ROTARY ENGINES.

No. I.

The subject of rotary engines is of such a fascinating character that there are few engineers who have not tried to design one, and the possible solutions of the problem are so multitudinous that almost as many have succeeded in their object. The pursuit, although it has almost universally proved discouraging, is one which is not by any means confined to the average engineer; engineers of the highest eminence, from those of the time of Watt down to those of our own day, have been devising methods of obtaining the revolving motion of a shaft by a more direct application of the power than is employed in the ordinary reciprocating engine. Watt and his pupil Murdoch produced a number of practical methods, and though none of their productions was capable of pushing aside the original pattern, yet each of these able mechanical engineers seemed to think that some kind of rotary engine would eventually be introduced and universally adopted. Hundreds of inventors since their time have devised and patented hundreds of engines, and amongst those who could not resist the attractiveness of the subject, but have not pursued it as far as the Patent-office, are some of our present foremost engineers.

With such a vast number of rotary engines, there is a great variety in the shapes and dispositions of the parts of which they are composed. Some of them have rectangular pistons, others have that part which corresponds to the piston in the shape of an excentric cylinder. Circular pistons, depending for their steam tightness upon centrifugal force, pistons in the form of a sphere, sections of a sphere, inclined planes, have all been adopted. The chamber in which the piston works is shaped to correspond with the particular kind of piston used, and is farther complicated by having to be formed so as to provide for the necessary steam and exhaust passages. In the most recent types of these peculiar engines no step towards lessened complication seems to have been made. The Tower engine, besides bewildering one with the strange movement of the piston, discourages the investigator with a piston composed partly of spherical surfaces, partly of inclined and partly of fair surfaces, adhering to which is a collection of pin joints for fastening up to the constrained pieces. The Fielding engine appears at a cursory examination of its interior to be a strange looking kind of cobra contorted into complicated coils. Here, however, the piston piece is composed of a collection of four pistons proper, the working surfaces of each being of double curvature, fitting into a chamber of corresponding form.

In the majority of cases, in fact in all cases until recently, this great fertility has not been attended with any useful result. Practical engineers and men of general science were therefore naturally curious to know what could be the reason that so much ingenuity and zeal should be so constantly foiled in its endeavour to solve a problem at the first sight of such easy solution. Although at first this could not be very well accounted for, yet many writers, taking experience for their guide, denounced the undertaking as unpractical, their chief point being that it was uniformly attended with too much complication of internal parts, which rendered it impossible to make a secure and durable joint. In this spirit Bourne, in writing of rotary engines, speaks lightly of their originators, and alludes to their notions of the "imaginary imperfections of the direct-acting engine." Another writer, eminent on the philosophical side of the question, Reuleaux —to whom and to whose translator, Professor Kennedy, we are indebted for much excellent information bearing on this matter—in his articles on the subject, denounces the engines as "useless machines, that have been the means of wasting much capital and thought," and puts aside their designers gently, but firmly, as "would-be inventors that have been warned again and again." Such discouragement as this, coming from philosophers and engineers, is sufficient to cause any man of inventive ability to hesitate; and such opinions, coupled with a knowledge of the results of actual experience, would certainly have left the field to waste, if it had not been for the discovery of a new quality in the rotary engine, and a new demand for that special attribute. Whether true or not, this class of engine seems to have the property of running at great speeds at moderately small powers; and this action is exactly that required for generating electricity for lighting purposes. With this fresh object, inventors have returned to the old problem with greater eagerness and hope than ever, and the result has been the production of wonderful specimens of ingenuity, among which are a number of engines of practical use for driving dynamos. The patent list is again bristling with devices for obtaining rotary motion direct, the advertisement pages again publish the virtues of many particular types, and at the Inventions Exhibition is a very good collection, though by no means complete or well organised.

It is the general opinion that in a rotary engine, as the object desired is a more direct application of the steam in turning the shaft, that therefore they must necessarily be of a simple construction. The ordinary reciprocating engine is looked upon as a circuitous way of arriving at the desired end, and although even in apparently neat rotary engines there is always a difficulty of keeping the many internal rubbing surfaces steam tight, it is supposed that this mere practical side of the question will be met when metallurgy gives us an unwearable material and engineering a perfect joint. It is, however, an entire mistake to suppose that any engine worked by a pressed fluid, such as steam, compressed air, coal gas, or water, can be made which can possibly work without a reciprocating movement; as also it is to suppose that any reduction in the number of working parts takes place, below that used in the simple cylinder engine, without destroying its efficiency. Some time has elapsed since these facts were foreshadowed by many engineers, and definitely enunciated by Reuleaux; and yet we find persons who are either unacquainted with them, or disposed to disagree with them. The chairman at one of the meetings of the Society of Arts, held for the purpose of listening to an excellent paper on the development of machinery, said it was a standing disgrace to mechanical science that it had to have recourse to a reciprocating movement when it wished to end with a rotary one. This opinion, we think, must have been hastily offered; for if the eminent speaker had directed special attention to the matter, had considered closely any of the vast number of engines professing to produce rotary motion direct, and that which had been written upon this point, he would have seen that no fluid-pressure engine exists which has not a reciprocating movement, either relative or absolute, and which has not, if complete, the same number of working parts in its composition as the much despised ordinary cylinder engine. Even the inventors of rotary engines seem disposed, in many cases, to think they have done away with the reciprocating movement; and however plainly the action occurs in their combination, they tacitly ignore it, as though it were something to be ashamed of. Those who are disposed to dislike the apparently indirect action of ordinary steam engines might also raise similar objections against many other constructions and operations. They may say that it is absurd at the Channel Tunnel to have to descend to a great depth below the surface of the sea when the desired object is to transfer an individual from one point in a horizontal plane to another point in the same plane. They may accuse railway engineers of employing engines whose parts have a multitude of movements of a very complicated character, when their object is simply to give a rectilinear movement to a load of carriages. Epicycloids, hypocycloids, ellipses, and circles would seem to be greatly debasing their dignity, when obliged to contribute to the production of motion in a straight line, and those who found it necessary to employ them would appear to be extremely wide of the point. The dissatisfied may even object to the formation of the stalks and husks in a cornfield, when all that is needed is the seed. But the defender of the simple engine does not need to incriminate the works of others, whether they are works of nature or of art; he is able to reasonably account for the facts as being physically necessary, and to point to every engine that has yet been constructed in proof of his opinion.

If we consider the character of the force which we employ in our steam engine, it is not difficult to understand the necessity of this original movement. In this class of engine we employ the pent-up energy contained in a fluid under pressure, and we could only expect this to produce movement of a continuous, uninterrupted character if the vessel in which we caused it to press against a loose resisting piece were of infinite length. In certain special cases this may be partially carried out. Atmospheric railways are somewhat on this plan, but it is not always convenient to provide such an enormous chamber as is there employed. Even in this case the size of the vessel must be limited, and in order for the resisting piece to make a second journey in the same direction it must previously be returned to its original position. Thus the movement becomes reciprocating. Considering that in all engines we wish to reduce the size of the working chamber as much as possible, it is evident that the movements of the piston backwards and forwards in its chamber must be very frequent indeed in order to take away fluid sufficient to do substantial duty. Turning again to the work of Reuleaux, he states that in the design of any engine intended to be actuated by a confined fluid, that always "two parts are to be taken into account, the arranging of one of the links in a chamber and pairing it with a reciprocating piece;" thus, for a continuous working engine, a working chamber and a corresponding reciprocating piece pairing with it are absolute necessities if it be actuated by a pressed gas or fluid. R.

SHAFTING AND ITS BEARINGS.

Of all the enemies against which the mechanical engineer has to contend, friction is one of the greatest, operating wherever motion of one body occurs on another. It is a great absorber of power, diverting it from useful work, causing instead destruction of surfaces and consumption of lubricants. In a general sense engineers have long felt the evil, but it is a little remarkable that until recently the subject has received small attention, and even yet investigation proceeds but slowly concerning the exact extent of the evil or the methods of its operation. A remarkable example of this engineering inertness presents itself in the case of the friction of slide valves, a resistance that apparently absorbs about 16 per cent. of the total power of steam engines with ports large in proportion to the size of their cylinders. We say "apparently" advisably, because as a matter of fact it is not established with anything like certainty. It is not, however, to slide valves that we desire to invite attention or on which we now mean to comment, but upon the mounting of shafting and the arrangement of its bearings. The waste of power from friction in bearings, its extent, or its causes, remained virtually unnoticed until, we may say, the other day, when Mr. Towers carried out his experiments, the lessons derived from which form a valuable contribution to engineering science.

Shafting, whether it be in the form of a short crank or other axle, or a propeller shaft, or lay shafting in a mill or a workshop, must, if it is to work with the minimum friction possible, be mounted in accordance with certain mechanical principles, the soundness of which is generally understood, though they are not always exactly acted upon. We may for convenience of comment briefly enumerate them here. In the case of short shafts, such as in ordinary engine work, the shafts must be not only absolutely straight, but they must be of a diameter sufficiently large in proportion to their length to prevent deflection when subjected to a load such as a heavy fly-wheel or the side strain of a driving strap. According to some authorities an iron bar, however large, will be elongated or deflected by the imposition of any load however small, the alteration in the bar being proportionate to the load; but practical rules of common sense indicate that a shaft may have certain loads imposed upon it which, while far exceeding those indicated by theory, do not cause injurious alterations of shape. In this matter a very considerable margin exists certainly, but unfortunately no one seems to know its exact extent. Text books give various rules for the proportions of shafting, but they mostly apply to torsional strains, which of themselves alone can scarcely cause friction in bearings, unless by shortening a shaft, and thus forcing the journal shoulders or collars against the ends of the brasses. Another principle is that side strain should be imposed as close as practicable to a bearing. A third is that in the case of long shafting it ought to consist of a succession of short axles each rotating in its own pair of bearings, independent of its neighbours in every respect save that of torsion. Lastly, bearings should be as rigid and inflexible as it is humanly possible to make them. Bearings should support the shaft, not be supported by it. A good test of a perfect shaft, perfectly supported, would be the placing of the pedestals or plummer blocks on smooth and greasy metal faces, the shaft with a light fly-wheel accurately balanced to be keyed on the shaft midway between the bearings, and the wheel set rotating, when any error in the shaft itself would cause motion in one or both pedestals. The most perfect mounting for a short shaft is to cast both pedestals in one with the bed plate, which must itself be so shaped as not to be susceptible of flexure or change of shape through change of level in its foundation. The pedestals ought to be eyes, if the design of the shaft will admit, these eyes being bored out with one boring bar, brass liners being subsequently forced into them, and these again bored out while in position. This method, however, will not suffice to reduce friction if the other points we have indicated are neglected; for if a fly-wheel be mounted on the outer part of the shaft at a long overhang, a deflecting action is at once set up in the shaft, which is now simply a girder of the continuous and cantilever order, loaded vertically so far as the fly-wheel is itself concerned, and if a driving belt be worked on the fly-wheel, loaded in extent and direction proportionate to the resultant of the two strains of the weight of the wheeel and the pull on the belt. Again, if the wheel be not truly balanced a strain is also put on the shaft by the centrifugal action of the preponderating weight, for all rotating bodies have centres of gyration which are fixed by the position of their centres of gravity, and round these they will ever try to rotate, resisting any force tending to confine them to any other rotative centre with an effort greater or less in proportion to the divergence existing between the natural and the enforced centre. Although the truths we now point out ought to be well known, some of the shafting to be seen at work is, without apparent reason, mounted with disregard to them. Wall-box supports are commonly used, yet they are altogether vicious and unscientific contrivances; and we venture to say that if sufficiently accurate gauges were applied to test the centreing of all the wall-boxes in use for, say, any period exceeding twelve months, not 10 per cent. of them would be found true. We will admit that cases exist and arise where they are necessary evils; the necessity does not, however, do away with the evil, and we are inclined to think that they are sometimes employed without necessity compelling it. The use of three bearings on short shafts is to be avoided as much as possible, and it is infinitely preferable to make a shaft self-supporting by enlarging its diameter, which may be done either in the ordinary way as a solid or by the use of hollow shafting.

When we come to regard the usual method of mounting lay shafting, we also perceive a neglect of first principles. We find shafting small in diameter in proportion to its length, even as regards the distance apart of its supports, and far more so regarding the shaft as a single rod, which, from the mode of uniting its separate lengths, it becomes. Such a bar, even before its pulleys are put on, is anything rather than straight; the load of the pulleys puts it still more out of truth, and then finally comes both the deadweight of half the belting driven by it and also the diverging strains of the loads on the driving sides of the belts. All these make a length of shafting serpentine, and this is increased in proportion to the distance of this or that pulley from a bearing. Hence it follows that the bearings must and do suffer; so also does the oil bill and the coal bill. Another source of friction and brass cutting is to be found in the methods sometimes observable of fixing the hangers or brackets, such as bolting to joists or flooring overhead, either of which are subjected to constant variations of load, and consequent alterations of line; or bolting to the members of an iron roof or its supporting columns, which are in perpetual movement of expansion, contraction, or from wind stresses. In many cases there is no better way practicable; but then the evil can be met by putting up shafting in independent lengths, each having its own pair of supports, and transmitting the rotating power by universal joints, or the simpler expedient of crossends plain on one end and "taken on to" by studs or pins fixed on the other crossend. It is probable that not one steam user on a large scale in a hundred can tell how much power is absorbed in overcoming preventible friction in his shafting. Yet it could be ascertained by the simple process of putting an idle pulley under each shaft pulley, and loading it to such an extent as would put a strain on the shaft there equal to that caused by the machine driven by that pulley, then running the engine at its usual speed, subsequently running the engine idle, and noting the difference of power absorbed. We may also point out that brass is used far more freely than is necessary for lay shaft beams. Hard wood such as hornbeam or beech is much better and cheaper when the loads are not too heavy. Wood bearings will run for years. They soak up oil and come to a beautiful surface, and they never cut a shaft as brass will do. The virtues of wood are not understood as they ought to be.

If what we have said of ordinary shafting, when at least all the steadiness and solidity of *terra firma* are present, how much more do these comments apply to screw propeller shafts. If any shaft ought to be laterally flexible a propeller shaft is that one, yet it seems, to judge by marine

practice, that our engineers are unable to make a propeller shaft which shall be torsionally steady, and at the same time laterally flexible. We venture to say that no other branch of engineering can show finer examples of steam machinery than can our first-rate marine firms; but, on the other hand, no other branch can show examples of shaft fitting so utterly opposed to all true mechanical principles; and the result is that no other shafting causes so much trouble, fails so often, or whose failure is attended with such dire results to life and property. This is a severe thing to say of a class of engineers whose work in every other respect is as nearly perfect as human ability and enterprise can make it. It does us all good, however, to hear the truth at times.

A VISIT TO THE FORTH BRIDGE.

Human interest in anything of the nature of a struggle may, perhaps, explain the attractiveness of a great undertaking in which men think hard and work hard to overcome the natural difficulties which ever present themselves in opposition to the realisation of a grand conception in any art, and especially in that of the engineer. With him boldness of conception is checked by a knowledge of details which trammels the imagination and prevents him building castles in the air. He cannot conceive a superstructure alone. The reality to his mind of the inseparability of action and reaction, and the equal reality of the inseparability of weight and stress, prevent his inception of an idea concerning a structure unaccompanied by hundreds of more or less opposing ideas concerning the properties of structural materials and the exigencies of construction. The loftiest flight of the poet owes its possibility to immunity from thought of means of flight or of resting place. But the engineer occasionally makes a grand excursion though he cannot disregard the detail which the poet scorns. He must dare much whilst he wrestles with the imagination-dwarfing tendency of the ever present current of thought which reminds him of physical limits, and of means as well as result. Ancient builders did some big things, but most of these, like the pyramids, were merely big in quantity of material, and the difficulties were only those of transport and lifting. These are small matters to the engineer of to-day, who spans a mighty river without affecting its flow, and one of whose greatest efforts is the construction of the bridge over the Forth. Here we have a splendid example of what men may dare even with the fullest comprehension of that knowledge which tends to cramp the efforts of all but the most determined of fertile brains. We have on several occasions given accounts of this great undertaking, but without a visit to the works it is impossible to acquire an adequate notion of the enormous proportions of this work in steel; or of the amount of care and research brought to bear on every detail. For many years we have been accustomed to great spans suspended from chains or wire ropes; but the boldest have shrunk from the attempt to make a rigid bridge with an arch of more than 525ft. span. In the Forth Bridge, however, we have a span of a third of a mile built up of two mighty arms or cantilevers, either of which in the course of their erection will stretch out over the gusty Forth about 680ft. into the air, and there join hands by girders 350ft. in length. On paper this does not make the brain reel even a little, but some more adequate conception of what these figures mean may be gained by the reader who stands below the clock tower at Westminster Bridge and then tries to realise the construction of a mighty arm stretching out into the air from above the clock level and clearing St. Thomas's Hospital like the arm of a Brobdignag over a Lilliput house. Standing on the hill at South Queensferry may now be seen down below the shore girders, resting on the granite piers, built up to a height of about 20ft. above high water, and this gives a dwarfing idea of that part of the work; but when the attention is drawn to a mast planted on the hill, with a board near its top, bearing aloft the rail level mark, the brain fails in a conception of the magnitude of the work that has to be done before the great structure with its 1700ft. spans is reared to a height that shall bring its roadway high above the valley sides, its huge piers to nearly the height of St. Paul's, and shall make the great valley's space seem measurable.

In entering the large workshops built at Queensferry, and fitted out not only with all the appliances of a great bridge building establishment, but with the special machinery designed by Mr. W. Arrol, and unique both in size and character, the visitor is shown a wood model, about 12ft. in height, of one pier superstructure and cantilever, but the mind is so unaccustomed to anything of the vast dimensions of the structure that even this model poorly serves the purpose of comparison. It is on the upper floor of a shop 200ft. by 60ft., the whole of which is laid with very narrow boards, planed over and blacked for the purpose of setting out parts of the bridge, the floor being actually a drawing board of 12,000 square feet area. Descending from this, one sees the steel material of the bridge, including plates up to 1·5in. thickness, being drilled, planed, and bent to shape, the plates being curved at a dull red heat to the necessary radius in a long hydraulic press with the moving part actuated by four 24in. hydraulic plungers. All the drilling of the plates is done by twist drills, not of the kind known by that name, but simply twisted drills made in the workshops and with the point of the usual flat form, except that the cutting edges are ground so that they have a smaller angle than usual or "more cut," the form approaching more to what would be used for hard woodwork than that of the drills usually used for cast or wrought iron. These drills bring out curled shavings sometimes over 3ft. in length. In fact, they cut the holes out instead of scraping them out. Much of the machinery employed was fully illustrated in our impression for the 16th January last, so that it is unnecessary to refer to it here. The punching of the 1·25in. plates is heavy work, but is only resorted to for cutting off a piece of the plate. We saw a 1·5in. punch bent and upset, much as though it were of soft Swedish iron, though it was of the best steel used for punches; but punches will not last very long in punching 1·5in. holes in 1·25in. steel plates. The work done in the brief part of a second that the punch occupies in passing through the plate can be measured by the area sheared in making the hole. The die was nearly 2in. diameter for the purpose of making the work as light as possible, and the punching from the plate had a mean circumference of 5·5in., giving an area sheared by the most uneconomical form of shear, namely, a punch of about 6·87 square inches. The work done upon the small area concerned is thus very great, and though the time is so small, the temperature acquired by the punched out piece is not much less than 200 deg., affording some notion of the rate at which steel will take up heat.

