very useful for makers of dynamos. The machine as shown will admit 20in. diameter and 3ft. between the centres. It is made by Messrs. Wilkinson and Lister, Keighley.

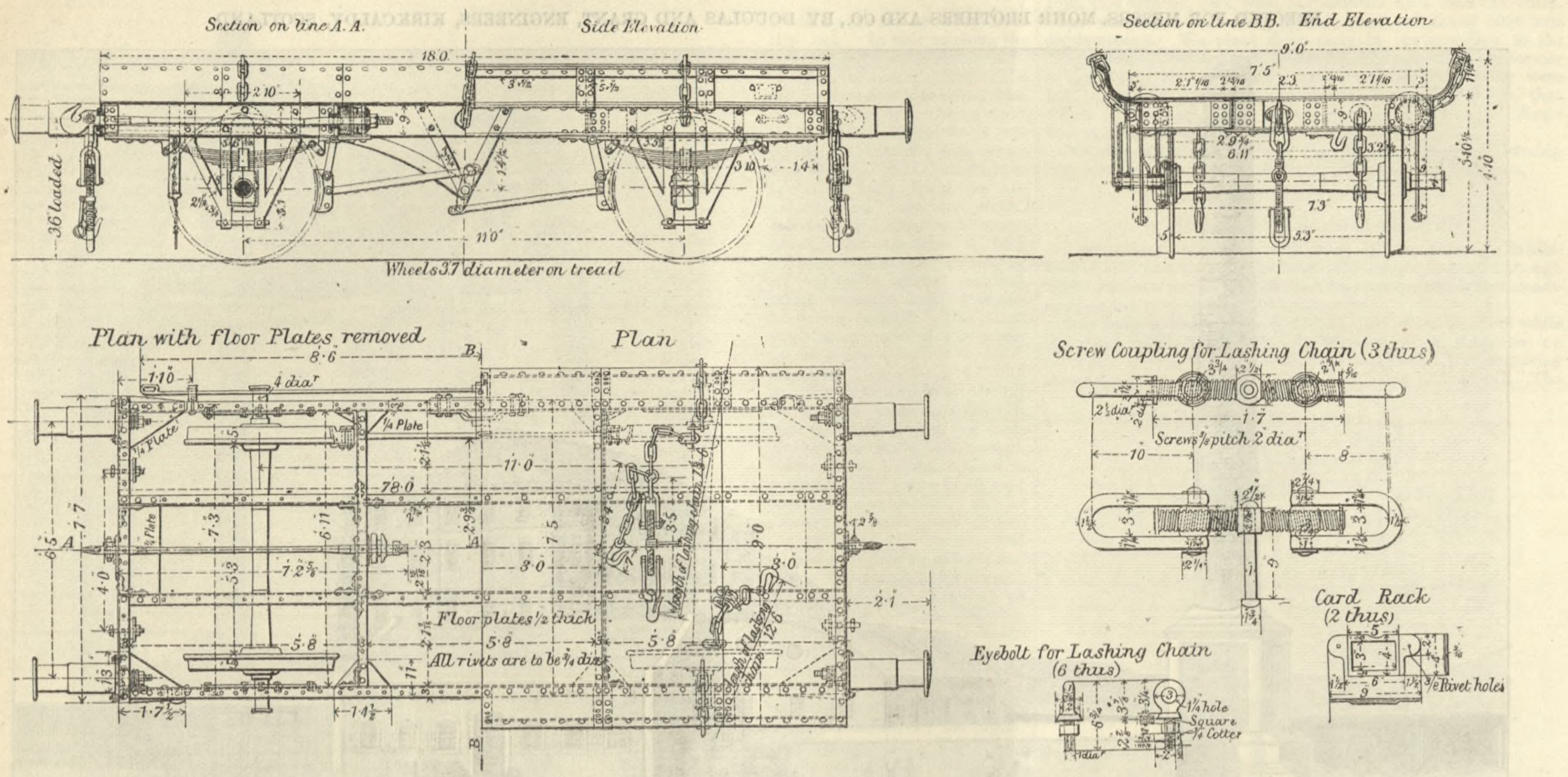


WILKINSON AND LISTER'S DYNAMO WINDING MACHINE.

INTERCOLONIAL RAILWAY OF CANADA.

At a meeting of the Association of the Manchester Students of the Institution of Civil Engineers, held on Wednesday, 17th inst., Mr. W. T. Olive, Assoc. M. Inst. C.E., chief engineering assistant to the Manchester Corporation, read a paper on "Some Features of the Intercolonial Railway of Canada." The author at the outset dwelt at considerable length on the difficulties that were experienced in regard to the question of the boundary line between New Brunswick and Maine, through the action of the United States when it had become known that a direct railway between Quebec and St. John was in contemplation. The drainage areas of the country being involved in the negotiations which followed, an enlarged map showing the various watersheds was supplied, to which frequent reference was made in following the several routes that were from time to time surveyed and proposed. At last, in 1842, the Maine boundary was finally settled by the Ashburton Treaty, whereby the boundary was carried some hundred miles to the north of that defined in the treaty of 1783, thus ceding to the United States 11,000 square miles of British territory, equivalent in size to two of the smaller States, its effect being almost to sever the geographical connection between the maritime provinces and the Canadas. The location of the line being necessarily confined to British territory, it was forced to make a considerable detour to avoid entering the State of Maine and for military purposes, thus necessitating the construction of an additional 250 miles of railway, and an expenditure of £2,000,000 which otherwise would not have been required. Proceeding to other difficulties which had to be met, Mr. Olive instanced in detail (1) the negotiations which took place ere the necessary capital was forthcoming—eventually a Bill in 1867 provided £3,000,000; (2) the opposition encountered by the engineer-in-chief, Mr. Sandford Fleming, C.E., C.M.G., the chief engineer also to the Canadian Pacific Railway, in determining that all superstructures of bridges be of iron instead of wood; (3) the detriment to the line, for all time, coming through turning it a long way out of its course to serve private interests; (4) the interference of the commissioners appointed to manage the railway as to the basis on which contracts should be entered into; (5) the lack of any surveys or maps of the country passed through, &c. The engineering character of the line was next dwelt upon, and was illustrated by pen-and-ink sketches, showing (*a*) the system of deep drainage in embankments and cuttings to prevent damage from the severe frosts; (*b*) the clearing of the line in forest land to avoid obstruction from falling trees or risk of bush fires; (*c*) the form of cutting to allow for the heavy snowfalls of some districts and of the action of snow ploughs—cuttings generally were 30ft. wide at formation, with slopes $1\frac{1}{2}$ to 1; (*d*) the type of box culverts, with deep apron walls; (*e*) the arch culvert for streams requiring a waterway from 4ft. to 20ft.; (*f*) iron pipe culverts bedded in concrete, with masonry cross-walls; (*g*) the arrangements for diversion of streams in crossing ravines; (*h*) the detail of the permanent way—steel rails, 57 lb. to the yard, with scabbard joints, and spiked to cross sleepers; (*i*) the forms of piers or towers used, in place of abutments and wing-walls as in this country, with a contrast of the cost, showing a great economy in the adoption of this system; (*j*) ice breakers for the river piers of bridges, &c. In the Nova Scotia district occur the sharpest curve—1432ft. radius—the steepest gradient—1 in 100—the highest bridge, and the deepest embankment. On the Intercolonial Railway the bridge spans range from 24ft. the minimum to 200ft. the maximum. A description was given in detail of the Mélis and Amqui Bridges, and the mode of their erection, and a series of views of the most important structures was exhibited.

CONTRACTS OPEN—IRON TIMBER TRUCKS.



CONTRACTS OPEN.

INDIAN STATE RAILWAYS—PUNJAB NORTHERN RAILWAY.

The work required under this specification comprises the construction, supply, and delivery in England, at one or more ports named, of underframes, underframe and body ironwork, with all requisite bolts and nuts and rivets for putting the work together in India, for fifteen iron timber trucks, 18ft. long. The contract does not include wheels and axles, bearing and draw and buffer springs.

The whole of the materials used to be of the best quality, and subject to the approval of the Inspector-General. All draw-bars, with their hooks and nuts complete, safety chains with their hooks, eyebolts and nuts complete, screw couplings complete, and coupling shackle, are to be made of Lowmoor iron, supplied direct from the Lowmoor Iron Company, cut to suitable lengths and sizes for each article; and each piece is to bear the stamp or brand of the Lowmoor Iron Company. All other wrought iron to be best best, or iron of similar quality in the opinion of the Inspector-General. No iron of foreign manufacture is to be used in any part of the work under this contract. The channel bars of steel and the angle bars and plates may be made of steel of such strength and quality that it shall be equal to a tensional strain of not less than 26 tons, or more than 29 tons, with contraction of 35 per cent., and must be capable of being bent double on itself without showing any signs of fracture. Every piece of iron or steel must be made to template, and be interchangeable.

	Cwt.	qr.	lb.
Total weight of steel channel bar for one underframe	15	3	10
" ironwork " "	9	2	18
" buffer ironwork " "	6	3	4
" Lowmoor ironwork " "	4	2	6
" cast iron " "	1	0	9
" brake gear " "	2	3	9
" body ironwork " "	39	0	11½
" bolts and nuts " "	0	2	0½
" rivets for one underframe and body	1	1	0
Estimated total weight of steel and ironwork required for one iron timber truck, 18ft. long	81	2	22

Tenders to be sent in by the 6th April, 1886.

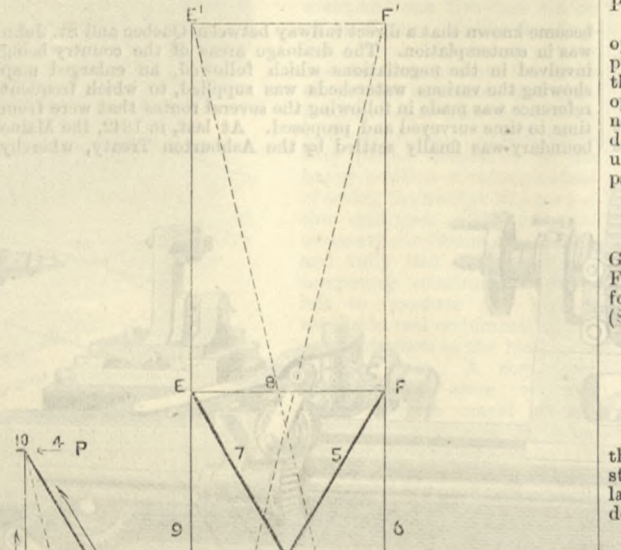
LETTERS TO THE EDITOR.

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

AMERICAN BRIDGES.

Sir,—The two letters appearing in your issue of this week do not appear to advance the settlement of the vexed question of unbraced cantilevers under wind. Mr. J. Reilly merely repeats Waddell's treatment in greater detail; and I must congratulate him both on the good tone of his communication and on that larger capacity for swallowing Waddell's assumptions, with which, I regret to say, nature has not endowed me. First, I deny the assumption that the wind load is entirely transmitted to the lower transverse bracing; on the contrary, I hold that the frame, in righting itself under excentric load, casts about an equal share of the wind load upon the upper and lower systems. In other terms, I treat the frame for torsion free to move both at head and foot. I have outlined this idea in my second paper, which is now in your hands. Then, again, the assumption that the shearing force can leap the unbraced panel and reach the feet E and F, without giving rise to local bending moments at those points, is simply preposterous. Professor Smith's diagram depends on this assumption, which he acknowledges in his last note, but at the same time tries to saddle the same error upon my shoulders. I should be very sorry to accept Professor Smith's treatment of an unbraced beam as a Bollman truss. Then Professor Smith compares his "ideal" bars to "imaginary quantities" in algebra. Here I am disposed to take him at his word; for, as everybody knows, an "imaginary quantity" is an even root of a negative value. But what the Professor really means is, of course, a "subsidiary quantity." Then, why not use the correct term, and avoid having to "paraphrase" loose expressions? But the fact is Professor Smith does not use his bars as subsidiary quantities, which, having served their purpose, are cast aside in name but retained in value under other forms. Take, for instance, the joint K, which is in equilibrium under the action of the downward pull O F or 6, the upward pull 9, the eastward pull 8, the westward pull 11, and the eastward thrust 12. If we take away any one of these stresses the joint ceases to be in equilibrium; therefore, I strongly object to Professor Smith taking an axe and ruthlessly chopping away his bracing. But let us look at the very foundation of the diagram, where Professor Smith, assuming that the point F is a double point at which the two bars 5 and 6 meet, considers that the two forces 1 and 2 compound into a single resultant force R, resolving itself into a downward pull O F, or 6, along the lower part of the column, and a dig or thrust along the rafter 5. Here, at the very outset, I object that there is no rafter; that the joint F is not a double but a single point with only one bar 6 terminating there; that, therefore, the forces 1 and 2 cannot compound and resolve themselves in two directions as shown, but that the system reduces to a force and a couple incapable of further simplification. To these objections Professor Smith can find no better answer than that they are "very funny."

Mr. Reilly is not correct in taking the stress in the column as O 4, for the line O 4 is really the resultant of the supposed tensions O F or 6 in the lower half, and D E or 9 in the upper half of the column, or what Waddell calls "the released weight V.," and would cease to exist with the tensions of which it is the difference. It will be seen by the figure that lines O F^1 and D E^1 increase in length as the imaginary rafters approach the columns, becoming infinite when the former vanish into the latter. In my last note I put O and C at infinity in consequence of F and E passing to infinity. This, of course, is merely a mathematical deduction depending on the fact that an infinite line must have both its ends at infinity. The same mathematical result can be deduced from Professor Smith's admission that both F and E pass to infinity, for then $V = O F - D E = \infty - \infty$; that is, the tensions



in the column both above and below joint K are infinite, and therefore their resultant V is zero. I would, however, easily pass over a mere mathematical singularity of this kind, if the assumptions made were tenable under other aspects.

I would ask Mr. Reilly to pass a horizontal section above the strut J K in his figure, cutting the two columns and the vibration rod G K, and then apply the test that the horizontal projection of the stresses in the severed bars should balance the horizontal projection of all external forces between the section and the free end of the cantilever. The column stresses, being vertical, have no horizontal components; that of the vibration rod is, when $d = 2f$, $V \tan. \theta = 2(2P + P^1)$; whilst the sum of external horizontal forces is only 2 P. It will be seen that this is merely an analytical repetition of the objection I put into graphic form in my article of the 5th, where it is worth notice that the reciprocal figure of the joint K, drawn to fit Waddell's formula for the stress J K, gives us $V \tan. \theta = 2P =$ sum of external horizontal forces, whereas the same value, as deduced from his formula for V, gives us $V \tan. \theta = 2(2P + P^1)$.

Further, Professor Smith remarks that my assumption that D C bisects O 4 (O z) is incomprehensible. Here Professor Smith fails to understand his own diagram; for, by the figure, since by hypothesis O C = D z and the direction of D C is constant, we have $zy = Oy$.

Lastly, Professor Smith charges me with attacking Professor Waddell in his absence. Now, he must know that the "attack"—if a free and frank expression of implicitly invited opinion can be so misnamed—was not perfectly spontaneous on my part.

March 27th. R. H. Graham.

Sir,—Mr. Graham and Professor Smith are doing a great deal of harm to the cause of graphic statics. They are both apostles of the science of using lines instead of figures to arrive at certain results. Their discussion has, so far, gone to prove that graphics will not enable an engineer to calculate stresses with any certainty. If this view is rejected, and we are to assume that graphics are all right, then the conclusion is forced on us that Mr. Graham and Professor Smith are unable to use them.

To calculate the stress in a trussed bridge is not a very dreadful operation, yet I find that your correspondents are each unable to perform the operation in a way that satisfies the other. How is this? They are dealing with matters of fact, not of theory or opinion; and unless your correspondents can advance something newer and more valuable than they have yet done, the sooner the discussion is closed the better. Up to the present it has been most unedifying, and well calculated to convince students that neither party understands very clearly what he is writing about.

Birmingham, March 30th. Juventus.

Sir,—I think it might interest some of your readers if Mr. Graham would explain why it is that "the tension along the post F H is not a constant quantity, but varies from the value V at the foot to a much less value in the neighbourhood of the joint K." (See The Engineer, page 180 *ante*). W. B. Coventry.

Cardiff, March 28th.

PILE DRIVING.

Sir,—My equation $P = \sqrt{\frac{2 W h E A}{L}}$ is obtained by equating the work in the monkey at the time of impact with the work stored in the pile during elastic compression, clearly shown in my last letter, where the expression is given from which equation (1) is derived. If that expression needs further analysing for Mr. Donaldson, I must say that $\frac{d\,l}{L} = \frac{\frac{P}{A}}{E}$, $d\,l$ being the shortening of the pile by compression. Multiplying $d\,l$ by $\frac{P}{2}$ we get the work latent in the pile when compressed. We might add to this a similar term involving the work latent in the compressed monkey. But the length of the monkey in the numerator of the term being small, and its elasticity in the denominator being large, the difference in the result would not materially affect the practical consideration. But we cannot substitute the complicated articulated structure of a man's body, as in Mr. Donaldson's extraordinary suggestion. Natural history alone should have taught him that what applies to a monkey does not always apply to a man. The 134 tons and 190 tons and any other loads evaluated from equation (1) are contingent values only attained when piles soon after their entry into the ground come upon some unyielding obstruction, such as a large boulder, in such a way that the shoes are not broken up. How far or how little a pile would be damaged by such a load I am not prepared to say. The practical experience adduced to show that a 10 cwt. monkey may be allowed to fall 4ft. on a pile which makes no advance is not satisfactory, because in that case there may still be a virtual value of d, which is an amount to be measured by some special arrangement attached to the pile near ground level. This value of d is due to elastic compression of the ground, and is probably of important magnitude when we reach such small advances of the pile as ⅛in. Hence, we cannot accept $d =$ ⅛in. unless precautions have been taken to prove that it includes the absolute advance of that part of the pile at ground level before any recoil. If this has been done I see no reason for doubting that the loads as calculated by the formulæ are correct, providing there is no excessive loss through friction at the guides.

We must remember, too, that the value of L will be affected if we consider the pile when any considerable length of it is in the ground. If we assume the resistance of the ground to be equally spread over the buried length of the pile, the value of L will be the length standing out of the ground plus half the buried length.

The interpretation of the equation $m v = W\sqrt{\frac{2 H}{g}}$ is a very different thing from the interpretation of the result after using it to a particular case. Algebraic equations are true only of abstract numbers. The equation in question is true only when each letter represents a number. We may easily show this by taking as our unit of mass the mass of a body weighing 16 lb., instead of that of one weighing 32 lb. With this alteration, the equation $m v = W \sqrt{\frac{2 H}{g}}$ is not true. If the momentum of a body was equal to a certain number of tons, why should it be equal to twice that number of tons by only changing the value of one of our units? It is the same body, with the same velocity, and has moved through the same height. The fact is the momentum of the body is not equal to 100 tons, but to 100 units of momentum, and changing the unit of momentum changes the numerical result. If I solve an equation containing implicitly the value of x, my result only tells me that x equals an abstract number. The interpretation of that result does not depend on any other term of the equation, but on the original assumption of the representation of x. Let W, H, and g represent quantities as before with reference to any one pile driver Mr. Donaldson likes to take. Let x = the number of gallons contained by a vessel I have. Given $x = W \sqrt{\frac{2 H}{g}}$, will Mr. Donaldson calculate this out and tell me the value of x? Will he give me the result in tons or in pounds?

I am at a loss to know where the method first came from of multiplying m by v or W by v, and getting the result in tons. There is no doubt it is constantly quoted, and in places one would certainly expect not to find it. I have before me, on page 85 of "Molesworth's Pocket-book" of a few years ago, the "theoretical force of the blow of a falling weight," calculated by multiplying the weight by the velocity, and the result tabulated in tons. If this has ever been used—and if so, how applied practically—I should much like to know. SCRUTATOR.

March 29th.

COMPOUND LOCOMOTIVES.

SIR,—It may be of interest to some of your readers to know that several Dreadnoughts are now working on the Crewe-Carlisle section. They have had new connecting-rods for the high-pressure engine. I give an extract from the Crewe "Coal-sheet" for December, 1885, as I think it may also be of interest. It gives the top and bottom engine in each link and also the average consumption of the whole.

Number of engines.	Miles run.	Coal per mile.	Cost per 100 miles.	Link.
			£ s. d.	
513	4975	34·9	1 4 1	Large compounds
511	1011	49·9	1 7 1	Euston and Carlisle.
Average ..		37·9	1 5 5	
857	5266	33·3	1 3 8	Precedents.
2181	5565	38·2	1 5 1	Preston and Carlisle.
Average ..		35·56	1 4 3	
333	4366	28·7	1 2 11	Small Compounds
374	4565	33·9	1 4 9	Holyhead (Irish Mail).
Average ..		30·8	1 3 6	
231	3900	27·3	1 1 10	Ramsbottoms
1215	3163	34·8	1 4 6	6ft. 6in. 4-coupled engines
Average ..		31·9	1 3 4	

I fancy this will rather astonish the gentlemen who think that by adopting Mr. Webb's system they will effect a saving of fuel. Comparing the precedents and the large compounds it will be seen that the former run a much greater mileage. This is because the compounds are in the shops for repairs so long. According to drivers there is no end to the list of failures. But their heavy coal consumption is, I think, the most conclusive proof against them. Comparing the precedents with the compounds in this respect the comparison damns the compound at once, for, as you truly said in your admirable articles on compound locomotives, "if they are not more economical than ordinary engines, compound locomotives should have no place on our railways, because it can be shown that they possess no other advantage." On this point I entirely agree with you. Mr. Webb has simply elaborated his engines all to no purpose. Here we have two engines, one with 175 lb. boiler pressure, cylinder area equal to two 22⅛in. ordinary cylinders, 20 square feet of grate, and weighing 42½ tons in working order; the other with 17in. cylinders, 150 lb. steam, 17 square feet of grate, and weighing about 30 tons, both doing the same work, and the small engine being far and away the best. The compounds seldom keep time with a good load. A few nights ago the Sarmatian brought the 8.30 into Euston with fifteen carriages four minutes late; again, the Ajax lost fifteen minutes from Rugby to Willesden with twelve carriages on, the train being the up Scotchman due at Euston at 7 p.m. It is, I think, quite clear now that the Webb engines are complete failures. ANTI-COMPOUND.

March 20th.

A DIFFICULT SEARCH.

SIR,—For many years there was located in the darkest and stuffiest part of the dark, stuffy place called the South Kensington Patent Museum, a set of patent specifications, to which access could be had without payment every day in the week. As such specifications could be examined up to 10 p.m. on Mondays, Tuesdays, and Saturdays, it suited my convenience during the last ten years to make many searches amongst them, and I have a very lively recollection of the many discomforts and petty miseries I have suffered whilst doing so. However much it may be my misfortune, I hope it is not my fault that I am a biggish man, measuring 6ft. in height and weighing some 14 stone, that I am obliged to wear spectacles, and that I am unable to kneel for an hour at a time without much discomfort. But whatever my personal imperfections may be, I never could understand why the Museum officials should, in the way they arranged the specifications, have exercised such remarkable ingenuity for the apparently only purpose of distressing me and others like me. Why, for instance, should they have compelled me to go upon my knees in dark, dirty corners with a dripping candle in one hand and a pocket-handkerchief, to serve as a duster, in the other, and then painfully double over my long back till I got my spectacles within range of the half-obliterated dates and numbers on the faded backs of books some 9in. above the floor? Why, again, should I have been obliged to risk my neck by having to balance my fourteen stone on the top of a ricketty ladder, in order to reach heavy books covered with dust and placed on shelves some 12ft. or 14ft. from the ground, the heaviest of which were the bound volumes of THE ENGINEER, located upon the highest shelf of all? I should also like to know why the officials always selected the lightest and most accessible positions for specifications which were seldom or never required, and carefully retained the darkest and most unable-to-be-got-at places for those in the greatest demand; and why the sequences of their years and dates could not have been arranged in a manner more intelligible than the disconnected, haphazard, and difficult-to-follow one always adopted. I could say much more of the strange mismanagement which pervaded the place, were it not the principal object of this letter to call attention to changes recently made, and a state of things now existing which appears to me, if possible, still more objectionable than the old one. A few evenings since I went to the Museum to make a search, and expected to have to do so after the old pattern, when I was surprised to find that it had been broken up, and that the library was closed. On inquiry, I was told that the specifications had been removed to the library of the Science Department, and having made my way there, I was ushered into a large room, at the tables of which were seated a considerable number of ladies and gentlemen deeply engaged in reading or copying books, some of which I noticed were of a very advanced and abstruse character. I was then invited to take my seat at a table amongst them, and informed that as the way in which the specifications had been arranged would not permit of my personally searching amongst them, they would be brought to me by the attendants if I would furnish them with a list of what I required to examine. Feeling a presentiment of what was coming, I selected one of the few vacant seats at a table where I thought I should cause the least trouble to others, and having handed in a list of some 160 specifications I required to see, my search began. Now it so happened to me —and it may happen to others—that a great part of my list referred to patents taken out under the old law, the printed specifications of which are bound together apart from their drawings, all of which latter are mounted in large separate volumes measuring 2ft. by 18in., and weighing some 10 lb. or 15 lb. each. For four hours that evening and three more the next, with more politeness than I could have expected under such aggravating circumstances, the attendants were engaged in getting down and bringing me from a long distance these heavy volumes. I kept no statistics of the scores of journeys they made, the miles they walked, nor the many hundredweights they carried to and fro upon their shoulders. I did not count the heavy bangs which resounded all over the room when the books were dropped upon the table, nor did I measure the number of square feet, or rather yards, of table and floor space I had to appropriate to the exclusion of readers and others better entitled to it than I was. I am also thankful to say that I have no record of the looks of astonishment and the evidences of annoyance shown by those seated around and beyond me, whose studies I was interrupting and whose comfort I was so unwillingly disturbing; but this I do know, that throughout those seven hours I felt ashamed of my position, disgusted with the commotion I was causing, and indignant to think that those who have charge of these specifications cannot arrange them in such a way and in such a place as to permit of my examining them without having to put myself in the incongruous position of a bull in a china shop, and without compelling me to destroy the comfort and spoil the studies of all around me. Feeling too much annoyed to go a third time through such an ordeal, I at much inconvenience finished my search at the Patent-office Library, the arrangement of which would be very nearly perfect if the specification boxes were dusted occasionally.

In conclusion, I would add that although the South Kensington Library was free every day under the old arrangement, a charge of sixpence is now made on each of three days of the week. I do not know whether this charge is a legal one, but at any rate it seems strange that London, unlike most of our large towns, cannot have, as it should do, a free patent library open till ten o'clock every evening of the week. NEMO.

March 22nd.

A CONDENSER PUZZLE.