In the drilling machines for drilling the 12ft. built-up tubes the drills are lubricated with water, a jet under considerable pressure being directed into the hole being drilled. Each of these machines has ten drill heads on five arms, and a separate engine and boiler to work them, the whole being mounted on a covered-in truck. Some other drilling machines of most unusual construction are to be seen in the works, consisting chiefly of a large rectangular frame built up of girders about 30ft. span, fixed to end girders mounted on wheels to run on rails. On the cross girders are mounted drilling machines for drilling holes all over plates placed in their relative positions on the floor. These and other machines for drilling are driven by fast running overhead cotton ropes the whole length of the shops. A number of special plate edge planing machines are in use, the sides and ends of all the plates used, whether flat or bent into cylindrical or other forms, being planed to definite widths and lengths.

In the yard, visitors may see the great horizontal and vertical tubes, as well as those which take diagonal positions, being fitted and temporarily put together; and some help in forming an idea of the size of the bridge is given by the four pier bases for the Inchgarvie pier, these four forming the base of a rectangle no less than 270ft. in length longitudinally, in which direction they are connected by 12ft. built up steel tubes. Diagonally from corner to corner are big lattice strut and bracing girders about 100 yards in length. In forming the junction between the diagonal tubes that reach from the four bases to the tops of the piers, as shown in the engravings we published last week, and also in uniting the big vertical tubes with these bases, there is some rather difficult shaping and bending of the plates, resembling, indeed, ship work except as to the thickness of the plates. Here great care has to be exercised in working the plates and in examining them afterwards. Enormous stresses will be visited on these parts and the skew backs, which will have to be resisted by the well-disposed plate and angle work; and if one ventured the slightest doubt as to the strength of any point in the bridge, it would be with reference to these parts; but even here the main stresses are so directly transmitted to the horizontal tubes that the idea does not linger for a moment. One look at the pier bases, and the very large footing or ground they cover confirms the statements made as to the stability of the structure, as far as this is concerned. With the exception of the accidentally tilted caisson of one, the main piers are rapidly approaching completion. The granite masonry of the upper portion of those resting on the concrete in the 70ft. round caissons is a splendid specimen of work, the joints being all perfectly level and nowhere more than $\frac{1}{4}$in. in thickness. In sinking the caissons, with their enormous contents of masonry and concrete, no serious mishap to the Italian workmen below has occured, although the daily papers chronicled as a fatal accident a harmless mistake last week with an air lock. It is noteworthy that the men do not find it at all necessary to leave the chamber they are working in when shots are fired for removing the rock to permit the descent of the caisson, the air pressure maintained within and the escape of air under the bottom edge of the caisson into the water soon clear the atmosphere sufficiently for the Italians to consider it quite endurable. The bed-plates on the top of the granite of the Fife, Inchgarvie, and Queensferry main piers are built up of a number of steel plates countersunk rivetted together, and making a large steel slab. The method of rivetting them up on the piers was illustrated in our last impression. The thought occurs to an outsider that thick rolled plates like armour plates are probably not used for some good reason. These bed-plates carry the bases of the steel part of the piers already referred to, and provision is made on two of each of the groups of four granite piers for the sliding of the bases of the superstructure on the bed-plates as expansion and contraction occur. To lessen the friction between the surfaces crude petroleum and ground cast iron borings mixed will be used.

The central girders will, like the cantilevers they connect, be erected by the overhang or out-building process which has of late years found much favour.

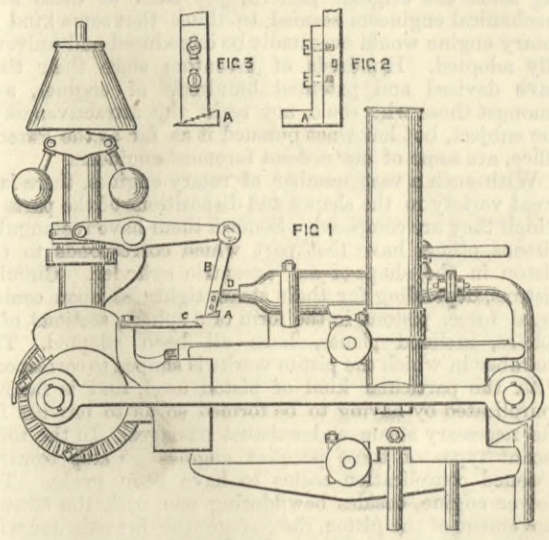
The wind pressure of 56 lb. per foot being taken as a maximum, will be 2600 tons on one span, and the rolling load never more perhaps than 600 tons, as more than two trains cannot be on the bridge under the block system at one time, will produce stresses quite insignificant compared with either wind or permanent load. On many parts of the superstructure the stress per square inch is under $3\frac{3}{4}$ tons per square inch, and in no part exceeds the regulation six tons.

Since the design of the Forth Bridge was made public a railway bridge has been completed on the same system over the Niagara. The plates were rolled and the bridge finished in ten months, and owing to the type of design and to the method of erection, Mr. Vanderbilt said the bridge had cost him half what he had expected. Two bridges of the same type are building in India, namely, the Hooghly and the Sukkur bridges, both of which have been described in our columns.

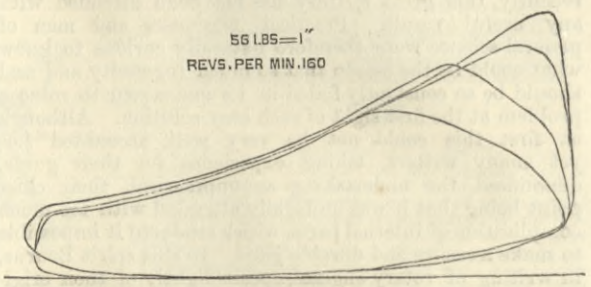
On so large a work as the Forth Bridge small accidents to the men are of course of daily occurrence, sometimes many cut or broken fingers in one day, and occasionally much more serious calls for aid are made. To meet the requirements, an infirmary has been built provided with all necessaries, a doctor is at hand, and an ambulance corps established. Each man subscribes to a fund for this purpose, and the contractors provide an equal sum. Contributions to the men's fund are also made by visitors. A day's visit to the bridge works is too short, but one may save time by staying at either North or South Queensferry, where there is good hotel accommodation, and whence good views of the work in progress can be obtained.

VOLK'S GAS ENGINE GOVERNOR ATTACHMENT.

The device illustrated by the accompanying engravings has been made by Mr. Magnus Volk, of Brighton, for governing the 8-horse power Otto Crossley gas engine which drives the machines for the Brighton Electric Railway, by varying the quantity of gas admitted instead of either admitting the usual charge or cutting it quite out. The engraving Fig. 1 is of the



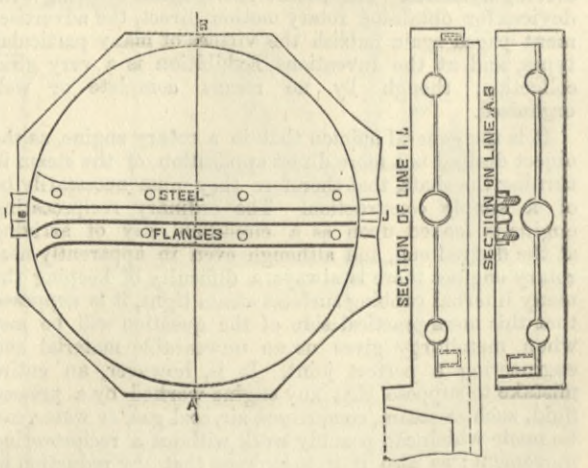
end view of the engine, and shows the governor, gear, the igniting slide, and gas valve. In the ordinary way the gas valve spindle D is pushed in by the projection C, on the igniting slide, through the medium of the pendent lever B when that lever is low enough for the piece A^1, as shown in the detail Fig. 2, to come into contact with C. Thus the gas is admitted in the same quantity throughout that range of speed which is represented by the rise or fall of the governors through the height of the thickness of A^1. Thus the engine gets full gas or no gas, and between these there is a change of speed which,



though of no importance for most work, is productive of slight irregularity, which is undesirable in electric work. To overcome this, Mr. Volk has adopted the stepped form of projection shown at Figs. 1 and 3. By this means the quantity of gas is regulated through as many gradations as there are steps. Mr. Volk has had it at work several months, and finds that it considerably improves the running of the engine. The accompanying diagram, taken from this engine with the gear attached, shows the effect on the combustion and pressure of the charge due to the admission of varying quantity of gas.

O'KEEFE AND ROBSON'S SELF-ACTING TRAMWAY POINT.

The self-acting tramway point illustrated by the accompanying engraving is made by Messrs. O'Keefe and Robson, of Roscoe-street, Liverpool. The tables have been laid down in that city, and have worked satisfactorily. The table consists of a circular cast iron table about 3in. thick and 2ft. diameter, with a steel rail running through the centre, having a bell-mouthed entrance. The table is fitted into an octagonal iron frame and works on ball bearings. The front wheel of the bar on touching the table puts it in line, and on passing the centre the pressure of the wheel to the left or the right turns the table instantly, so turning the wheel on to the right or left line, as



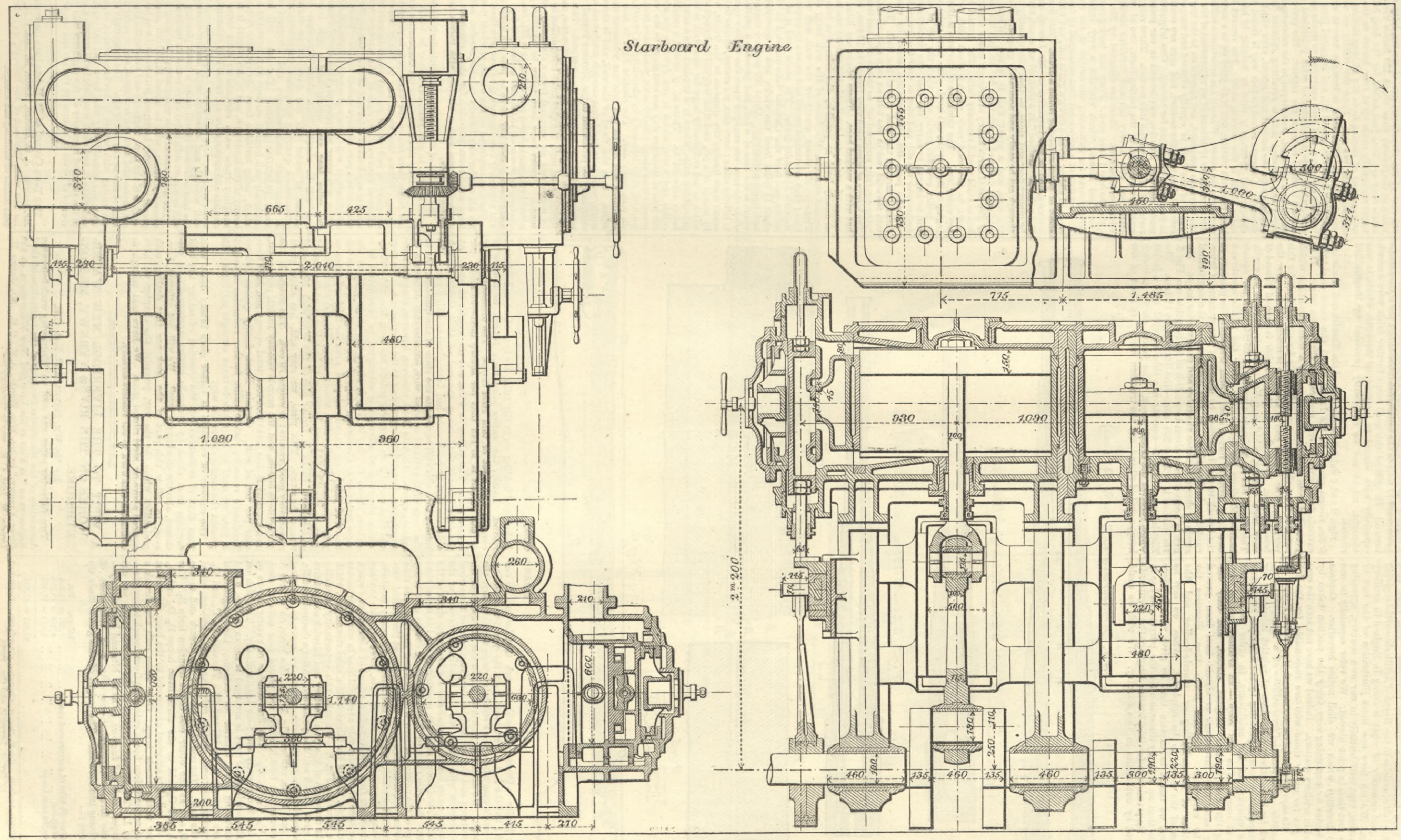
the case may be. We are told that the point will do equally well where mechanical motive power is employed, and for three-way junctions as well as for two ways. The inventors also claim that it will save the cost of frequent repairs to present points, as it will wear as long as the rails, and will also lessen the wear and tear on both horses and cars. On taking up a table after being in use some length of time there was not the slightest sign of dirt or water in the bearings.

THE ANTWERP EXHIBITION—COMPOUND ENGINES OF THE PHLÉGÉTON.

LA SOCIÉTÉ ANONYME CLAPAREDE, ST. DENIS, FRANCE, ENGINEERS.

(*For description see page 303.*)

Starboard Engine



A FRENCH VIEW OF ENGLISH GUNS.*

We have before us a French pamphlet. This work is a reprint in full of articles in the Revue d'Artillerie—articles giving a very good summary of what is doing in England in artillery matters. We see here one more illustration of the fact of information, kept confidentially in our own country, appearing for the first time in print abroad. We refer especially to one or two drawings which we shall notice hereafter. Captain Bosch begins by explaining very fairly the position taken by England in artillery matters. Indeed we have not seen the case better put for us by those who are responsible for the line taken. He says England, less concerned than other Powers in the possible occurrence—*l'éventualité*— of a European war, accepted for her artillery a position of relative inferiority for some years, in the hope of profiting by the attempts, sometimes by the mistakes, of her neighbours, in order to construct finally at once — *d'un seul coup* — an artillery system embodying the best features adopted abroad, and only employing such new inventions as should have been proved good by experience. Captain Bosch then discusses the alternatives of breech-loading or muzzle-loading and the question of the metal to be employed. When we say he discusses, we ought to explain that he gives what is more valuable than an ordinary discussion for the purpose he has in hand. He presents in forcible, concise language the arguments employed by authorities in this country. We wish we could do the justice to Captain Bosch's French that he does to our English; but the fact is that, apart from the question of ability, this is just a case where the French language seems to have the advantage. We need not, however, follow the discussion of Sir W. Armstrong and Colonel Maitland's statements, or the arrival at the decision with which we are familiar in favour of the interrupted screw breech stopper and De Bange gas check or the adoption of steel hoops after the preliminary trial of coiled steel bars, &c. So again Captain Bosch cannot of course give better drawings of the newest pattern Woolwich and Elswick guns than were given by Colonel Maitland in his paper at the United Service Institution which we gave at the time in a summary, to which, by-the-way, Captain Bosch refers. He, however, adds to these some drawings from the American report of Lieutenant Jaques, and also some which exist only as official ones in our departments —for example, that of the Elswick 10in. steel riband gun, which we give herewith, Fig. 1. We take this opportunity of adding to it the drawings of the Gun Factory and Elswick competitive riband guns, Figs. 3 and 2 respectively. After a discussion of Mr. Longridge's labours on the wire system, we come to the steel riband gun 10·2in. calibre, Fig. 1. In this piece, on a tube A which carries the breech screw are placed four coils of steel riband C_1, C_2, C_3, C_4. The first consists of twenty layers of riband laid transversely and four longitudinally. The plan on which the longitudinal wire is arranged is shown in Figs. 6 and 7. Numbering from interior to exterior, the longitudinal layers are numbers 8, 11, 16, and 22. The coils C_2, C_3, and C_4, of decreasing thickness, contain only transverse wire—*i.e.*, coiled round the tube. The coil C_1 is fixed at the breech end to the hoop D, and at the other end to the trunnion hoop D_1. The coils C_2 and C_3 hold to the three little hoops D_2, D_3, and D_4, finally the coil C_4 is attached at one end to the hoop D_4, and at the other to the muzzle hoop. Over these coils are shrunk a series of wrought iron hoops extending from breech to muzzle—*vide* Fig. 1. The contact surfaces of the various hoops are cut in V-shaped lands and furrows, so as to bite and hold tightly—land into furrow—throughout—see Fig. 4—a thin sheet of copper being laid between. The weight of this gun is made up as follows :—

	kilogs.	lbs.
Whitworth tube of compressed steel	7,397	= 16,304
Steel riband	6,025	= 13,285
Wrought iron hoops	7,915	= 17,453
	21,337	= 47,042

* *L'Artillerie Anglaise.* Par E. Bosch, Captaine d'Artillerie. Published by Perger, Levrault, and Cie., Paris.

During the firing trial a charge of 215·6 lb. (97·8 kilogs.) and a projectile of 403·4 lb. (183 kilogs.) were employed, with which a muzzle velocity of 2162ft. (659 metres) was obtained with a pressure of 17 tons to the square inch (2680 kilogs. per square centimetre.) In spite of this good result further trials were desired, especially with regard to longitudinal strength, which, it was thought, might not be sufficiently provided by longitudinal riband.

Figs. 2 and 3 exhibit the designs of the Elswick and Woolwich 9·2in. riband guns. In the latter, Fig. 3, the inner steel tube extends from end to end, and carries the breech screw. It is protected from erosive action of gas by a thin steel tube which extends from the obturator sufficiently far up the bore for this purpose. The breech end of the tube is much thicker over the breech screw. Over the chamber portion is wound riband of very high quality, which supplies great transverse strength. The riband has an ultimate tenacity of 95·24 tons per square inch—150 kilogs. per square mm. Over the riband are shrunk two long hoops of forged steel, which transmit the pressure on the breech to the trunnions by means of two systems of interrupted or broken rings. In this construction the longitudinal strain is shared between the tubes and the exterior hoops. The gun is hooped up to about two-thirds of its length— see Fig. 3. Its calibre is 9·2in —234 mm.—and its weight 19 tons. The Elswick gun—Fig. 2—consists of a tube covered with a jacket which receives the breech screw. The jacket carries a breech hoop, a coil of riband, and the trunnion hoop. In front of the jacket, and holding on to the tube, are two other coils of steel riband. Lastly, the entire piece from breech to muzzle is covered with a set of thin steel hoops. The ultimate tenacity of the riband is 57·145 tons per square inch—90 kilogs. per square mm. The calibre is 9·2in. and the weight 18 tons. At the conclusion of the trials at the end of 1884, Captain Bosch observes that no preference had been given to either gun. We believe that this still represents the state of the question. As to the form of the riband or steel wire, considerable difference of opinion exists. Captain Bosch observes, however, that the rectangular or riband form is preferred to the circular one. We may add that recently an ingenious patent has been brought out by which longitudinal strength is attempted to be supplied by a section shown roughly in Fig. 5, where the rings hold on the same principle as the conical rings of De Bange. We have not heard of this being actually adopted even for trial ordnance as yet. Captain Bosch refers, among other Elswick steel riband guns, to the 6in. 33½ cwt. howitzer to be taken asunder carried on elephants' backs in India; also of the Woolwich 10in. steel riband howitzer. This piece, we may add, has since given remarkably good results; it weighs 70 cwt. The weight of the projectile is 360 lb., and the muzzle velocity 1030ft. per second, consequently it has 2648 foot-tons total energy and 9439 foot-tons per ton of gun. Captain Bosch finally quotes Colonel Maitland's remarks, that to utilise further reduction in weight in guns we need to know how to make stronger carriages. At present the carriage stops the way.