SIR,—The air pump of one of our engines—compound Corliss horizontal—has given me considerable trouble ever since it started, and I would be greatly favoured if any of your correspondents would help me in the matter. The pump is 36in. diameter, and is driven from the crosshead of the low-pressure piston rod by means of rods and a bell crank lever in the ordinary manner. The stroke is 3ft., and the engine makes fifty revolutions a minute, so the piston speed of pump is 300ft. per minute. There is no separate vessel for a condenser, the exhaust pipe connecting the bottom of the cylinder with the bottom of the pump being used instead of a condenser. The injection enters at the top of this exhaust or condenser pipe, just immediately below the low-pressure cylinder, and 8ft. above the bottom of the pump, so that the water and condensed steam go tumbling down this condenser pipe together, through the foot valve and into the bottom of the pump. The foot valve is 3ft. 6in. wide and 16in. deep. What perplexes me with this pump is the fact that it works very well and very easily for ten or twelve strokes, when, on a sudden, there is a very heavy thud or knock, first at the bottom of the pump, and then at the top. It works again for a few strokes all right, and the knock is again repeated, first at the bottom on the down stroke, and then at the top on the upward stroke. I have a small pet cock immediately below the delivery valve, and I put another air cock in between the bottom of the pump and foot valve. These two cocks helped it a little, but still it knocks, although not quite so bad as at first. Thinking that the knock was caused by sluggish working of the foot valve, and so causing an unsteady flow of water into the pump, I cut the valve into six parts across its width, and left ¼in. between each piece open. Each part could then act independently, and, as I thought, would act smarter, but that did not cure it. I took out the foot valve altogether, and that just about made it right. But when I worked without the foot valve my vacuum came down a little, and that would not do. How the vacuum came down I cannot make out, unless it was that some of the exhaust steam blew right through into the pump. I enclose a diagram taken below the delivery valve, which speaks for itself. There is no doubt but that the pressure on discharge is excessive, and I am afraid it may break a rod or something else. The pressure in the hot well is only 4 lb. when discharge takes place. I hope that some of your correspondents may help me in the matter. PUZZLED.

March 30th.

[No diagram accompanies our correspondent's letter. So far as we can see, the pump loses its water from time to time, and this is the cause of the thump. In other words, the pump is too large for its work. As a rule air pumps are always made much too large.—ED. E.]

GOOD AND BAD CHAINS.

SIR,—The admirable article in your issue of the 22nd January last on "Good and Bad Chains," whilst no doubt acting as a warning to both makers and dealers in iron chains, has also at last stirred into activity the society known as the South Staffordshire Iron Masters' Association, who have issued a circular on the subject and have doubtless sent you a copy. So far as it goes it is all very well, but may not the users and buyers of chains exclaim—"Surely, gentlemen, if it is important, for us to see we get good quality, it is equally if not more so for you to see that your good name is not degraded and your business transferred to other makers. And if this be so, should not your circular contain something more than a warning to buyers? Ought you not in their interest, and for your own protection, to state distinctly that the society will occupy itself for the future in the discovery and exposition of frauds, and will undertake to prosecute any and every case perpetrated against any of its members?"

That there is need for such a notice, those who are engaged in the iron trade are but too well aware. It was iron from Staffordshire that first brought English iron into such high repute abroad and it is still that brand which commands the readiest sale. But is the brand to be relied on? Unfortunately not, because it is quite a common occurrence for manufacturers to be asked by merchants to supply inferior iron branded Staffordshire best. Where the lie —for you can call it nothing else—originates, whether with the merchant here or abroad, it is difficult to say, but that it ought if possible to be put a stop to there can be no question, for by its action both the maker and consumer are defrauded, and if the law regulating trade marks is not sufficiently comprehensive to punish such unjust acts, the present President of the Board of Trade would surely so extend its power as to enable a prosecution to be instituted.

The English manufacturer has hitherto relied on the merchant for the sale of his goods in foreign parts, but he must in future, if he desires success, act more for himself. Patriotism is not a commodity which brings much profit to a merchant, and it is therefore not surprising that if by selling German or Belgian iron instead of English he reaps more advantage, he should neglect the latter in favour of the former.

It is unfortunate perhaps that a new order of things should be necessary, but there is no doubt that if old-established houses, such as Lord Ward's, Barrows, and the New British Iron Company wish to perpetuate their trade and character in the colonies, India, &c., they must follow the advice given in the *Times* of the 23rd May last by Mr. T. R. Morrison, and know for themselves the ins and outs of the foreign trade. FAIR PLAY.

March 31st.

SIR,—I am glad to see that your correspondents, Messrs. J. Wright and Co., Tipton, have noticed my letter of the 12th inst., and given your readers some valuable information about crane chains. But they are professional chain makers, and recommend the very best quality chains replacing them with new ones when strained and worn, which no doubt is the right thing to do. But those who use chains for lifting purposes in large quantities and at great cost would like to take out of their chains the greatest possible amount of work consistent with safety to life and property. And as the treatment of chains for lifting purposes is an important factor, it would be interesting to your readers if we could have the plans adopted by the various large docks in and about London where there are large numbers of cranes of all kinds; also our large gasworks, coal shippers, large warehouses, and extensive factories on the banks of the river Thames. In these large concerns it must be the work of a number of men to have constant supervision of lifting chains, making daily inspection of them when working constantly lifting various substances.

If your readers connected with the various dock companies, &c., would give their method of working and treating these chains, along with our large crane makers, who must have a large practical knowledge of the proper handling of chains, it will prove of great service to those who have not as yet made any provision for the security necessary in working with lifting chains where men's lives are at stake. Bad treatment of the very best chain will ruin it in a short time; good treatment of an ordinary crane chain may prolong its days till it has paid itself in work done, and all the time with perfect safety from the careful attention given to it when at work. CLYDE.

London, March 27th.

SIR,—Messrs. Joseph Wright and Co., of Tipton, having honoured me with a reply to some of my remarks that appeared in your issue of the 19th inst., permit me again to refer to this subject, and I will be brief. In their letter of the 24th inst., addressed to you, they say I am entirely wrong in supposing that public tests can, in any way, improve the quality of branded chains. Now, Sir, I did not suppose anything of the kind. What I say is this: Public tests, as prescribed by me, will prove the quality of any chains, branded or unbranded; and I am one of the many who have little sympathy with the monopoly of created brands, makers' tests, and makers' examinations, believing the public test the proper place to brand the quality of every chain. "Facts are recorded there, not opinions" (Kirkaldy).

I have no knowledge of the conditions of purchase of chain by the Indian-office or the Colonial Department, but I do know that at the present moment the Admiralty have chains proved at public testing establishments. Will Messrs. Joseph Wright and Co. say that the Admiralty contract is not placed with Messrs. Wood and Co., of Saltney, and that chains are not tested at the Saltney public test house, in the presence, and to the satisfaction of an Admiralty inspector?

Criticism on the safe working load of chains, as given by Messrs. Wright and Co., I will not attempt, the conditions being so numerous; but I will venture to say that he is a courageous expert in slinging heavy weights that will lift a finished machine or piece of machinery of 20 cwt. with a ⅜in. sling chain.

The Lawe, South Shields, W. PENMAN.

March 31st.

CURTIN'S BOILERS.

SIR,—I see a letter from Mr. McDonald in your last number as to fixing water tubes in boilers in accordance with my patents, and although this letter is far from clear, I will endeavour to answer it to the best of my ability.

Mr. McDonald makes the assertion that "the flanging of the tube-holes would be a great hindrance to the method ever becoming popular." My experience is quite different, as with proper tools I see no difficulty at all, whilst in further proof of this I may say that two of the largest firms in the country have also offered to do this work for me. What Mr. McDonald means by "sixty tube strakes in one plate" I fail to understand, and must confess that I should be completely floored with such a terrific piece of work. This gentleman also assumes that my tubes are 10in. diameter at large end, and 5in. diameter at small end. This is not correct, neither do I punch the rivet holes in the flanges from templates, but drill them and mark off the tubes afterwards.

I again beg to repeat that I lay no claim to the flanged uptake in the vertical boiler, and as to inspection of the quality of the work, I do not intend to "defy" it, but invite it at all times.

Bristol, March 31st. EDWARD J. CURTIN.

[We can publish no more letters on this subject.—ED. E.]

DR. OTTO'S PATENTS AND THE KORTING GAS ENGINE.

SIR,—Referring to the article on the "Körting Gas Engine," which appeared in your last issue, I think the public should know that so far from its inventors being, in the opinion of Dr. Otto, beyond his reach, the latter gentleman has begun another action against them under the "construction" claim of his German patent. This claim was affirmed to be good in the recent judgment of the German Court of Appeal, and Otto's invention declared to mark an era in the history of the gas engine. That this is true, none who know anything of the subject will dispute. The fact that Messrs. Körting have again been obliged to defend themselves is significant. It shows how difficult it is to make a gas engine which is of any use except on Dr. Otto's lines. Messrs. Körting's former engine would not have infringed the construction claim referred to, but it has been abandoned for that type which Dr. Otto holds that the Court has secured to him as his property.

Manchester, March 30th. F. W. CROSSLEY.

BOILER EXPLOSIONS.

SIR,—Kindly allow me to say it is not correct for you to publish in your leading article that "the inception of the first Boiler Insurance Association was by the late Sir William Fairbairn, in Manchester." It would be more correct to say that that gentleman and high authority did not advise boiler insurance at all, but did actually disapprove and condemn it, He was the founder of the first association for the *prevention* of—not the insurance of, or dealing in—boiler explosions.

The principal originator, I believe, of the first Boiler Assurance Company was the late Mr. Forsyth, who was himself killed by a boiler explosion! JOHN SWIFT.

Ayrfield, Stanmore-road, Birmingham,
March 30th.

DRAUGHTSMEN IN LONDON.

SIR,—Sometime since I saw in THE ENGINEER that a Society of Draughtsmen had been formed in Newcastle-on-Tyne, and I think, from opinions I have heard expressed, that if a similar society were started in London, by some well-known gentlemen, a great many draughtsmen would join it. Perhaps some of the numerous readers of your paper could give some particulars of the Newcastle Society. The society might be formed with similar objects to the Society of Foremen Engineers and Draughtsmen, viz., to read and discuss papers, keep a register of members wanting situations, and to provide a superannuation fund for members. Would you kindly insert this in your valuable paper, and perhaps it may induce some more qualified men than myself to take it up. W. H. R.

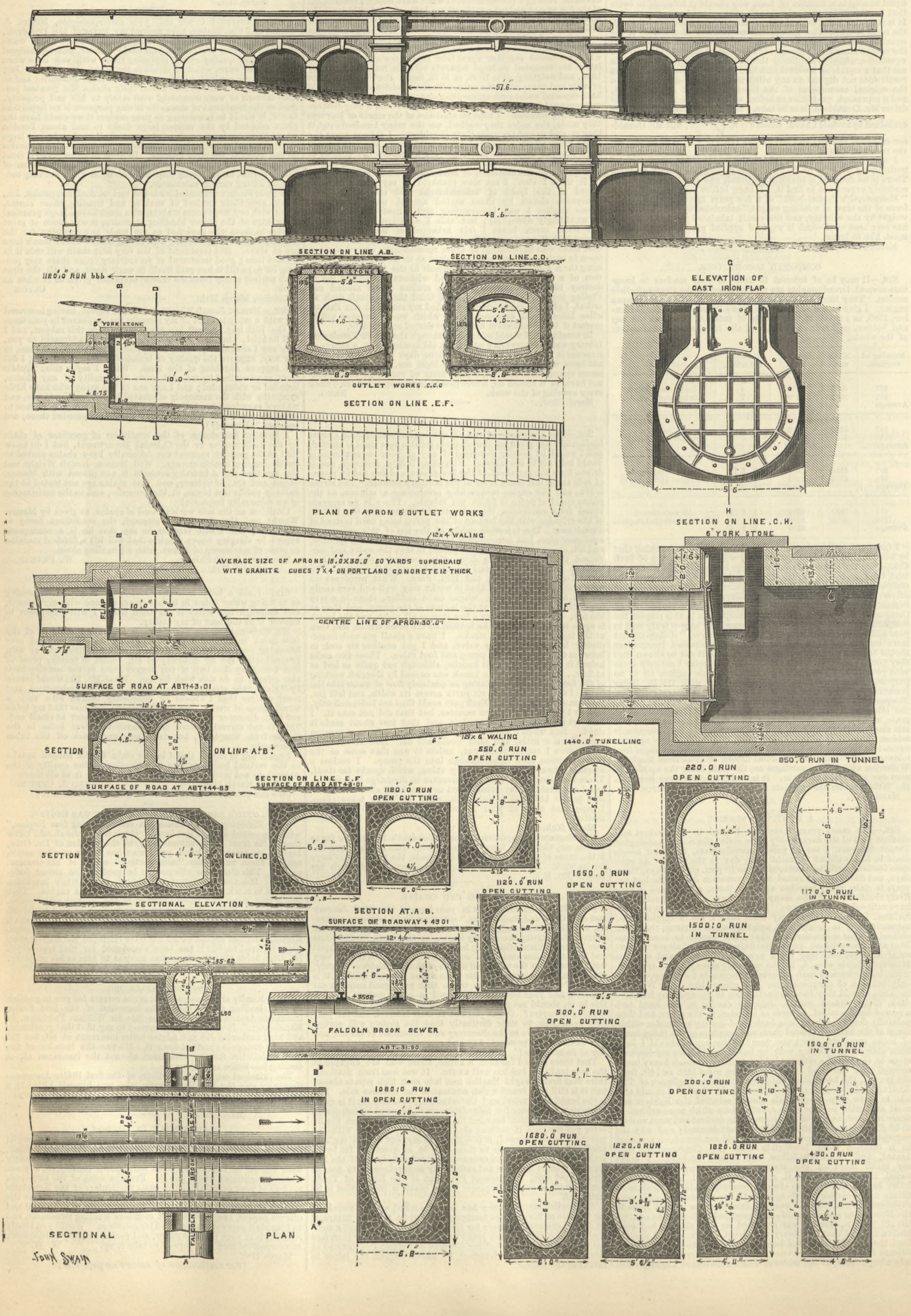
March 17th.

[*For continuation of Letters see page* 272.]

SEWERAGE OF CLAPHAM, BATTERSEA, WANDSWORTH, AND PUTNEY.

SIR JOSEPH BAZALGETTE, M.I.C.E., ENGINEER.

(*For description see page* 270.)



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

R. A.—*James Watt.*

K. BROS. (Delfshaven).—*The Metropolitan Board of Works, London.*

S. W. S. (Brighton).—*We would willingly comply with your request, but the official lists give no information on the subject sufficiently detailed. A very large number of patents begin with provisional protection, while comparatively few are complete from the first, and there is no separate list of completed patents available; but you can always obtain information concerning any particular patent, or patents, by applying to the Great Seal Patent-office, Southampton-buildings.*

NITRIDE OF ZINC.

(*To the Editor of The Engineer.*)

SIR,—Will any reader tell me if nitride of zinc is a marketable liquid, as I make a large quantity as a bye-product? PYRITES.

London, April 1st.

BALANCING LOCOMOTIVES.

(*To the Editor of The Engineer.*)

SIR,—Can any of your correspondents give information as to the existence of a translation in English of a pamphlet written by Le Chatelier in 1849, "On the Balancing of the Reciprocating Parts of a Locomotive?" MASTER MECHANIC.

Canada, March 16th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Tuesday, April 6th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "Water Purification: its Biological and Chemical Basis," by Mr. Percy F. Frankland, Ph.D., B.Sc., F.C.S. Friday, April 9th, at 7.30 p.m.: Students' meeting. Paper to be read, "Locomotive Engine and Carriage Sheds, as used on the Caledonian Railway," by Mr. Gilbert M. Hunter, Stud. Inst. C.E. Mr. J. Wolfe Barry, Member of Council, in the chair.

SOCIETY OF ENGINEERS.—On Monday, April 5th, at the Town Hall, Caxton-street, Westminster, at 7.30 p.m., a paper will be read "On Obscure Effects of Reciprocation in High Speed Steam Engines," by Mr. Arthur Rigg, Past-President, of which the following is a synopsis:—Effects of load and compression of exhaust in retarding the reciprocating parts. Exact data given from actual work. New form of circular pressure diagram introduced. Causes of the same engine working well or badly at high speeds investigated, and the results shown graphically and simply, so as to be intelligible to the practical engineer.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS, 25, Great George-street, S.W.—Thursday, April 8th, at 8 p.m.: Continued discussion "On Electric Lighting by Means of Low Resistance Glow Lamps," by Mr. Alexander Bernstein, Foreign Member.

KING'S COLLEGE ENGINEERING SOCIETY.—A business meeting will be held on Tuesday, April 6th, at 4 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—The eighth general meeting will be held in the Lecture Hall of the Literary and Philosophical Society, Newcastle-upon-Tyne, on Wednesday, April 7th, at 7.45 p.m.: Adjourned discussion on Messrs. Patterson and Sandison's paper "On Forced Draught."

SOCIETY OF CHEMICAL INDUSTRY.—On Monday, April 5th, in the Lecture Theatre, Central Institution of the City and Guilds of London Institute, Exhibition-road, South Kensington, at 8 p.m.: Lecture "On the Principles and Methods of Testing Cementing Materials," by Professor Unwin, M.I.C.E.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, April 5th, at 8 p.m.: Cantor Lectures. "The Arts of Tapestry-making and Embroidery," by Mr. Alan S. Cole. Lecture I.—Points of resemblance between weaving, tapestry-making, and embroidery. Special technical peculiarities of each process. Ornamental effects as characteristics common to decorative textiles. National styles. Works by Cavemen and Eskimos. Types of cosmopolitan ornamental devices. Coincident similarity between ornaments produced by different people at various periods. Types of New Zealand ornament. Types of Scandinavian ornament. Résumé. Wednesday, April 7th, at 8 p.m.: Eighteenth ordinary meeting. "Preparation of Drawings for Photographic Reproduction," by Mr. J. S. Hodson. Thursday, April 8th, at 8 p.m.: Applied Chemistry and Physics Section. "Asbestos and its Applications," by Mr. James Boyd. Sir Frederick Abel, C.B., D.C.L., F.R.S., Chairman of Council, will preside. Saturday, April 10th, at 3 p.m.: Special lecture. "Electricity," by Professor George Forbes, M.A., F.R.S.E.. Lecture II.—Currents and resistance.

DEATHS.

On the 24th March, WILLIAM DREDGE, C.E., aged 64.

On the 25th March, at Thirlmere, Silver-hill, St. Leonard's-on-Sea (late of New Barnet), Mr. SAMUEL PONTIFEX, C.E., age 72. Friends please accept this intimation.

THE ENGINEER.

APRIL 2, 1886.

WAGES.

DURING the present depression in trade the sufferings of the unemployed appeal most keenly to the public sympathy, and it may be instructive to see how far the men are themselves answerable for their misfortunes, and to what extent they hinder attempts at amelioration. The fall in the value of almost all kinds of produce, of minerals, and of every variety of manufactured goods, has been unprecedented and continuous, to the loss of everybody engaged in trade, and indirectly to other classes of the community. How is the anomaly to be explained, that while in former times hunger and misery were the result of famine, now misfortune seems to attend a plethora of food and merchandise. In the first place, the misfortune is to no one class so great as the fall in prices suggests, because it is so widely diffused. An engineer, or ironfounder, if he has to sell cheaply buys cheaply also, and the lessened gain is partly due to the fact that a customary percentage by profit is earned on a less amount. Even now there are manufacturers of specialities who are doing as well as formerly, for though they are selling at lower prices, the difference is only that of the material, and they still demand and obtain the old profit. But in the great majority of trades just now, there is, because of an excess in the power of production, as great a fall in the rate of profit as with the grower of produce or the maker of the iron and steel. The advantage of low prices must, however, fall to somebody, and the unalloyed benefit is obtained only by those whose receipts remain the same while they share in the reduction in price of food, clothing, and everything else they buy. Therefore, the classes who have annuities, fixed salaries, or preferential dividends, are enjoying in the greater purchasing power of their money a large addition to their effective income. Amongst this class, forming, indeed, the principal part of it, may be placed those workmen who are still employed, and whose wages remain unaltered, for they are in this enviable position, that while their masters and the capitalists who provide the factories in which they work and the ready money for each Saturday's wages, have seen their incomings slowly dwindle and in many cases cease altogether, they are richer than ever. In fact, the changes so eagerly and fiercely demanded by the Socialists, namely, all to the worker and little or nothing to the capitalist, seem in the way of fulfilment if the present state of things continues. The shareholders in many of the large manufacturing companies have received no dividends for some time past; and the whole of the earnings have gone to the workers who have none of the anxieties arising from bad debts, deteriorating machinery, and lost investments. For the industrial class, the discharged workmen, and those dependent on them, alone seem to suffer. If in a town with 10,000 working men and boys with an average wage of £1 per week, half are unemployed, the total income is £5000, to the great suffering not only of the men and their families, but of all the tradesmen. If by a reduction of $7\frac{1}{2}$ per cent. in the rates of wages employment could be found for the whole number, the wages fund of the town would be at once increased to £9250, and yet the cure recommended to the men by some of their leaders is a reduction in the hours of working, so that, as they assert, more men may be employed, as though the masters, already handicapped by 40 per cent. dearer labour than on the Continent, would obtain more orders with the difference increased.

The workmen and their advisers are too apt to consider the manufactories of this country as engaged in supplying the needs of the British Isles—of thinking that the work must in any case be done, and that if only they remain firm, "fair wages" must be paid to them. The enormous extent of our foreign commerce and the large proportion of the total wages fund that comes from abroad seem unheeded. The workmen see the orders that come, but appear to know or care little about those that are lost by foreign competition. This is not a question of Free Trade. No system of Protection will alter it, or, for instance, induce a Brazilian merchant to buy at high prices here rather than at low prices on the Continent. Taking the engineering trades alone, at the present time bridges, rails, and locomotives are being made in Germany and Belgium for our foreign and colonial markets that would, by preference of the buyers, be made here if the workmen would only accept their share of the reduction in wages that their employers and all the trading classes associated with them have had to bear for the last two years. A reduction of 10 per cent. in wages would to-day probably add 30 per cent. to the gross earnings of the working class.

It may be said that cause and effect will by natural laws produce a remedy, and that if there be less demand for labour wages will irresistibly fall. This may prove so in the long run, and is already the case where no artificial restrictions prevent it; but, unfortunately, there are circumstances that prolong unnaturally the interval, to the loss of the community and really to the great harm of the workmen themselves. In this country some of the largest employers of skilled labour are large corporations, who have no balance-sheets to show profit or loss in their manufacturing departments, and yet who to a large extent control the labour market. At Crewe, Derby, Swindon, and other similar centres the railway companies are every year trenching more deeply on the province of the manufacturers, and are acquiring a larger share of influence in determining the rates of wages. When, then, the private firms and manufacturing companies attempt to reduce wages to a level corresponding with that of prices, and the railway managers decline, as they are in most cases doing, to join in the change, the railway workmen support by their earnings the trades unions in resisting the reduction proposed by the real traders of the country, and the latter, unable to compete with continental manufacturers, see their accustomed trade leaving them, and have to discharge more and more of their men. It is hardly too much to say that the want of co-operation by the carrying companies is not only damaging the interests of the manufacturing classes, but is reducing greatly the tonnage of raw material and finished goods that are carried to the ports.

We are by no means disposed to take up the case of the masters against the men, and to a large extent sympathise with the latter in their desire to retain the advantages they have gained in the past. But the men make a great mistake in classing together as points of equal importance the present rates of wages and the hours of working. The present limit of hours, including the Saturday half-holiday, we believe to be of advantage not only to the men themselves, but, in many ways too numerous to mention here, to the whole community, although we think a further reduction impolitic and, indeed, for a long time to come, impossible. But when the value in money of what the workman creates falls—and at the same time almost as a corollary there is a similar fall in everything he buys—it is time he acknowledged the greater value of each shilling by accepting fewer of them as fair wages.

We believe that one great cause of the present depression, or what may be even designated a degradation of prices, is likely to pass away, namely, the low wages of foreign workmen. Belgians, Frenchmen, and Germans will not always go on working 20 per cent. longer hours for 20 per cent. less wages than Englishmen, and there are already signs of alteration. The riots and destruction that have been raging in Belgium during the last few weeks are but wild, inarticulate expressions of the misery and despair of ignorant miners and artisans, goaded to crime by the hopelessness of their lot, of that condition which alone enables their masters to send iron to England at starvation prices. Not only in long hours, but in the absence of those conditions which in England mitigate the position of the working classes, is the difference between the countries to be seen. The Mines Regulation Act, the Master and Workmen Act, and the Truck Act are wanting across the Channel. The labour of women and children is still permitted at the mines in Belgium and Northern France, and tends to reduce the wages of the able men, while inflicting irretrievable injury on their families. The sensational description given by Emil Zola in his "Germinal" and other recent works does not exaggerate the evils he deplores. But while English workmen may assist in redeeming the lot of their fellows abroad by retaining the shortened hours of labour, they will be foolish if they do not concede to their masters as an equitable compromise an immediate reduction of wages, which will, at any rate, help to retain here the trade of India and our Colonies, which is in danger of slipping from us.

PILE DRIVING.

AN interesting discussion has been going on in our pages for some weeks concerning pile driving. For the benefit of our younger readers it may be well to explain what it is all about. It turns on a question often asked, namely—What is the force of a blow? It is a remarkable circumstance that this question seems to constitute a *pons asinorum* for a very large number of persons, although the solution of the problem presents no difficulties of any kind to those capable of understanding a few very simple physical laws. As, however, we know that the whole problem is a vexation of spirit to many students; and that even engineers of larger growth have quite failed to understand it, we propose here to give such an explanation of it as will, we hope, suffice to clear up all obscurities and render its solution perfectly easy.

To simplify matters, we shall assume that the blow with which we have to deal is caused by gravity—that, in a word, it is due to the arrest of a falling weight, such, for example, as the monkey of a pile-driver; but our readers will, we think, have no difficulty in understanding that a blow is a blow, no matter how dealt; whether it be delivered on a target by a shot projected from a 100-ton gun, or with a tiny hammer on the head of a tin tack. In their nature both blows are the same; they only differ in degree. A falling body cannot do more work when its progress is arrested than has been done on it in lifting it up to the height from which it has fallen. Thus, for example, let us suppose that the monkey of a pile engine weighs 1 ton, and that it falls 4ft. on to the head of a pile; then the work in the monkey cannot be either more or less than equivalent to four foot-tons. A foot-ton is simply an arbitrary unit. The proposition may be expressed in various ways. Thus, the work in the monkey at the moment it touched the head of the pile would be sufficient to raise the monkey up again to the point from which it fell; or to raise a weight of 4 tons a height of 1ft.; or to raise 1 lb. through a height of 2240 × 4 = 8960ft.; or to raise a weight of 48 tons through a height of 1in., and so on. It is essential that this little matter of equivalence be clearly understood. To drive it home still further, we may say that a horse-power is equivalent to lifting a weight of 33,000 lb. through a height of 1ft. in a minute. But the result would be the same if 1 lb. was raised 33,000ft. in a minute. We may, in short, go on ringing the changes how we please between weight and height. The result will invariably be the same, one element in the calculation being always diminished as the other is increased. Now, it is clear that if our monkey were employed to raise 1 ton through a height of 4ft. it must exert a force or push of 1 ton throughout the distance 4ft. If it did not, it would not move one ton at all, for it would be overbalanced. If it were called upon to raise 4 tons through a height of 1ft., then it must exert a push of 4 tons through a distance of 1ft. If to lift a weight of 48 tons, then it must exert a push of 48 tons through a distance of 1in., and so on. Bearing this in mind, there will be no difficulty in understanding the following simple rule. *The force of a blow is measured by dividing the whole distance x passed through by the monkey before impact, by the distance y passed through after impact, and multiplying the weight by the quotient.* Thus let the monkey weigh 1 ton, let the fall x be 48in., let the pile descend 1in. $= y$ at each blow, then the force of the blow—or, in other words, the push or effort exerted by the monkey on the top of the pile—will be $\frac{48}{1} = 48$ and $48 \times 1 = 48$ tons. If the fall was 20ft., or 240in., then the effort would be 240 tons, and so on. It must be understood that this is the mean or average force of the blow. Its initial effort may be much greater and its terminal effort may be much less, because at the instant of impact the monkey is moving at its full velocity, while at the moment when the pile ceases to descend it will have no motion at all, and consequently will exert no push, except that due to its weight. With this aspect of the question, however, the student need not now concern himself. It will be seen that the force can be varied by altering either the distance passed through before or after impact. For example, the monkey weighing 1 ton and falling 48in., let the pile descend only ⅛in., then $48 \times 8 \times 1 = 384$ tons; and this leads to an important deduction. If y becomes infinitely small, the force of impact will become infinitely great. We are led thus to the ancient problem, If an irresistible force encounters an insurmountable obstacle, what will happen? No such condition can by any possibility occur in practice. Some movement must take place after impact.