The subject of carriages is rather more briefly dealt with than that of ordnance; but the question of saving the field carriage from shock by hydraulic buffers, springs, &c., is discussed, also the checking of recoil. We will not attempt, however, to follow this part of the book nor that dealing with projectiles, which, by the way, precedes the chapter we have noticed above on steel riband guns. We have said enough to commend this work to our readers already.

Fig. 1. Armstrong 10·2 inch (21 tons)

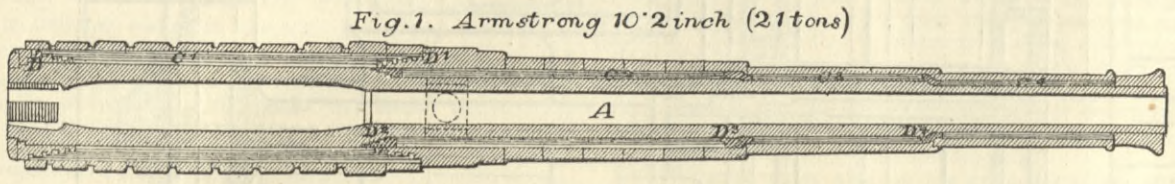


Fig 2: 9·2 inch 18 ton gun (Elswick)

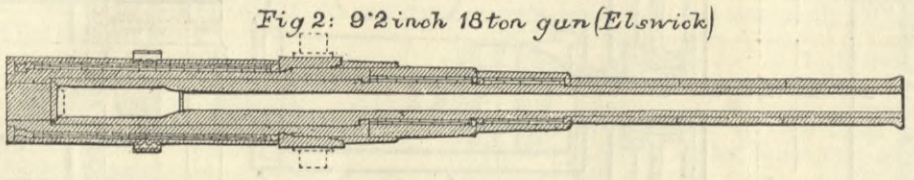


Fig. 3. 9·2 inch 19 ton gun (Woolwich)

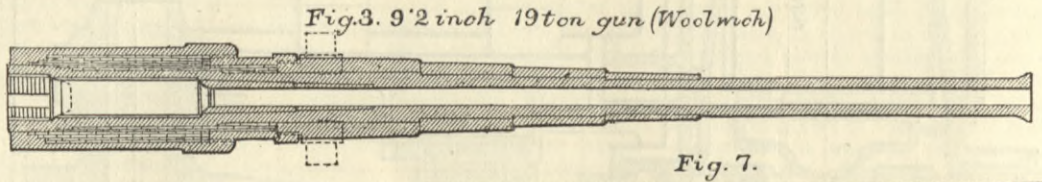


Fig. 4.

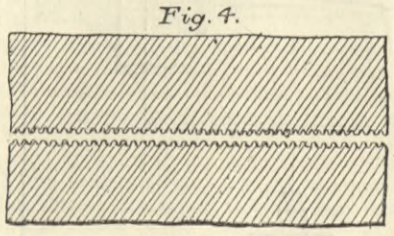


Fig. 5.

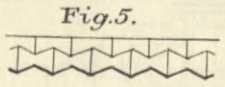


Fig. 7.

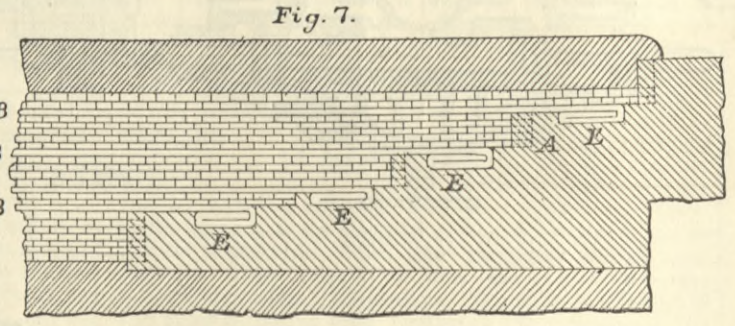
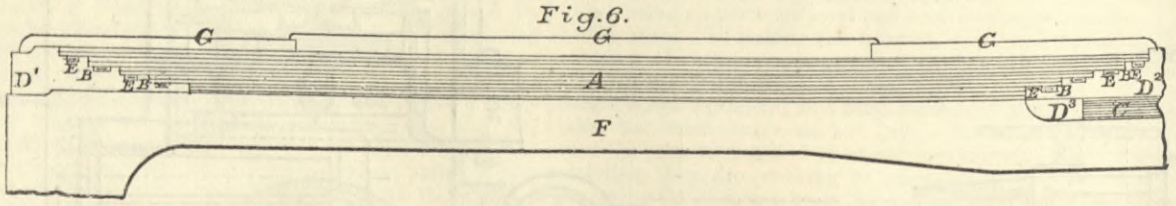


Fig. 6.



RIBAND GUNS.

A VISIT TO THE LIVERPOOL NEW WATER-WORKS ON THE RIVER VYRNWY, MERIONETHSHIRE.

By Mr. Wm. Spinks, A.M. Inst. C.E.

The following paper was read on Wednesday week before the Association of the Manchester Students of the Institution of Civil Engineers on "A Visit to the Liverpool New Waterworks on the River Vyrnwy," by Mr. Wm. Spinks, A.M.I.C.E. Mr. James H. Lynde, M. Inst. C.E., was in the chair :—

On presenting our credentials we were taken in hand by one of the assistant engineers, who courteously explained the details of the various parts. Our first visit was to the stables, which, like all the rest of the structures, are of timber, lofty and airy, and in which at the present time about 120 horses are stalled, and fine cattle they are too, just suited for the long hilly district. The teams are usually made up of four horses to the wagon, and the average cost of carting from the railway station, about ten miles distant, is 12s. per ton. From the stables we went to the sand-washing sheds. The sand is brought here in small trucks on a tramway from the gravel pit, and is passed from thence into the washing cylinders, and then conveyed on trucks again to the mixing shed, where it is amalgamated with pulverised stone before the cement is added to form the mortar. The gravel, which is separated from the sand, is conveyed to the concrete shed, and is measured and emptied into a revolving cylinder which thoroughly amalgamates the cement and gravel, after which water is forced through. Concrete mixed in this way is found to be done more cheaply and thoroughly than by turning by hand. Adjacent to these sheds is the cement store. The cement is brought direct here from the station, and is emptied on to a series of trays lying one above the other. When it has arrived at a sufficient temperature it is turned over by means of an adjustment of the louvres of which the trays are composed, and thrown on to the tray below; thus the whole of the bulk is equally exposed and tempered. Very great care is taken with the cement, and men are continually employed in preparing briquettes for testing. One briquette, which had been made eighteen months, was broken in our presence, and gave a result of 870 lb. on the inch section. Three very excellent testing machines are fixed in the testing-room, two of which are hydrostatic, and give a very fair and excellent result, there being no vibration whatever. These are designed by Mr. Deacon, and are quite the best I have seen. From the testing-room we moved to the Float House, which contains a very ingenious automatic arrangement for indicating the height of the river at all times. This consists of a suspended float connected by means of pulleys to a pencil sliding up and down a guide rail, and which indicates on a sheet of paper revolving round a drum. This is a very clever contrivance, and is the invention of Mr. Deacon also. The river at this point is "trained" in a channel of equal sectional area made by cement floor and sides, so that the quantity of water flowing through can be easily and accurately gauged. We now went on to the wall, and a great wall it is too. When the works were originally designed it was intended to dam the reservoir by means of the usual earth bank; afterwards it was decided not to do this, but to build a solid masonry dam. The ground has been got out down to the solid rock, which is about 140ft. below the intended top water level. The thickness of the wall is 120ft. at foot, tapering up to 20ft. at the cill level. The total width across the valley is rather over 400 yards, and upon the top of the wall a viaduct will be formed to carry the road, the water flowing between the arches over the cill, and thence into the gauge basin, into which will also come the compensation water by means of a tunnel formed through the east side of the wall. The wall is benched into the solid rock in the hills on each side, all shale and loose rock being carefully stripped off, so that a firm and true bed is obtained. The blocks of stone used vary from 5 to 10 tons, irregular in shape, but with a worked base. These blocks are lifted into position by means of cranes, and are bedded in cement mortar, and carried up as nearly level as possible, the interstices being filled up with cement concrete, the faces of the wall being of coursed ashlar. There are six steam cranes on the wall, each weighing about 35 tons; they are turned round and moved by means of Ransome and Rapier's hydraulic jacks. The stone used is of a blueish cast in colour, and is of the Caradoc beds quarried in the Cynon Valley about 1¼ miles from the works, and is conveyed thence by locomotives on a tramway. About 500 men are engaged at the quarry, which is the face of a hill, and presents a particularly brisk sight when the men are engaged upon the various operations necessary to lift the stone; here also, six cranes, similar to those on the wall, are at work loading the stone on to the trucks, when it is washed by means of a jet, and then weighed and dispatched. The stone, which is not sufficiently large for the wall, is taken down to the pulverising mills, where it is crushed into a sand for the mortar as before referred to. There is, of course, a considerable amount of rubble and waste, which is run down to the spoil bank. About 500 tons of stone per day are sent down to the wall, and up to the present time about 130,000 cubic yards have been used. The shots are fired simultaneously by electricity at twelve o'clock noon and six p.m. each day. The electric light is also fixed on several standards, and can be put into use whenever the necessity for it arises. It is also fixed at the wall, and is there used when particular work is in hand that compels continuous operations. From the quarry we proceeded to the Hirnant Tunnel, which is the commencement of the aqueduct to Liverpool. This tunnel is nearly 2¼ miles in length, and is to be 7ft. diameter, and is being driven through solid rock, the shot holes being drilled by machines worked by compressed air supplied from a stationary engine outside the tunnel. Powers have been taken to lay three pipe lines, but at present only one is being put down, it is 3ft. 6in. diameter, with a discharging power of 13,000,000 gallons per day. The tunnels are being made sufficiently large to pass the whole of the water that will ultimately flow through the three pipe lines.

The men employed on the works, of whom there are about 1400, are all comfortably housed in neat wooden houses. There is a large cocoa-room provided for their recreation, a post and telegraph-office, and also a church, with parson to look after their spiritual wants.

The rainfall of the district is particularly heavy, having been as much as 90in. in one year, but it may be taken to average about 70in. To keep this water pure the Corporation has purchased what few farms there are on the watershed, to prevent the manuring in spring. Before the water can be finally impounded, it will be necessary to pull down several small farmsteads and the whole village of Llanwyddyn, some of the tenements in which are quite equal to any Irish or Highland cabin. Consequently, their destruction will be a gain to the national health. When the wall is finally completed, it will impound about 12,000,000,000 gals. of water, which will cover an area of 1115 acres, forming a lake about five miles long and nearly half a mile broad, and the surface will be about 825ft. above Ordnance datum. 9,000,000 gallons of water per day have to be turned off for compensation—a quantity altogether unprecedented in the history of waterwork undertakings; and Liverpool takes at present about 18,000,000 gallons. The lake will be skirted by an extremely well-formed carriage way, fenced by a neat iron hurdle, which, being invisible from the opposite side, does not mar the beauty of the landscape, and in this respect is far superior to the unsightly stone walls surrounding some large reservoirs. The rivulets and streams are all crossed by substantial and handsome stone bridges. The valley now is very picturesque, the slopes being well wooded, and crowned with heather-covered moors. When the lake is formed it will make a most pleasing landscape, and it will be a most delightful drive round its banks along the new road.

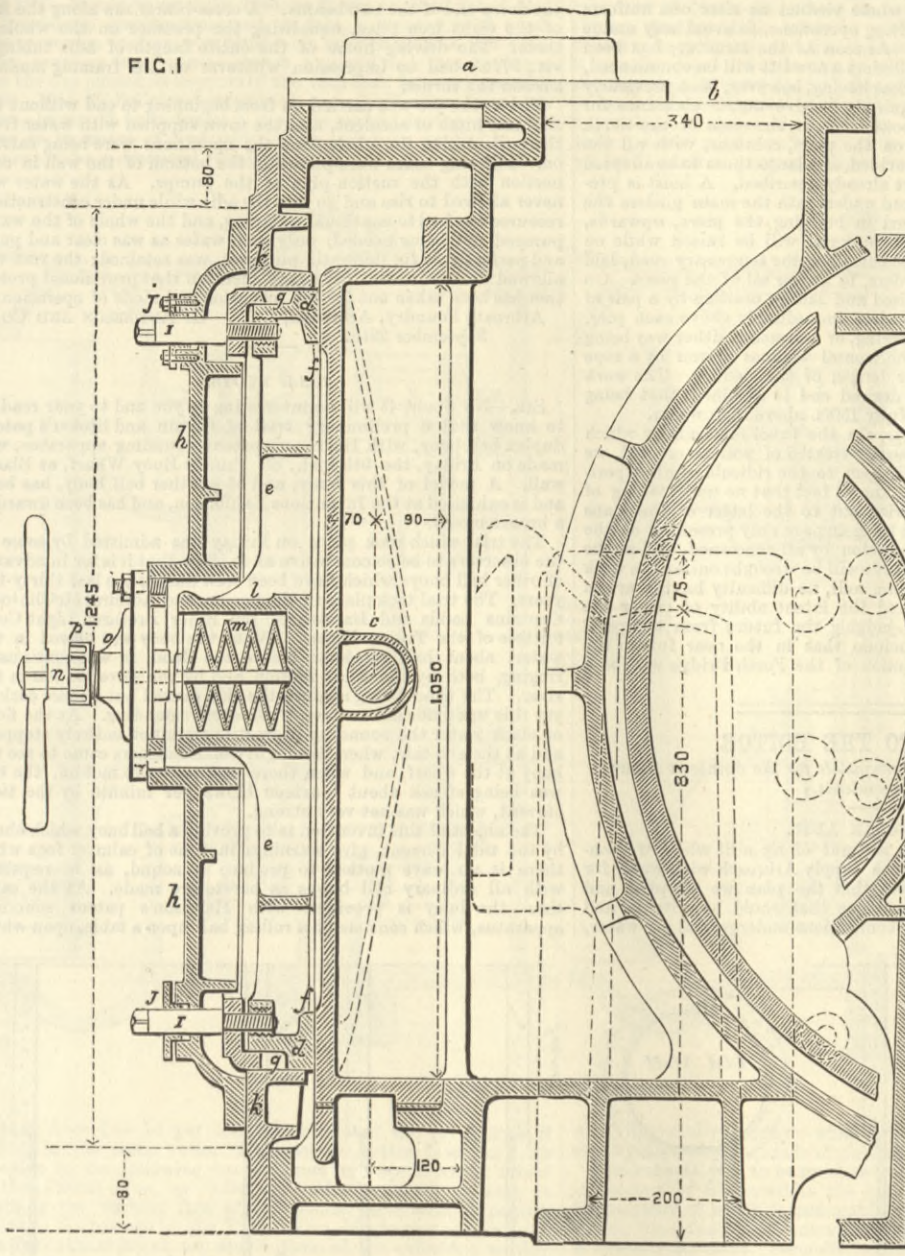
The total cost of this undertaking, including the aqueducts with necessary works, will be about £1,750,000 sterling, and it is expected will supply Liverpool with water for at least 100 years. The work is of the most thorough and substantial kind that forethought can devise and care can command, and is equal to anything of the kind of this or any other age. The magnitude of the scheme, and the energy with which it has been pushed on, reflect great credit upon the municipality who have had the pluck and enterprise to undertake it, and when completed will remain a magnificent tribute to the skill and ingenuity of the engineers who "have directed the sources of power in nature for the use and convenience of man."

The Town Council of St. Helens have instructed their engineer, Mr. George J. C. Broom, Assoc. M. Inst. C.E., to prepare plans for the main drainage of the borough, and also report as to the best means of utilising the sewage.

BALANCED VALVES OF THE GUNBOAT PHLÉGÉTON.

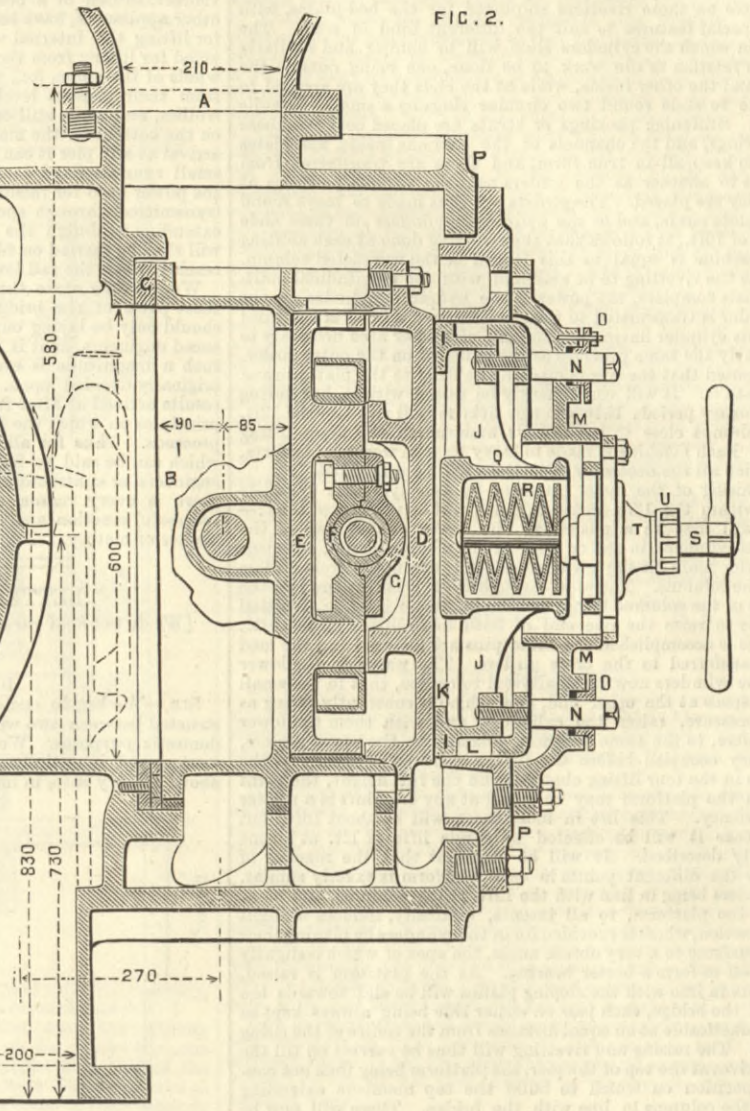
(*For description see page 303.*)

FIG. 1



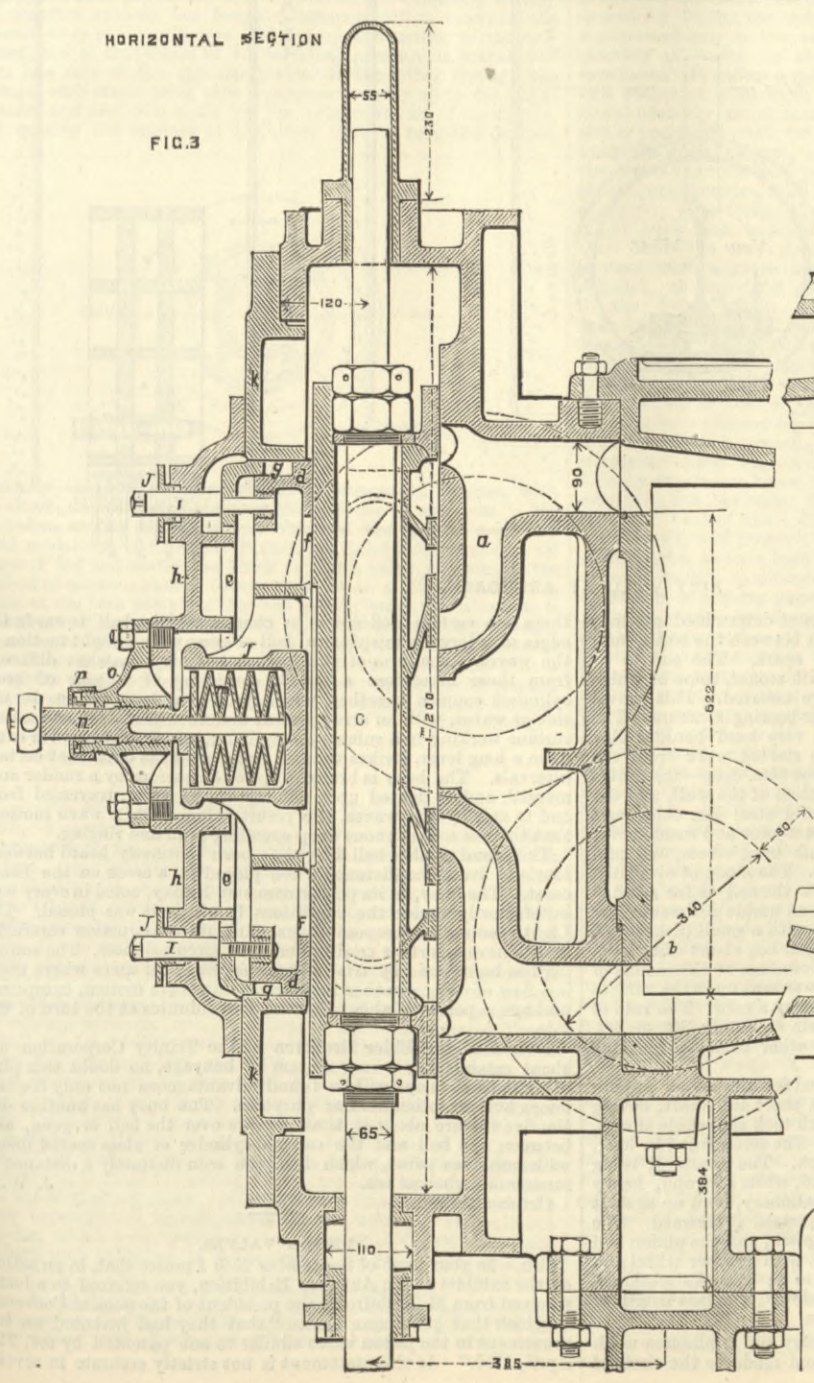
VERTICAL SECTION

FIG. 2.



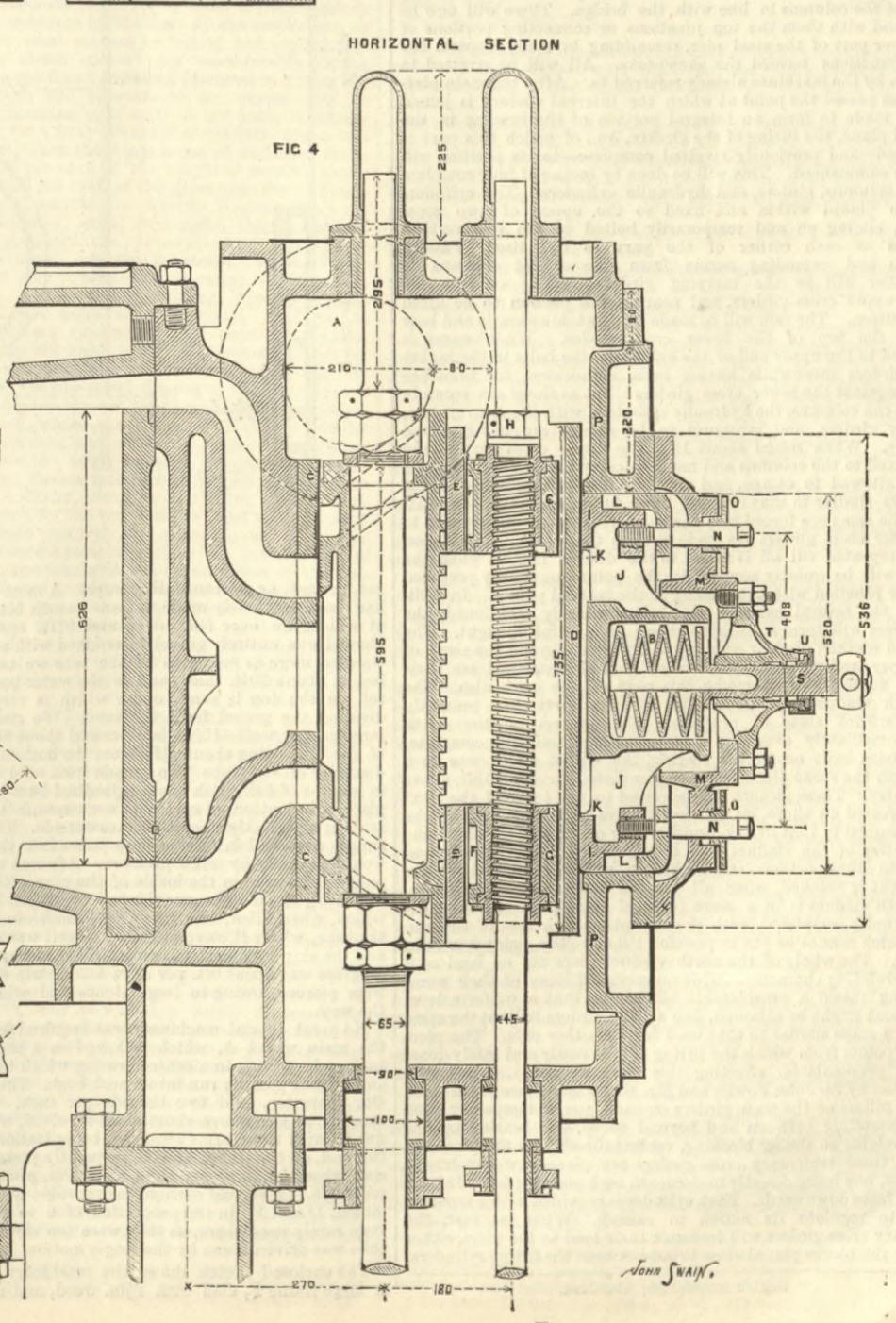
HORIZONTAL SECTION

FIG.3



HORIZONTAL SECTION

FIG 4



John Swain.

THE FORTH BRIDGE.*

PROPOSED METHOD OF ERECTING THE MAIN STEEL PIERS AND APPROACH VIADUCTS.

By Andrew S. Biggart, C.E.

(*Concluded from page* 285.)

In our last impression we gave the first portion of this paper, together with a number of illustrations relating to it. We now give the concluding part.

The rivetting machines employed will be of various forms, the common type being used for such work as the bracing girders, while those for the rising and horizontal columns will be the same in principle as those rivetters employed for the bed-plates, with several special features to suit the different kind of work. The girders on which the cylinders slide will be similar and similarly placed in relation to the work to be done, one being outside the column and the other inside, while at the ends they are secured to and made to slide round two circular rings by a small hydraulic cylinder. Stiffening packings or struts are placed between these circular rings, and the channels of the columns inside, and plates outside to keep all in true form, and these are transferred from one point to another as the girders pass the various positions at which they are placed. The girders are thus made to move round the complete circle, and as the hydraulic cylinders on these slide a length of 16ft., it follows that the rivetting done at each shifting of the machine is equal to this length of the completed column. To enable the rivetting to be executed with the longitudinal built-up channels complete, the power of the hydraulic cylinder on the inner girder is transmitted to the rivet through a lever of the third order, this cylinder having the amount of greater area necessary to exert nearly the same pressure as the cylinder on the outer girder. It is proposed that the whole machine be fixed to the platform and underneath it. It will consequently be raised with it, but during the stationary periods between the lifts it will rivet up the 12ft. rising columns close to but always underneath the main lifting girders. Each machine is made to carry its own working platform, from which all the necessary operations will be conducted.

The raising of the main platform by the hydraulic cylinders placed within the 12ft. rising columns will be performed thus:—Water will first be admitted to the lower end of two of the hydraulic cylinders, in one or other of the sloping planes, sufficient to ease the main lifting girders and the two upper cross girders within the columns. The pins through these cross girders and the channels of the columns being withdrawn, water is again admitted and made to raise the one end of both main lifting girders 1ft.; when this is accomplished the same pins are inserted and the load again transferred to the cross girders. The water in the lower end of the cylinders now being allowed to escape, that in the small annular space at the other end, and which is constantly acting as a back pressure, raises the cylinders, and with them the lower cross girders, to the same position, relative to the upper girders, which they occupied before the lifting operations began. As the pin holes in the four lifting channels run the full height, the point to which the platform may be lifted at any one shift is a matter of expediency. This lift in most cases will be about 15ft., but in any case it will be effected by single lifts of 1ft. at a time as already described. It will be apparent that the manner of lifting at the different points in each platform is exactly similar. the cylinders being in line with the 12ft. rising columns, and made to raise the platform, to all intents, vertically, induces a slight rocking motion, which is provided for in the cylinders by planing their bottom surfaces to a very obtuse angle, the apex of which is slightly rounded off to form a better bearing. As the platform is raised, the girders in line with the sloping planes will be slid towards the centre of the bridge, each pair on either side being always kept as near as practicable at an equal distance from the centre of the rising columns. The raising and rivetting will thus be carried on till the whole arrives at the top of the pier, the platform being then in a convenient position on which to build the top members extending between the columns in line with the bridge. These will now be built, and with them the top junctions or connecting portions of the upper part of the steel pier, resembling in many respects the lower junctions termed the skewbacks. All will be rivetted in position by the machines already referred to. After the main platform has passed the point at which the internal viaduct is joined to and made to form an integral portion of the bracing in the vertical plane, the lifting of the girders, &c., of which this part is composed—and previously rivetted complete—to its position will then be commenced. This will be done by means of four complete sets of columns, girders, and hydraulic cylinders. The cylinders will be placed within and fixed to the upper of two cross girders, sliding on and temporarily bolted to the two vertical columns at each corner of the part to be raised. Passing between and extending across from one set of columns to the other will be the carrying girders, resting on the top of the upper cross girders, and bearing the portion to be lifted into position. The ram will be made to point downwards and bear against the top of the lower cross girder. When water is admitted to the upper end of the cylinders, the bolts in the higher cross girders meanwhile having been withdrawn, the rams are forced against the lower cross girders; but as these are securely fixed to the columns, the hydraulic cylinders, with the cross girders, carrying girders, and structure to be raised, are bodily lifted upwards. When raised about 1ft., the upper cross girders are again fixed to the columns and made to carry the load. The water is now allowed to escape, and as there is a back pressure in the cylinders similar to that in those used for raising the main platform, the rams are forced into the cylinders, and being secured to the lower cross girders are made to raise these also. This action will be repeated till all is raised to the desired height, when the girders will be quickly secured to the points previously prepared for their junction with the bracing in the vertical planes. In addition to the several parts of the bridge already mentioned, the cantilevers will form a leading subject for careful thought. The proposed method of their erection is, however, beyond the scope of this paper, and we need only remark that all concerned see their way to successfully overcome this part of the work also. The approach viaducts on both sides of the Firth are presently in a forward state of progress. The girders on the south side, immediately over the water, being practically complete, having been built on timber staging, the top of which was on a level with the stone piers, so far as completed, or about 18ft. above high-water. These girders will be raised to the level of the next stage, erected on shore, on which will have been built, during the time occupied in that lifting, another pair of girders to which the first portion of the viaduct will be connected. This raising and joining to other portions, still higher up, will be continued till the full height is reached, when all the ten spans will be complete. The north viaduct is in a more forward state than the south, it being wholly completed, with the exception of a few of the end bays, which cannot be put in position till a higher point has been reached. The whole of the north viaduct piers are on land of a very undulating character. This necessitated some of their number being raised a considerable height, so that a uniform level throughout might be attained, and all the girders built at the same time on a stage similar to that used for the other side. The piers provide points from which the lifting can be easily and safely done. Various proposals for effecting this were discussed, that finally sanctioned by Sir John Fowler and Mr. Baker is to place underneath the end pillars of the main girders on each pier a temporary cross girder extending between and beyond these, and bearing up the whole weight, on timber blocking, resting directly on the pier. In each of these temporary cross girders are placed two hydraulic cylinders, one being directly underneath each main girder. In both the ram faces downwards. Each cylinder is provided with a separate valve, to regulate its action in raising. When at rest, the temporary cross girders will transmit their load to the piers, either through the blocks placed close to but between the lifting cylinders, or those outside and nearer the ends of the piers, this being determined by the point at which building has to be carried on. If in the centre, then the supports are outside, and *vice versâ*. The ram, when lifting, will bear on a prepared sole of hard wood spreading somewhat over the stonework. Great care must exercised to keep the different bearings in the whole viaduct as near one uniform level as possible during the lifting operations, to avoid any undue straining of the main girders. As soon as the structure has been raised the full stroke of the cylinders a new lift will be commenced, the blocks on which the rams bear having, however, been previously packed up. The height required to give ample clearance for building underneath will be about 4ft. At the ends of the north viaduct, in lieu of a bearing on the piers, columns, with all the other appliances, have been provided, similar to those to be adopted for lifting the internal viaduct already described. A hoist is provided for lifting from the ground underneath the main girders the whole of the stone, &c., required in building the piers, upwards, from their present level. This material will be raised while on trollies, and while still on these run along the temporary road, laid on the bottom of the main girders, to any or all of the piers. On arrival at any pier it can be raised and laid in position by a pair of small runners fixed to the girders immediately above each pier, the power used for raising, lowering, or traversing either way being transmitted through special horizontal winches driven by a rope extending well-nigh the entire length of the viaduct. The work will thus be carried on till the desired end is attained, that being reached when the rail level is fully 150ft. above high water.

Were we to state that these are the exact methods by which those parts of the bridge presently treated of will be erected, we should only be laying ourselves open to the ridicule of all experienced engineers, as it is a well-known fact that no undertaking of such a magnitude is ever carried out to the letter of the plans originally decided upon. The foregoing are only presented as the results arrived at after full discussion by all concerned, and as the principles on which the full details will be wrought out as the work proceeds. Thus far all has gone well, no difficulty having arisen which can be said to have taxed the latent ability of either the engineers or contractors; and judging the future from the past, there is every reason to conclude that in the near future the successful erection and completion of the Forth Bridge will be a matter of history.

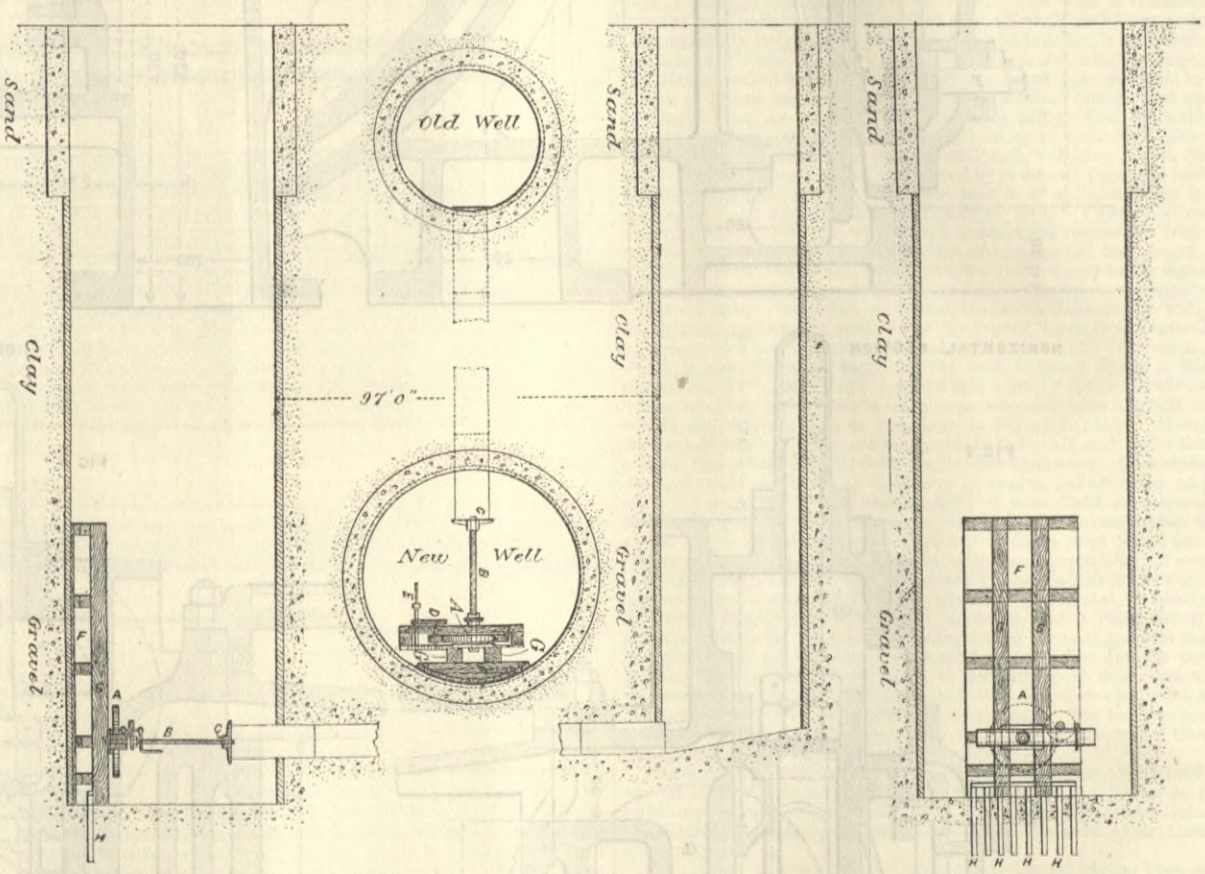
* British Association, Aberdeen.