If our readers have followed what we have said, they will see that to ask how to calculate the force of blow, giving only the weight and the fall, is to put an absurd question. Three factors are in all cases necessary, namely, the weight, the height of fall, and the distance through which the body which receives the blow moves. In practice it is by no means easy to ascertain the latter with precision; and the energy in the falling body can be expended in more ways than one. For example, when the head of a pile is struck, two effects take place simultaneously—the monkey is shortened and so is the pile. The elastic rebound of each immediately takes place, and the monkey jumps up from the top of the pile. Again, the top of the pile becomes highly heated. In very dry weather the top of a pile has been known to take fire under the blows of a light monkey rapidly repeated. The elasticity of the pile plays an important part in influencing the rate of its descent. A monkey weighing 100 lb., falling a height of 50ft., will have stored in it on impact $50 \times 100 = 5000$ foot-pounds, and if the progress of the pile were 1in., its driving force would be $600 \times 100 = 60{,}000$ lb. A monkey weighing 1000 lb., and falling 5ft., would also have 5000 foot-pounds of work in it, and would exert a driving force of 60,000 lb. over a space of 1in.; but it does not follow that the former would be equally effective in driving the pile. On the contrary, the lighter monkey striking the pile with a higher velocity might be much less efficient of the two, because the force of the blow would not be transmitted through the pile, but would be expended in compressing the top of it, probably in shattering the wood. We do not propose to go here into any questions concerning modulus of elasticity, which would only serve to complicate a statement which we desire to keep so simple that it may be understood by those who only possess the most elementary mathematical knowledge; but this article would, on the other hand, be manifestly incomplete if we did not say something further concerning the respective values of light and heavy monkeys and hammers, and high and low falls.

When a pile is struck on the top, what is known as a wave of compression passes through it; and this wave requires time for its passage. Such a wave is set up in all columns when stress is suddenly brought on one end. Thus, for example, if the muzzle of a fowling piece containing a column of air is plugged up with a cork, or with snow or mud, the barrel may be burst when the weapon is fired, simply because, while the pressure at the muzzle is yet too small to move the cork, the pressure at the breech end is great enough to burst the barrel. The wave of compression will not reach the muzzle till the breech has been burst. In the same way the detonation of a lump of dynamite on a rail will break it, the action being so sudden that the wave of transmission of pressure has not time to pass through the air surrounding the dynamite, and the air really plays almost the same part as a block of steel round the explosive. The effect of a heavy ram falling a short distance on a pile-head resembles a push, in a sense, and gives time for the transmission of the effort throughout the whole pile; but when a light monkey falls, the effect may be confined to the top of the pile, which is shattered. In order to make this quite clear we must take into account the element time, concerning which we have said nothing yet.

The velocity with which a monkey strikes a ram is calculated by extracting the square root of the height of fall in feet and multiplying it by 8. Thus, let the monkey fall 4ft.; the square root of 4 is 2, and $2 \times 8 = 16$ft. per second. If the monkey fall as stated in our last example—50ft.—then we have 7 as the nearest whole number square root, and $7 \times 8 = 56$ft. per second as the velocity with which the monkey would strike the pile. If this speed was greater than that at which the wave of transmission could pass through the pile, then little or no effect would be produced in the way of causing its descent; nearly the whole of the work would be done in compressing the top of the pile or in shattering it, and the driving effect would be *nil*. This, it will be seen, is the aspect of the question now being discussed by Mr. Donaldson and "Scrutator," and there is plenty of room for discussion, because very little seems to be really known concerning a great many practical points connected with pile driving. The efficiency of the pile driver is affected by the length, weight, and material of the pile, the condition of its head, and the character of the ground in which it is being driven. The effect of the element time is not sufficiently well understood. About, indeed, the only thing fully recognised is that a heavy monkey falling from a moderate height is, other things being equal, much more efficient than a light monkey falling from a great height.

THE INSTITUTION OF CIVIL ENGINEERS.

The annual dinner of the Institution of Civil Engineers took place on Saturday evening in the Hall of Lincoln's Inn. The President, Sir F. Bramwell, was in the chair, and among the guests were the Prince of Wales, Prince Albert Victor, and the Duke of Cambridge. Among the speakers were the Prince of Wales, the President, the Duke of Cambridge, and Lord Charles Beresford. The lighting of the Hall, library, council-rooms, and approaches with 220 Swan lamps of twenty-candle power was carried out last autumn by Messrs. Clarke, Chapman, Parsons and Co., of Gateshead-on-Tyne, and has been much admired for the steadiness and brilliancy of the result. The current is generated direct from one of Parson's turbine electric generators, running at a speed of 9000 revolutions per minute, the steam being supplied from a boiler of locomotive type in the adjoining cellar. These cellars measure only 16ft. by 7ft. 6in. each, yet there is ample room for access to all the parts of the machinery; the electric generator, consisting of motor and dynamo combined, measures 9ft. long by 12in. wide, by 2ft. 6in. high, and having a total weight of 15 cwt.

THE RATING OF MACHINERY AND THE PROPOSED AMENDMENT OF THE EMPLOYERS' LIABILITY ACT.

With regard to the above questions, which so vitally affect the industrial interests of this country, prompt and energetic action is being taken by the various employers' associations representing the leading branches of industry throughout the kingdom. A numerously-attended meeting was held on Thursday last, at the Westminster Palace Hotel, to consider—first, the question of the rating of machinery, which is already occupying the attention of the law courts, with reference to several important appeals taken up by the Iron Trades Employers' Association against the rating of loose plant and machine-tools in engineering works; and secondly, what steps should be taken with regard to the two Bills which have been introduced into Parliament by Mr. O'Connor and Mr. Burt, for the amendment of the Employers' Liability Act. The meeting was composed of representatives of the National Association of Occupiers of Factories and Workshops, the Iron Trades Employers' Association, the Clyde Shipbuilders' and Engineers' Association and Glasgow Shipowners' Association, the Agricultural Engineers' Association, the Hull and Leeds Iron Trades Employers' Association, the Manchester Cotton-Spinners' Association, the Builders' Institute, the National Association of Master-Builders, and the Central Association of London Builders. Upon the question of the rating of machinery, the meeting unanimously expressed its approval of the Bill which Mr. Brinton, M.P., proposed to introduce for exempting from rating certain classes of machinery, and it was resolved that the executive of the Associated Chambers of Commerce be requested to take charge of the Bill, and to procure its presentation in Parliament, the following names being suggested to the Associated Chambers of Commerce as desirable ones to back the Bill:—Sir Bernhard Samuelson, Mr. Brinton, Mr. Houldsworth, Mr. Jackson, Mr. Lewis Fry, and Mr. Ruston. The various associations represented at the meeting, and others who may be willing to join for the purpose, were also asked to take steps to urge upon all members of Parliament in every constituency where the several associations have a seat or branch to support the Bill by votes in Parliament, and to report the results of such applications to the Associated Chambers of Commerce. With regard to the Employers' Liability Act Amendment Bills, the meeting strongly expressed its opinion "that any extension of the principal Act in the direction of imposing additional liabilities or pecuniary responsibilities upon employers of labour towards their workpeople is, in the present depressed state of the industries of the country, highly inexpedient;" and it was resolved "that the passing of the two amending Bills, bearing respectively the names of Mr. O'Connor and Mr. Burt, ought to be opposed in the interests of the trade of the country." With this object in view a committee, consisting of the representatives of the various associations forming the meeting and of others willing to co-operate with them, was appointed to secure adequate representation of the views of the meeting before the Select House of Commons Committee, to which the two above-named Bills have been referred, and also to watch the proceedings of the Committee. That the various employers' associations are thoroughly in earnest with the determination to resist the proposed amendment of the Employers' Liability Act may be gathered from the strength of the committee which they have appointed to carry out their opposition to the two Bills of Mr. O'Connor and Mr. Burt. This committee consists of representatives of the National Association of Occupiers of Factories and Workshops, the Iron Trades' Employers Association, the Central Association of London Builders, the Agricultural Engineers' Association, the British Iron Trades' Association, the Mining Association of Great Britain, the National Association of London Builders, the Hull Iron Trades Employers' Association, and the Manchester Cotton Spinners' Association, with Mr. Henry Whitworth, of Manchester, as the secretary. The various associations throughout the country are also requested to urge upon the members of Parliament in the constituencies where they are located to resist the passing through Parliament of the two Bills referred to, or of any others having like objects; and further, the various associations are directed to prepare petitions against the passing of these Bills, which are to be presented to Parliament when the proper time arrives.

LITERATURE.

Guide pour l'Essai des Machines à Vapeur et le Production Economique de la Vapeur. Par J. Buchetti, Memb. de la Société des Ingenieurs Civiles. Paris: Bernard Tignol. 1885.

There is, we believe, no book like the one before us in the English language. It is a carefully written description of the instruments, apparatus, theory, practice, and methods of testing and determining the power, efficiency, or the work done, by steam engines, boilers, and fuel. It is the "Complément du Traité 'Les Machines à Vapeur Actuelles,'" by the same author, and is a systematic treatise which might be very usefully translated, and sent to some of our engineering colleges. The order in which the subjects are treated is, firstly, a description of all the known or practically useful indicators, and their construction, including the simple indicators of the Watt and Macnaught type; those with an amplified movement of the pencil—that is to say, those with springs of short range, and with mechanism for multiplying that range in the pencil—beginning with the Richards indicator; continuous indicators, beginning with Richardson's; and totalising, or power integrating indicators, such as the Ashton-Storey. These descriptions are accompanied by a clear exposition of the theoretical and practical reasons for the alterations and improvements which have been the object and work of the several inventors.

The mounting of the indicator follows these descriptions, illustrated descriptions of the different methods of mounting the indicator on various kinds of engines being given in a very satisfactory and practical way, including, of course, the various methods of imparting the movement to the indicator drum. Several kinds of reducing pulleys are described.

The third part is on the working of the indicator, and of the things to be considered in using it. The effect of inertia of the several parts of the indicators, including all the parts to which any movement is communicated either by the string or other connection or by the steam; the effect of change of length of the string; effect of the oscillations of the spring, with different relations between pressure area of indicator piston and revolutions of engine—are very clearly set forth in this part. Of this part it may be mentioned, as bearing upon a paper recently read before the Institution of Civil Engineers, that the author gives the possible inaccuracy due to the difference between the range of flexure of the spring when hot and when cold at from 2 to 3 per cent. in excess of the true diagram area. He also describes his method of testing indicator springs for pressures above and below atmospheric pressure, and obtaining therefrom a characteristic curve if the flexure is not precisely equal for both, or a right line if they are equal. The effect of friction of pencil, parallel motion, and piston, and of the oscillation period of springs, is also briefly but clearly described, and reference is made to the writings of M. Maupeon on these subjects. The effect of inertia of the drum, and of the lengthening of the string, are also here dealt with, and it is pointed out that they are nullified by the Garnier-Martin indicator, in which the drum is moved by means of a worm and wheel, the spring for returning the drum being upon the worm spindle, which is worked by means of a light pulley.

In the second chapter the author deals with the analysis of diagrams of various kinds, and the causes of various imperfections and characteristics, and the action of steam in the cylinder, commencing with a brief discussion of the thermal questions relating to the properties of steam saturated and superheated.

The discussion of the various illustrations of early and late or slow admission and exhaust; of expansion under various conditions in simple slow and fast speed simple and compound engines; adiabatic and hyperbolic expansion; the steam jacket, and the construction of adiabatic and hyperbolic curves, is very satisfactory.

The third chapter is on work indicated, and deals with the measurement of diagrams by the various usual methods; the consumption of steam, and the quantities of water in the cylinder as shown by the rise of the expansion curve above the hyperbolic curve. The methods of arriving at the same thing as adopted and described by the Société Industrielle de Mulhouse—"Bulletin" 1880—are also described.

The brakes of Prony, Thiabaud, Balk, Deprez, Cadiat, Amos, Beer, and Brauer are well described and illustrated in this third chapter, and carefully-written accounts given of trials or tests by indicator and brake.

Chapters four and five are on evaporation, and steam generators; the former dealing with the calorific value of fuels, combustion, quantity of air necessary for different fuels, and the proper methods of stoking, reference being made to the instructions on the means of minimising the production of smoke issued by the Conseil d'Hygiene de la Seine; instructions which might be usefully posted up in every boiler-house in this country. In the chapter on generators, heating surface and grate surface for different boilers are first estimated, and then boilers, chiefly of the continental types, are described in detail. The Galloway boiler is described, but even this is continentalised by putting two long water vessels in the two low side flues, from which the heated water is conveyed into the boiler proper. The methods of conducting boiler tests are described, and some useful information is given on chimneys, although the sizes of chimneys, determined by the various formulæ given, would in many cases, as they are in this country, be larger than is usually necessary. The author's treatment of the flues is, perhaps, the only unsatisfactory part of the book. The gist of his remarks on this subject is that the flue sections should be at least equal to that of the chimney, and that in practice it varies from

0 75 to 0 5 of the area of the open part of the grate. The book concludes with the French law concerning land boilers, given as an appendix. We commend M. Buchetti's book to all interested in steam engine performance and the use of the indicator.

Notes on the Chemistry of Iron. By MAGNUS TROILUS. 8vo. pp. 97. New York: Wiley. London: Trübner. 1886.

IN this volume, which is little more than a pamphlet in dimensions, the author gives in plain language a description of such chemical methods of analysis of iron and steel as have come under his personal notice during several years of practice. The text is mainly devoted to the analytical operations occurring in the laboratory routine of iron and steel works such as the examination of cast and wrought iron, iron ores, slags, limestone, and fuel, together with some notes on gas analysis. There are also some useful tables for the rapid calculation of analytical results which display considerable ingenuity. Although there is no want of similar works already published, both in this country and abroad, the volume will be found of value to the special class of chemists to whom it is addressed, as the processes are simply and practically described, and the bewildering number of modifications contained in larger treatises are avoided with advantage. The description of the mode of determining carbon by combustion is the most interesting part, several ingenious modifications, which will be new to many readers in England, being described in detail. Among these a shaking apparatus for facilitating the solution of iron in chloride of copper and ammonia is specially noticeable. The author seems to work with rather large samples, and is somewhat free with his reagents. Thus "a few cubic centimetres of bromine" are stated to be used for the precipitation of manganese in an ordinary analysis. Probably this should have been drops. In the introductory chapter we find the statement that iron forms alloys in *any* proportions with, among other elements, copper, sulphur, silicon, and arsenic. Here the word alloy does not seem to be used in the sense ordinarily attributed to it in this country.

A Rudimentary Treatise on Coal and Coal Mining. By W. W. SMYTH, F.R.S. 6th Edition. London: Crosby Lockwood and Co. 1886.

THE steady demand for this well-known treatise having exhausted the former issues, it has been reprinted for the sixth time, with such revision as was compatible with the maintenance of the text substantially in its original form, the alterations and additions being mainly in the form of notes at the foot of the page. The principal additions are, however, to be found in the excellent preface, which notices some of the chief points of interest that have arisen in connection with the safe working of collieries—such as the use of mechanical means for breaking down coal, instead of gunpowder; the modification of the older form of safety lamps, called for by the high speed of modern ventilating currents; and the importance of coal dust as a source of danger in fiery mines. As regards the first of these questions, the author calls attention to the fact, which is apt to be neglected by outsiders, that by shortening men's time of labour at the face of the coal, gunpowder undoubtedly prevents many disasters from falls to which they would be exposed if mechanical means of breaking down the coal were relied upon exclusively. As regards the safety-lamp question, reference is made to the exhaustive series of experiments made by the Royal Commission on Accidents in Mines, under the presidency of the author, whose report will probably be issued to the public in a few days time.

PRIVATE BILL LEGISLATION.

SUBSTANTIAL progress has been made during the last fortnight with the Private Bills before Parliament. The chief advance has, of course, been made in the Committee-rooms, but in the two Houses a fair number of these measures have been forwarded a stage onward either prior to or after being dealt with by Select Committees. These may be mentioned first, it being assumed in each case that the Bill has already passed through one House.

First readings in the Commons: Rhondda and Swansea Valley, Leamington Corporation, Dublin, Wicklow, and Wexford Railway Bills. Second readings in the Commons: Cleator and Workington Junction Railway, Halifax High Level and North and South Junction Railway, London, Brighton, and South Coast Railway; London, Chatham, and Dover Railway; Kensington Vestry, Morecombe Tramways, Rowley Regis and Blackheath Gas Bills. Third readings in the Commons: Listowel and Ballybunion Railway, Beaconsfield, Uxbridge and Harrow Railway (Abandonment); Forth Bridge Railway, Kirkcaldy and Dysart Railway, Metropolitan Markets, Bridlington Gas, Highgate and Kilburn Open Spaces, Plymouth and Devonport Extension Tramways Bills.

Second readings in the Lords: Hull, Barnsley, and West Riding Junction Railway Bill. Third readings in the Lords: Eastbourne, Seaford, and Newhaven Railway; Bristol (Totterdown Bridge), Chatham and Brompton Tramways, Southampton Docks, Rhondda and Swansea Bay Railway, Newport (Monmouthshire) Gas, Leamington Corporation, Swansea Harbour, Bray and Enniskerry Light Railway, Dublin, Wicklow, and Wexford Railway, Morecombe Tramways, Bristol Corporation (Docks), Highgate and Kilburn Open Spaces Bills.

The Examiners in the House of Commons have reported that the North London Tramways, Cricklewood, Kilburn, and Harrow-road Tramways, London Street Tramways, and Stapenhill Bridge Bills, have not complied with the Standing Orders. They have accordingly been referred to the Select Committee on Standing Orders for further consideration.

The Bill promoted by the Corporation of London for providing open spaces at Highgate and Kilburn has passed unopposed through the House of Lords. Having already been sanctioned by the House of Commons, it is expected that it will receive the Royal Assent immediately, after which the work of preparing the lands for public use will, it is understood, be pushed forward as rapidly as possible. A report was prepared for the Lords' Committee by the Attorney-General on the provisions contained in the Bill, in which he speaks approvingly of the scheme, which is to enable the Ecclesiastical Commissioners to transfer to the Corporation the land known as Gravel Pit Wood at Highgate, comprising about sixty-nine acres and certain land at Kilburn containing about thirty acres, lying within and forming part of a large area belonging to the Commissioners.

The Standing Orders Committee of the House of Lords having refused to dispense with the standing orders not complied with by the promoters of the Gravesend and Northfleet Docks and Railways Bill, this measure cannot be proceeded with session. By this Bill, which met with a similar fate last session, it was proposed to construct a main dock 380 yards in length and 300 yards in width, with two branch docks 626 yards long and 100 yards wide, together with a lock and tidal basin with an entrance from the river Thames, on the site of the grounds known as the Rosherville Gardens, Crete Hall, the Mount, and the Northfleet Dockyard. The capital proposed in the Bill, including borrowing powers, was £2,000,000, out of which nearly three miles of railway were to have been constructed to connect the docks with the South-Eastern Railway and the Gravesend branch of the London, Chatham, and Dover Railway. A clause in the Bill sought powers to pay interest out of capital during the construction of the works.

We have previously stated that the Wimbledon and West Metropolitan Railway Bill will not be further proceeded with; but a few words of explanation are desirable. The principal object of the measure was to compel the London and South-Western Company to proceed with the construction of the bridge across the Thames at Putney, authorised for the purposes of the Kingston and London Railway, so as to allow the railway of the promoters, sanctioned in 1882, to be constructed from Wimbledon to Putney, with a means of access to the Metropolitan District Railway at Fulham by running powers over the bridge at Putney. This object having been fully assured by an agreement with the South-Western Railway Company, which has undertaken to construct the whole of the authorised Wimbledon and West Metropolitan Railway, which agreement Parliament will be asked to confirm this session, has rendered it unnecessary to obtain sanction to the Bill now abandoned. In connection with this Bill, it may be mentioned that the five petitions deposited against the London and South-Western Railway—Various Powers—Bill have been withdrawn, the Bill, which was to have come before a Select Committee of the House of Commons, will pass unopposed. Among other powers granted by this Bill Parliamentary authority is given to the abandonment of almost the whole of the Kingston and London Railway, which was authorised in 1881 for the purpose of constructing a railway from Fulham under Putney Heath, skirting Wimbledon Common in the rear of the rifle-butts, from whence it was to have passed direct to Kingston. Powers are also given to the company to acquire the sole ownership of the authorised railway from Wimbledon, through Wimbledon Park to Putney, where a junction will be formed with that portion of the unabandoned Kingston and London Railway between Putney and Fulham, thus giving access to the City *viâ* the Metropolitan District Railway. The Bill also empowers the company to acquire certain properties for completing the widenings near Waterloo Station; and it is also proposed to absorb into its system the Swanage Railway, which was constructed about two years ago. The Bill does not authorise the raising of any fresh capital.

The Bill which proposed to construct a number of short tramways in extension of the Southwark and Deptford Company's system has been reported by the Examiners of Petitions as abandoned.

A Select Committee of the House of Commons has passed the Uxbridge and Rickmansworth Railway Bill, the first purpose of which was to gain further time for completing the line, authorised in 1881, to connect the Great Western Railway at Uxbridge with the London and North-Western Railway at Rickmansworth. The Bill also sanctions a deviation of the line at Rickmansworth, for the purpose of having a joint station there with the North-Western Company. Powers are also given to raise £30,000 additional capital, and upon this capital and the £144,000 authorised in 1881 the company is to be permitted to borrow £58,000. The company is also to be allowed to pay interest out of capital during the construction of the railway, the aggregate amount to be so expended not to exceed £20,000.

The most important railway Bill of the session—viz., the Bedford and Peterborough Bill—has been withdrawn in the face of strong opposition. It proposed to incorporate a company, with a share capital of £800,000 and a loan capital of £266,000, with powers to construct a railway from near Bedford, where junctions were proposed with the main line and Northampton branch of the Midland Railway to Peterborough, where connections were to be made with the North-Western. The line was to be over thirty-one miles in length.

A House of Lords' Committee has passed so much of the Bexley Heath Railway Bill as extends the time for the completion of the line sanctioned in 1883, rejecting that portion of the Bill which proposed to extend the existing line at Eltham to Blackheath.

By a House of Lords' Committee has also been passed the Bill transferring the Marquis of Bute's dock undertaking at Cardiff into the hands of a joint stock company, with a capital of £3,500,000, and borrowing powers not exceeding £1,150,000. The promoters, at the request of the opponents, consented to strike out the clause empowering the Great Western, the Taff Vale, and the Rhymney Railway Companies to purchase the stock of the new company. The effect of this will be to make these companies come to Parliament with a Bill of their own for leave to purchase and hold stock, which Bill will then be considered on its own merits.

All opposition to the Bill dealing with works and agreements connected with the Midland Railway having been withdrawn, the measure will now pass as an unopposed Bill.

A similar result has ensued with respect to the Accrington, Clitheroe, and Sabden Railway Bill for making railways in connection with the Lancashire and Yorkshire Railway between Accrington, Clitheroe, and Sabden, to enable them to run over and use portions of the Lancashire and Yorkshire Railway, and to pay interest upon calls during the construction of the railway.

The East and West Yorkshire Union Railways Bill, which we have previously described, has passed the Commons' Committee.

A House of Lords' Committee has passed, as an unopposed measure, a Bill authorising the construction of a railway in the Isle of Wight, nearly eleven miles in length, commencing at Chale, by a junction with the already sanctioned, though not yet constructed, railway from Shanklin to Chale, and terminating at Freshwater. For the construction of the railway, which will run along the coast for the whole distance, it is proposed to raise £100,000 share and loan capital.

The shareholders of the London, Brighton, and South Coast Railway have approved and decided to press three Bills, viz.:—(1) A Bill for making a railway from Brighton to Rottingdean and Newhaven, in the county of Sussex, and for other purposes. (2) A Bill for the making and maintenance of the Eastbourne, Seaford, and Newhaven Railway, and for other purposes. (3) A Bill to authorise the construction of a railway between Portsmouth and Hayling Island, with a bridge available for road traffic over the southern entrance to Langstone Harbour and other works, and for other purposes.

Among the schemes before Parliament this session is that entitled the Horse Guards Avenue Bill, the object of which is to construct a new approach to the Victoria Embankment from opposite the Horse Guards to the south-western end of the ornamental gardens. This road formed part of the original scheme for the Thames Embankment, and was authorised by the Act of 1862, but in consequence of the expense which would have been incurred at that time in buying up the interests of the tenants on the site, the proposal had to be abandoned for a time. During the past year most of the leases on the site required for the new road having fallen in, the freeholders to whom the adjacent land belongs have offered the ground required free of cost to the ratepayers. The land abutting has been let for the purpose of erecting first-class mansions in flats. Through the present commercial depression, the company which started these works have for some months past been unable to carry on their operations, but a number of capitalists have recently formed an association, and undertaken to complete the works at a cost of about £400,000. The St. Martin's Vestry contemplated opposing the Bill, but they will probably not persist in that course.

Besides the various schemes above referred to, there are many others which might be mentioned as having passed through Committees or been rejected, but we can only now refer to what is, after all, the most interesting measure of this session, as it has been of three previous sessions, viz., the Manchester Ship Canal Bill. When we last alluded to it this Bill had safely passed the second reading in the House of Common, but there was some doubt as to how far its progress would be stopped by the efforts of the opponents to obtain a *locus standi* to appear before the Select Committee. The promoters lodged petitions against such *locus standi*, on the ground that the opponents were not injuriously affected by the payment of interest out of capital, and there was for a time every prospect of a further contest. Happily, however, the threatened action of the opponents was withdrawn at almost the last moment, and on Wednesday the Bill passed the Commons' Committee on unopposed Bills, and was reported to the House for third reading. The withdrawal of the opposition was due, it is believed, to the recent divisions on the second reading of the Bill, and the hopelessness of inducing a Committee to reject the Bill after the decided opinion expressed by the House. It is, however, understood that this action on the part of the petitioners will in no way prejudice their right to oppose in the House of Lords, where every opposition will be offered to the passing of the Bill. The question of the *locus standi* of the petitioners to oppose the Bill in any form will now be raised before the Select Committee in the Upper House.

The Manchester Ship Canal (payment of interest) Bill has now been read a third time in the House of Commons, and passed. So far, therefore, as the Lower House is concerned, this measure is safe; but it has yet to get through the House of Lords, and will probably have to fight again the objections which failed to defeat it in the Commons. In reporting the Bill to the House from the Committee on Unopposed Bills, Mr. Courtney says:—"The Bill does not authorise the construction of any new works. The object of the Bill is to authorise the Manchester Ship Canal Company to pay, during the period of seven years, interest to the shareholders of the Company on the amount from time to time paid up on their shares, from the respective times of such payments." A report from the Board of Trade, with respect to the object of the Bill, was laid before the Committee and considered by them. The report states that the provisions of the Bill with respect to such payments are in accordance with those required by Standing Order 167, to be inserted in railway bills seeking the like powers, and are similar to those contained in the Regent's Canal, City, and Docks Railway Act, 1885. The report further stated that the provisions of the Bill with regard to the mode of raising the capital for the construction of the canal appeared to the Board of Trade to be deserving of the favourable consideration of Parliament. There are no other circumstances of which, in the opinion of the Committee, it is desirable the House should be informed.

A rather serious blow has been given to the Bill authorising the Salford Corporation to invest a quarter of a million in the Ship Canal by a report to Parliament from the Local Government Board. The Board expresses disapproval of the Bill. Referring to the clause by which the Corporation propose to borrow the money for this purpose, the Board submit for the consideration of the Committee on the Bill the question whether it is desirable that the Corporation should be allowed to take that course, and whether, unless it be shown that the construction of the docks and works will be a direct advantage to the borough, it is desirable to confer on the Corporation any powers of raising money for the purpose of taking shares in the Company. They urge that the construction of canals and docks are matters not coming within the scope of the ordinary duties of municipal corporations and urban sanitary authorities, and that the rapid increase of late years in the indebtedness of urban authorities, and the many calls likely to be made upon them in future for works that do come within those duties, render it inexpedient to give the powers now asked for, citing several instances in which similar powers have been refused by Parliament. The Board further advise that before this Bill is sanctioned the Committee should be very fully informed of the probability of the success of the undertaking, and also as to the extent to which the Corporation are likely to require to borrow money for sanitary necessities of the borough.

The opposition threatened to the Horse Guards Avenue Bill, described above, is understood to have now been withdrawn, the opponents finding little support, and but slight grounds for objecting.

On the other hand, the South Kensington and Marble Arch Subway Bill has met with some opposition from the Office of Works, and is in consequence suspended—not withdrawn—as the promoters hope to overcome the objections of the Department.

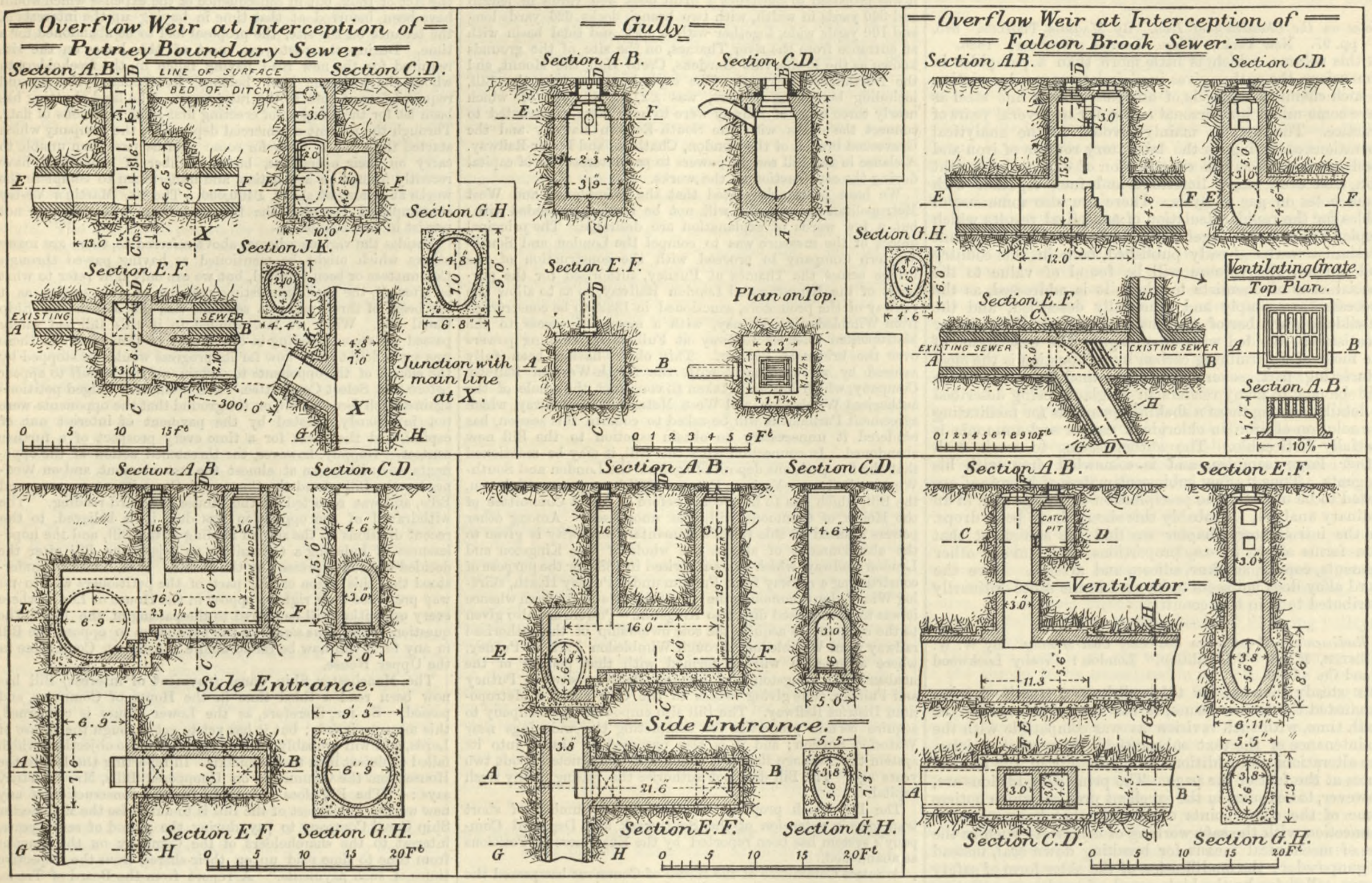
The London, Brighton, and South Coast Railway, the London, Chatham, and Dover Railway, and the London and South-Western Railway Bills have passed through the Commons unopposed; while the Metropolitan Markets Bill to convert the Farringdon Fish Market into a general market, having already been sanctioned by the House of Commons, has also passed through the Lords, and now only awaits the Royal Assent.

At the first sitting for evidence of the River Lea Committee, Mr. Cobble, clerk to the Lea Conservancy Board, was examined, and in the course of his evidence he admitted a very striking circumstance, viz., that the Board had not hitherto exercised their full powers, simply contenting themselves with securing sufficient water for navigation purposes. One or two more such confessions would well explain the foul condition of this river.

Up to the date of the last official report on the progress of Private Bills, viz., last Friday, 11 Bills had been read a third time in the House of Commons, 31 had been reported for third reading, and 79 had been read a second time. Eight Bills had been withdrawn after the first reading, 3 had been declared not proved, and 2 had been rejected for non-compliance with Standing Orders.

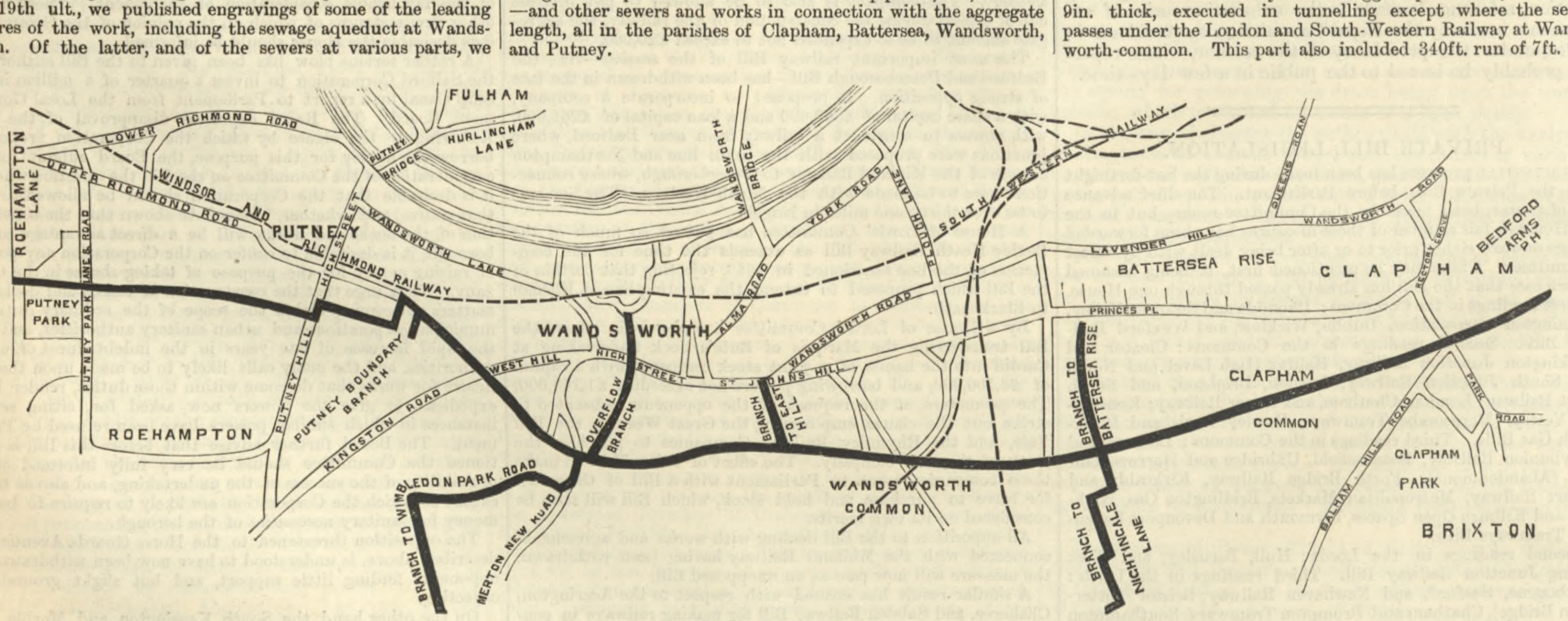
SEWERAGE OF CLAPHAM, BATTERSEA, WANDSWORTH, AND PUTNEY.

SIR JOSEPH BAZALGETTE, M.I.C.E., ENGINEER.



SEWERAGE OF CLAPHAM, BATTERSEA, WANDSWORTH, AND PUTNEY.

Some very extensive and important works for the drainage of the above-mentioned places, which have been constructed by the Metropolitan Board of Works, are now nearing completion. The work has been done by Mr. John Waddell, as contractor under Sir Joseph Bazalgette, as engineer. In our impressions of the 12th and 19th ult., we published engravings of some of the leading features of the work, including the sewage aqueduct at Wandsworth. Of the latter, and of the sewers at various parts, we now give further engravings, together with a map, showing the locality of the main sewer, more particularly that of the aqueduct across the Wandle valley. There are in all 27,876ft. run of main line sewer. Commencing at the Bedford Arms, Clapham, the sewer passes along High-street, Clapham, across Clapham Common, Wandsworth Common, St. Anne's-hill, South-street, Wandsworth, the river Wandle, the Merton-road, along nearly the whole length of Ringford-road, along the Upper Richmond-road, across Putney-hill, Putney Park-lane, and grounds, to Roehampton-lane. Besides this, there are also 2060ft. run of sewer from the main line at the eastern end of Chatham-road, Battersea, to Battersea Rise; 2730ft. run of sewer from the same place southwards along Webb's-lane, Broomwood-road, Gayville-road, Thurleigh-road, Winchelsea-road, and Nightingale-lane, to the Falcon Brook sewer—see page 266 and above—also 1320ft. run of sewer from the main line near Allfarthing-lane, along Geraldine-road to East-hill, Wandsworth; also 5460ft. run of sewer from the main line at Merton-road, along Merton-road, Wimbledon Park-road, West Hill-road, Melrose-road, and Sutherland-road, across Granville-road, and into Wimbledon Park-road; also 300ft. run of sewer from the main line into the Upper Richmond-road, Putney, along the route of the existing Putney boundary sewer; also 2410ft. run of sewer from the main line at or near Merton-road, under High-street, Wandsworth, along Wandsworth Plain, and Frogmore-lane, across the Parish Wharf situate on the tidal portion of the river Wandle, this part being designated "overflow branch from Merton-road to the tidal portion of the river Wandle," and illustrated by plan and sections of the branch and overflow at p. 210, and by one of the engravings on page 266, the main line and branches comprising an aggregate length of 42,156ft. run of sewers. There is also the sewer aqueduct at Wandsworth for carrying above the ground a portion of the main line—see p.p. 210, 228, and 266—and other sewers and works in connection with the aggregate length, all in the parishes of Clapham, Battersea, Wandsworth, and Putney.



MAP OF MAIN SEWER.

as represented on page 266. They were executed in open cutting, and include two splays of 10ft. run each, and for the whole of the remaining 230ft. run comprises two lines of culverts 5ft. by 4ft. 6in., or together 460ft. run of that size, and these culverts for the short length where they cross over the existing Falcon Brook sewer are constructed with cast iron inverts or bottoms supported by cast iron girders, as shown by three sections on page 266. See also above. The main line, part 2, includes 4340ft. run of 7ft. 9in. by 5ft. 2in. egg-shaped sewer, brickwork 9in. thick, executed in tunnelling except where the sewer passes under the London and South-Western Railway at Wandsworth-common. This part also included 340ft. run of 7ft. 9in. by 5ft. 2in. egg-shaped sewer in continuation, the brickwork 4½in. thick, executed in open cutting, 20ft. of splayed sewer between the lastly-mentioned and next-mentioned lengths. The brickwork to be 9in. thick, and the concrete outside of it squared off and extending to 7½in. above, 7½in. below, and 7½in. on each side, and executed in open cutting; 130ft. run of 6ft. 3in. barrel sewer in continuation. The brickwork above the springing 13½in. thick, and below the springing only 4½in. thick, and executed in open cutting.

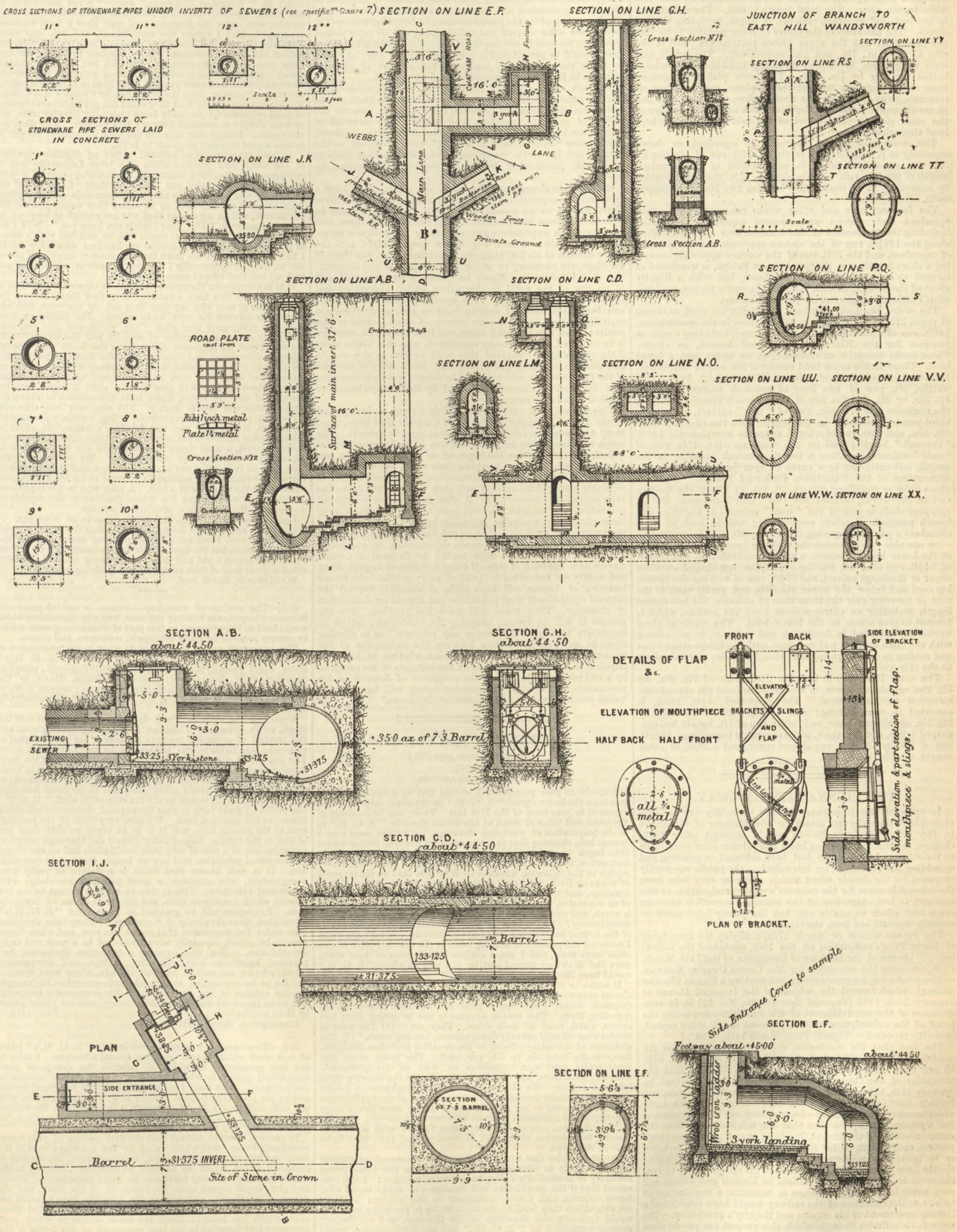
The sewers are partly of brickwork in Portland cement-mortar and partly in Portland cement concrete, and of the lengths, sizes, and forms shown by the cross sections and plans, we give numerous sections at page 266 and above. The main line, part 1, commences with 700ft. run of 7ft. 3in. barrel sewer near the Bedford Arms by a connection with existing sewers. The brickwork is 4½in. thick, executed in open cutting. There is next 7420ft. run of 9ft. by 6ft. egg-shaped sewer, in continuation of and along the main line route to a point at the western side of Clapham-common and eastern end of Chatham-road, the brickwork being 9in. thick, and executed in tunnelling. In this length the sewer passes at a considerable depth under Clapham-common. There is next 330ft. run of 8ft. 3in. by 5ft. 6in. egg-shaped sewer in continuation of the main line route, with brickwork 9in. thick, executed in tunnelling. There is 25ft. run of splayed sewer between the lastly-mentioned and next-mentioned lengths, brickwork 9in. thick, and concrete outside squared off and extending to 7½in. above, 7½in. below, and 7½in. on each side, executed in open cutting. Next is 160ft. of 6ft. 9in. barrel sewer in continuation, brickwork 4½in. thick, executed in open cutting. By reference to page A the difference in thickness and character of the sewer and concrete support, or cover, when built in cutting and in tunnel, are clearly shown. The 250ft. run of sewers in Chatham-road, Battersea, are of special construction,

The sewer and eastern approach to the aqueduct include 128ft. run of 6ft. 3in. barrel, and other work. The sewer aqueduct comprises 2064½ft. run of 7ft. 9in. by 5ft. 2in. egg-shaped sewer, with sewer viaduct of the same length carrying it above ground, the length comprising twenty-four arches or spans east of South-street, Wandsworth, one straight span over South-street, sixty arches west of South-street, and eighty-six piers, including the end or abutment piers; total, eighty-five spans. The span No. 25 is a skew iron girder bridge, 44ft. on centre line on plan.

The sewer bridge, span No. 25, and cast iron sewer, shown particularly on page 228, is over South-street, Wandsworth, and is oblique, or skew 68 deg., on plan. The span in the clear between the abutment piers is 40ft. 10in., measured on the square, or 44ft. on the skew, and the headway at the centre

SEWERAGE OF CLAPHAM, BATTERSEA, WANDSWORTH, AND PUTNEY.

SIR JOSEPH BAZALGETTE, M.I.C.E., ENGINEER.



about 17ft. above the middle of the carriage way of South-street. The abutment piers are built on a bed of concrete 3ft. thick, and of the dimensions and forms shown generally in our engravings. The cast iron egg-shaped tube or sewer is carried by eight wrought iron cross girders resting on two wrought iron main girders, and a footway is formed over the sewer by wrought iron curved plates, supported by sixteen cast iron girder joists resting on the top of the main girders, as shown on page 228. The two main girders are single web-plate girders, placed 7ft. 7in. apart from centre to centre, their total length being 50ft., with uniform depth of 9ft., measured from back to back of angle irons, the top flange being 15in. wide, and the bottom flange 18in. wide; the upper flange of each girder consisting of one plate 15in. by $\frac{1}{2}$in., extending the whole length of the girder, and one plate 15in. by $\frac{1}{2}$in., extending for a distance of 15ft. 11in. on each side of the centre line of girder. The bottom or lower flange to consist of one plate 18in. by $\frac{1}{2}$in., extending the whole length of the girder, and one plate 18in. by $\frac{1}{2}$in., extending for a distance of 15ft. 11in. on each side of the centre line of girder. The joints of the flange plates are covered by plates and strips of the lengths, widths, and thickness as shown on the engravings. Each flange is attached to the web by two angle irons, 4in. by 4in. by $\frac{5}{8}$in., with rivets $\frac{7}{8}$in. diameter, having a pitch of 4in. as shown. The web of each girder is constructed of plates 9ft. in length by 3ft. in width, excepting at the ends, where the plates are to be 2ft. in width, the thickness varying from $\frac{1}{2}$in. to $\frac{3}{8}$in. The joints of the web plates are covered alternately by tee irons 6in. by 3in. by $\frac{1}{2}$in., placed back to back, and by angle irons 3in. by 3in. by $\frac{1}{2}$in. placed back to back, fastened to stiffening plates $\frac{3}{8}$in. thick. Each main girder is built with a rise or camber of 2in. The rivets through top and bottom flanges throughout are ⅞in. diameter, and the rivets through the webs, stiffeners, and cross girders are ¾in. diameter. All abutting joints and edges of plates and joints of angles are planed, and all holes through flanges and main angles drilled. The cast iron egg-shaped sewer is 7ft. 9in. high by 5ft. 2in. wide in the clear. The total length is 56ft. The tube is cast in five sectional segments, each 6ft. in length, excepting the end pieces. The thickness of the invert or lower portions to be 1in., the sides ⅞in., and the upper crown portions ¾in.; and of the ribs to be 1⅛in., 1in., and ⅞in. respectively. The whole cast with flanges 6in. in depth—including thickness of plates—bolted together by ⅞in. bolts. The lower plates or segments have supporting lugs with chipping pieces cast on them at intervals, so as to rest on the cross girders, and these lugs and pieces are made variable in depth suitable to the 2in. camber of the main girders. The invert of the cast iron sewer is kept level throughout.

The sewer and western approach to aqueduct, as shown especially at p. 210, includes, as shown, 70ft. run of 7ft. 9in. by 5ft. 2in. egg-shaped sewer in continuation of the aqueduct length of 206½ft. run. The brickwork, 4½in. thick, surrounded by concrete. It is constructed between two 9in. stone-capped walls.

The footway over and other works connected with sewer aqueduct and eastern and western aqueduct approaches, including the top surface of the concrete over sewer extending along the 191½ft. run of the eastern approach, the 206½ft. run of aqueduct, and the 70ft. run of the western approach, excepting a short length over the South-street Bridge, is weathered or formed to curvature generally as shown, but with a slightly grooved channelling on each side, and the entire surface rendered with Portland cement mortar ¾in. in thickness.

The weirs, penstock chambers, &c., at Merton-road, as shown at pages 210 and 228, include, as described in the specification, 140ft. run of special works at Merton-road, including a spur or junction for the Wimbledon Park-road branch, as shown. These works comprise culverts, &c., at an upper and a lower level. Those at the upper level consist of 9ft. run of bellmouth, 14ft. run of two lines of culverts, 6ft. 6in. high by varying widths, 3ft. run of two lines of penstock culvert openings, 4ft. 3in. by 4ft., 5ft. 6in. run of two penstock chambers, also on the northern side 37ft. 6in. run of "weir" culvert, including a third penstock chamber in the length, 50ft. run of 5ft. 9in. by 6ft. 3in., and 21ft. run of splayed sewer to complete the 140ft. "through" length; and on the southern side, 47ft. run of "weir" culvert, including a fourth penstock chamber in the length, and extending by a curve or spur junction to the commencement of the Wimbledon Park-road branch. There is also a cross or equalising culvert, 3ft. 9in. by 3ft., at the western end of the works, between the two "weir" culverts; also an entrance-shaft to each of the "weir" culverts at the third and fourth penstock chambers respectively; and in each of these chambers a penstock opening, 3ft. 3in. by 2ft. 9in., is constructed—on one side—to communicate with the lower level. The works at the lower level constitute a third or middle line, and consist of 34¾ft. run of a 4ft. 9in. by 3ft. 9 1/16in. egg-shaped overflow sewer or discharge culvert, and 37½ft. run of varying size situate between and below the upper culverts, and partly open to the roof or covering over the three lines of culverts, the last-named length including an entrance-shaft from the surface, which is formed to give access to the lower level. The whole of these works are executed in brickwork and concrete, in accordance with the cross-sections and drawings, with Yorkshire stone floors and roofing in certain parts, and with Yorkshire stone cappings to the side walls.

The main line, part 3, includes 220ft. run of 7ft. 9in. by 5ft. 2in. egg-shaped sewer, in continuation from the special construction at Merton-road. The brickwork, 4½in. thick, is executed in open cutting; also 1170ft. run of 7ft. 9in. by 5ft. 2in. egg-shaped sewer, and 1500ft. run of 7ft. by 4ft. 8in. egg-shaped sewer, also 9in. thick, and executed in tunnelling; 1080ft. run of 7ft. by 4ft. 8in. egg-shaped sewer, and 1200ft. of other sewers, 6ft. 9in. by 4ft. 6in.

THE VIENNA CITY RAILWAY.