LETTERS TO THE EDITOR.

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

DRIVING AN ADIT.

Sir,—We beg to enclose an account of an adit which we constructed between two wells which supply Arbroath with water for domestic purposes. We believe that the plan we adopted and worked out is entirely new, and one that would be suitable, and above all very safe, in making connections underground for water, gas, sewage, or air ventilating ways. A most determined attempt had been previously made to form an adit between the wells, both of which are over 50ft. deep and 97ft. apart. The soil to be pierced was entirely gravel intermixed with stones, some of which were so large as nearly to fill the tube we inserted. This gravel bed is about 20ft. thick, and is the water-bearing stratum. The soil on the top is sand, under which is very hard boulder clay dividing the gravel from the sand. We started work from the large or new well—15ft. diameter and about 55ft. deep—the centre of the tube being about 4½ft. from the bottom of the well, and the diameter of the tube 28in., made from mild steel ⅛in. thick, and in lengths of 6ft., with one longitudinal butt joint and inside cover plate, all rivetted up cold with countersunk head rivets, and presenting a perfectly smooth surface outside. The mode of operation simply consisted in forcing these tubes into the soil as far as they would go easily by screw pressure. After an undue resistance was reached the man in the inside of the tube with a small pick, lever, or shovel, cleared the gravel into a V-shaped box about 42in. long, which, when filled, was drawn by a small windlass to the mouth of the tube, where it was emptied. The grit was sent up to the surface and the skip was again drawn into the tube by a cord. The rate of progress was about 6ft. per day; but certain days only 3ft. or 4ft. were pierced, owing to large stones and other obstacles blocking the way.



ADIT WELL AT ARBROATH.

No great special machinery was required for the screw power; the main wheel A, which is keyed on a short 4in. shaft, having back end running in a centre bearing which took the whole thrust, and a front bearing run into a neck bush. The screw was 7ft. long, 4in. diameter, and two threads per inch. The screw B being coupled to the above short shaft revolved, while a strong, heavy nut C, with three arms attached, being stationary, bore up against the end of the tube, and consequently pressed it forward. The spur-wheel A had ninety-eight teeth, 2in. pitch, and the pinion had ten teeth. A second motion was provided with another wheel and pinion, D and E, in the proportion of 6 to 1; but the workmen very rarely used them, as they were too slow. The last length of tube was driven home by the single motion.

The enclosed sketch shows the machinery and appliances used. A large frame F, clad with 2½in. wood, and made to the circle of the well—15ft. diameter—was placed directly opposite to the bore, after which two pitch pine beams G, 20ft. long, 15in. by 15in., were placed vertically in front of this frame to distribute the pressure. In the bottom of the well eight iron bars or piles, H, were driven down in a soft, sandy rock, to sustain the pressure on the down end of the two beams. A cross-bearer ran along the face of the eight iron piles, equalising the pressure on the whole of them. The driving home of the entire length of adit tubing—viz., 97ft.—had no impression whatever on the framing made to sustain the thrust.

The entire job was carried on from beginning to end without the slightest hitch or accident, and the town supplied with water from the wells during the whole time the operations were being carried on. Filtering boxes were placed in the bottom of the well in connection with the suction-pipe of the pumps. As the water was never allowed to rise and go into the adit while under construction, recourse was had to continual pumping, and the whole of the water pumped not being needed, only such water as was clear and pure, and perfectly fit for domestic purposes, was retained; the rest was allowed to run waste. We may mention that provisional protection has been taken out for the invention and mode of operation.

Arbroath Foundry, Arbroath, September 26th. G. Anderson and Co.

BELL BUOYS.

Sir,—No doubt it will be interesting to you and to your readers to know that a preliminary trial of Gosein and Stoker's patent duplex bell buoy, with Harrison's patent sounding apparatus, was made on Friday, the 9th inst., off Trinity Buoy Wharf, at Blackwall. A model of this buoy, and of another bell buoy, has been and is exhibited at the Inventions Exhibition, and has been awarded a bronze medal.

The trial which took place on Friday was admitted by some of the observers to be so conclusive as to show that it is far in advance of other bell buoys which have been seen during the last thirty-five years. The trial took place in the presence of Admiral McClintock, Captains Ladds and Barlow, of the Elder Brethren Light Committees of the Trinity House. When the buoy was placed in the water, about half an hour before the flood, it was continually ringing, both by the tidal motion and by the wave motion in the river. The wind being against the tide caused but a mere cockle; yet this was sufficient to keep a perpetual sounding. At the flood or slack water the sounding properties were not entirely stopped, and at the ebb tide, when the Light Commissioners came to see the buoy at the wharf, and when there was no wave motion, the bell was being struck about fourteen blows per minute by the tidal current, which was not very strong.

The object of this invention is to provide a bell buoy which shall, by the tidal current, give warnings in time of calm or fogs when there is no wave motion to produce a sound, as is requisite with all ordinary bell buoys as heretofore made. At the same time the buoy is provided with Harrison's patent sounding apparatus, which consists of a rolling ball upon a table, upon which there are certain deflectors to cannon off the ball towards the edges of a large hemispherical bell or gong with a slight motion of the waves. The form of this patent buoy is somewhat different from those heretofore adopted, consisting of a pair of steel cylinders coupled together, which present a long surface to the tide or waves, with an arrangement underneath of a fan or vertical turbine working in a submerged cylinder, which, acting with cams upon a long lever, strikes the bell or gong on the outside at certain intervals. The buoy is brought up to the surface by a rudder submerged, and is floated upon the top of the water, traversed from end to end by the waves, the result being, with a wave motion, that there is a continuous deep sounding hum and ringing.

The sound of this bell buoy has been distinctly heard between four and five miles distance when placed in a creek on the Essex coast. The buoy, in its performance on Friday, acted in every way satisfactorily under the conditions in which it was placed. The Light Committee propose to examine its construction carefully, and to have a further trial under other circumstances. The sounding has been found by trial to be constant at all times where there is a flow of tide, whether in calm or with wave motion, excepting, perhaps, a period of about three or four minutes at the turn of the tide.

Now that the Elder Brethren of the Trinity Corporation are about establishing a new system of buoyage, no doubt this plan of cylindrical buoys will be found advantageous not only for bell buoys but for other similar purposes. The buoy has another distinctive feature about it, that it bears over the bell or gong, and between the bell and the cage, a cylinder of glass coated inside with luminous paint, which has been seen distinctly a distance of some miles when at sea.

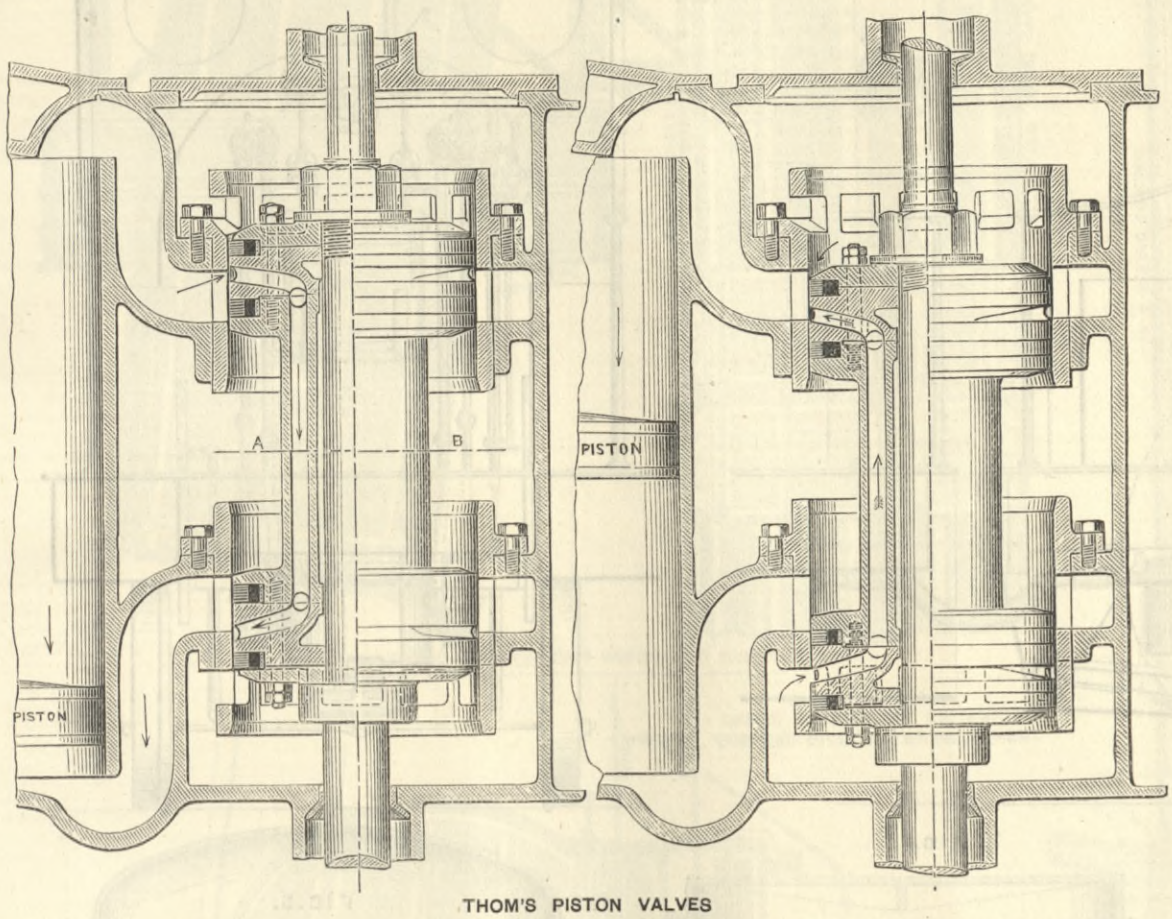
J. W.

October 13th.

PISTON VALVES.

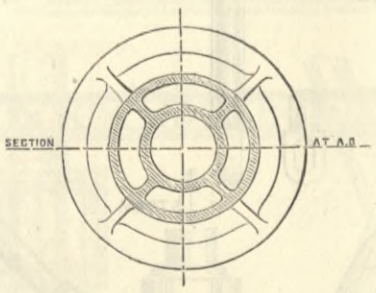
Sir,—In your issue of September 25th I notice that, in an article on the exhibits at the Antwerp Exhibition, you referred to a letter received from M. Bellefroid, the president of the Société Cockerill, in which that gentleman states "that they had invented an improvement in the piston valve similar to one patented by me, 21st April, 1885." As this statement is not strictly accurate in several

important particulars, perhaps you will favour me by inserting this letter in your next issue—with sketch, if possible—as it may injuriously affect my patent if allowed to pass uncorrected. In the first place I may observe that the date given—namely, April 21st, 1885—should be 1st July, 1884, as it was on that date I filed my provisional specification; and, in fact, a steamer, with quadruple expansion engines, was fitted with my piston valve last year. If you examine the enclosed sketch, you will find that it differs from the one published in yours of the 18th inst. in a very material point. Had M. Bellefroid examined my specification for piston valves, he would have found a more important feature than he seems to be aware of, and which, if it had been applied to the engines you have described, would have reduced the consumption



THOM'S PISTON VALVES

of steam from 8 to 10 per cent., or increased the revolutions, if desired, in the same ratio. I cannot do better than draw his attention to the following extract from my specification, issued by the Patent-office, as follows:—"My invention consists in providing the working face of the piston valve with a passage similar to the passage in the Trick valve, but having positive and negative exhaust lap at top and bottom of the cylinders, so that the negative exhaust lap forms a communication between the opposite ends of the cylinders just before exhausting to the condenser, and so that steam at its terminal pressure is transferred from one side of the cylinder piston to the other through the passage, such steam being then compressed nearly up to the initial pressure and used over again on the return stroke of the engine, and causing the engines at the same time to turn the centres,



especially the low-pressure cylinder of compound engines, with less shock, due to having steam in the cylinder to compress." My flat valves on the same principle obtained the highest award—a silver medal—at the present Inventions Exhibition, London. Of course I did not claim the Trick or Allen valve, but simply the method of communication between the ends of the cylinder. In yours of the 18th you state that the piston valve you illustrate is patented by the Société Cockerill, but this is apparently contradicted by M. Bellefroid, who says they did not attach sufficient importance to the improvement to patent it; nor would I have thought it worth while taking out a patent for the Trick passage except in combination with my method of opening a communication between both ends of the cylinder.

JOHN THOM.

8, Storey-square, Barrow-in-Furness,
September 30th.

THE BEHAVIOUR OF STEAM IN THE CYLINDER.

SIR,—I observe in Chief Engineer Isherwood's account of certain experiments on steam engines, published in your last issue of the 9th inst., page 279, that he continues to claim the "discovery that the cylinder of a steam engine acted alternately as a condenser and as a boiler, condensing a portion of the entering steam during its admission, and revaporising the resulting water of condensation during the period of expansion and during the exhaust stroke, which phenomena were caused wholly by the interaction of the metal of the cylinder," &c. This discovery, he says, "was made a great many years ago by him, and stated and used in his published professional writings," and he refers to his "Engineering Precedents," vol. ii., 1859; and to his "Experimental Researches in Steam Engineering," 1861 and 1863. He adds that "no one contested the discovery, or even used it, until quite lately." I presume he herein alludes to my paper, "On the Behaviour of Steam in the Cylinders of Locomotives during Expansion," published in the minutes of "Proceedings" of the Institution of Civil Engineers,"* of which I enclose to you a copy; and this reference must be my apology for asking you to publish this letter in reply.

In the copy of my paper, enclosed, I have summarised the results of my experimental investigations on the action of steam in the cylinder, which were conducted in the year 1850, and the results of which were published in the course of the year 1852†; or seven years before Mr. Isherwood ever made or published his experiments bearing on the question. In the enclosed paper I have briefly re-stated the evidence and arguments employed and published by me in 1851-52, in investigating the behaviour of steam in the cylinders of locomotive steam engines, showing, amongst other things, the formidable losses by condensation and re-evaporation of steam in cylinders, and the augmentation of the loss in proportion to the degree of expansion to which the steam is worked; and showing that, without the adoption of special means for preventing or lessening condensation within the cylinder, expansive working, by cutting off earlier than at from one-half to one-third of the stroke, could not be practised with economy. If you will allow me I will quote a paragraph direct from "Railway Machinery," in which I specially announce what Mr Isherwood calls *his* discovery, seven years before he made or published his experiments:—

"In general, it is to be concluded that, first, when the cylinder is thoroughly immersed in the hot bath of the smoke-box, the temperature of which is commonly much higher than that of the steam, the quantity of water existing as steam during expansion is virtually constant. Secondly, when the cylinder is placed nearly or entirely beyond the influence of the heat of the smoke-box, or is protected only in the usual manner by felting and plating, the quantity of water or steam varies very considerably during expansion. It suffers a rapid and transient diminution during the first stages of expansion, and amounts to an excess over the initial quantity, which increases uniformly as the ratio of expansion is prolonged; till, for a final volume of about three and a-half times the initial volume, when the steam is cut off at 15 per cent., the excess amounts to 57 per cent. of the weight of sensible steam cut off, or otherwise, to 36 per cent. of the gross quantity of steam admitted. The foregoing results are directly contrary to what might have been anticipated, as, at first sight, they appear to show that the less protected the cylinders the more work is done with a given initial quantity of steam. In the inside cylinder, so far from any apparent evaporation or accession to the total weight of the steam during expansion, the quantity is at least not more than constant, and is, in fact, slightly reduced during expansion. The outside cylinders, on the contrary, show, by the great excess of steam at the end of expansion, very significant amounts of factitious evaporation. In this case, as in that of the low-speed diagrams, the difference is referable to a primary condensation of the steam during admission, by which water is formed, whilst the temperature of the cylinder is raised. After suppression, and when the steam temperature falls by expansion below the newly-acquired temperature of the cylinders, the hot water flashes into steam in virtue of its own heat and that of the cylinder, according to the law of the maximum density and pressure for the temperature; and what appears, at first sight, to have been positively one advantage of an exposed cylinder, in the auxiliary evaporation during the later stages of expansion, is nothing more than a partial resuscitation of the precipitated steam, as a compromise for lost initial action. The greater the proportion of expansion, the greater is the final excess of steam, as the extreme temperatures become more widely different; and, moreover, for the higher degrees of expansion, smaller absolute volumes of steam are admitted, for which there is always the same cooling superficies of cylinder; and this is relatively greater, of course, as the period of admission is reduced. In the enclosed inside cylinder, on the contrary, bathed in hot air or enveloped in cinders, actually hotter than the steam that passes through them, the initial pressure of the steam as it enters the cylinders is maintained in its integrity, as, even for the greater expansions, there appear no symptoms of a resurrection of steam. The evidence goes rather to show that the steam is superheated during its passage through the steam pipes previous to admission."*

I have supplied direct evidence of alternate condensation and re-evaporation by direct comparison of the quantity of steam cut off, according to the indicator-diagram, and the quantity of water measured from the tenders of locomotives—not necessarily in terms of their weights, as Mr. Isherwood appears to insist on, but in terms of the volumes of water, as steam and water from the tender, which are, of course, exact measures of quantity. In fact, measurement by volume is the basis of the investigation. If, as he implies, he weighed the sensible steam, how did he weigh it? And if he did weigh it, why is weight a better measure than volume? I have given very full details of experiments and observations on the performance of locomotives to prove by direct measurement, quantitively as well as qualitatively, the pregnant fact of the alternate condensation and re-evaporation of steam. In the case of No. 42 express locomotive on the Caledonian Railway, in 1850, and of several other locomotives, the results were published in detail in 1852.†

Then Mr. Isherwood says, "No one contested the discovery, or even used it, until quite lately." I may say, for my part, that since the first publication of my experiments and deductions in 1851-52, I have repeatedly announced the fact of alternate condensation and re-evaporation as a matter first demonstrated and established by myself.* Mr. Isherwood appears, also, to forget his correspondence with Mr. G. A. Hirn in 1879, respecting the claim of Mr. Isherwood, in the *Journal of the Franklin Institute* for July, 1878, to his having published for the first time his "discovery." M. Dwelshauvers Dery published the correspondence in 1879,† from which it appears that Mr. Isherwood was anticipated by Mr. Hirn by several years—in 1857—although Mr. Hirn, again, was anticipated by me in 1851-52. Mr. Isherwood is therefore in error in stating that "no one contested the discovery."