In spite of the numerous rumours pervading the political atmosphere since the last attack on the Minister of Commerce in the House of Commons—in which, amongst other grave charges, allusions of anything but a playful character were made to the motives by which he had been actuated in granting and upholding the concession for this railway—the public was hardly prepared for the double event which, whatever may have been the ostensible cause for the minister's sudden resignation at this moment, is too suggestive of the natural connection between cause and effect to enable any but the purely legal mind to entirely separate one from the other.

The *Vienna Gazette* of March 17th, notifying the acceptance of Baron Pino's resignation on the 16th, contained the following:—"Decree of the Minister of Commerce of the 14th March, 1886, repealing the concession for the Vienna Circular Railway. —The concession for constructing and working a Vienna Circular Railway, which formed the subject of the Imperial Decree of January 25th, 1883 (*Imperial Law Gazette*, No. 18) is, in consequence of the non-fulfilment of the conditions respecting the proof of the subscription of and payment on the share capital, herewith repealed.—(Signed) PINO, March 14th, 1886."

The fact that the concession, which was granted under the conditions that £1,000,000 of shares should be subscribed, with 40 per cent. fully paid up by July 25th, 1883, and that the remainder of the shares (£1,500,000) should be subscribed by January 25th, 1884, with £300,000 paid up on the same date, and further £300,000 by April 25th, 1884—none of which have, unfortunately, been fulfilled—has not long ago been repealed, is less a matter of surprise than that the minister who, from the commencement of the project, has been one of its warmest supporters, and, in fact, so far identified himself with its fortunes as to provoke accusatory interpellations from his opponents, should have chosen the last moments of his official career to consummate an act whose consequences to himself and Vienna will perpetuate in future generations as mournful a recollection of failure as the execution of the railway would have established a lasting monument of his success and the city's prosperity. The various vicissitudes through which this project has passed since it was first presented to the public in 1881, and the numerous phases it has assumed, no less than its somewhat tardy, but still unexpected collapse, although hardly calculated to point a moral or adorn a tale, are not entirely devoid of interest, as throwing a side light on matters which have hitherto been subjected to no other than the direct and directed rays of official and other luminaries. From its earliest infancy, through all the wearying stages of its ripening maturity, in its decadence as in its final dissolution, it has equally suffered from and been fatal to friends and foes. Every difficulty that the ingenuity of man, singly and collectively, could invent, was thrown in its way. Its promoters were subjected to open and surreptitious opposition, or pestered with offers of assistance, the burden of whose eternal song was—give. Its supporters—and this perhaps will form the single pleasant recollection amidst a host of painful experiences that amongst them were numbered a chosen few, whose assistance was proffered and steadfastly given with no other object than to promote a good cause and further the interests of their city—whether actuated by the purest motives, or following more selfish views, were alike abused and calumniated, and its more violent opponents revelled in the depths of absurdity to which the gift of speech could be prostituted in inventing popular cries by which to tickle the vanity and captivate the support of ignorant believers in their boasted patriotism and convictions.

Through every grade of society, educated and uneducated; from prominent members of the Corporation down through the various societies, scientific, political, and æsthetical, even to the guilds of milkmen, saddlers, and cabmen, the downfall of Vienna, the loss of trade, the depreciation of property—in short, nearly every "ill that flesh is heir to," were predicted as the natural and inevitable consequences of a Metropolitan Railway in Vienna, constructed by foreign capital and managed by foreigners.

It may seem almost incredible that the influx of so large a sum, and its expenditure on a construction which would have placed Vienna on an equal footing with other capitals, and in time have become the property of the State, should have met with so much opposition; but something more than a superficial acquaintance with a city, and a deeper insight into the under current of its life, than can be obtained from the front of the stage, are necessary to enlist the sympathies and co-operation of its inhabitants. Money has power if properly used, and in no city of the world is this axiom better understood and appreciated than in Vienna. The boasted possessions of others and the anticipation of success have no charms for Viennese capitalists unless they see some chance of participation in the profits; when this is denied them, and their assistance, even ere it be proffered, ostentatiously repudiated, who can blame them if the sympathy and support they were anxious to give should give place to antipathy and opposition. The sources of this and of the failure of the scheme must be sought in deeper currents than the shallow channels indicated by the frothy rhetoric of political popularity-mongers.

This was only the outward and visible sign of an inward and deeply rooted intention to frustrate a scheme that brought no profit to those who felt they had a local right to share it. The lesson now taught has been a severe one. The decree of repeal is final, and extinguishes the hopes of as fair a scheme as was ever launched. The loss has been great to all, but will be most heavily felt by the Viennese themselves, as their sole chance of regaining their old ascendancy over their rivals on the Spree has been relegated to future ages. A wiser and more sober-minded generation may yet arise who will learn to hate the memories of those whose narrow-minded prejudices helped so much to retard the progress of their city; but if not, and if the same spirit of mistrust, suspicion, and wholesale denunciation of everybody and everthing connected with capital be fostered in certain classes, as it has been of late—if every question of improvement and utility be converted into one of party politics—the future historian of Vienna will have little to chronicle beyond the internal squabbles of rival politicians and actions for defamation of character. Time alone will solve the problem. For the present it will be better, adopting Mr. Gladstone's advice to inquisitive members "to receive any rumours" as to whether there be any real connection between the resignation of the minister and his repeal of the concession, whether he has been impelled to so severe a measure in the interests of his party, or by a reckless desire to imitate the vengeance of Samson on his persecutors, and whether the caution money will be refunded "with prudent reserve and wholesome scepticism."

LETTERS TO THE EDITOR.

(*Continued from page* 265.)

WORKSHOP DRAWINGS.

SIR,—With your permission I should like to make a few comments on the letter signed "R. G. H." on the above subject, which appeared in your issue of the 19th inst. There can be no doubt of the truth and value of much of the advice given by "R. G. H." as to the preparation of workshop drawings, but at the same time I cannot help thinking that it is the advice of one who rather wishes than hopes to see it carried out. It would, in my opinion, be instructive, if some among your readers would give satisfactory replies to the following question:—Why is it that in the majority of works so little attention is given to the question of workshop drawings, and the drawing-office is looked upon rather in the light of an expensive, but almost useless necessity, costing more than it is worth, and not as one of the most important departments in the manufactory? I have been in the shops and drawing-office of one of the largest engineering works in this country, and for some years I occupied the position of leading hand in the drawing-office of two other large firms, and I must confess that in none of these works were the drawings turned out in the way in which "R. G. H." would have liked to see them.

It seems to me most improbable that drawing-offices should be almost universally regarded in the light indicated by the foregoing question, unless there was a good and sufficient reason for so regarding them. This reason appears to me to spring from two causes, which react on each other. They are:—(1) The want in the drawing-office of not only draughtsmen, but engineers. (2) The smallness of the salary offered to the so-called first-class draughtsmen, usually from 35s. to 50s. per week. This latter cause prevents really good men—engineers as well as draughtsmen—accepting such posts, and this in its turn brings the drawing-office into bad repute. We all know that the draughtsman's labour market is woefully overstocked, but the nature of the applications received in answer to an advertisement clearly show that a large majority of the applicants are men who turn to a drawing-office for employment, not because they are fitted for the work to be done therein, but because such work is more genteel than that to be done in the shops.

Can one wonder that a man who has not brain enough to conquer such false pride as this should be deficient in the brain power necessary to successfully design an intricate machine? I feel convinced that if the proprietors and managers of works would offer better salaries and better treatment to the workers in their drawing-offices they would have no difficulty in procuring men who would turn out the drawings in the thorough and satisfactory manner suggested by "R. G. H.," and the drawing-office would cease to be expensive, as the quality of the work would repay over and over again the cost of keeping it up.

One word more and I have done. Why is it that, of late, so many writers have such a love for the adjective "practical," and such a contempt for the adjective "theoretical" before the noun "man"? I had hoped that this absurd wordy war would have ended long ere this. I have read pages and pages of printing in which practical men are held up as shining lights, and theoretical men are condemned as little better than fools; but none of the writers prove, at least to my mind, that the foolishness of the one is the result of his knowledge of theory, or that the wisdom of the other is derived from his ignorance of this much-laughed-at accomplishment. A definition by such writers of what is meant by the adjectives "practical" and "theoretical" would add greatly to the clearness, if not to the value, of their productions.

London, March 22nd. N. Z.

SIR,—Your correspondent "R. G. H.," in a very interesting letter on "Workshop Drawings," asks—"What becomes of all the pupils, especially the really many intelligent and well-educated youths, who enter the business, and who have a good workshop training?" May I return the compliment, and ask him where does the demand for first-class practical men exist? and also inform him that that demand can be supplied by paying the first-class men a fair remuneration, and not the beggarly pittance which employers think is sufficient for men who have spent several hundred pounds and some years of their lives in their professional training. The same thing is exemplified by Cooper's Hill College. The Government found that they could not get a sufficient number of good engineers for service in India under the Stanley rules, and so were obliged to establish Cooper's Hill College. And what was the reason? Simply that they did not offer advantages enough to induce a good engineer to go out to India.

My own experience is as follows: After an expensive training in the shops and drawing-offices of a large Lancashire firm of engineers, I applied for a position in the drawing-office of a well-known firm of engineers and bridge builders. I saw one of the principals, who informed me that my testimonials and experience were satisfactory, and that as to salary they would give me £52 per annum, and on my saying that was not enough to keep me, he answered me with, "Oh! your friends can keep you." Now I ask is this fair? Is it likely that pupils will be satisfied with a salary of that description? After several applications with a like result, I had to accept very little more than the amount mentioned above, and on the first opportunity I left that branch of engineering and took up one that offered more advantages.

It is the employers themselves who are to blame for this state of things. When they have a vacancy, they find that they can get any number of men who say that they can do the work, and who offer their services for very little money. The employers then meet the really good men with, "Oh, we cannot give you that salary, we can get any number of men for half the money," with the result that the applicant either takes the berth with a small salary, is dissatisfied, and constantly on the look-out for another berth, or he refuses the offer, and the vacancy is filled up with an incompetent man who, with a vast amount of supervision, can make a drawing that will pass muster until it comes into the fitting and erecting shops, where it is the occasion of enormous waste of time and loss of money. The employer then cries out, "I cannot get a good draughtsman." No, certainly you cannot, my friend, if you only pay him labourer's wages. £1 saved in drawing-office salaries often means a very large amount lost in the shops; besides, a head draughtsman should not be employed in constantly overlooking his subordinates. He will have quite enough to do in working out the general lines and arrangement of the work, without being constantly referred to for the thickness of a casting or the diameter of a bolt. A man who is not capable of grasping and working out the whole machine is not capable of working out the details in a satisfactory manner.

I quite agree with "R. G. H." in his remarks on drawings. It is absolutely necessary to have good and clear drawings, in order to produce a good machine. A good drawing saves not only the time of the men, but the time of the draughtsman as well. Then a man who makes a bad and indistinct drawing must of necessity spend a great deal of time in the shops explaining matters.

Wandsworth, March 23rd. AN EX PUPIL.

SIR,—The subject of workshop drawings is one of great and increasing importance to every engineer, and any suggestions which would lead to improvement in this part of engineering work would be eagerly received by many principals, managers, and others.

The important points to be kept in view in the preparation of working drawings were very clearly set forth in "R. G. H.'s" letter which recently appeared in THE ENGINEER—viz., complete drawings, fully dimensioned; general drawings, drawn to the largest possible scale; full-sized detail drawings; copious notes as to cores, moulding, machining, &c. These points are absolutely essential in all cases.

Regarding the style in which drawings should be sent into the shops, much difference of opinion exists among leading men, and the method of mounting tracings on boards has been rejected as cumbrous, and liable to tear the tracing, by many first-class firms. The method of fixing the tracings to rollers is probably the most popular, and has the advantages of portability, stowage in small space, and keeping the tracing in good condition. The remarks of "R. G. H." will be justly taken exception to by many first-class draughtsmen. With regard to the drawing-office staff, "R. G. H." has evidently great faith in that blatant and obstructive individual known as the practical man. We hear very little of the practical man at the present time, and it is to be hoped we shall hear less of him in the future. Indeed many shrewd and thorough engineers recognise him as a man of very little intelligence and no knowledge of theoretical principles, and are no longer disposed to encourage him. It is well known that there is a dearth of really good draughtsmen, who combine a good practical knowledge with theoretical principles. This is due to a great extent to the low salaries which employers offer, and the social status of draughtsmen. Employers will be gratified to learn from "R. G. H.'s" letter that there are plenty of "geniuses." They have doubtless been under the impression that genius was rare, and when found was to be prized, especially when embodied in a neat and rapid draughtsman. Men who combine a first-class theoretical and practical knowledge with reliability, energy, and comparative youth, who are not restless and full of fads, whose work does not require to be overhauled and re-schemed—except in the narrow-minded opinion of the practical man—are occasionally met with, and when found are well worth their money, and are justly prized by their employers. PENCILIUS.

Birmingham, March 26th.

SIR,—There are a few remarks contained in "R. G. H.'s" letter of last week which appear to claim special attention. I refer to the last paragraph, in which he laments the dearth of good mechanical engineers who are willing to offer their services as draughtsmen. This may, I think, be attributed to several causes, and as the prosperity of this country is so closely connected with the skill and genius of its engineers, a few words on the subject from one who has served in the drawing offices of several firms of good standing may not be out of place.

In passing, I would remark that the first portion of your correspondent's letter—that which refers to the drawings—has in the main my hearty approval, though, in my opinion, the amount of elaborate detail which he appears to consider necessary in the drawings would in many instances be quite superfluous. Much, however, would depend upon the character of the work, and the degree of intelligence possessed by the men who have to make use of the drawings. So far as my experience goes, the first great cause which has brought about the state of things which your correspondent describes in the last paragraph of his letter is the want of appreciation by employers of the qualities which go to make a good draughtsman. The draughtsman is looked upon by many as a mere tool, a kind of necessary evil, to be dispensed with wherever possible. It is not to be wondered at, therefore, if the tendency is for the draughtsman to become more of a machine and less of an engineer. In other words, there are few "intelligent and well-educated" draughtsmen, for the simple reason that the heads of departments—in this country, at least—though nearly always active and pushing men, are rarely possesseed of that special education which is so desirable in an engineer, and therefore fail to appreciate it in others. This may appear a damning charge against the profession, but it is only partially so. The early engineers, the men who did so much to make England a great and prosperous nation, were almost without exception men of deficient education. They worked to a great extent by the data furnished by experience, and surmounted great obstacles more by the aid of their own native genius than by any help the science of the day could furnish them with. Their field was a wide one, and the pioneering work which fell to their share did not require that attention to detail which your correspondent rightly judges necessary in these days of economy. It is the old law of supply and demand. If there was a call on the part of employers for men of ability and education, and if sufficient inducements were offered to really good men, there would be no lack of skilled engineers who would be glad to offer their services. As it is, there is not a single man of any ability in the drawing-office whose one aim and object is not to get out of it at the earliest possible opportunity, even though this may involve a pecuniary loss.

The great tendency, or rather, the common practice, is to work by rule of thumb, and to follow old examples, or the examples of some enterprising neighbour, and this, perforce, because those who have the management of affairs are unacquainted with any other rule, and are unable to check the calculations of those who possess a better knowledge of theory. And here I would remark that this same "theory" is at a terrible discount amongst many who pass as competent engineers. These gentlemen look upon anything of the kind with the utmost disdain, after the manner of the fox who had the misfortune to lose his tail, as related by Æsop, the only difference being that in their case the defect is congenital. A lack of practical experience is certainly much worse, but why divorce practice from theory?

This leads to another remark, viz., that in the drawing-office every opportunity of acquiring practical experience in the carrying out of work is taken away. The draughtsman's connection with a job usually ends when the designs leave his hands, unless he happens to have made a mistake, in which case he is sure to hear something further of the matter. The remedy for the present state of things is a closer connection between the shops and drawing-offices. A different status should be given to the draughtsman. It is a well-recognised principle in another branch of the profession that the man who designs a work of construction is the fittest person to supervise the execution of the design. Were this the rule in mechanical engineering, there would be no working at cross purposes, and, as a consequence, infinitely less waste of time and materials than under the present system. This would, I admit, require men of a higher stamp than are often, if not usually, found in drawing-offices; but if the status were raised, and if it were understood that the drawing-office was in reality the brain, so to speak, of the works, the place where the best positions were to be obtained, there would in time be no lack of good men to fill every vacancy. The rising generation of engineers would soon discover the qualities which were most sought for, engineers would be better educated, draughtsmen would be more practical, and managers would be highly skilled engineers, the result being shown in better designs, more skilfully carried out, and in a vast improvement, not only in the *morale* of draughtsmen, but in the tone of the profession generally. At present the chief desideratum in a manager appears to be practical experience in carrying out work, a draughtsman being valued according to his previous experience in work of the same nature as the job in hand, the question of general ability being a minor consideration, as though the chief object in engaging a draughtsman was to obtain the designs of other firms. The tendency, as before stated, is for the draughtsman to get into a groove, becoming more limited in his experience and less practical in his ideas, and for the manager to become less of an engineer in the highest sense of the word, and more of a "rule-of-thumb" man.

Under the present circumstances, my advice to draughtsmen is, get as great a variety of work as possible whilst in the drawing-office, and to this end do not stay in one office too long, and get out of the drawing-office at the first opportunity.

Manchester, March 29th. EX-DRAUGHTSMAN.

HEATING RAILWAY CARRIAGES.

SIR,—Will you allow me to call attention to a matter which I think your railway companies ought to seriously consider before the winter of 1886-7. I refer to the entire absence of any good system for the heating of their carriages. The only system in England that I am aware of is that of the ordinary foot-warmer, which is almost ignored by most of our companies, and which at its best is practically a failure, besides being most injurious to health. Why should we, who think we rank first in railway accommodation, be among the most backward in the item of warmth in travelling? I am not prepared to say what is the best system to be arrived at, or whether that in use on the German State railways, the Russian railways, or the trains of the International Service—Germany, Belgium, France—are without their faults. I know this much, that I have travelled in winter in Germany and France, when I have found the carriages so hot that it has been necessary to remove my second coat. In fact, overheated carriages have their faults, but I think we could put up with the inconvenience of this, rather than perish with cold, as we have up to now with the system (?) that our railway companies adopt. CALOR.

London, March 20th.

COMPETITION IN SHIPBUILDING.

SIR,—I have just read Captain Gambier's article on shipbuilding in Italy; a few pages further on I find the statement that in France, Italy, and the United States shipbuilding is declining. So, as a mere looker on, I still incline to believe there may be some truth in the cry of over-production in this matter. But the story at the end of the article as to the super-excellent cheap German steel so exactly fits the statements recently made in your editorials, that I am tempted to ask whether the English makers or the English merchants are at fault in this matter; and whether the steel and workmanship that is good enough for the engines of the Lepanto is too poor for her hull; and lastly, whether Messrs. Thorneycroft or Yarrow find it necessary to go abroad for steel when they propose cutting the record in torpedo boats? Any way, I thank Captain Gambier for Cavour's "Above all, be honest."

Kensington, March 30th. W. A. S. B.

STEEL RAILS FOR ITALY.

SIR,—The following is from the *Journal of Public Works and Railways*, published in Rome 24th inst.:—"A tender has been received from a foreign firm for the supply of 27,800 tons of steel rails, at 118f. delivered at Leghorn. In 1873 the Italian railways had to pay 500f. per ton for steel rails. Such a large difference cannot be entirely attributed to improvements in means of production alone, but must be due to some extent to the industrial crisis generally prevalent in Europe. Such a state of things, in our opinion, renders the prospects of the manufacture of steel rails in Italy even more remote, and we doubt not but that the efforts of energetic men of business in this direction will prove illusory, unless the Government intervene with a protective duty, such as has been imposed by Prince Bismarck in favour of German manufacturers."

107, Fleet-street, E.C., March 26th. H. H. SPILLER.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, March 20th.

MERCHANTS and manufacturers have been much annoyed and interested for the past few months, over the unfair Custom House practices in reference to undervaluations. These difficulties are about being settled and more rigid and protective regulations will be established. The Gowen interests in the Reading Contests will in a few days announce their policy and programme. It is understood they will bitterly contest the general bond-holding interests. The best prediction that can be made is that the Reading difficulties are no nearer settlement than they have been for years, and that a compromise is more improbable now than at any time. The stronger party refuses to yield to the weaker, and as Gowen has taken up the cause of the weaker side, it is likely the contest will continue, and probably result in foreclosure. The anthracite coal trade shows no signs of improvement so far as prices are concerned, but business is quite active. The accumulation at tide-water points to day is 1,250,000 tons. Purchasers look for lower prices and therefore refuse to stock up. The Reading Company will advance prices 15 cents per ton next week. A suspension is talked of at the mines. There is a general strike among the bituminous interests, affecting 20,000 men, and very little coal is coming from the bituminous fields. General business is in a rather unsatisfactory condition owing to strikes and other unfavourable influences. At the same time, the manufacturing establishments throughout the country are running full time, believing that the demand will soon reassert itself, and enable the manufacturing interests to distribute their accumulations without sacrifice. The strikes are drawing to an end. The iron trade has developed no special activity in any branch as furnaces and mill interests are well sold up. The report of the Metal Exchange of this city, just published, exhibits a satisfactory condition of business, and trade prospects are spoken of as favourable. Several large engineering requirements are soon to be brought on the market for pipes, rails, plates, building material, as well as for merchant steel and crude iron. Steel rails are 35 dols. to 35 dols. 50c. The demand for old rails has greatly fallen off. Interest in tariff agitation is subsiding. Neither side expects any legislation this spring, but the manufacturing interests are a unit in position, and have canvassed the members of Congress pretty well, and have, it is believed, secured an opposition vote, that has discouraged the revenue reformers, or, at least, deprived them of all the enthusiasm with which they entered upon the discussion a month or two ago. A large amount of railway construction is to be undertaken next month, as bonds have been recently placed in this city for several hundred miles of road, to be constructed in some of the Southern States and in the North-west. A great deal of lumber, iron ore, and copper territory has been opened up, and the supplies of those products will be considerably increased during the coming season. Ore is high, and the bulk of the Lake Superior product already sold. Large lumber on tracts are being placed for summer delivery.

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

(*From our own Correspondent.*)

AN attempt to meet Belgian competition is the action which the Patent Shaft and Axletree Company, Wednesbury, is now pursuing in the laying down at great cost of a new steel rolling plant at its Brunswick Works, for the manufacture of channel and girder iron of large sections for engineering purposes. The company hopes to have the new works ready in a few months, and the steel will be supplied from its Monway Works near at hand, smelted upon the Bessemer and the open hearth basic methods. This will be the only works of this special character in Staffordshire; engineers at present have to buy their supplies in much part from Belgium.

The Ironmasters' Association have appointed a special sub-committee to deal with the question of the fraudulent marking of iron and the fraudulent manufacture of chain cables. The more the matter is investigated the more evident it becomes that this dishonest style of trading is being carried on to a greater extent than was at first supposed. The secretary of the Association states that he hears upon numerous hands of fresh instances of the malpractices. There are ironmasters who have recently been in receipt of communications from shipping merchants, offering them any quantity of orders if they will only put a brand of some leading firm upon common iron intended mainly for exportation. The circulars, too, issued by merchants, offering to supply consumers with the iron of the Earl of Dudley, Messrs. W. Barrows and Sons, and such A1 houses, at between £5 and £6 per ton for bars, have no doubt that the brand found upon iron supplied at such prices would be forged.

The demand for iron has not perceptibly increased since last week, and in view of the quarterly meetings buyers are postponing operations wherever possible.

Marked bars keep at £7 10s. to £8 2s. 6d., with some houses still quoting £7. Second-class bars rolled by the branded houses are £6 10s.; ordinary sorts, £6; and common, £5 down to £4 15s. Hoops are £5 to £5 5s. for common sorts, and £5 15s. to £6 for superior. Tube strips are £4 17s. 6d. to £5. Sheets—doubles—remain at £6 to £6 5s., and lattens £7 to £7 5s. The usual difference of 25s. which formerly existed between singles and doubles has now almost wholly vanished. Wire rods are quoted £6 per ton for No. 6 f.o.b. Liverpool for export purposes.

Consumers of native pigs offer as low a price now as 29s. for common pigs, which were recently commanding 32s. 6d. and 35s. per ton. Makers declare that such prices mean a loss. Part-mine pigs are 35s. to 42s. 6d.

The competition of Midland pigs is undiminished. Exceptional sales of Derbyshires are being made at as low as 36s. and 36s. 9d. delivered at railway stations here, while for other Derbyshire brands nothing less than 39s. at stations will be accepted. Many Derbyshire and Northampton firms are selling at a full 2s. 6d. per ton loss. All-mine hot blast can scarcely command more than 52s. 6d., since hematites are offered at 50s. to 53s. per ton.

The notice which has been served upon the operatives at the works of the Staffordshire Steel and Ingot Iron Company for a termination of contracts is, I am informed, in a very fair way of being settled, by the workmen consenting to a reduction in wages of something like 10 per cent. The reduction of expenses has for some time been a growing necessity, if the works were to continue running, in the face of the sharp competition from other steel-making districts.

Mr. Alfred Hickman, M.P., has just submitted in writing to the President of the Board of Trade, on behalf of the ironmasters, the alterations which they suggest should be made in the new Railway Bill which the Staffordshire deputation urged upon Mr. Mundella last week. Among other changes, they submit that an altogether new clause is required providing power for a trader to demand through rates over different railways and canals forming an unbroken chain of communication, and upon any such through rate being granted by the different companies interested, that the Commissioners shall have power to determine its legality. At present only the companies, and not the traders, have power to make this demand. The traders also suggest an enlargement of Clause 24—which provides for a revised schedule of maximum rates as regards railway traffic—so as to include canal rates. It is declared that such revised schedule is quite as necessary for water ways as for railways.

Some of the engineering concerns in this district are just now managing to secure exceptional rates from the London and North-Western, Great Western, and Midland Railway Companies for conveyance to Liverpool and other shipping centres of special contracts which are upon their books. The carriers are showing wisdom in attempting to meet traders in this way, for it is only by extraordinary efforts aiming at economies first in one direction, and then in another, that engineering concerns are able to make both ends meet.

The Small-arms Factory at Sparkbrook, Birmingham, formerly owned by the National Arms and Ammunition Company, has now been acquired by Government, and, with a view to improving its capacity for output, it is undergoing large structural alterations, and is being stocked with new machinery. As the old floors were not deemed strong enough for the heavy kind of work which is now to be undertaken, the building has been fitted with new floors, which are supported by strong iron girders, at a cost of some thousands of pounds. The order for machinery has just been executed by Messrs. Archdale and Co., of Ledsome-street, Birmingham, in a very short space of time. It comprises thirty-eight machines, many of them of a most costly character, and puts the War Office to an expense of more than £3000. The contract includes fifteen single profiling machines, one double ditto, two slotting machines, one screw-cutting lathe, one drilling machine, three copy milling machines, one body or shoe drifting machine, one barrel spotting lathe, three rough turning lathes, four finished turning ditto, one sofa bush running apparatus, one planing machine, one large profiling machine for die sinking, one cutter milling machine, one shot drilling machine, and one cutter grinding ditto. These are for the most part of the patterns known to the trade, save where the ingenuity of the makers has introduced minor improvements. A 20 cwt. steam hammer is also being made for the factory by Messrs. B. and S. Massey, of Openshaw, Manchester.