As the question of prior discovery has been raised, perhaps, Mr. Editor, you will allow me to quote a disinterested authority, Mr. Anatole Mallet, past president of the Institution of Civil Engineers of France, who has kindly recognised my priority on this question, in his communication to that Institution in 1877, on the utilisation of steam in locomotives:—"Etude sur l'Utilisation de la Vapeur dans les Locomotives et l'Application à ces Machines du Fonctionnement Compound," in the *Mémoires de la Société des Ingénieurs Civils*, 1877. In this paper Mr. Mallet says: "Mr. D. K. Clark was the first experimentalist who, by practical evidence, traced to its true source the excess of the quantity of steam, or the water equivalent of it, in the cylinder, at the end of the expansion. He demonstrated that a portion of the steam when admitted at each stroke was condensed, and that it was in part re-evaporated at the end of the expansion; and that by this destroying process the efforts at economy by cutting off early and expanding were baffled, insomuch that it was practically impossible with economy to cut off earlier than at one-third of the stroke." Mr. Mallet proceeds to say: "In these publications—already named in the second foot-note—has been for the first time so completed elucidated the behaviour of steam in the cylinders of locomotives, and the part that is played by the condensation of the steam during admission—a characteristic phenomenon which gives the key of the difference which always exists between the practical expenditure of engines and the calculated consumption, and the reality of which, strange to say, many engineers, otherwise very distinguished, really believed could be contested ten or twelve years after the publication of those works"—p. 852. See a series of articles, in behalf of Mr. Hirn's claim, on "Les Découvertes Récentes Concernant la Machine à Vapeur"—"Recent Discoveries in the Steam Engine"—by Mr. V. Dwelshauvers-Déry, in the *Revue Universelle des Mines*, tomes iv., v., and vii., for 1878, 1879, and 1880. Also several contributions by Mr. O. Hallauer and others to the *Bulletin de la Société Industrielle de Mulhouse*.

8, Buckingham-street, Adelphi, W.C., D. K. CLARK.
October 12th.

COMPOUND LOCOMOTIVES.

SIR,—Before you go further into the question of compound locomotives, it would be well, I think, to point out that there is a radical objection to the system of compounding adopted by Mr. Webb, namely, that in which the only connection between the high and low-pressure pistons is steam.

It is imperative that locomotives should be able to start their trains quickly. Now, before the low-pressure cylinder of the Webb engine can get any steam at all, the trailing drivers must revolve; but they can only do this either by slipping or starting the train. Consequently only one-half the tractive power of the engine is available just when the whole is wanted. When the trailing wheels slip—as they usually do at starting—they fill up the intermediate receiver, especially if the low-pressure crank is on the dead centre, and then all the cylinders are powerless, because the back pressure in the first two is as great as that in the boiler, and the low-pressure cylinder is on the dead centre. It is not remarkable, then, that these compounds are very bad starters.

Now if we examine the Mallet or Worsdell engine, we find that this difficulty is quite overcome by the use of a small supplementary valve. I am told that the compound engines have been withdrawn this month from express service on the Scotch route north of Crewe.

DUPLEX.

Swindon, October 14th.

SIR,—Your article in your issue of the 9th inst. on compound locomotives I have perused with much interest. The question is an important one, and deserves discussion in the pages of THE ENGINEER.

In reference to the four questions which you suggest as a basis of discussion, I would refer briefly to a few points bearing upon each. But as no thoroughly effective compound locomotive can, as yet, be said to have been produced, any remarks bearing upon the subject can, of course, only allude to what the system is capable of.

Your question (1) Is the compound locomotive more economical in fuel than the simple engine?

In answer to this I have no hesitation in saying that it is more economical in fuel, provided the compounding is effective.

Question (2): Is it more economical in repairs?

The low-pressure cylinders of all compound locomotives should be arranged to work under high pressure in starting from stations and getting into speed. This admits the employment of larger diameter driving wheels than would be practicable otherwise. By this alone a large saving in wear and tear is effected, while the engine is far more efficient for high-speed. But the system in many other ways admits of greater economy in repairs.

Question (3) Is it more generally efficient under all conditions of load, fuel, and weather?

By effective compounding the greater part of the force retained in the high-pressure exhaust is intercepted and utilised in the low-pressure cylinders. This being all gain in power, must add largely to the engine's efficiency under all conditions of load, fuel, and weather.

Question (4) Does the principle of compounding enable a more powerful engine to be produced than is possible without it?

Having partly answered this question in answering the preceding ones, I need only say that, in my opinion, a much more powerful engine is capable of being produced.

One of the chief things to be obtained is a free exhaust, as far as practicable, with a view of avoiding back pressure. A compound locomotive without this, or, in other words, with defective compounding, can hardly be expected to be more efficient or economical than the ordinary simple engine.

It is in this where the defect in Mr. Webb's engine really lies. The engine is spoken of as a bad starter, and the high-pressure driving wheels as slipping badly before taking a grip of the rails and before the engine moves. The fact is, however, the wheels do not grip the rails at all, but are pulled up through their cylinders getting choked, and the engine becoming powerless until a move is made by the low-pressure piston. But should the low-pressure piston happen to be on a dead centre, both engines, as a matter of course, become completely blocked; and as this no doubt frequently happens, it is not surprising the engines are complained of in regard to starting.

Then before getting into speed after a move is made, should more steam pass through the high-pressure cylinders than can be freely utilised by the low-pressure one, the back pressure upon the high-pressure pistons continues, and it may continue to such extent as to throw the whole of the work upon the low-pressure piston. This is actually what occurs when the unsteady motion takes place, so frequently felt in trains worked by these engines when starting and getting into speed.

Then in regard to high speed, you specially allude to Mr. Webb's engines as not coming up to the mark. This also is clearly the result of defective exhaust from the low-pressure cylinder, and excessive back pressure. But as this is a defect that can easily be rectified in compound locomotives, it will be admitted as hardly fair to judge the system by the results achieved by this engine.

Bristol, October 13th. D. M. R.

* See vol. lxxii. of the Minutes, Session 1882-83, page 275.

† See "Railway Machinery," 1851-56, Blackie and Son, pages 77 to 85; also a paper on the "Expansive Working of Steam in Locomotives," in the "Proceedings" of the Institution of Mechanical Engineers, 1852, pp. 63, 105.

* "Railway Machinery," page 82.

† See "Railway Machinery," 1851-56, pages 144 to 151; also "Proceedings" of the Institution of Mechanical Engineers, 1852, pages 120 to 126.

* See "The Exhibited Machinery of 1862," page 300; "Steam and the Steam Engine," 1875, page 267; "A Manual of Rules, Tables, and Data for Mechanical Engineers," 1877, page 880.

† See *Revue Universelle des Mines*, vol. v., 1879, page 494.

INVENTIONS EXHIBITION—THE AUTOMATIC VACUUM BRAKE.

THE AUTOMATIC VACUUM BRAKE COMPANY, LONDON, ENGINEERS.

(*For description see page* 300.)

FIG. 1

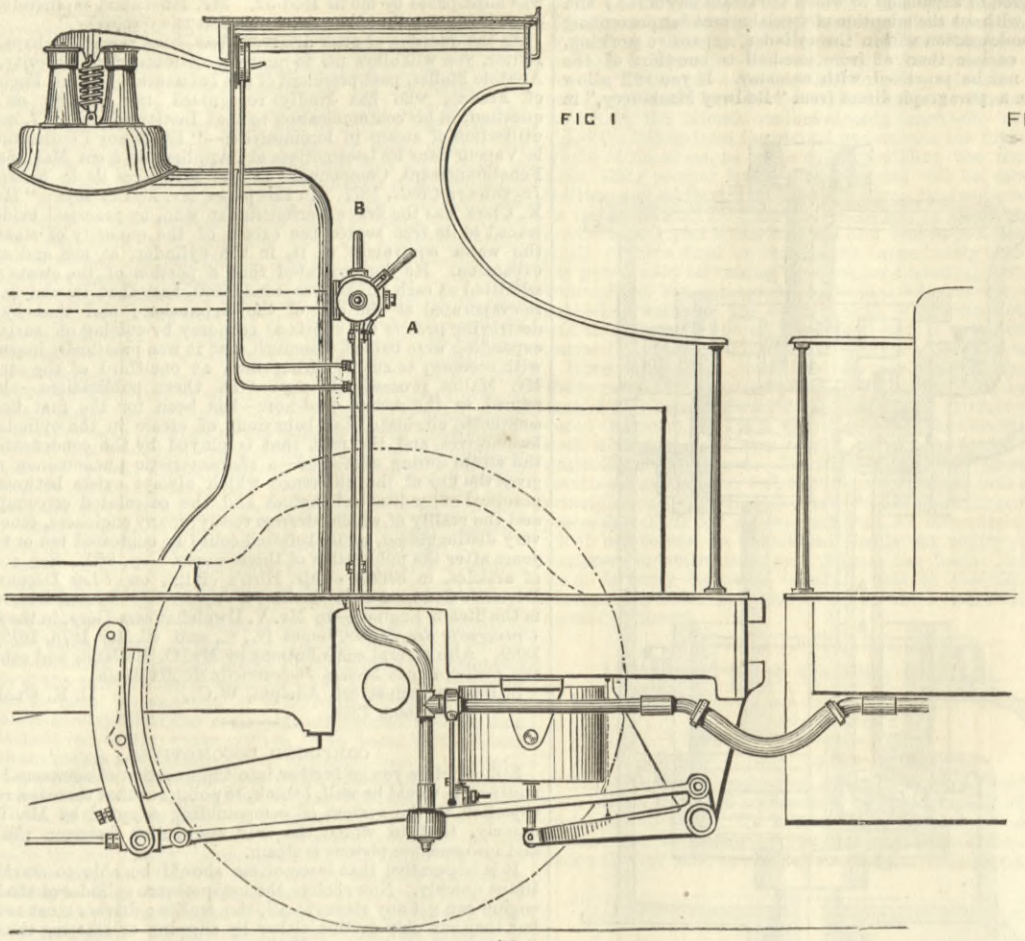


FIG.2

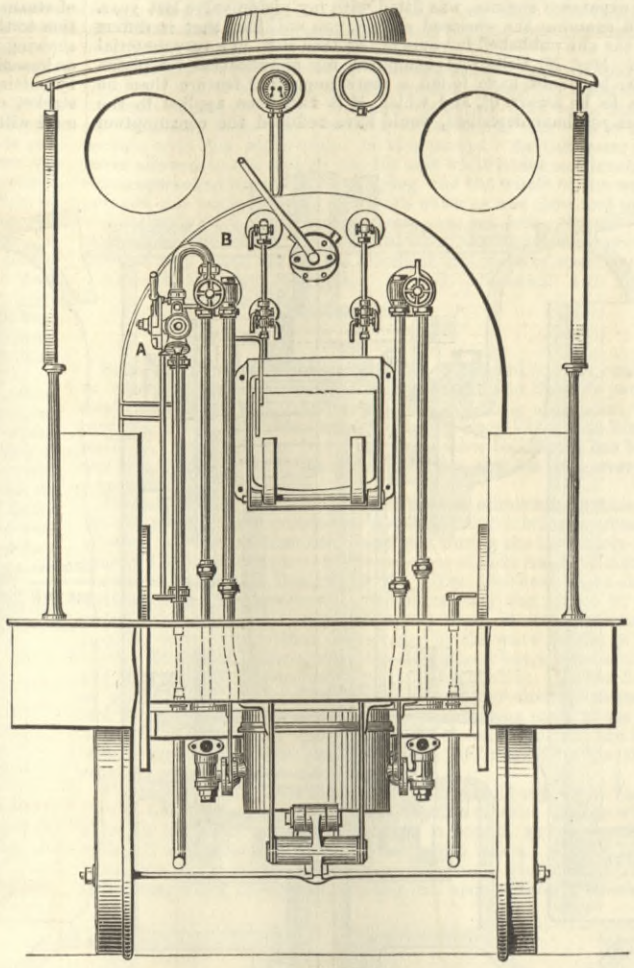


FIG.3

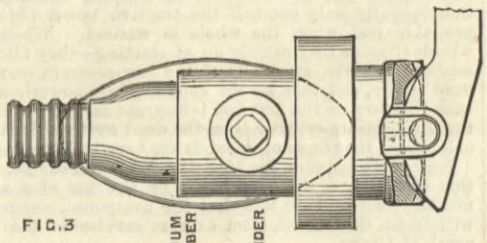


FIG.4

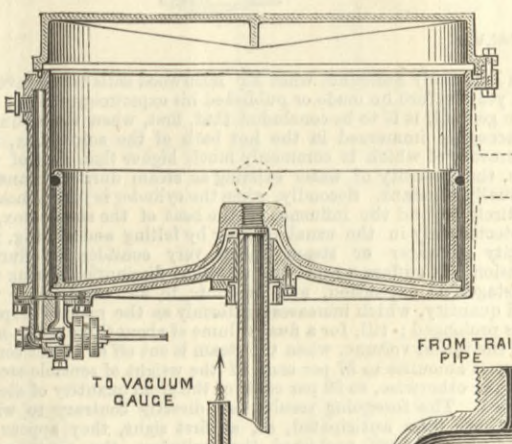
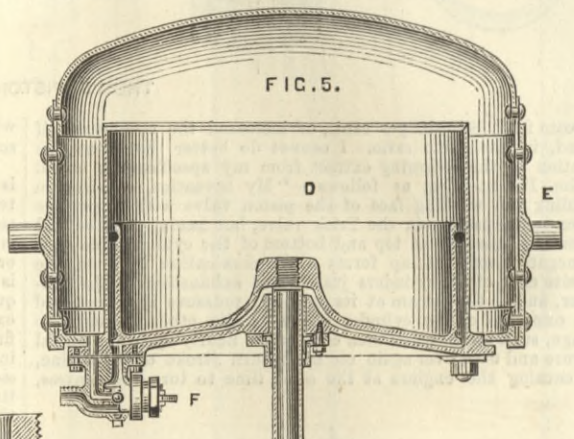


FIG.5.



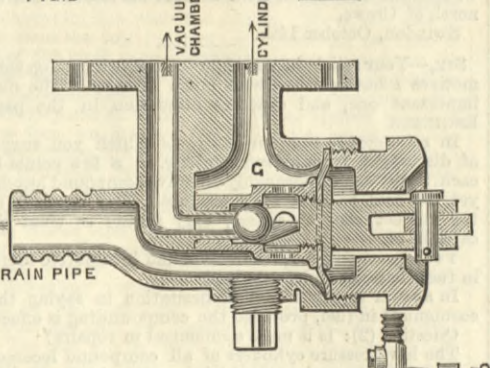
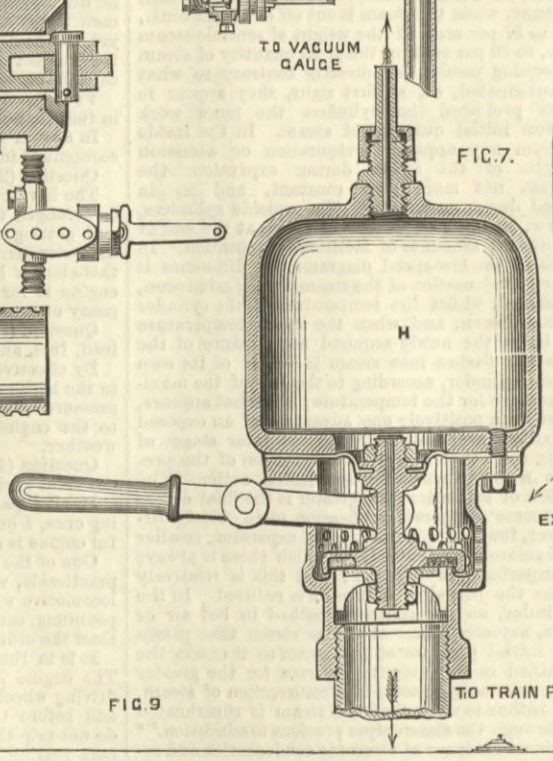


FIG.6

FIG.7.



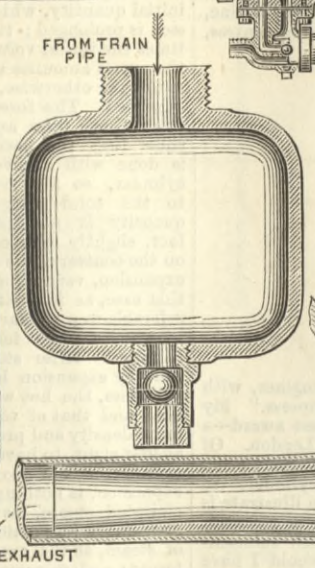


FIG.8

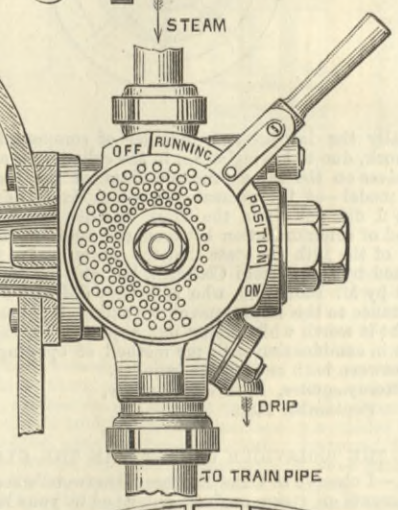


FIG.9

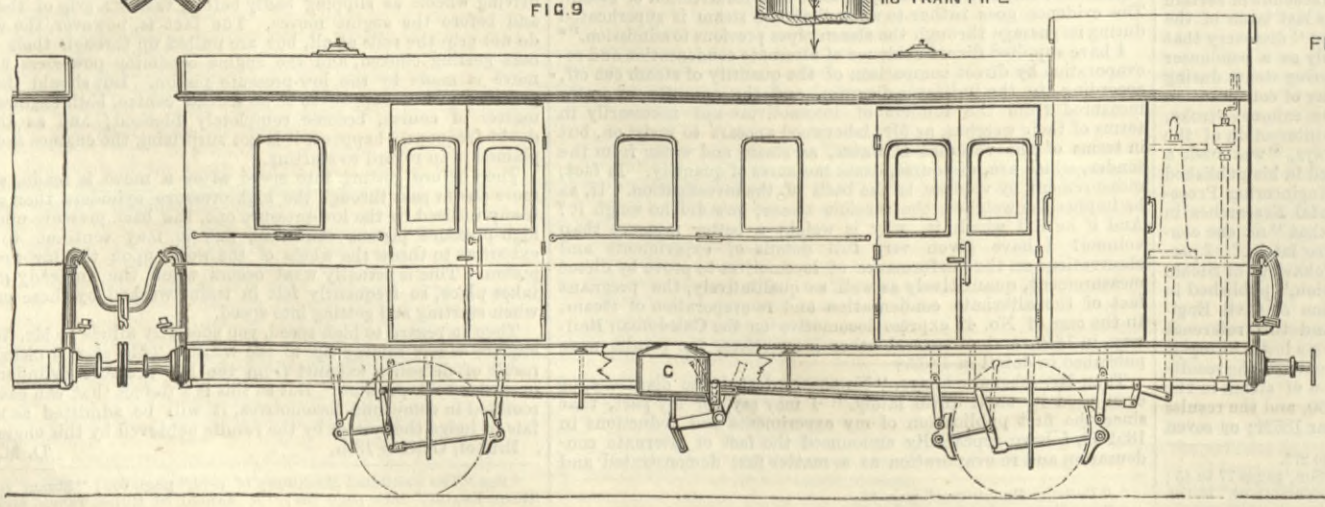
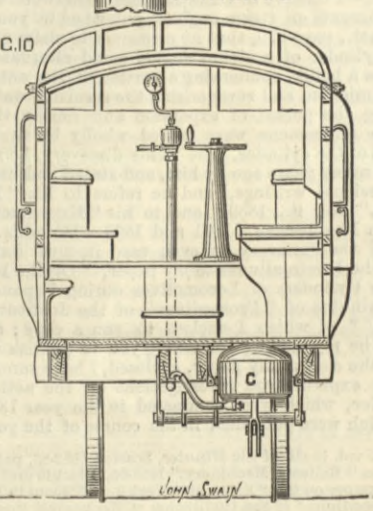


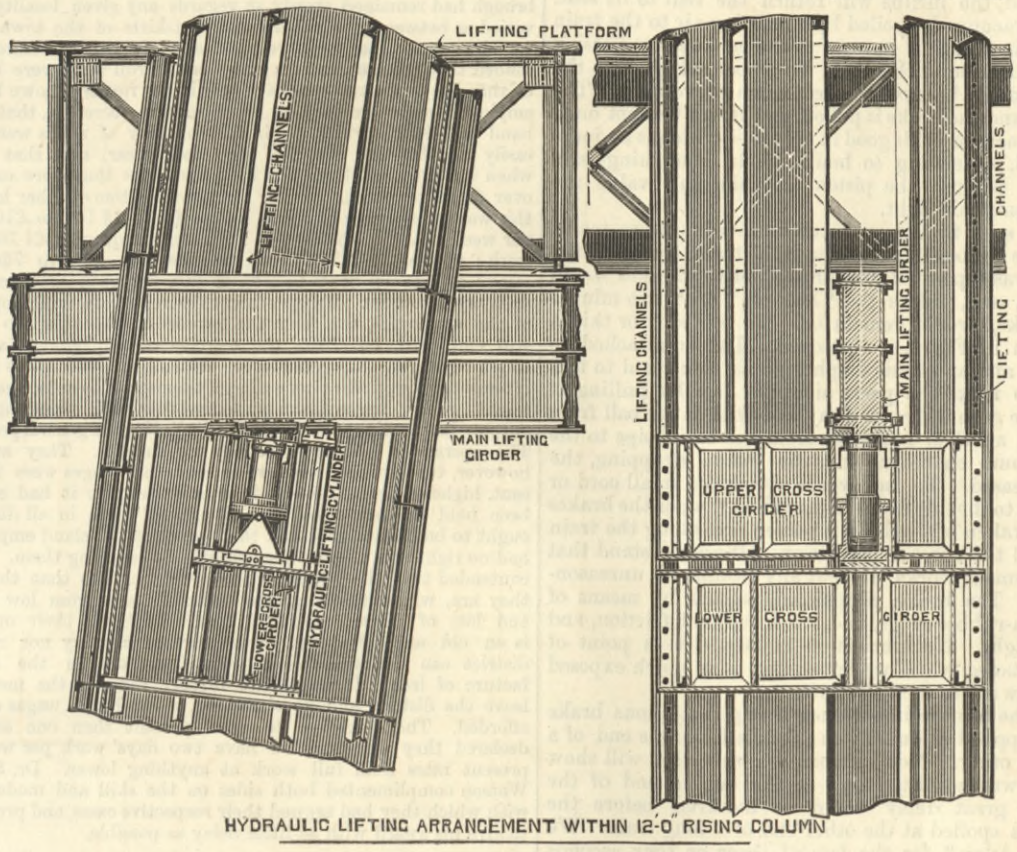
FIG.10



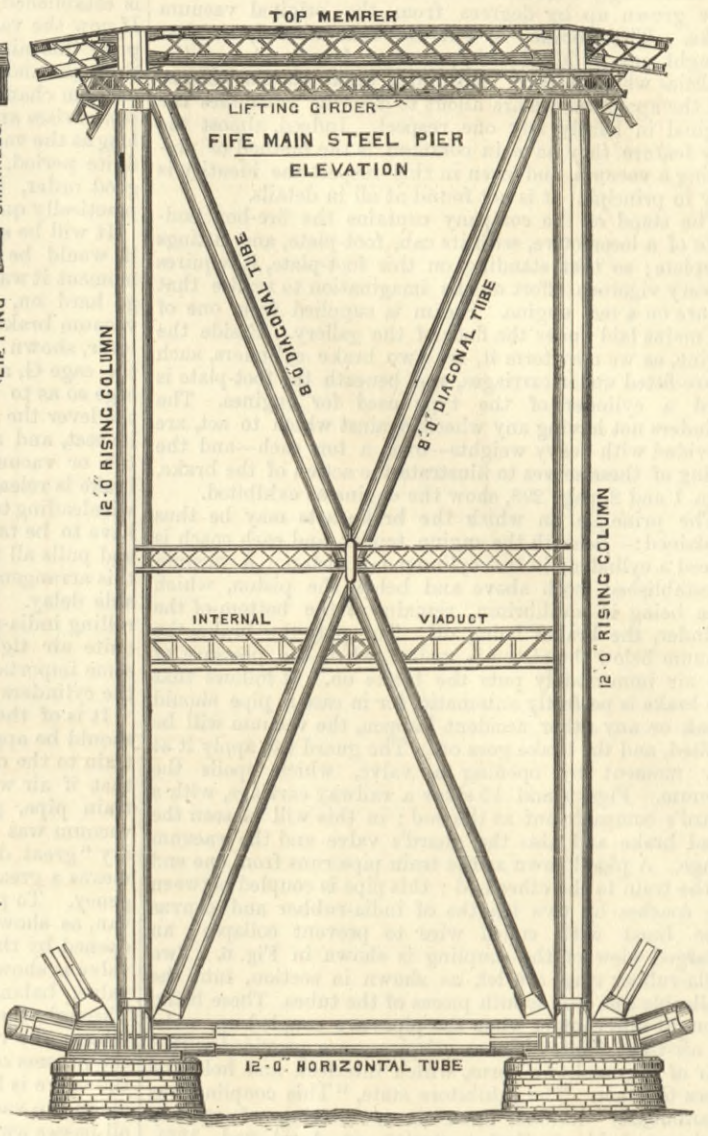
ERECTION OF THE FORTH BRIDGE.

SIR JOHN FOWLER AND B. BAKER, MM.I.C.E., ENGINEERS.

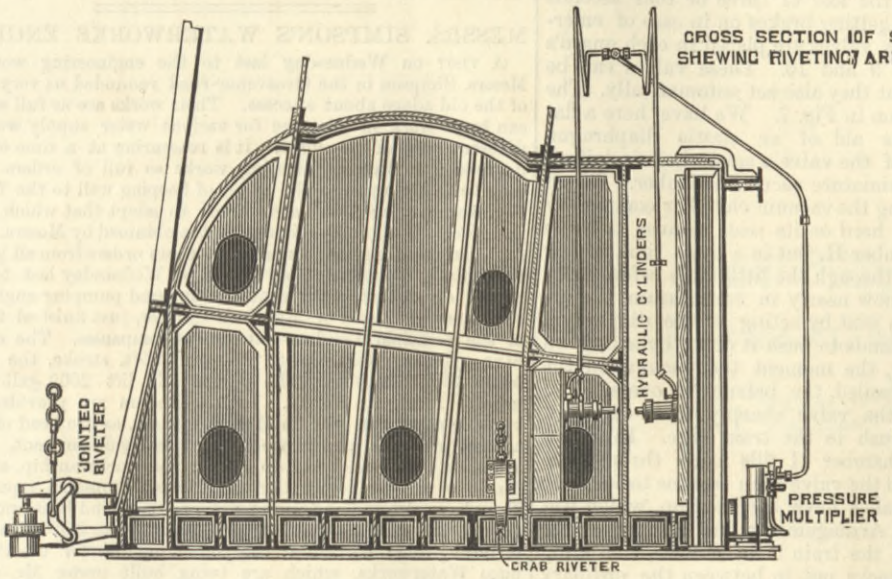
(*For description see page 296.*)

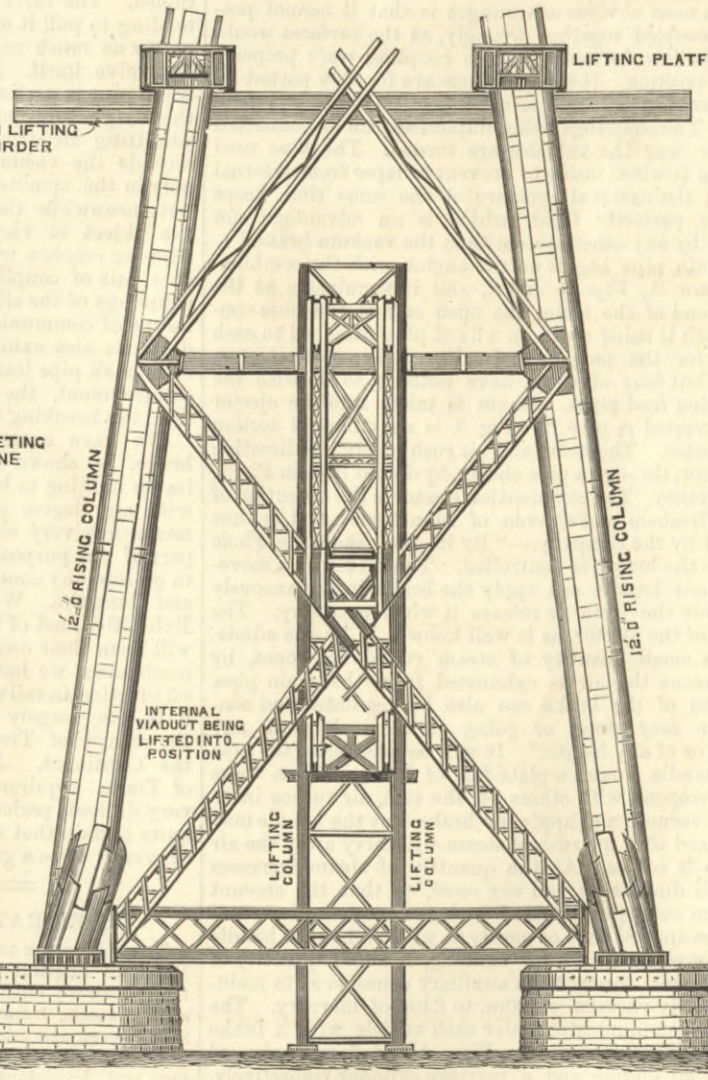


HYDRAULIC LIFTING ARRANGEMENT WITHIN 12'-0" RISING COLUMN

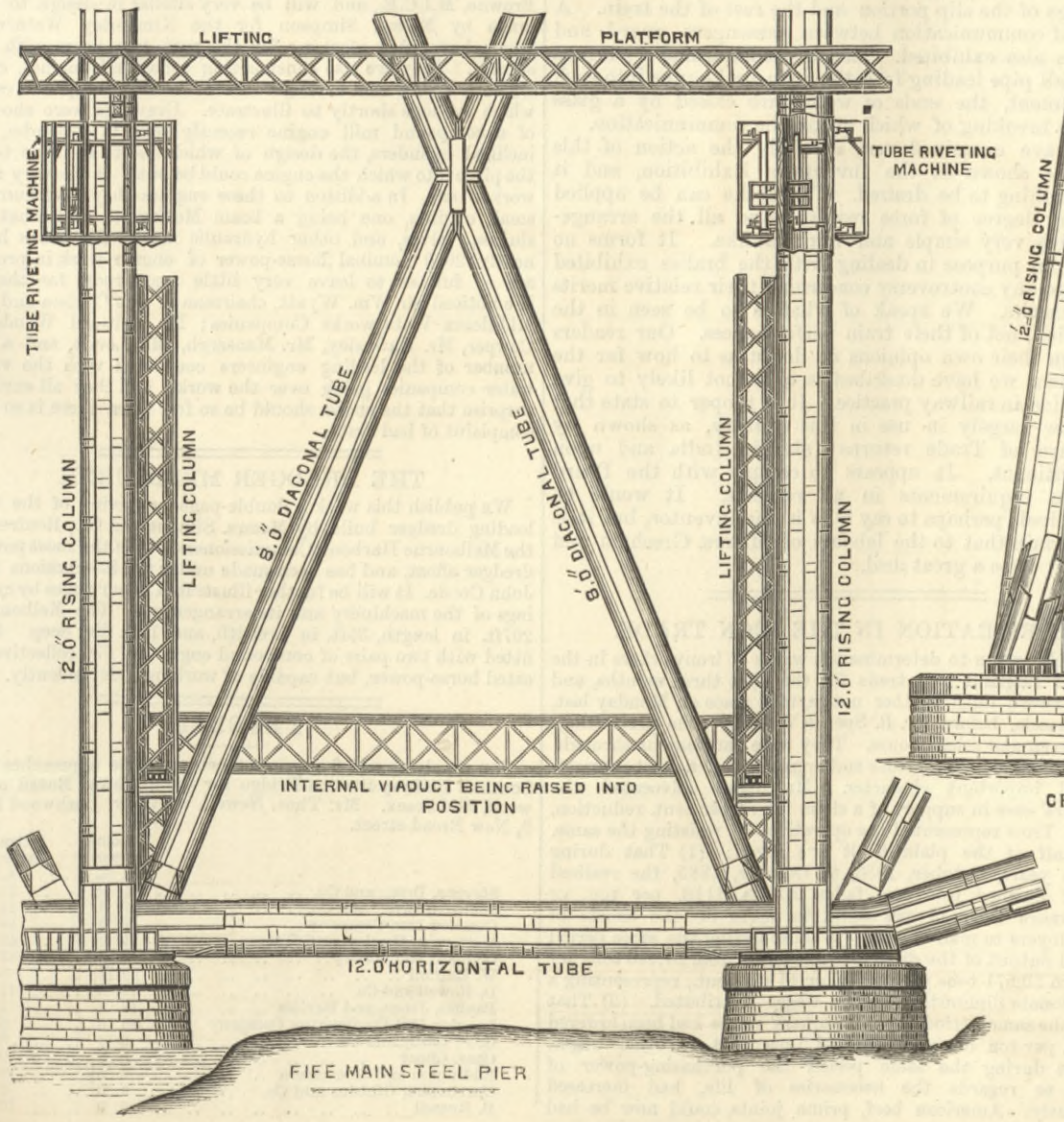


CROSS SECTION OF SKEWBACK SHEWING RIVETING ARRANGEMENT

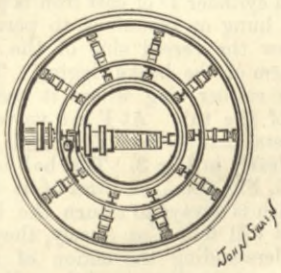




CROSS SETION LOOKING ON VERTICAL PLANE
FIFE MAIN STEEL PIER



FIFE MAIN STEEL PIER



PLAN OF TUBE RIVETTER

BRAKES AT THE INVENTIONS EXHIBITION.

THE AUTOMATIC VACUUM BRAKE.

The Vacuum Brake Company, of Queen Victoria-street, exhibits in the Main Gallery of the Inventions Exhibition an exceedingly ingenious brake, which may be said to have grown up by degrees from the original vacuum brake. That brake, it will be remembered, as first brought out by Mr. Smith, possessed few or none of the qualities which a good continuous brake should possess, and the apparatus we are about to describe resembles the original in hardly any one respect. Indeed, almost the only feature they have in common is the method of producing a vacuum, and even in this respect the identity is only in principle; it is not found at all in details.

The stand of the company contains the fire-box end-plate of a locomotive, with its cab, foot-plate, and fittings complete; so that standing on this foot-plate, it requires no very vigorous effort of the imagination to realise that we are on a real engine. Steam is supplied from one of the mains laid under the floor of the gallery. Beside the engine, as we may term it, are two brake cylinders, such as are fitted under carriages, and beneath the foot-plate is fixed a cylinder of the type used for engines. The cylinders not having any wheels against which to act, are provided with heavy weights—over a ton each—and the lifting of these serves to illustrate the action of the brake. Figs. 1 and 2, page 298, show the engine as exhibited.

The principle on which the brake acts may be thus explained:—Beneath the engine, tender, and each coach is placed a cylinder; in this cylinder is a piston. A vacuum is established both above and below the piston, which then being in equilibrium, remains at the bottom of the cylinder, the brakes being off. To apply the brake, the vacuum below the piston is spoiled, when the pressure of the air immediately puts the brake on. It follows that the brake is perfectly automatic, for in case a pipe should break or any other accident happen, the vacuum will be spoiled, and the brake goes on. The guard can apply it at any moment by opening a valve, which spoils the vacuum. Figs. 9 and 10 show a railway carriage, with a guard's compartment at the end; in this will be seen the hand brake and also the guard's valve and the vacuum gauge. A pipe known as the train pipe runs from one end of the train to the other end; this pipe is coupled between the coaches by two lengths of india-rubber and canvas hose lined with coiled wire to prevent collapse; an enlarged view of the coupling is shown in Fig. 6. Two india-rubber rings are let, as shown in section, into the malleable cast iron mouth pieces of the tubes. These being brought into contact when the pipes are coupled up, make an air-tight joint. The mouthpieces are provided with a pair of lugs and two horns, which interlock and hold the pipes together. The exhibitors state, "This coupling was unanimously decided upon at a meeting of railway engineers held at Euston station on April 2nd, 1881. One of its most obvious advantages is that it cannot possibly be coupled together wrongly, as the surfaces would not meet unless the horns of each coupling were properly placed in position. If the couplings are forcibly parted by the severance of the train or otherwise, no damage is done to them. The couplings being duplicates, can be connected whichever way the vehicles are turned. The hose used with them is wired inside to prevent collapse from external pressure; the external pressure at the same time keeps the joints perfectly tight, which is an advantage not possessed by any other system than the vacuum brake."

The train pipe begins on the engine with the combination ejector A, Figs. 1 and 2, and it terminates at the opposite end of the train, the open end of the hose connected with it being stuck on a fixed plug attached to each carriage for the purpose. In Fig. 2 five vertical pipes are seen, but four of these have nothing to do with the brake, being feed pipes. Steam is taken into the ejector by the inverted ∩ pipe B. Fig. 8 is an enlarged section of the ejector. The steam and air rush out in the direction of the arrow, through a pipe shown by dotted lines in Fig. 1, to the chimney. The combination ejector is the invention of Messrs. Gresham and Craven, of Manchester, and is thus described by the company:—"By its one handle the whole power of the brake is controlled. The driver by a movement of one handle can apply the brake instantaneously throughout the train or release it when necessary. The working of the ejector, as is well known, is by the admission of a small quantity of steam round the cones, by which means the air is exhausted from the train pipe. The action of the brake can also be regulated and controlled in easy stops, or going down inclines of any gradient or of any length." It will be seen that the boss of the handle carries a plate full of holes. When these holes correspond with others in the seat, air rushes in to spoil the vacuum and apply the brake, but the handle may be so placed that the rush of steam will carry away the air as fast as it comes. As the quantity of steam increases that of air diminishes, and *vice versâ*, so that the amount of vacuum can be determined with the greatest nicety and the brakes applied hard or gently at will. When the handle is in the position shown for running, a small quantity of steam is passed through the auxiliary cones so as to maintain a steady vacuum of 20in. to 24in. of mercury. The train pipe communicates under each vehicle with a brake cylinder C, Figs. 9 and 10. Figs. 4 and 5 are enlarged views of an engine and a carriage cylinder respectively. They are so nearly alike that it will suffice to describe Fig. 5.