At a meeting of the Dudley Chamber of Commerce on Tuesday, a discussion took place on the circular sent out on the iron trade frauds, and the disreputable proceedings were fully commented on, after which the discussion was adjourned.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The rapid upward movement in Scotch warrants has during the past week lent some little excitement to the dull monotony of the iron trade in this district, but apart from this there is no very material change to report. The precise cause of the sudden advance on the Glasgow Exchange has been a somewhat agitating problem, for which it has been difficult to find any really satisfactory explanation. As, however, I have pointed out in previous "Notes," prices have been forced down to such an abnormally low point that they are very sensitive to any influence likely to operate for a rise, and in this instance the remotely probable effect upon trade here of the strikes in Belgium, and the renewed suggestions for a general reduction of the output of pig iron, seem to have combined to set in motion the upward movement in prices. The advance, however, not being backed up by any actual increase in the demand is wanting of the chief element of stability, and this is a fact which buyers here do not fail to recognise. Here and there buyers who have been holding back show more readiness to place out orders, and so far as sellers are concerned, there is, perhaps, less eagerness to accept the excessively low cut prices at which some brands of pig iron have been offered recently; but the weight of actual business doing has been very small, with sales only practicable at extremely low prices, and the effect has been rather to unsettle the market, buyers and sellers being both uncertain what to do. Should, however, the upward movement of prices in Scotland be maintained, it will no doubt have a strong influence in bringing hesitating buyers into the market, whilst it may also bring out a good deal of buying on account of uncovered "bear" sales, which would very soon force up prices here.

There was again but a small business doing in the Manchester iron market on Tuesday, and prices were without material change from last week. For local and district brands of pig iron quoted prices remained at about 37s. 6d. to 38s. 6d., less 2½ per cent., for delivery equal to Manchester; but in one or two moderate sales which were reported a little under these figures had to be taken, and there are still some brands of Lincolnshire iron which are offering at fully 1s. to 1s. 6d. per ton below these prices. What business there was doing in Middlesbrough iron was also at no appreciable advance upon late rates.

Hematites still meet with but very little inquiry in this district, and any actual business offering is so small that prices are scarcely tested; nominally 51s. 6d., less 2½ per cent., remains about the current price for No. 3 good foundry qualities delivered here.

In the manufactured iron trade a tone, which if anything is rather more hopeful, seems to prevail in some quarters; but there is nothing in the market to indicate any actual improvement, and prices remain quite as low as ever, £5 per ton being the average figure for bars delivered into this district, £5 7s. 6d. for hoops, with local made sheets to be got at about £6 10s. per ton.

Some of the tool makers report rather more inquiry stirring, but there is no appreciable increase of actual new work giving out, and with the exception of three or four large firms who are engaged on special work, slackness generally is still reported throughout all branches, with the tendency, as a rule, rather in the direction of lessened than increasing activity.

Messrs. W. and J. Galloway and Sons, of Manchester, have undertaken the whole of the contract for the electric illumination of the gardens and fountains at the forthcoming Colonial and Indian Exhibition in London. I may add that at this exhibition the illuminations are to be carried out on an even more elaborate scale than at the Inventions last year, and Messrs. Galloway are putting down an entirely new plant for the purpose. The engines are to be of the twin compound type, specially adapted for running dynamos, and for the illuminations a variety of lamps of different kinds are to be employed. The Galloway engines which were put down for the Health Exhibition and the Inventions will remain to drive the Canada section in the Colonial Exhibition. Messrs. Galloway have also received orders for engines to be put down in the Liverpool Exhibition precisely similar to those which they put down for the Inventions Exhibition last year.

An improvement in pressure-reducing valves has also just been introduced by Messrs. Schaffer and Budenberg, which I may briefly notice. In this improved construction the throttle valve proper is combined with a cut-off valve, adjustable by hand, in such a manner that the passages or ports of the throttle valve may be wholly or partly covered by the cut-off valve. By this means the area of the passage corresponding to the lowest position of the governor may be adjusted at will—that is to say, a constant initial throttling may be obtained, while for the further and variable throttling, up to the complete closing of the throttle valve, the whole lift of the governor remains available. This improved construction consequently enables the same variation to be obtained while the valve is in operation as by exchanging an ordinary throttle valve for one of different capacity.

In the coal trade a fairly steady tone has been maintained with the opening of the month. Although the current sales of house fire coals are only very small, deliveries on account of old orders still keep the collieries in most cases tolerably well employed, and there has been no announced reduction in prices. The tone of the market is, however, weaker if anything, and where concessions are absolutely necessary to secure orders sellers give way a little. Common round coals, so far as the inland requirements for steam and iron-making purposes are concerned, continue in very poor demand, but there is a tolerably good shipping trade doing. Engine classes of fuel move off fairly well, but in the Manchester district supplies are rather a drug, especially of burgy, upon which a reduction of 5d. per ton in the delivered rates has been made this month. At the pit mouth prices average about as under:—Best coal, 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common house coal, 5s. 6d. to 6s.; steam and forge coals, 5s. to 5s. 6d.; burgy, 4s. to 4s. 6d.; ordinary slack, 3s. to 3s. 6d.; and best sorts, 3s. 9d. to 4s. per ton.

The effects of the present depression of trade as regards the iron industry were very forcibly set forth at the annual general meeting of Messrs. Bolckow, Vaughan, and Co., at Manchester, last Friday. The report which was submitted stated that the depression had continued throughout the past year with increasing severity, with the result that pig iron had touched the lowest price ever known in the history of the trade, Mr. H. D. Pochin, the vice-chairman of the company, adding that the price of pig iron had been 3s. 6d. per ton lower than in the previous year, representing a loss of £60,000 to the company.

Barrow.—There is no change to note in connection with the hematite pig iron trade. The demand is confined to a very few purchases which are necessary for immediate requirements of consumers, but apart from this there is no life in trade. The consumption of pig iron does not represent more than half of the maximum output of the district, and makers at present are mainly indeed almost wholly, employed in the production of iron to meet delivery engagements entered into some months ago. Makers have in hand work which will furnish employment at the present rate of production for a few months to come, and therefore in the meantime they are not pressing sales at the low rates which are now ruling. Prices remain at about 42s. 6d. per ton, net at makers' works, for mixed parcels of Bessemer pig iron, although in some instances sales are noted at rather lower values than these, but of course this is in instances where needy sales have had to be made to clear; 41s. 6d. is about the market price for ordinary hematite pig iron, net at works, but sales of this class of metal have of late been more than ordinarily limited, and as a matter of fact, makers are producing very little beyond the Bessemer qualities and the requisite spiegeleisen which is wanted for purposes of steel conversion. The demand for steel rails remains much restricted, and this will remain the case until the dissolution of the Railmakers' Association is accomplished. This cannot take effect until the second week in April, and then a better demand is expected to spring up alike for pig iron and steel, but prospective buyers are expecting cheaper prices all round. Whether their hopes will be realised or not the next few days will show. Shipbuilders have booked no new orders, and very few are offering. No change can be noted in the engineering trade, which is busy in the marine department and slack in the general branch. Iron ore finds a very poor market, but prices remain steady at from 8s. 6d. to 11s. per ton net at mines. Coal and coke quiet, but in steady consumption. The tonnage of imports and exports at local ports is very low.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THROUGH the kindness of a friend, who has been favoured by Mr. Charles McLaren, M.P., with a proof—obtained from the Secretary of State—of a portion of the mining and mineral statistics of the United Kingdom for 1885, prepared by her Majesty's Inspector of Mines, an idea is obtained of the production of coal in the United Kingdom during the twelve months. The output amounted to 159,351,418 tons, as compared with 160,757,779 tons for 1884, 163,737,327 tons for 1883, and 156,499,977 tons for 1882. The number of colliers employed in these periods were respectively 520,632, 520,376, 514,933, and 503,987, the number of tons produced per collier being 306, 309, 318, and 311. The production of coal in Yorkshire was 18,497,778 tons against 19,220,144 tons in 1884. For Derby, Nottingham, Leicestershire, &c., the weight was 16,963,684 tons against 16,080,682 for 1884. It will be noticed that the production of coal in Yorkshire decreased in 1885, as compared with 1884, by 722,366 tons, while Derby and Nottinghamshire show an increase in the same period of 883,002 tons. The miners' strike, which caused a stoppage of about two months, accounts for the decrease in Yorkshire, as well as the increase in the adjoining coalfields, from which supplies were drawn when the pits in Yorkshire were closed. Yorkshire, which gained in production a million tons in 1883 over 1882, now shows a less output than in 1882, which is not a satisfactory feature for South Yorkshire.

The committee appointed by the Sheffield Town Council to consider the letter addressed to the Mayor in regard to the alleged fraudulent trading in Sheffield by local factors and manufacturers, held its first meeting on Monday, when a chairman was appointed. It is intended to be a very secret committee, the members having pledged to each other not to reveal their deliberations until they are presented to the Corporation in the form of a report. Meanwhile our American and other rivals are making the most of these so-called "disclosures." The *Chicago Tribune* of the 8th ult. contains a letter, dated "Sheffield, England, February 25th—Special correspondence," headed "Perfidy at Sheffield," with sub-heads running thus:—"The Great Cutlery Manufacturers Playing Havoc with their City's Reputation," "Importing Inferior German Goods and Re-exporting them as Home Manufactures," "Some Revelations that American Dealers will do well to Ponder Over." This is the danger that was foreseen. Of course, no "great" Sheffield firm does anything of the kind. The Sheffield cutlery trade with America is done by our best houses, who never had German goods inside their premises or falsely marked a knife in their lives. But the "lie" has got a start, and it will be hard to overtake it. German rivals are at the same game, and all this because a few instances are supposed to have been found where factors or makers were not careful to distinguish between Sheffield and German goods. There are, it is feared, tricks in the cutlery as in all other trades; but the buyer who is willing to pay a fair price for a good article can yet rely on Sheffield cutlery, which, as an industry, will compare favourably in honest and upright dealing with any other trade in the country.

Some capital orders in military material have recently been received here. One firm has been able to secure a contract for guns and gun jackets, and similar work, which will run up to six figures, and it is no secret that the same firm have excellent orders from a shipbuilding firm for propeller blades, crank shafts, and similar heavy goods.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE amount of business done in Cleveland pig iron last week was somewhat more than usual, and the prices realised were slightly better than those which have recently ruled. At the iron market held at Middlesbrough on Tuesday last the tone was still firmer, no doubt in sympathy with the rise in price which has taken place at Glasgow. Consumers were generally willing to pay 30s. 6d. per ton for No. 3 g.m.b., but makers hope for better things shortly, and hesitated to commit themselves to sell at that price. In most of the transactions which took place on Tuesday the sellers were merchants, and the price agreed on was 30s. 6d. per ton for prompt delivery. Only in one or two instances was 3d. less accepted. For delivery over the next three or four months 31s. is now the usual price quoted.

Holders of warrants are less anxious to sell, and have advanced their price to 30s. 6d. per ton.

The stocks at Messrs. Connal and Co.'s stores continue gradually to rise. On Monday last the stock at Middlesbrough had reached 209,787 tons, being an increase of 2594 tons. At Glasgow, on the same day, the quantity held was 714,224 tons, or an increase of 8035 tons.

Shipments have improved since the mild weather set in, but they are still below the average for the time of year. The quantity sent to foreign ports is especially deficient. The total pig iron shipped up to and including the 29th of March was 56,235 tons. The total for February was 52,754 tons.

Finished iron manufacturers are no better off, and there is no present prospect of the works which are standing being restarted. Prices do not fluctuate much. The quotations on Tuesday were as follows:—Ship plates, £4 10s. to £4 12s. 6d. per ton; angles, £4 5s. to £4 7s. 6d.; and common bars, £4 10s. to £4 12s. 6d. all free on trucks at makers' works, less 2½ per cent. discount.

Notices were posted up at all the blast furnaces in the North of England on Friday last, stating that engagements with workmen would terminate on the 17th of April. This step has been taken with a view to obtaining a reduction of wages, but to what extent has not yet been announced.

The directors of the North-Eastern, London and North-Western, Midland, Lancashire and Yorkshire, as well as of several of the other leading railways in Great Britain, are much exercised in their minds about the Bill entitled "The Railway and Canal Traffic Bill," just introduced into Parliament by Mr. Mundella, President of the Board of Trade. The Bill proposes a revision of traffic rates forthwith, the revised rates being subject to approval or veto by the Board of Trade. At any future time a new revision may take place by the same authority, should it be petitioned to that effect by any properly constituted public body or association of aggrieved freighters. Railway directors are calling meetings of their share and debenture holders in all directions, in order that they may at once consider their position and decide on a course of action. In the convening circulars they profess to invite consideration of the matter by their constituents; but it is quite clear from the somewhat heated language they use that these railway directors have made up their own minds in a kind of panic, without much, if any, consideration at all. They designate the powers sought to be given to the Board of Trade "confiscatory powers," and they seek to invoke and direct against the promoters something of the horror and antipathy which citizens naturally feel towards robbers and bandits. The sudden volubility of these public administrators, as manifested in circulars calling shareholders' meetings, contrasts most strikingly, and almost amusingly, with the lofty quietude and dignified reserve with which they have hitherto been wont to receive applications for the redress of grievances relating to traffic rates. Sir Bernhard Samuelson, in his recent report to the Association of the Chambers of Commerce of the United Kingdom, says that after the fullest investigation he has failed to find any principle regulating railway rates beyond "the haphazard estimate by traffic managers of what the traffic will bear." If there is water or other competition than a low rate as given; if there is no competition, then woe betide the freighters.

So it comes that merchandise rates vary from ·6 of a penny to 5d. per ton per mile, and on the average are far above continental rates. Now it is this sort of thing which freighters, acting singly, and in bodies, have long endeavoured to persuade railway directors to modify. But to a great extent they have endeavoured in vain. Now that trade is universally depressed attention is naturally directed to everything tending to prevent a revival. Rates which, though unduly high, might be tolerated in good times, cannot be tolerated in bad ones. Hence Mr. Mundella's new Bill. It is brought forward in the interest of the public, with whom the railway companies appear to be much at variance as to their respective rights. The term "confiscation" may be used by both sides. Had not the companies, through their officials been systematically demanding and taking more than they ought whenever they thought the "traffic would bear it," the present Bill would not have been necessary, and would never have been thought of. Unduly high rates where the public cannot resist are surely instances of "confiscation," if that term is ever applicable at all; unless, indeed, railway directors think they have a divine right to a monopoly of the term as well as to the traffic on their particular routes. The flutter which has taken possession of the railway mind and has made it for the moment forsake its customary dignified taciturnity and take to almost indiscreet volubility, has revealed in an amusing manner the railway administrator's views of his company's rights. That view seems to be that railways should be conducted just as private enterprises are—namely, solely or mainly in the interest of the firm or company conducting them. But private companies and firms have not the advantage of Acts of Parliament to shield them from competition. Indeed they are fully subject thereto, and are thereby held most effectually in check if too greedy of gain. Railway companies, on the other hand, are specially protected by Acts of Parliament. They have practical monopolies in their own districts as public carriers; and this advantage is given them by the public, acting through their representatives in Parliament, in consideration of their submitting themselves to parliamentary control, and conducting their operations in the public interest, and for the public good. Railway directors are, indeed, or should be, trustees for the public, who are their employers, and only after competent tribunals, such as the Board of Trade or the Railway Commission, are satisfied that all reasonable public demands have been attended to, have they any right to amass wealth for their shareholders. Viewed in this light it is clear that all Mr. Mundella's Bill proposes to do is to restore to the public that proper control of railway and canal traffic rates to which they have a right, in return for the special privileges accorded by Parliament, but which right has not hitherto been sufficiently exercised by them, and which has been virtually ignored by the companies.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market was very excited in the beginning of the present week. Warrants were not to be obtained, and the consequence was that prices advanced by Tuesday afternoon to 41s. cash, being a rise of 2s. 10d. a ton as compared with the rates current that day week. Two brokers having found it impossible to cover their "bear" accounts were obliged to suspend payment, and after the intimation of their stoppage had been made a sudden reaction occurred in prices. These occurrences confirmed the impression formerly entertained that the upward movement in prices was largely due to the state of brokers' accounts, and in a very small degree, if at all, owing to legitimate trade influences. At the same time the labour strikes in America and on the Continent have undoubtedly had their influence in imparting a more cheerful tone to the market, and this feeling has been heightened by the effort of the British Iron Trade Association to bring about an agreement for the curtailment of the output of pig iron.

In the meantime, the volume of business continues unsatisfactory. The shipments of pig iron from Scottish ports during the week ending Saturday last amounted to 6013 tons, as compared with 7142 in the preceding week, and 10,877 in the corresponding week of 1885. One furnace has been relighted at Glengarnock, and there are now ninety-six in blast, against ninety-two at this date last year. Upwards of 8000 tons have been added in the course of the week to the stock in Messrs. Connal and Co.'s Glasgow stores.

Business was done in the warrant market on Friday at 39s. 3d. cash. On Monday the market was excited, with a very large business up to 40s. 7½d. cash. The excitement continued on Tuesday forenoon, when the cash price of warrants further advanced to 41s., from which, however, there was a relapse in the afternoon to 40s. 1½d., after the failures had been announced to which allusion has been made above. Business was done on Wednesday at 39s. 10d. to 39s. 6d. cash, recovering to 39s. 10d. at the close. To-day—Thursday—transactions occurred down to 39s. 8d., but at the close 39s. 11d. was the cash quotation.

The values of makers' iron were affected by the state of the warrant market, and are higher, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 45s.; No. 3, 42s.; Coltness, 48s. 6d. and 44s.; Langloan, 45s. and 42s. 6d.; Summerlee, 47s. 6d. and 42s. 6d.; Calder, 47s. 6d. and 41s. 6d.; Carnbroe, 44s. and 41s. 6d.; Clyde, 43s. 6d. and 40s. 6d.; Monkland, 41s. and 39s.; Quarter, 41s. and 39s.; Govan, at Broomielaw, 41s. and 39s.; Shotts, at Leith, 46s. 6d. and 46s.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. 6d. and 42s. 6d.; Glengarnock, at Ardrossan, 44s. 6d. and 41s. 6d.; Eglinton, 40s. 6d. and 37s. 6d.; Dalmellington, 42s. and 40s.

There has been rather more doing in the shipment of manufactured iron and steel goods from the Clyde. Those of the past week embraced £5300 worth of machinery, of which the greater part was sugar crushing plant, £7560; sewing machines, £25,500; steel goods, of which £18,500 were for railway sleepers and bolts for South Australia, and £29,900 general iron manufactures, including £7750 sheets, pipes, stoves, and plates for Brisbane, and £8330 worth of similar goods with the addition of bars for Sydney.

The order for 50,000 tons of cast iron pipes, received by Messrs. Macfarlane, Strong, and Co., of Glasgow, for the Bombay Waterworks, coming to the firm within a short time of a contract for 27,000 tons for the Manchester—Thirlmere—Waterworks, will keep them in employment for a long time. The same day they got notice of their success at Bombay, they also received a moderately good contract for America. The great bulk of the pig iron for these contracts will be brought from the Cleveland district, and the time allowed for the execution of the Bombay contract is about three years.

Several orders for vessels have been placed within the past few days with Clyde shipbuilders, but they were of comparatively small size.

There is a somewhat more cheerful feeling in the coal trade. Large arrivals of vessels have taken place within the past few days, and an increase in the amount of the exports is expected. The shipments of the past week were 22,824 tons from Glasgow, 1205 tons from Greenock, 9068 tons from Ayr, 3397 tons from Irvine, 7934 tons from Troon, 3202 tons from Leith, 7149 tons from Grangemouth, and 3987 tons from Bo'ness. The f.o.b. prices of coals at Glasgow are as follow:—Main coal, 5s. 9d. to 6s. 3d; ell, 6s. 6d. to 8s.; splint, 6s. to 6s. 6d.; steam, 7s. to 8s.

The Clyde shipbuilding trade has been quiet during the past month, the total tonnage launched having been 8158. An idea of the present state of the trade may be had from the subjoined figures of the comparative amounts of tonnage placed in the water:—

	March.		First quarter.	
	Vessels.	Tons.	Vessels.	Tons.
1886	9	8,158	22	28,5[illegible]8
1885	15	13,667	42	38,412
1884	18	26,820	42	62,760
1883	22	30,259	51	81,758

In previous years the tonnage was smaller than in 1883, but we require to go back for a very considerable number of years before we find it so low as in the past three months.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE was a larger export of coal from Cardiff last week, an excess of close upon 30,000 tons over the exports of the previous week, and still the prevailing feeling at Cardiff is one of gloom. On all sides, from shippers, coalowners, and railway managers, the comment is the same, "Times unbearably bad." I could give a lengthy and startling list of collieries working the best steam coal in the Rhondda and other places, where it means unceasing loss to the coalowners and almost starvation to the men. Some of the collieries—Caedcoe and Ocean, for instance—which have invariably been in good work when the coal trade has been quiet, are now scarcely doing anything. It is the same in house coal valleys. In the Rhymney Valley this has been the case for several weeks. Gwerna colliery is quiet, and look where one will, semi-stagnation is the prevailing feature.

There is another bad item, too, coming into account. Hitherto prices have been tolerably firm, and I have heard even of stiffness in price, caused by the small output; this especially in small steam. Coalowners, too, seeing that only a limited quantity of best three and four-feet was sent to bank, were naturally able in cases of necessity to exact even slightly improved prices. Now this is changing, and firms, in order to secure business, are lowering quotations. The market is perceptibly drooping, and not for secondary coals. The best steam shows an appreciable difference in price in the course of the last few days, and that difference is on the wrong side.

To add to the troubles of coalworkers, with only scant work, they have had a great deal to put up with of late with floods and storms, and the storms have hampered the transport of coal wagons and delayed steamers.

I fear that all this portents financial difficulties to the weaker men. The wonder is that Wales has been so long and singularly free from colliery breakdowns. Rumours are prevalent enough, almost too prevalent for public confidence.

The fifth annual meeting of the Miners' Provident Fund was held on Tuesday, Mr. Llewelyn presiding. Mr. Owen, the secretary, read the report, which was one of great interest and encouragement. At the close of the year 1885 the members numbered 37,459, and the ordinary revenue of the society was £27,746. During the past year there had been 7805 cases of disablement, and seventy-eight fatal accidents by which 141 members had been killed. These fatal accidents placed on the funds sixty-two widows and 117 children, and at the end of the year 143 widows, and 261 children were in receipt of annuities from the society. Amongst the speakers who highly commended the society was the Bishop of Llandaff, who testified to the excellence of its aims, and the great vigour and success with which it was conducted. Mr. Tylor, who regretted the absence of Sir W. T. Lewis, who had founded the sliding scale and the Miner's Provident Society, referred to the first institution as one in which employers and employed fought the battle of life together, and the record wherein they side by side fought the battle of death, and he reached the strong point of excellence in remarking that these institutions had done more than any before in bringing labour and capital in good social feeling together. The close of the meeting was marked by the adoption of an energetic protest against interference by Parliament with the arrangement entered into by coalowners and workmen in the matter of the Employers' Liability Act of 1880. The tendency to interfere is well marked, on the assumption that it would be better for the men so to do, but this is a fallacy, and the men know it.

Tynybedw Colliery, Rhondda, has now been stopped six months, and the Rhondda collieries generally are suffering. On Monday eleven pits were idle, on Tuesday six, and when my despatch left there was about the same number. Bute Colliery has only worked one day during the last two weeks. Colliers are planning emigration in large numbers.

Turning to the iron and steel trade, there are no signs of encouragement, though things are not quite so bad as represented. For example, it has been widely rumoured that the converters and mills at Cyfarthfa were to stop this week, but though one converter has been stopped, and the other is being repaired, and some mills are less active, the principal reason is stocktaking, it being the end of the financial year. Cyfarthfa, Dowlais, Tredegar, and Ebbw Vale are tolerably successful in getting a share of the small existing trade.

It is only a question of time for all the old-fashioned ironworks to be swept away. In the course of a week or ten days Gadlys Ironworks, Aberdare, are to be brought under the hammer, and as the plant is of that excellent quality of cold blast iron which won the support of Sir Wm. Armstrong, I expect that buyers will flock there from all parts of the kingdom. There are about 2000 tons of old castings, low-pressure blast engines, &c. A good deal dates from 1827-30, before the time when ironmasters began to alloy their metal with cinder.

Kindred industries are only moderately employed. The weather has told detrimentally on the tin-plate trade this week, affecting exports; otherwise the tone continues fairly satisfactory, and prices are sustained, especially for best brands.

Last week 60,000 boxes of tin-plates left Swansea, and as only 21,000 came into stock prices are assured. Ordinary cokes are 13s. 9d. to 14s.; wasters, 1s. less; Bessemer, 13s. 9d. to 14s.; and Siemens command 3d. more. The dispute with the forgemen is likely to be compromised. Masters want to enforce a reduction of 17½ per cent. The men are willing to 10 per cent. Two failures in the trade are reported this week. Orders in this week include a lot of squares, as well as the ordinary coke sheet.

An explosion occurred last week at the Werfa, causing three deaths.

There is a probable strike of engine-men and stokers at hand. Agitation is spreading, and at a late meeting it was determined to resist the reduction that begins April 1st. Like other classes of workmen, these see no inconsistency in striking, though work is considerably diminished. I hope better counsels will prevail. A bad trade and fettered action would be disastrous.

A Newport firm of auctioneers will sell the Gadlys plant—Messrs. Graham and Co.

NEW COMPANIES.

THE following companies have just been registered:—

Mitis Company, Limited.

Upon terms of an agreement of the 9th ult. this company proposes to acquire from Thorsten Nordenfelt certain inventions and patent rights for an improved method for castings in wrought iron or steel, and also to acquire from Henry Daniel Davies the freehold premises known as Hamilton's Windsor Ironworks, situate at Garston, near Liverpool, with the dock machinery, furnaces, plant, and fixtures belonging thereto. It was registered on the 19th ult. with a capital of £250,000, in £10 shares. The purchase consideration is £30,000 in cash or 6 per cent. mortgage debentures, an allotment to Mr. Nordenfelt of £124,750 in fully-paid shares, and an allotment of fully-paid shares of the nominal value of £124,750 to Mr. Davies. The mortgage debentures referred to are to form part of a total issue not exceeding £120,000, being a first charge upon the whole undertaking of the company. After the interest due upon the debentures has been provided for out of the annual net profits, Mr. Nordenfelt will be entitled to a royalty of one farthing per lb. weight upon all Mitis manufactured under the said patents. The subscribers are:—

	Shares.
*T. Nordenfelt, C.E., 5?, Parliament-street ..	1
E. Bruzewitz, 8, Prince's-street, Hanover-square, private secretary ..	1
W. R. Lunn, 6, Forest Drive, Leytonstone, agent	1
F. J. Norris, 69, Hinton-road, Loughborough Junction ..	1
C. Manbry, 39, Gospel street, Hoxton ..	1
G. Mackenzie, 2, Wimbledon Park-road ..	1
J. S. Lyall, 29, Canonbury-square ..	1

The number of directors is not to be less than three nor more than seven; qualification, £1000 in shares or stock; the first are Rear-Admiral William Arthur, C.B., Colonel the Hon. W. J. Colville, Mr. Alfred Giles, M.P., and Mr. T. Nordenfelt; remuneration, £300 per annum for each ordinary director, with an additional £200 per annum for the chairman. Any director employed as "special agent" may receive such further remuneration as the directors may determine.

Weighing Machine Company, Limited.

This company was registered on the 24th ult. with a capital of £20,000, in £5 shares, to acquire the exclusive rights under provisional protection No. 1968, dated 10th February, in so far as the same is applicable to weighing machines. The subscribers are:—

	Shares.
John Davis, 23, King Henry's-walk, Dalston, designer ..	1
G. H. Potts, 13, George-street, E.C., accountant ..	1
J. G. Greig, 22, Austinfriars, chartered accountant ..	1
W. R. Woollven, Sutton, Surrey, clerk ..	1
F. W. Ann, 3, Broad-street-buildings, merchant	1
G. Pallan, 184, St. George-street, E C., engineer	1
A. C. Dockerill, 83, Winston-road, Newington-green, secretary to a company ..	1

Most of the regulations contained in Table A of the Companies' Act, 1862, will apply.

American and Continental Sanitas Company, Limited.

This company was registered on the 18th ult. with a capital of £75,000, in £1 shares, to acquire and work the American and Continental patents of the Sanitas Company, Limited, upon terms of an agreement of the 19th ult. The purchase consideration is £5000 in cash and 25,000 fully-paid shares, and also one-third of the shares of any increase of capital. The subscribers, who render themselves liable for £1, are as follows:—

	Shares.
*W. H. Bosanquet, 11, Queen Victoria-street, solicitor ..	1
*D. Evans, 1, Wood-street, merchant ..	1
M. Zingler, 19, Buckland-crescent, Belsize Park, secretary to a company ..	1
*Major A. Wood, Abbey Wood, Kent, managing director of a company ..	1
R. M. Cunningham, 114, Earl's-court-road, secretary to a company ..	1
A. W. Burn, 13, Moorgate-street, solicitor ..	1
J. C. Berry, 80A, Paulet-road, Camberwell, clerk	1

The number of directors is not to be less than three nor more than seven; qualification, £500 of the nominal share capital; the first are the subscribers denoted by an asterisk, who will after allotment elect Messrs. C. T. Kingzett and M. Zingler to serve with them. The directors are empowered to appoint from amongst themselves a managing director and chemist at such remuneration as they may think fit. The remuneration of the ordinary directors will be £450 per annum, with an additional £100 for each £2 10s. per cent. dividend in excess of £5 per cent. per annum.

Cowley's Ship Share Company, Limited.

This company proposes to acquire shares in the Eddiside Shipowning Company, Limited, the St. Patrick Shipowning Company, Limited, the Mirzapore Ship Company, Limited, and in any other shipping companies managed by P. H. Cowley and Co. It was registered on the 18th ult. with a capital of £10,000, in £10 shares. The subscribers are:—

	Shares.
P. H. Cowley, Liverpool, shipowner ..	1
J. Potts, New Brighton ..	1
T. E. Parker, Liverpool, master mariner ..	1
H. W. Lowe, 7, East India-avenue, shipowner ..	1
J. G. Harker, Stockton-on-Tees, sailcloth manufacturer ..	1
G. H. Faber, 11 and 12, Clement's-lane, underwriter ..	1
W. D. Lloyd, 1, East India-avenue, shipowner ..	1

Mr. P. H. Cowley is appointed managing director.

D. F. Tayler and Co., Limited.

This is the conversion to a company of the businesses of D. F. Tayler and Co., and of Edelsten, Williams, and Co., of New Hall Works, Birmingham, and 89, Newgate-street, London, manufacturers of pins, hair-pins, general and colour printers, manufacturers and rollers of copper, brass, and other metals, wire drawers and manufacturers, and galvanisers. It was registered on the 23rd ult. with a capital of £200,000, in £5 shares. The subscribers are:—

	Shares.
*W. Williams, Edgbaston, Birmingham, manufacturer ..	1
*F. Williams, Edgbaston, Birmingham, manufacturer ..	1
H. Wiggin, M.P., Harborne, Staffordshire, manufacturer ..	1
*H. A. Wiggin, Harborne, Staffordshire, manufacturer ..	1
T. S. James, Edgbaston, bank manager ..	1
G. H. Kenrick, Edgbaston, manufacturer ..	1
W. A. Bolton, Edgbaston, iron merchant ..	1

The number of directors is not to be less than two nor more than five; qualification, 200 shares; the company in general meeting will determine remuneration. The subscribers denoted by an asterisk are the first directors. The purchase of the business, &c., is regulated by an agreement, the consideration being £90,000, payable as to £22,500 in cash, £22,500 in 5 per cent. mortgage debentures, being part of a first issue of 450 mortgage debentures of £100 each, and the balance of £45,000 in fully-paid shares. Messrs. Wilfred Williams and Francis Williams are appointed managing directors for five years at a salary of £2000 per annum, to be divided as they may mutually arrange.

Aycliffe Steamship Company, Limited.

Registered on the 19th ult. with a capital of £24,000, in £75 shares, to acquire the steamship Aycliffe, of Middlesbrough. The subscribers are:—

	Shares.
W. Hanson, Middlesbrough, ironmaster ..	1
G. Chapman, Aycliffe, Durham, lime merchant ..	1
W. Putnam, Darlington, forgemaster ..	1
T. Putnam, Darlington, forgemaster ..	1
C. Boagey, Catham, grocer ..	1
J. Constantine, Middlesbrough, ship store dealer	1
W. Henderson, Middlesbrough, shipowner ..	1

The number of directors is not to be less than two nor more than three. Most of the articles of Table A are adopted.

Herts Steam Laundry Company, Limited.

This company was registered on the 22nd ult. with a capital of £5000, in £1 shares, to carry on steam laundry works at Harpenden. The subscribers are:—

	Shares.
J. Wilsher, 42, Bygrove-street, Poplar, contractor	1
R. Owen, jun., Croydon, sack manufacturer ..	1
J. Hooper, 3, Oak-lane, dock contractor ..	1
L. Foley, 29, Hind-street, Poplar, Arctic flower factor ..	1
G. Chandler, 14, Wade street, Poplar, contractor	1
T. G. Bowick, 5, Oak-lane, Limehouse, electrician	1
F. Bartlett, 15, Dunstable Villas, Richmond, laundryman ..	1

Registered without special articles.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—At a general meeting held on Tuesday, March 23rd, the president in the chair, Mr. A. Collins read a paper "On Sanitary Houses." The author commenced by stating the importance of this branch of engineering, and dwelling on the benefits accruing from a general knowledge of the subject. But in his paper he proposed to confine himself solely to the description of sanitary appliances and their uses. After discussing the importance of the trap, Mr. Collins briefly touched upon the question of water supply, and then passed on to the subject of water-closets. These, it was stated, were first introduced into England during Queen Elizabeth's reign by Sir John Harrington under the name of latrines or ajaxes. Many kinds were described, and among those mentioned were the flush-out combination, Pearson's turn basin, Hellyer's optimus, and the hygienic closet. The uses and modes of fixing were next explained of housemaids' sinks, flushing tanks, baths, lavatories, and gullies, after which the different systems of ventilation of soil pipes were considered. The syphoning action of traps placed one above the other, and all connected to the soil pipe, was noticed, a working model being used by way of illustration. The systems of carrying away waste water were touched upon. Details were next given of the methods employed in laying drains, including a description of the Stanford joint, a model of which was shown, kindly lent by the agent, Mr. Henry Ough, C.E., 16, Austinfriars. The paper concluded with a few remarks on ventilation, dustbins, and the modes of locating leakages of sewer gas from soil pipes. Numerous diagrams drawn for the purpose illustrated the paper, and a collection of models kindly lent by Messrs. Doulton, of Lambeth, were also exhibited.

COPPER IN THE UNITED STATES.—The extraordinary increase which has taken place in the production of copper in the United States has completely revolutionised the European market, just as was the case forty years ago with the production of precious metals. In 1850 the copper mines produced from 40,000 to 50,000 tons per annum, but the average production had reached 120,000 tons in 1880, and is now just double. The Michigan mines have produced the largest quantities, and the centre of the industry is now the basin of Lake Superior, where there are twenty-six copper mines of varying richness, the most important of which is the Hecla and Calumet mine, which contains copper in a state of almost absolute purity, its output for 1884 being about 20,000 tons. The copper industry in the United States is very profitable, the shareholders in the various mines having received nearly three and a-half millions sterling in the way of dividends last year. Next to the United States, Spain and Chili produce the most copper—about 40,000 tons each—Germany and Australia coming after with about 14,000 tons, while England, which a few years ago produced 15,000 tons, now has an output of only 3000 tons. Russia, Sweden, and Norway have an output of about 6000 tons, while a good deal of copper has recently been discovered in Venezuela, the consequence of this being that there has been a very great fall in the value of the metal, which, sold for as much as £120 per ton a few years ago, is now worth little more than a third of that sum. Owing to this great fall in the price of copper, several mines are being closed in New Orleans and California, their owners finding that it does not pay to extract the metal at its present price, and even in the basin of Lake Superior, the cost of deepening the mines and the increased price of labour are making the business very much less profitable than it was.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

23rd March, 1886.

4017. OIL CUPS, H. J. Allison.—(*J. S. Hall, United States*)
4018. FRAMEWORK of MANUMOTIVE CARRIAGES, I. Morris, Walsall.
4019. FIXING HANDLES to BRUSHES, A. Marr, Manchester.
4020. PREPARING ORE for SMELTING, G. Chapman, Glasgow.
4021. OIL GUARD, J. and W. Hamer, J. Hampson, and E. Crossley, Manchester.
4022. PIPES for TRANSFERRING GRAIN, &c., A. Thompson, Manchester.
4023. DOUBLE-CUT SCORING KNIFE, &c., J. Perry, Banbury.
4024. APPARATUS for SHAPING HAT BRIMS, L. H. Hoyt, London.
4025. CASTORS for FURNITURE, &c., S. Farrar, Halifax
4026. PORTABLE LIFTING BLOCK or HOIST, W. T. Eades, Birmingham.
4027. CONNECTING INDIA-RUBBER PIPES, J. Challender, Manchester.
4028. WHEELED VEHICLES for ROADS, W. Kermeen, Liverpool.
4029. TUBE EXPANDERS, W. W. Popplewell.—(*W. I. B. McHale, United States*)
4030. REMOVING SOLES from CLOGS, &c., B. Crossley, Halifax.
4031. HEATING BUILDINGS by HOT WATER, T. K. Shipman, Leicester.
4032. SECURING the PICKING SPINDLES of LOOMS for WEAVING, H. Almond, J. Turner, and L. Boothman, Halifax.
4033. BRAKES, R. Mercer, Glasgow.
4034. SPINDLES, T. L. Dalt y, Manchester.
4035. CORRUGATED, &c., SANITARY PAN, E. Whaington, Wolverhampton.
4036. SECURING GRINDSTONES from BREAKING, E. Chatham, Ruabon.
4037. INTERCHANGEABLE TARGETS, &c., A. L. Winser, Brighton.
4038. STRIKING the ARC in ELECTRIC LAMPS, C. Brown, London.
4039. CHIMNEY COWL, T. Pessel and H. J. Mills, London.
4040. PADDED HORSESHOE, C. D. Leng and R. J. Nicholson, Sheffield.
4041. CORK BORING MACHINES, J. Dakin, London.
4042. STEAMING and DRYING SOLUTIONS, O. Klaunig, Halifax.
4043. BELT FASTENERS, W. W. Popplewell. (*E. C. Smith, United States.*)
4044. POLES for LAWN TENNIS NETS, G. Lane.—(*W. Herring and C. Braithwaite, United States.*)
4045. MACHINES for MANUFACTURING ICE, O. H. Castle, London.
4046. VAPOUR FUEL, W. P. Thompson.—(*A. I. Ambler, United States.*)
4047. VACUUM PANS, A. B. Frenzel, London.
4048. GOVERNORS, A. J. Boult.—(*A. O. Tengvall, United States.*)
4049. GLOVES or MITTENS, H. A. T Skyrme, Liverpool.
4050. APPARATUS for MAKING PAPER, R. Horrox, Liverpool.
4051. OPEN ENDS of SACKS, &c., D. A. B. Murray, jun., Glasgow.
4052. STEAM GENERATORS and ENGINES, J. Neil, Glasgow.
4053. CIGARETTE PAPERS and CIGARETTES, A. Crosbie, London.
4054. PORTABLE BLAST FURNACE PLANT, C. L. Hartsfeld, London.
4055. ATTACHMENTS for VELOCIPEDES, J. Goldschmidt, jun., London.
4056. BOTTLE, W. Luntley, London.
4057. VOLTAIC PILES and ACCUMULATORS, P. Haddan.—(*J. Crosse, France.*)
4058. TELEGRAPHIC RECORDING INSTRUMENTS, A. M. Clark.—(*The New Haven Clock Company, U.S*)
4059. FLUSHING CLOSET PANS, A. C. Henderson.—(*C. Chorlier, France.*)
4060. SEPARATORS, L. Stewart, London.
4061. REMOVING PENCIL MARKS, &c., F. Wittram, London.
4062. TREATMENT of RANCID BUTTER, J. Y. Johnson.—(*C. Marchaud, U.S.*)
4063. BAGS, C. Fuchs, London.
4064. PROPELLING BOATS, W. H. Hall, London.
4065. SPRING HINGES, S. Gerish, London.
4066. INVERTED GAS LAMPS, D. W. Sugg, London.
4067. PROTECTIVE SHIELDS, W. Tice and C. Armstrong, London.
4068. PREPARING STEARIC ACID, J. Weineck, London.
4069. TELEPHONIC APPARATUS, J. E. Dann and J. Lapp, London.
4070. CRYSTALLISED SULPHATE of CALCIUM, E. and E. M. Arthur, London.
4071. AERATING BREWERS' WORT, &c., F. Faulkner and W. Adlam, London.
4072. TELEGRAPHIC RECORDING INSTRUMENTS, A. M. Clark.—(*The New Haven Clock Company, U.S.*)
4073. ADVERTISING, J. Sykes, jun., Golcar.
4074. ATTACHING BUTTONS, J. R. Green and F. W. Plant, London.
4075. TOBACCO PIPES, J. L. Hinde, London.
4076. SPECTACLE FRAMES, G. Spiller, London.
4077. TENT, W. A. South, London.
4078. SEED DRILLS, A. M. Clark.—(*H. L. de Lapparent, France.*)
4079. FIRE-EXTINGUISHING APPARATUS, H. H. Lake.—(*W. T. Montgomery, United States.*)
4080. ROLLER SKATES, H. H. Lake.—(*C. Brinton, United States.*)
4081. HARVESTING MACHINES, H. H. Lake.—(*S. Johnston, United States*)
4082. SURGICAL STRETCHERS, &c., H. H. Lake.—(*W. H. Johnstone, United States.*)
4083. WATER-WASTE PREVENTER, &c., A. Emanuel, London.
4084. LAMPS, T. C. J. Thomas, London.

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4085. BOILER FEEDER, E. A. Muskett, Enfield.
4086. CONVERTIBLE TWO or FOUR-WHEELED CARRIAGE, A. H. and W. Davies, Dudley.
4087. LANTERNS and LAMPS, W. Clifford and G. Travis, Sheffield.
4088. COUPLING APPARATUS, T. Mitchell, Skipton-in-Craven.
4089. CHECKING FARES, H. Blamires and M. Horsfall, Huddersfield.
4090. CONNECTING HOSE PIPES to TAPS, J. Challender, Manchester.
4091. DRAIN TRAP, C. T. Greenfield, Brighton.
4092. SHAFT COUPLINGS, R. Tattersall, Manchester.
4093. BUSKS and FASTENERS for CORSETS, C. Longbottom, Bradford.
4094. DISTILLING MINERAL OILS, W. M. Fraser, Glasgow.
4095. OPERATING SHIPS' SAILS, W. Reid, Glasgow.
4096. CENTRIFUGAL MACHINES, J. Laidlaw and A. J. Liversedge, Glasgow.
4097. WEIGHING MACHINES, R. W. Brownhill, Aston New Town.
4098. SECURING SCARF PINS, H. W. Robinson, Northampton.
4099. PURIFYING and ENRICHING COAL GAS, A. Dempster, Elland.
4100. MOWING and REAPING MACHINES, S. B. Bamford, Uttoxeter.
4101. CHIMNEY TOPS, S. B. Bamford, Uttoxeter.
4102. SPECIAL CHUCKS for LATHES, S. Dixon, Manchester.
4103. SETTING the TEETH of SAWS, R. Elliott, Newcastle-on-Tyne.
4104. BOILER and PIPE COMPOSITION, J. Taylor, Cumnock.
4105. BALL VALVE TAP, E. K. Heaps and J. Willis, Sheffield.
4106. SAFETY PINS, H. W. Tonks, Birmingham.
4107. LUBRICATED PISTON for STEAM ENGINES, J. Drury, Brighouse.
4108. ADJUSTING TUBES on GUNS, W. W. White and J. W. Lowden, Dundee.
4109. SHUTTLE GUARDS for LOOMS, W. Dixon and F. Hibbert, Manchester.
4110. OPENING, &c., MAIN VALVES in WATER-CLOSETS, A. Abbott, Birmingham.
4111. WATERPROOF GARMENTS, B. Cohen, Manchester.
4112. IRON TELEGRAPH POSTS, W. E. Pedley, Old Brompton.
4113. SECURING CHAPLETS used in CASTINGS, G. Dyson, Leeds.
4114. BEVERAGE, A. S. Krueger, Lenzie.
4115. PIANOFORTES, H. Allen, London.
4116. FRICTION SIGNAL, &c., BOMB, J. Farnsworth, Manchester.
4117. ANTISEPTICS and DISINFECTANTS, A. L. Dussek, London.
4118 INCANDESCENT ELECTRIC LAMPS, C. Seel, London.
4119. CARVING FORK GUARDS, C. Bachhöffner, London.
4120. PRONGED SHOVELS, T. N. Robson, London.
4121. STAYS or CORSETS, D. Davies, London.
4122. BOTTLE STOPPER, G H Jones, London.
4123. FASTENINGS for FALL PIPES, &c., W. Sissons, London.
4124 COMBINED FLOWER-STAND and TABLE LAMP, C Kempton, London.
4125. SHADE HOLDERS for OIL LAMPS, C. Kempton London.
4126. VELOCIPEDES, J Lee, London.
4127. BRAKES for VELOCIPEDES, J. Goldschmidt jun., London.
4128. FASTENER for WINDOW SASHES, T. Gardner, London.
4129. COOKING APPARATUS, E. Edwards —(*J. Sabourdy, France*)
4130. RECORDING the NUMBER of MESSAGES TRANSMITTED over TELEPHONIC CIRCUITS, J. D. Miller, Glasgow.
4131. VALVES for REGULATING STEAM PRESSURE, W. Murdoch, Glasgow.
4132. DYNAMO-ELECTRICAL MACHINES, M. Bohdanecky and J. Nesetril, London.
4133. ELECTRIC ARC LAMPS, H. Pieper, London.
4134. DUST COLLECTORS, M. Martin, London.
4135. SUPPLYING GASEOUS FUEL to FURNACES F. Mönth, London.
4136 BRANDING CIGARS, W. Hucks, London.
4137. UTILISING WASTE HEAT from CHIMNEYS, T. F. Veasey, London.
4138. REVOLVING LAMPS, W. S. Oliver, J. Roots, and E. K. Purchase, London.
4139. ORDNANCE, G. Quick, London.
4140. KEYBOARDS for PIANOS and ORGANS, S Stewart, London.
4141. PHOTOGRAPHIC LENS SHUTTERS, C. Sands and J Hunter, London.
4142. WATER-HEATER, C. Toope, London
4143. MOTOR APPARATUS, H. H. Lake.—(*H. Schneider, France.*)
4144. AIR CHAMBERS, &c., for TORPEDOES, M. Delmard London.
4145. MOTIVE FORCE for DRIVING TRAM-CARS, W. McArthur, London.
4146. REGULATING the FLOW of GAS to GAS-BURNERS, W. T. and D. W. Sugg, London.
4147. UTILISING ELECTRIC BELLS, E. Tuteur, London.
4148. HYDRAULIC SHEARS, E. Boehme, Liverpool.
4149. HYDRAULIC SHEARS, E. Boehme, Liverpool.
4150 DIFFERENTIAL ACCUMULATOR, E Boehme, Liverpool
4151. FRAMES for WRITING SLATES, J. and H. Owen Liverpool.
4152. RAISING, &c., WINDOW SASHES, E. Brennan and W. G. Williams, Liverpool.
4153. FLUSHING APPARATUS for WATER-CLOSETS, T. and J. Holt, Liverpool.
4154. PROJECTILES for FIRE-ARMS, H. Studer London.
4155. DUMPING TROLLEYS, A. J. Boult.—(*G. Wartlinger and G. Rosenberg, Germany*)
4156. SHEEP-SHEARING MACHINE, F. Y. Wolseley, London.
4157. LADIES' SLIPPERS and BOOTS, W. Hemsley, London
4158. PREPARATION for RENOVATING HATS, A. and F. Samuel, London.
4159. TRITURATING CYLINDER, J. R. Alsing, London.
4160. HOLDING DOORS, &c., PARTLY OPEN, J. Osmond, London.
4161. VENTILATING STOKEHOLES, &c., A. Laing, London.
4162. ARRANGING ELECTRICAL CONDUCTORS, W Christiani, London.

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4163. REGULATING the FLOW of GAS TAR, A. Thomas, West Cowes.
4164. SOLDERING METALS, D. Brecknell and T. Mallett, Ashted.
4165. AUTOMATIC WATER-GAUGE for STEAM BOILERS, T. Crook, Preston.
4166. MAKING WOOD BOXES, J. Magill, Manchester.
4167. DISTRIBUTION and COMPOSITION of TYPES, G. Chapman, Edinburgh.
4168. TREATMENT of BREWERS' WORTS, W. Spencer and J. Jones, Liverpool.
4169. TRIMMING GRAIN in SHIPS' HOLDS, W. Goodwin, Liverpool.
4170. SPRING BILLIARD CUE, A. J. Aspinall, Liverpool.
4171. METALLIC BEDSTEADS, G. H. Horrell, London.
4172. HORSESHOES, J. Willis and E. K. Heaps, Attercliffe.
4173. RAISING the PILE of WOVEN FABRICS, J. R. and J. H. Atkinson, and W. A. Sutcliffe, Halifax.
4174. ASCERTAINING the PERCENTAGE of SAND in RAW COTTON, N. M. Bateson, London.
4175. SAFETY CATCH for RAILWAY CARRIAGE WINDOWS, J. Holmes, Keighley.
4176. FORMING UNDULATED EDGES in CLOTH, J. Kippax, Bolton.
4177. FURNACES for the PRODUCTION of STEEL, J. W Wailes, Liverpool.
4178. FRET CUTTERS' WORK TABLE and DRILL, E. Duckenfield, Northampton.
4179. CARTRO REPEATING PHOTO DARK SLIDES, J. D. Williams, Greenfield.
4180. COMBINED SCRAPER, BRUSHES, MAT, and TRAY, F. James, Dresden.
4181. BURNERS for BURNING PETROLEUM, C. Holy London.
4182. EGG WHISKS, G. Baker, jun., London.
4183. COLLAR SLIT, S. Barrett, Keighley.
4184. REFLECTOR for LIGHTING the OUTSIDE of SHOP WINDOWS, R. H. Burman, Birmingham.
4185. HYDRAULIC HAMMERS, A. Higginson, Liverpool.
4186. FOLDING PORTABLE SEAT, R. C. Hope, Scarborough.
4187. CONNECTING LINK for JOINING CHAIN CABLES, A. T. Allen and H. Cavill, London.
4188. PISTONS and RINGS for STUFFING-BOXES, A. T Allen and H. Cavill, Sheffield.
4189. POWDER DISTRIBUTOR, W. Whiteley, Halifax.
4190. BALANCE SWING or SEE-SAW, J. Bullock, Leeds.
4191. PRINTERS' QUOINS, &c., A. W. Marshall and T. Lahaye, London.
4192. FOLDING PORTABLE TABLE, R. C. Hope, Scarborough.
4193. DISTANCE and FARE INDICATOR for CABS, &c., J. Newey, Birmingham.
4194. AERATING DRAUGHT ALES, &c., W. A. How, New Malden, Surrey.
4195. SOLES and HEELS for BOOTS, &c., J. B. Walker and J. Horrocks, Southport.
4196. KEYLESS MECHANISM for FUSEE WATCHES, M. W. Skelton, Liverpool.
4197. STEAM PRESSURE GAUGE, &c., E. F. Bamber, London.

4198. Self-acting Mules and Twiners, J. Drabble and H. Brandon, Manchester.
4199. Fans for Ladies' Use, J. N. Kuhn, London.
4200. Gold from Ores, &c, A. H. Anderson and J. Noad, London.
4201. Night Lights, J. R. Greaves, London.
4202. Steering-gear, &c., A. Bowie, Liverpool.
4203. Purification of Sewage, L. G. Ghilain, Liverpool.
4204. Protecting Ships' Sides, M. M. Kelcey, London.
4205. Water-gauge Cocks, W. Schumann, London.
4206. Making Gas, E. Brook, London.
4207. Animal Substances, for Use as Food, L. C. Marshall, Glasgow.
4208. Weft Stop Apparatus for Looms, D. Morrison, Glasgow.
4209. Spring Candle Lamps, R. F. Heath and W. Crook, London.
4210. Boiler Flue Tubes, W. Arnold, London.
4211. Holders for Lead, &c., W. F. B. Massey-Mainwaring and L. Geofroy, London.
4212. Wreath or Flower Cases, H. Shearer, London.
4213. Pile Drivers, J. A. Menck, London.
4214. Electric Baths, C. Wells, London.
4215. Combination Shipwreck Recorder, C. Wells, London.
4216. Carrying a Cable to Shore in the event of Shipwreck, C. Wells, London.
4217. Life-saving Torpedo, C. Wells, London.
4218. Ornamental Boards from Various Fibrous Substances, H. R. Minns, London.
4219. Calming the Sea, G. W. Mallet, London.
4220. Heat for Generating Steam, M. P. W. Boulton, London.
4221. Railway Signal Apparatus, F. Dalby, London.
4222. Envelopes, K. H. Pedrick, Massachusetts.
4223. Envelopes, K. H. Pedrick, Massachusetts.
4224. Ornamenting Panels &c., A. E. Ryles, London.
4225. Painting Carriages, &c., A. E. Ryles, London.
4226. Wire Netting, C. Mollman, London.
4227. Pumps, W. C. Warren, London.
4228. Receiving, &c., Cash Payments for Tramcars, &c., M. T. Neale, London.
4229. Double Swing Doors, M. P. Ismay, London.
4230. Telegraphs, A. M. Rosebrugh, London.
4231. Telephones, A. M. Rosebrugh, London.—15*th August*, 1886.
4232. Telegraphs, J. Y. Johnson.—(*A. M. Rosebrugh, Canada.*)
4233. Observatory, M. Delmard, London.

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4234. Gas Engines, P. Niel, London.
4235. Girders, R. A. Stoffert and T. Dykes, Glasgow.
4236. Applying Steam Injectors to Pneumatic Despatch Tubes, C. F. and T. Cook, York.
4237. Pulping and Grinding Fibre, G. Hibbert, Gateshead-on-Tyne.
4238. Horological Instruments, R. Brown, York.
4239. Ladders, &c., A. W. H. Wood, Ullesthorpe.
4240. Making Wire Ropes, W. and G. Chappell, Manchester.
4241. Indicators for Machines, H. Moon and P. Gallimore, Birmingham.
4242. Feathering Paddle-wheels, A. C. Kirk, Glasgow.
4243. Ornamenting Wooden Floors, J. Brierley, Halifax.
4244. Feeding and Feed-heating Apparatus, A. C. Kirk, Glasgow.
4245. Wood and Earthenware Floors, J. Brierley, Halifax.
4246. Grinding Metallic Surfaces, D. Johnston, Glasgow.
4247. Gas Generator and Boiler Furnace, B. H. Thwaite, Liverpool.
4248. Breakfast, &c., Cooking Apparatus, J. Stevenson, Birmingham.
4249. Cutting Out Shovel Plates, &c., L. Wache and R. James, London.
4250. Producing Forced Draught, T. and W. Toward and J. Meek, Newcastle-on-Tyne.
4251. Drop-down Small-arms, R. Chaplin, Birmingham.
4252. Brushing Machine, W. A. Sutcliffe and G. Thomas, Halifax.
4253. Setting the Iron Flanges of Weavers' Warps and Sizers' Beams, J. Barnes, Hopwood
4254. Stamping Machine for Boots and Shoes, K. Johnson, Leicester.
4255. Ensuring an immediate Supply of Water to Water-closets, R. H. Little and T. Duncan, Tynemouth.
4256. Slide Valve Appliances, E. A. Slade, South Shields.
4257. Cooking Apparatus, T. Shipton, Handsworth.
4258. Raising-gigs, J. Walker and T. G. Beaumont, Halifax.
4259. Power Loom Weft Stop-motion, R. Ackerman and W. Shore, Grimsbury.
4260. Flax Preparing Frame Rubbers, A. Dawson, Ballymena.
4261. Safety Lamps, M. Mercier, London.
4262. Gas Engines, J. Ramsbottom, London.
4263. Rakes, R. R. Riches, London.
4264. Piping or Decorating Biscuits, E. Herissé, London.
4265. Percussion Fuses for Projectiles, H. C. Seddon, London.
4266. Exhibiting Advertisements, J. Bradley, London.
4267. Heating Apparatus, J. Lockhart, Sheffield.
4268. Bath Boilers, E. Hadley and C. Darrah, London.
4269. Hoods, &c., for Hansom Cabs, G. Finney, Liverpool.
4270. Hansom Cabs, G. Finney, Liverpool.
4271. Screw-drivers, A. W. Tipper.—(*Z. T. Furbish, United States.*)
4272. Curling Tongs, T. Crookes, Sheffield.
4273. Cyclist's Tire Cementer, A. C. Pemberton, London.
4274. Envelope Opener, L. R. C. Hamber, London.
4275. Dot and Dash Printing Telegraphs, H. A. C. Saunders and A. C. Brown, London.
4276. Fire Alarm Telegraphs, H. A. C. Saunders and A. C. Brown, London.
4277. Crimping Leather, T. T. Marshall, Ontario.
4278. Opening and Closing Road Gates, T. Gerrard, Glasgow.
4279. Main Spring for Watches, &c., C. E. Jacot and E. Bovy, London.
4280. Electro-Magnetic Apparatus for Curative Purposes, J. R. Chislett, London.
4281. Brick-moulding Machines, W. Hellier, London.
4282. Moulds for Bending Plate and Sheet Glass, T. Ide, London.
4283. Safety Appliances for Wheeled Vehicles, Vincenzo, Count di Tergolina, London.
4284. Moulding Bread, A. Pentzel, London.
4285. Casements, R. N. Shaw and W. P. Wenham, London.
4286. Rivetting Machines, C. Litchfield, London.
4287. Aerial Navigation, J. H. W. Stringfellow and H. Lane, London.
4288. Sash, Casement, &c., Fasteners, J. Walker and H. B. Worsey, London.
4289. Drop-down Small-arms, J. Deeley, London.
4290. Guards for Circular Saws, R. Willoughby, London.
4291. Safety Valves, W. Bragg, London.
4292. Lamps, D. C. Defries, London.
4293. Cooking Apparatus, J. Margets, London.
4294. Safes and Strong Rooms, J. M. Hart and J. W. Swann, London.
4295. Support for Boots and Shoes, J. J. Crocker, London.
4296. Closing Bottles, H. Codd, London.
4297. Jack Tricks, J. Mosley, London.
4298. Loading or Unloading, A. J. Boult. — (*G. Warttinger and G. Rosenberg, Germany.*)
4299. Stoppers for Bottles, &c., A. J. Boult.—(*U. Delporte, Belgium.*)
4300. Pencils, N. S. Burnell and R. W. Charlesson, London.
4301. Converters, E. Servais, London.
4302. Oil Bottles, &c., J. Robinson, London.

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4303. Railway Chairs, H. Barlow, Walsall.
4304. Trouser Stretchers, A. Dornan, London.
4305. Paper Fastener, E. Orchard, Birmingham.
4306. Button Trimmings, H. Vollmer.—(*Messrs. Elsass and Bocks, Rhenish Prussia.*)
4307. Hats, &c., G. W. Wilson and E. Wilson, Manchester.
4308. Dental Engines, A. Kirby, Bedford.
4309. Measuring Snuff, B. G. Faux, Hunslet.
4310. Bottles and Bottle-stoppers, W. Sherar, Birmingham.
4311. Maturing Alcoholic Liquids, W. W. Crawford, Glasgow.
4312. Miners' Safety Lamps, A. Howat, Manchester.
4313. Combined Benzine Lamp and Cigar Cutter, W. Fischbach, London.
4314. Automatic Syphon Cisterns, &c., J. Jaffrey, Manchester.
4315. Honey Sections, L. W. Stone and J. Perry, Banbury.
4316. Drying Clothes, W. H. Cartwright, Rowley.
4317. Trousers Braces, J. Moynan, Dublin.
4318. Dough-kneading Machines, W. F. Mason, Manchester.
4319. Weaving of "Dhootas," W. Gadd, Manchester.
4320. Transparent Ice, W. W. Nightingale, London.
4321. Gas Engines, E. T. Hughes.—(*W. Gavillet and L. Martaresche, France.*)
4322. Staying the Plates of Steam Generators, &c., A. Beldam, Liverpool.
4323. Preparation of Fibrous Spun Material, B. Fiegel, London.
4324. Electric Lighting, R. C. Hanrott, London.
4325. Colouring Glass, &c., H. Norris, London.
4326. Brushes for Cleaning the Interior of Bottles, A. J. T. Wild, London.
43 7. Circular Hosiery Machines, B. Kerr, London.
4328. Combining India-rubber, &c., S. Banner, Liverpool.
4329. Book-binding, F. Schubert, London.
4330. Brick, &c., Walls, G. H. Couch, London.
4331. Roofing Tiles, &c., G. H. Couch, London.
4332. Ridge, &c., Tiles, G. H. Couch, London.
4333. Steer-gearing, J. H. Biles and J. McKechnie, Glasgow.
4334. Perforating the Sides of Capsules for Bottles, C. Cheswright, London.
4335. Perambulators, J. A. Macdonald, London.
4336. Bread and Biscuits, J. Montgomorie, Glasgow.
4337. Bundling, &c., Straw, &c., G. F. Redfern.—(*Joly-Michel, France.*)
4338. Steam Engines, E. Dehaye, London.
4339. Slide Valves of Engines, J. Gaskell, Manchester.
4340. Power Hammers, A. Beaudry and F. H. Cunningham, London.
4341. Fire-arms, J. G. Howard, London.
4342. Steering Gear of Vessels, &c., R. S. White, London.
4343. Combined Match box and Cigar-cutter, R. Gilders, London.
4344. Injector for Steam Boiler, &c., Furnaces, A. H. Smith, London.
4345. Tipping Billiard Cues, G. R. Holding and D. Richards, London.
4346. Tandem Tricycles, &c., G. Singer and R. H. Lea, London.
4347. Advertising Apparatus, T. Allen and T. M. Potter, London.
4348. Neckties, O. Engau, London.
4349. Combustible Compound, W. von Ruckteschell, London.—15*th December*, 1885.
4350. Candle-holder, R. Slazenger, London.
4351. Combined Newspaper Stands and Files, W. E. Bailey, London.
4352. Voltaic Batteries, T. J. Jones, London.
4353. Harness, F. L. Hemry, London.
4354. Lifting Apparatus, H. H. Lake.—(*Bohler Bros. and Co., Austria.*)
4355. Working and Interlocking Points and Signals, W. Holland and W. T. Page, London.
4356. Screw-driver, J. E. Tonks, London.
4357. Hall Lamps, &c., J. Grubb, London.

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4358. Extinguishing Fire, J. Purrett, Worle.
4359. Football, S. E. Statham, Manchester.
4360. Tongues for Boots and Shoes, H. Willis, Worcester.
4361. Door Knobs, J. Walker, Birmingham.
4362. Coupling and Uncoupling Wagons, &c., F. W. Trewhitt, J. Thompson, and W. Ormandy, Barrow-in-Furness.
4363. Combined Shackle and Swivel, L. G. Moore, Northampton.
4364. Gas or Air Pressure Gauges, M. Piper, Oldham.
4365. Candlesticks, T. Briggs, Darwen.
4366. Floats or Buoys for Fishing, &c., W. A. Smith, Glasgow.
4367. Cutting Circular Milling Tools, T. Gare, Stockport.
4368. Reservoir Penholders, M. Reschke and I. Leutner, London.
4369. Cleaning Tin and Terne Plates, T. H. Johns, London.
4370. Windmills, J. Griffiths, Caergwrle.
4371. Cricket Bat Handles, G. H. White, London.
4372. Wet Gas Meters, J. Brown and A. C. Fraser, London.
4373. Cast Steel Wheels and Tires, S. Osborn, G. J. Smith, R. Woodward, A. Pye-Smith, and A. E. Wells, London.
4374. Scoring, Registering, and Marking, J. R. Cunnington, London.
4375. Optical Instruments, C. E. M. Rohrbach, London.
4376. Music-stools, W. Hillman, W. H. Herbert, G. B. Cooper, R. A. Dalton, G. F. Twist, and A. Rotherham, London.
4377. Packing for Engine, &c., Glands, J. Kirkman, Liverpool.
4378. Syphon Cistern, J. Barnes, East Dulwich.
4379. Hardening or Tempering Steel Bullets, &c., C. T. Cayley, London.
4380. Oil Lamps, J. Roots, Tottenham.
4381. Button Fastener, J. McDonnell, London.
4382. Organs, J. Clark, London.
4383. Sail Grommets, W. W. Wilcox, London.
4384. Swivel Blocks, W. W. Wilcox, London.
4385. Thatch Sewing Machines, F. C. Lake, London.
4386. Mills for Rolling Wire, &c., F. Rosenbaum, London.
4387. Colouring Matters, H. H. Lake.—(*A. Leonhardt and Co., Germany.*)
4388. Ammonia Soda, T. Capper.—(*S. Pick, Austria.*)
4389. Dyeing and Bleaching Cotton, &c., J. Y. Johnson.—(*N. Lecomtte, France.*)
4390. Rotary Engine, J. A. Wade and J. Cherry, London.
4391. Thrashing Machines, A. W. Mantle, London.
4392. Tannin and Vegetable Extracts, A. Morand, London.
4393. Disinfectant and Toilet Paper Cabinet, G. W. Johns, London.
4394. Self-acting Fire Alarm, C. F. Hilkier, London.
4395. Angular Iron Frame Phaeton, J. E. H. Colclough, London.
4396. Solid Steel Shaft for Light Draught Vehicles, W. A. Colclough, London.
4397. Stiffeners for Wearing Apparel, J. G. Ingram, London.
4398. Dextrine, A. Rossi and C. Hellfrisch London.
4399. Tramcars, &c., J. Menzies, London.
4400. Propelling Torpedo and other Vessels, L. Sanderson, London.
4401. Telephones, E. Edwards.—(*E. A. J. Rosoor, France.*)
4402. Regenerative Hot-blast Stoves, B. Ford and J. Moncur, Glasgow.
4403. Strainers for Wire Fencing, W. Orr, Glasgow.
4404. Lubricating Compound, J. L. Wade, Glasgow.
4405. Extinguishing Fire and Saving Life, &c., J. F. Haskins, London.
4406. Boilers, &c., W. Schmidt, London.
4407. Electric Arc Lamps, F. Thornton, London.
4408. Sewing Thimbles, A. G. Brookes.—(*W. H. Burns, United States.*)
4409. Axle or Shaft Bearings, J. Gibbons, London.
4410. Centrifugal Apparatus, E. F. M. Farcot, London.
4411. Enamelled Letters, &c., W. N. Sears.—(*J. Cæsar, United States.*)
4412. Testing Boxes for Electrical Conductors, J. G. Lorrain, London.
4413. Air Guns, A. Arbenz.—(*Messrs. Flurscheim and Bergmann Germany.*)
4414. Beam Engines, A. M. Clark.—(*E. Fourlinnie, France.*)
4415. Cyclometers, T. W. Short and W. J. Mason, London.

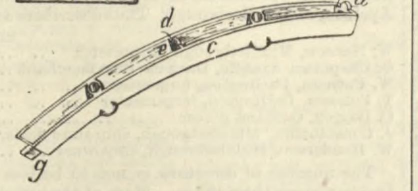
SELECTED AMERICAN PATENTS.

(*From the United States' Patent Office official Gazette.*)

334,949. Metallic Felly for Wheels, *James W. Haworth, Decatur, Ill.—Filed November* 10*th*, 1885.

Claim. — In wheels, the combination of felly *c*, concave in cross section, cross braces *e f*, embossments

334,949

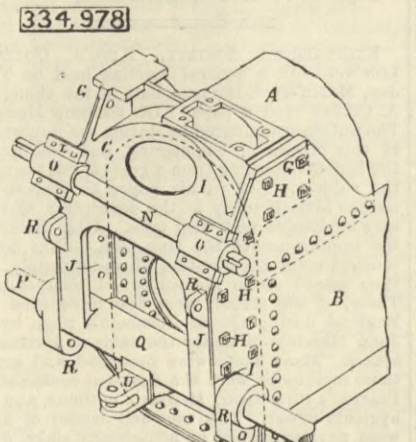


a on braces *e f*, and tire *d*, having longitudinal concavity *b*, as and for the purpose set forth.

334,978. Traction Engine *Edgar Penney, Waynesborough, Pa.—Filed November* 27*th*, 1885.

Claim.—(1) A gear frame or casting which connects the outside edges of the fire box sheet, and which has bearings for the axle and counter shaft, and a seat upon which the bed of the engine is supported, substantially as shown. (2) The combination of the boiler, the sheet B, the gear frame or casting, which is bolted between the ends of the sheet, and which is provided with bearings for the counter shaft and axle, substantially as set forth. (3) The combination of the boiler, the sheet B, applied thereto, and the casting or gear frame provided with the flanges G, to support the frame in position, and which frame is provided with bearings for the shaft and axle substantially as set

334,978

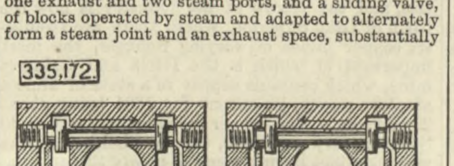


forth. (4) The combination of the boiler, the sheet B, applied thereto, the gear frame or axle provided with a suitable bearing upon its top for the engine bed, the flanges G, and the bearings for the counter shaft and axle, and which has suitable openings through it substantially as specified. (5) The combination of the boiler, the sheet B, the gear frame or casting C, provided with a bearing upon its upper end for the engine bed, suitable openings through it, bearings for the counter shaft and axle, and the lugs or projections R, substantially as shown. (6) The combination of the engine bed provided with the bearings X at one end, a suitable support for the rear end of the engine bed, the boiler, the bearing W, upon the boiler and a coupling pin or bolt for connecting the bearings X W thereto substantially as set forth.

335,172. Cut-off Valve, *George W. Anderson, Westport, Ind.—Filed May* 25*th*, 1885.

Claim.—(1) An automatic steam actuated exhaust cut-off valve, located within the exhaust chamber of a sliding valve, substantially as set forth. (2) The combination, with a sliding valve having a depending projection in its exhaust chamber, of a pair of sliding blocks seated in said projection and adapted to alternately open and close an exhaust, substantially as set forth. (3) The combination with a sliding valve, of a pair of steam actuated sliding blocks, located within the exhaust chamber of the valve, and adapted to open and close an exhaust port substantially as set forth. (4) The combination, with a cylinder provided with one exhaust and two steam ports, and a sliding valve, of blocks operated by steam and adapted to alternately form a steam joint and an exhaust space, substantially

335,172.

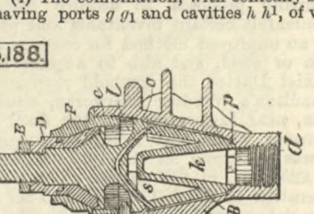


as set forth. (5) The combination with a sliding valve having a depending projection located within its exhaust chamber and provided with an exhaust port extending through the projection, of a pair of blocks connected by bars or rods seated within the said port and adapted to open and close the port substantially as set forth. (6) The combination, with a sliding valve having a depending projection within its exhaust chamber and a pair of sliding blocks connected by bars or rods seated in the said projections secured to the backs of the blocks and adapted to work in sockets formed in the ends of the valve, and steam ports connecting the sockets with the face of the valve substantially as set forth.

335,188. Balanced Rotary Valve, *John S. Glenn, Chicago, Ill.—Filed November* 6*th*, 1885.

Claim.—(1) The combination, with casing A, having ports $g\ g^1$ and cavities $h\ h^1$, of valve B, having ports $i\ i$ and $j\ j$ and cavities q, substantially as described, for the purpose specified. (2) The combination with conically bored casing A, having ports $g\ g^1$ and cavities $h\ h^1$, of valve B, having shoulder o, ports $i\ i$ and $j\ j$, and cavities q, as described. (3) The combination, with casing A, having ports $g\ g^1$ and cavities $h\ h^1$, and with valve B, having ports $i\ i\ j\ j$ and cavities q, of intermediate bearing strips r, in either casing A or valve B, all substantially as and for the purpose described. (4) The combination, with conically bored casing A, having ports $g\ g_1$ and cavities $h\ h^1$, of valve

335,188.

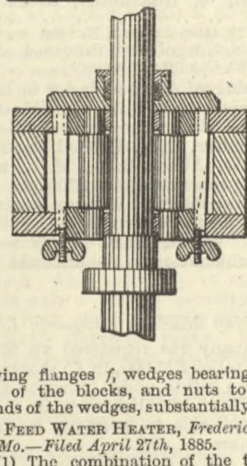


B, having chamfered end p, ports $i\ i$ and $j\ j$, and cavities q, as described. (5) The combination with casing A, of valve B, having ports i and j, and cavities q, each pair of diametrically opposite cavities communicating through channels s, all substantially as and for the purpose set forth.

335,418. Millstone Bush, *Daniel A. Bellows, Mulberry Ga.—Filed July* 16*th*, 1885.

Claim.—In a millstone bush, the combination with a frame and the spindle C, journalled therein, of the rollers journalled in the frame and bearing against the spindle, said rollers having reduced ends, the adjusting

335,418.

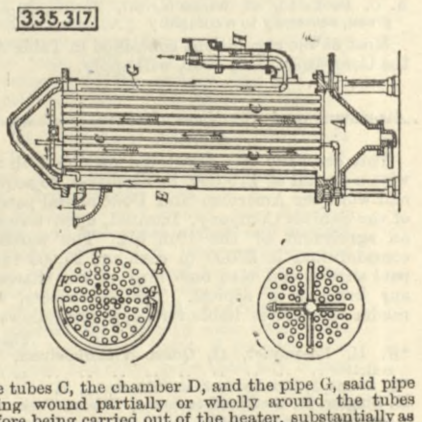


blocks having flanges *f*, wedges bearing against the outer sides of the blocks, and nuts to engage the threaded ends of the wedges, substantially as set forth.

335,317. Feed Water Heater, *Frederick Shickle, St. Louis, Mo.—Filed April* 27*th*, 1885.

Claim.—(1) The combination of the tubes C, the chamber D, the pipe G, the shell E, and the steam inlet H, said water discharge pipe passing out through said steam inlet, substantially as described. (2) The combination of the chambers A D, the tubes C, the pipe G, the shell E, and the steam inlet H, said water discharge pipe passing out through said steam inlet, substantially as described. (3) The combination of

335,317.

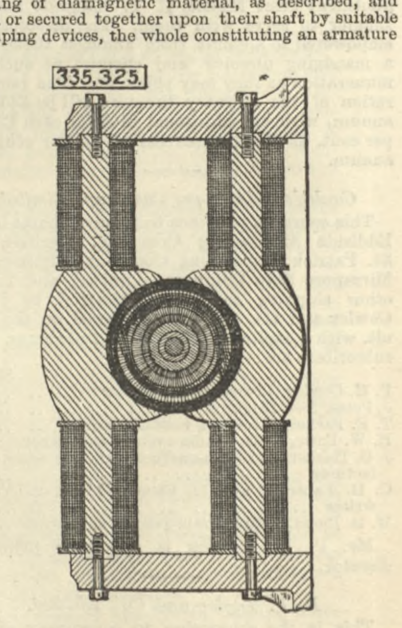


the tubes C, the chamber D, and the pipe G, said pipe being wound partially or wholly around the tubes before being carried out of the heater, substantially as described. (4) The combination of the tubes C, the steam space F, the chamber D, and the pipe G, said pipe being extended from the chamber D, downward through the steam space toward the lower end thereof substantially as described.

335,325. Dynamo-electric Machine or Motor, *William L. Voelker, Morton, Pa.—Filed June* 15*th*, 1885.

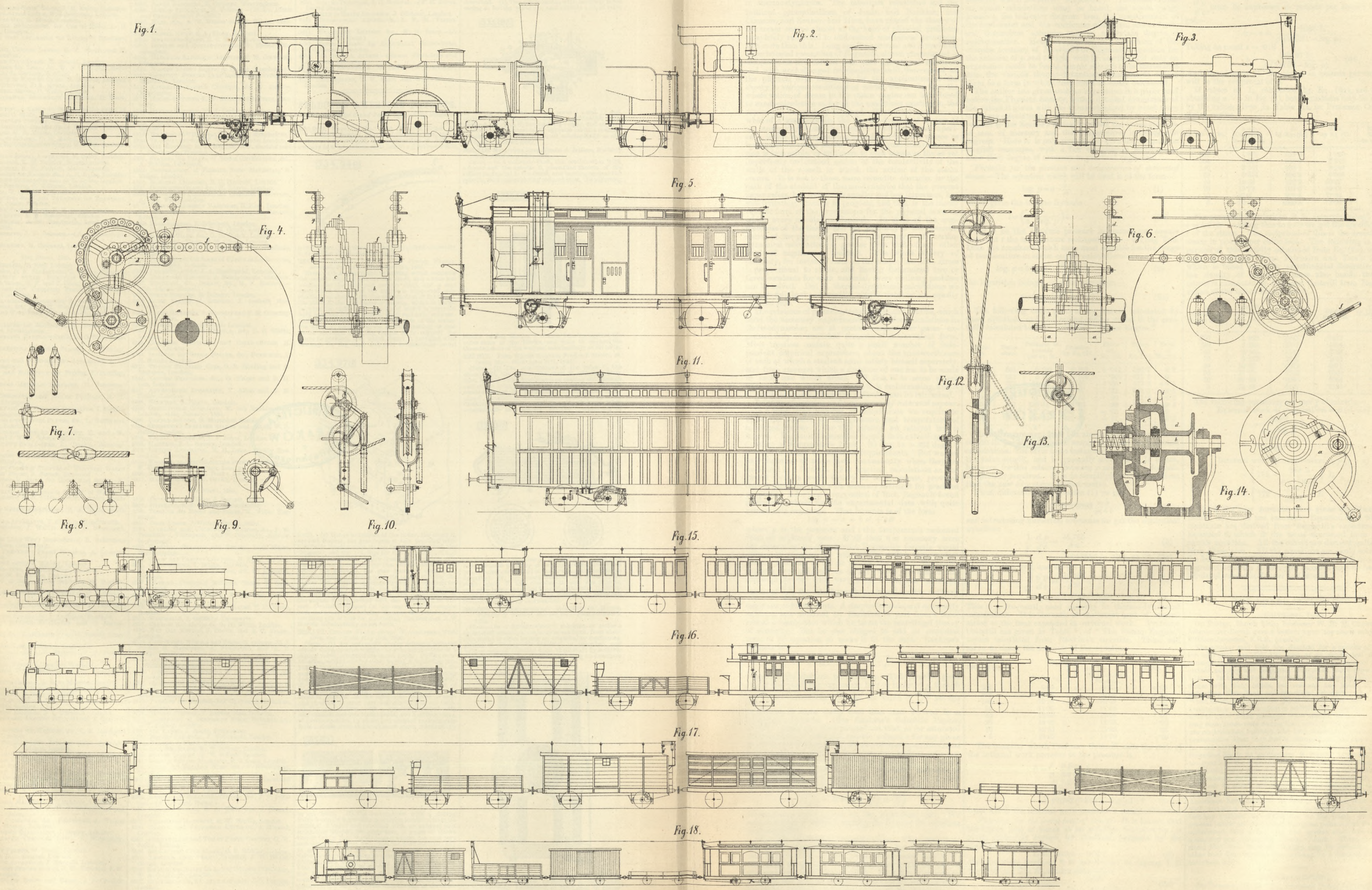
Claim.—In a dynamo-electric machine or motor a cylindrical armature made up as set forth, from sheet iron plates or discs having an electrical or mechanical plating of diamagnetic material, as described, and held or secured together upon their shaft by suitable clamping devices, the whole constituting an armature

335,325.



body made up of separate or individual plates in contact with one another, so that the armature shall be mechanically subdivided or laminated in planes coinciding with the lines of magnetic force, and magnetically subdivided by films of diamagnetic metal each united on one side with a disc or plate of iron, and having its other side constituting a plane surface resting in contact with a separate plane surface to make a plane of subdivision.

THE AUTOMATIC FRICTION BRAKE.—"HEBERLEIN SYSTEM."



J. SWAIN, PHOTO LITHO.