Each cylinder D of cast iron is placed in a wrought iron "tub," hung on trunnions, to permit the piston-rod head to follow the versed sine of the curve described by the lever arm of the brake rigging. The piston-rod is packed with a rubber ring where it passes through the lower cover of the tub. At F is a valve-box, containing a little gun-metal ball the size of a small marble. This is shown very clearly in Fig. 3. The ball is placed in a perforated cage G, Fig. 3, and in front of it is an incline, the action of which is always to return the ball to its seat. If our readers will follow us closely, they will have no difficulty in understanding the action of this valve. When the piston is at the bottom of the cylinder, and the tub is full of air, the ball will rest against its seat as shown in Fig. 3. The moment a vacuum is established in the train pipe by the ejector on the engine, the air will rush out from the cylinder direct through the cage, and it will also rush out from the vacuum chamber or tub by pushing the little ball valve off its seat. As soon, however, as an equilibrium is established, the incline will return the ball to its seat. If now the vacuum is spoiled by admitting air to the train pipe, this air will find its way to the *cylinder* by passing through and around the cage; but it cannot get into the vacuum chamber because the ball valve prevents it. The piston rises and the brake is put on, and it can be kept on as long as the vacuum holds good in the tub—which is an indefinite period, extending to hours when everything is in good order, because the piston and the ball valve are practically quite air-tight.

It will be seen that if no further provision were made, it would be impossible to shunt a train, because the moment it was separated from the engine the brakes would go hard on, and, unlike the "leak-off" or "two-minute vacuum brake," would remain on. To provide for this, a lever, shown in Fig. 3, is employed. This is attached to the cage G, and an elastic diaphragm is connected to this cage so as to make the parts air tight, but by pulling at the lever the cage is drawn away and with it the ball from its seat, and air then rushes in from the train pipe to the tub or vacuum chamber, and the piston dropping, the brake is released. To the lever is attached a small cord or wire leading to the side frame of the vehicle; when the brakes have to be taken off by hand a porter runs along the train and pulls all the wires in succession. We understand that this arrangement works without any trouble or unreasonable delay. The brake pistons are packed by means of rolling india-rubber rings, and work without friction, and quite air tight. No lubrication is required—a point of some importance, when we remember how much exposed the cylinders are to dust and grit.

It is of the utmost importance that a continuous brake should be applied as quickly as possible from one end of a train to the other. Now, a moment's reflection will show that if air was admitted only at the engine end of the train pipe, great delay would be incurred before the vacuum was spoiled at the other end of a long train. We say "great delay," for the loss of three or four seconds means a great delay in getting brakes on in case of emergency. To prevent this, valves are placed in each guard's van, as shown in Figs. 9 and 10. These valves can be opened by the guard, but they also act automatically. The valve is shown in section in Fig. 7. We have here a flat valve, balanced by the aid of an elastic diaphragm. Through the spindle of the valve a small hole is drilled. Above the valve is a miniature vacuum chamber. When the process of exhausting the vacuum chamber commences the valve is held down hard on its seat, because there is air in the vacuum chamber H, but in a little time the air all passes away from it through the little hole before mentioned. The valve is now nearly in equilibrium, the air tending to pull it off its seat by acting on the diaphragm nearly as much as it tends to push it down by acting on the valve itself. Now, the moment the vacuum in the train pipe is partially spoiled, the balance is overset, and the diaphragm pulls the valve sharply from its seat, admitting air with a rush to the train pipe. In a few seconds the vacuum chamber H fills again through the hole in the spindle, and the valve then returns to its seat; but meanwhile the brakes have been put on, which was the object in view. Arrangements are also shown for slipping coaches whilst the train is in motion, consisting of a pair of coupling cocks put in between the ordinary couplings of the slip portion and the rest of the train. A means of communication between passengers, guard, and driver is also exhibited. This is accomplished by means of a small pipe leading from the main brake pipe into each compartment, the ends of which are closed by a glass disc, the breaking of which makes the communication.

We have examined very carefully the action of this brake, as shown at the Inventions Exhibition, and it leaves nothing to be desired. The brake can be applied with any degree of force required, and all the arrangements are very simple and workmanlike. It forms no part of our purpose in dealing with the brakes exhibited to go into any controversy concerning their relative merits and demerits. We speak of what is to be seen in the Exhibition, not of their train performances. Our readers will form their own opinions no doubt as to how far the mechanism we have described is or is not likely to give satisfaction in railway practice. It is proper to state that it is now largely in use in this country, as shown by the Board of Trade returns; also in India and upon the Continent. It appears to comply with the Board of Trade requirements in all respects. It would be very difficult perhaps to say who is the inventor, but it is quite certain that to the labours of Messrs. Gresham and Craven it owes a great deal.

ARBITRATION IN THE IRON TRADE.

The arbitration to determine the wages of ironworkers in the North of England iron trade for the next three months, and thenceforward until further notice, took place on Monday last, at Newcastle, before Dr. R. Spence Watson. The proceedings lasted seven and a-half hours. They were harmonious throughout, and included statements and arguments of a most interesting and important character. Mr. Head advocated the employers' case in support of a claim for 7½ per cent. reduction, and Mr. Trow represented the operatives in resisting the same. On behalf of the plaintiffs it was urged:—(1) That during the two years, October, 1883, to October, 1885, the realised price of finished iron had fallen £1 2s. 11¼d. per ton, or rather more than 19 per cent., in spite of the efforts of the employers to maintain it. (2) That during the same period the total output of the district had receded from 54,446 tons per month to 30,571 tons per month, or 44 per cent., representing a proportionate diminution in the wages distributed. (3) That during the same period the ironworkers' wages had been lowered only 6d. per ton on puddling, and 5 per cent. on other wages. (4) That during the same period the purchasing-power of money, as regards the necessaries of life, had increased enormously. American beef, prime joints, could now be had for 6d. per lb.; New Zealand mutton at from 8d. per lb. for forequarters of lamb down to 3d. per lb. for breasts of mutton. Bacon, cheese, flour, lard, and candles had fallen from 20 to 30 per cent.; coal, 10 per cent.; tea, 5 per cent.; soap, 25 per cent.; sugar, 20 per cent., and drapery 5 to 7½ per cent. The only necessary of life which appeared not to have varied was the rent of cottage houses, which in Middlesbrough had remained steady as regards any given locality, but varied as between the centre and outskirts of the town from 4s. 6d. to 2s. 6d. per week respectively. It was therefore contended that those operatives who were in full work were better off than they were two years ago. (5) It was further shown by the employers, and admitted by the operative secretary, that forehand puddlers working their full number of shifts were still easily making £1 19s. 6d. per week clear, and that even when working level hand and only five shifts they were earning over £1 7s. per week. As for the remuneration of other labour, this was in the case of plate rollers from £3 10s. to £10 10s. per week clear; in the case of shearmen, frequently £4 10s. per week; markers, £2 10s.; mill furnace men, 40s. to 70s. per week; and so on down to 18s. or 20s. per week in the case of ordinary labourers. The prevalent distress arose, in the opinion of the employers, not from the lowness of wages paid to those still employed, but from the scarcity of employment at any wages whatever. They, therefore, demanded lower wages in the interest of the operatives as well as of themselves, in order that they might better compete in the markets of the world, increasing their output, distributing more wages, and relieving the general poverty. The operatives had substantially no defence. They argued, however, that in Staffordshire ironworkers' wages were 2½ per cent. higher than in Cleveland; that in the past it had always been held by both sides that equality of rates in all districts ought to be maintained; and that therefore Cleveland employers had no right now to take the initiative in lowering them. They contended that the employers are suffering less than they say they are, whilst the men are suffering both from low wages and loss of time. Foreign competition, in their opinion, is an old and false cry, as no foreign country nor remote district can really compete with Cleveland in the manufacture of iron. If wages are further reduced the men will leave the district and go elsewhere, where better wages can be afforded. The operative delegates present then one and all declared they would rather have two days' work per week at present rates than full work at anything lower. Dr. Spence Watson complimented both sides on the skill and moderation with which they had argued their respective cases, and promised to give his award with as little delay as possible.

MESSRS. SIMPSON'S WATERWORKS ENGINES.

A visit on Wednesday last to the engineering works of Messrs. Simpson in the Grosvenor-road reminded us very much of the old adage about success. Their works are as full as they can be of work in progress for various water supply works in different parts of the world. It is reassuring at a time of great depression to find engineering works so full of orders. This may be looked upon as the result of keeping well to the fore in engineering science, and a readiness to adopt that which is new and good. The great economy that is obtained by Messrs. Simpson's pumping engines has procured them orders from all parts of the globe. We visited their works on Wednesday last to see a pair of direct-acting horizontal compound pumping engines on the reservoir system of Mr. E. A. Cowper, just finished for one of the principal London waterworks companies. The engines have cylinders 35in. and 21·5in. and 3·5ft. stroke, the pumps being 13in. diameter. The pumps will lift 2000 gallons per minute 160ft. in height. Both cylinders are provided with variable expansion gear on Mayer's system, as the head of water against which the pumps work varies nearly 50 per cent. Great attention has been paid to design and workmanship, and the result is an engine worthy of Messrs. Simpson's reputation. They have also in hand nine pairs of compound beam pumping engines of various powers, ranging from 150 to 350-horse power, including some horizontal compound engines for the Pernambuco Waterworks, which are being built under Mr. Oswald Browne, M.I.C.E., and will be very similar in design to those made by Messrs. Simpson for the Kimberley Waterworks, which have been working for the past two years with great success. They are also constructing some mill engines, one of which is a very neat arrangement of vertical compound engine, which we hope shortly to illustrate. Drawings were shown us of a compound mill engine recently sent to Colombo, with inclined cylinders, the design of which had to be made to suit the place into which the engine could be put. It was very neatly worked out. In addition to these engines they have numerous small engines, one being a beam McNaught, and what with sluices, valves, and other hydraulic work, the shops having nearly 2000 nominal horse-power of engine work in progress, are so full as to leave very little spare room for the men. We noticed Sir Wm. Wyatt, chairman of the Chelsea and West Middlesex Waterworks Companies; Mr. Edward Woods, Mr. Cowper, Mr. Hawksley, Mr. Mansergh, Mr. Levitt, and a large number of the leading engineers connected with the various water companies going over the works, and they all expressed surprise that the shops should be so full when there is so much complaint of bad trade.

THE DREDGER MELBOURNE.

We publish this week a double-page engraving of the barge-loading dredger built by Messrs. Simons and Co., Renfrew, for the Melbourne Harbour Commissioners. It is the most powerful dredger afloat, and has been made under the instructions of Sir John Coode. It will be further illustrated in our pages by engravings of the machinery and its arrangement. The Melbourne is 207ft. in length, 35ft. in breadth, and 11ft. 6in. deep. She is fitted with two pairs of compound engines of 670 collective indicated horse-power, but capable of working independently.

TENDERS.

For supplying and fixing iron fencing on the approaches to the Southall Railway Station Bridge for the Highway Board of Norwood, Middlesex. Mr. Thos. Newell, surveyor, Dashwood House 9, New Broad-street.

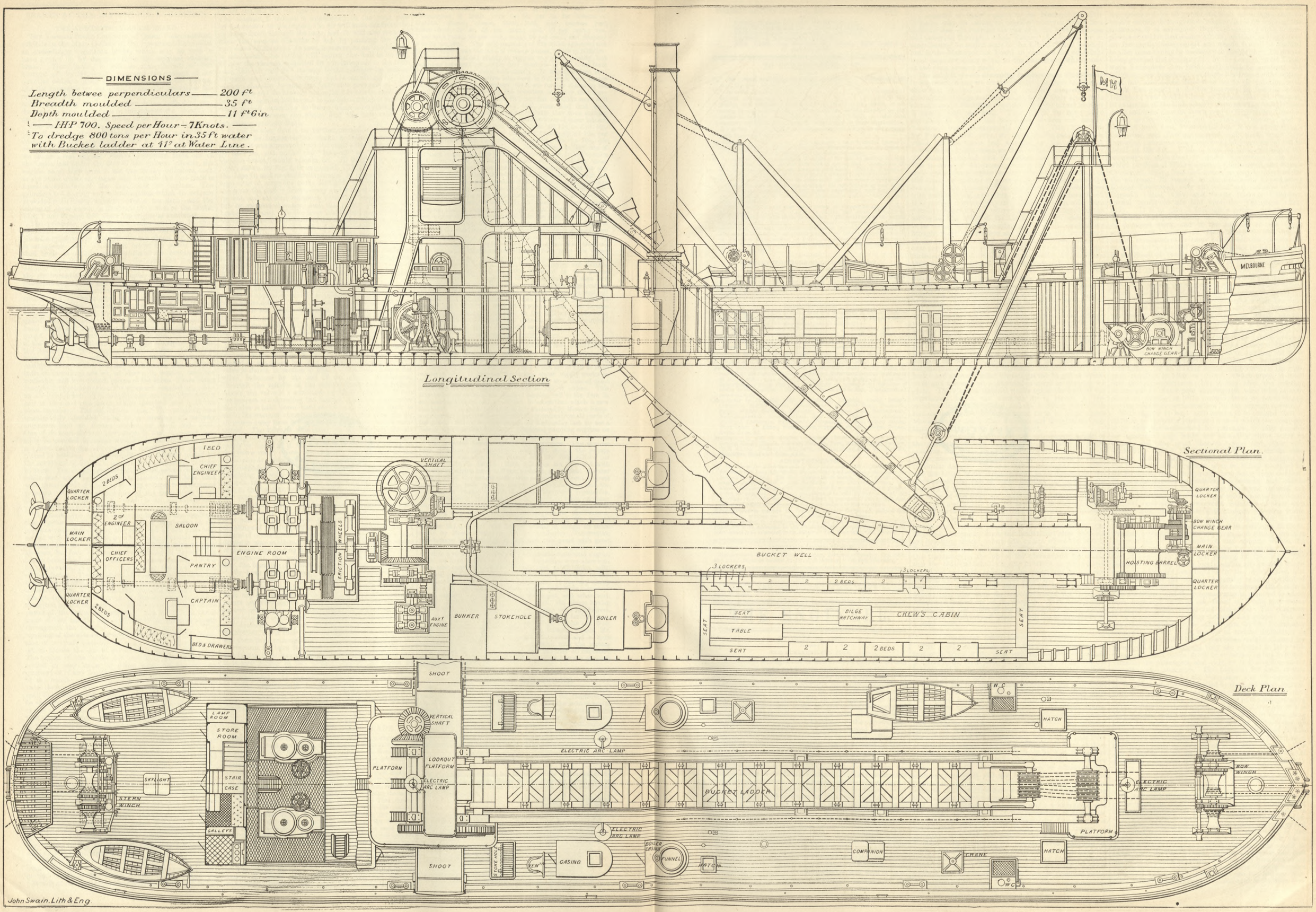
	Fencing per yard.	Extra standards each.
	s. d.	s. d.
Stevens, Bros., and Co.	15 9	13 0
Johnson, Bros., and Co.	12 3	14 6
Camelon Iron Company	12 0	14 6
Matterson, Huxley, and Watson	11 9	12 6
Goddard and Massey	11 6	13 6
W. Halford	10 11	9 6
D. Rowell and Co.	10 5	11 0
Bayliss, Jones, and Bayliss	10 3	7 0
Langley Mill Engineering Company	10 0	8 0
G. F. Darby and Co.	9 11	8 10
Chas. Choat	9 9	9 0
Eddington and Steevenson	9 5½	14 0
Christopher Gibbons and Co.	9 0	8 6
B. Russell	8 9	10 0

BARGE-LOADING DREDGER "MELBOURNE," FOR THE MELBOURNE HARBOUR COMMISSIONERS.

(For description see page 300.)

DIMENSIONS

Length betwee perpendiculars —— 200 ft
Breadth moulded —— 35 ft
Depth moulded —— 11 ft 6 in
—— IHP 700. Speed per Hour – 7 Knots. ——
To dredge 800 tons per Hour in 35 ft water with Bucket ladder at 41° at Water Line.



Longitudinal Section

Sectional Plan.

Deck Plan

John Swain, Lith & Eng

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*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 1d. *postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

W. Effigy.—*You are in error. The comparison must be drawn between a simple engine with a cylinder of the same dimensions as the low-pressure cylinder of the compound engine, and the compound engine.*

F. F. (Boston).—*You can ascertain the depth of the chill by putting the rolls in a lathe and turning the flat ends with a spring tool. Clean them off with dilute sulphuric acid and the grain will show. There is no means of determining the depth of chill in the middle without breaking the roll.*

T. G. N.—*You cannot superheat the steam until all the water is evaporated. After that has been done, if you continue the application of heat to the vessel the steam contained in it will become superheated, and may attain any temperature up to that at which dissociation occurs—something probably over* 4000 *deg.*

Sir Fon.—*Find the area of your pump piston or plunger in square inches. Multiply this by the length of stroke in inches, and divide the result by* 27·7, *the number of cubic inches in a pound. The result will be the weight thrown per stroke. Multiply this by the number of strokes per hour, and allow* 25 *lb. for each indicated horse-power per hour. Therefore, by dividing the total number of pounds pumped per hour by* 25, *you will have the indicated horse-power of the boiler your pumps will feed. The pump ought to be made with a large margin of power to provide for leakage past the piston and valves.*

WROUGHT IRON TUBE MAKING MACHINERY.

(*To the Editor of The Engineer.*)

Sir,—Will you allow me to ask in your next number where I can find any information about the wrought iron tube manufacture, and name and address of the makers of wrought iron tube machinery? A. A.

London, October 14th.

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

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

MEETING NEXT WEEK.

Engineering Society, King's College, London.—Tuesday, Oct. 20th, at 4 p.m.: Paper to be read by Mr. J. S. Archer, "On Bell Founding."

DEATH.

On the 12th Oct., at Stella House, Dulwich, Surrey, Nicholas Douglass Douglass, A.K.C., Studt. Inst. C.E., son of Sir James N. Douglass, aged 22 years.

THE ENGINEER.

OCTOBER 16, 1885.

THE CLERKENWELL FIRE.

The recent conflagration in Clerkenwell conveys certain lessons which ought not to pass unnoticed. Not that these lessons are altogether new, but they have a significance in that they confirm certain previous conclusions hitherto in a great measure disregarded. In this instance seventeen large warehouses were on fire in the space of an hour, and before the flames could be got under, as many as forty-six buildings suffered damage more or less serious. So intense was the heat that buildings on the opposite side of the broad thoroughfare of Clerkenwell-road caught fire, although they were not reached by the flames. Property valued at a quarter of a million was destroyed in little more than three hours, despite the most determined efforts on the part of a powerful body of Fire Brigade men, with splendid appliances and an ample supply of water from the mains of the New River Company. Thirty steam fire engines were at work, and so heavy was the demand on the *personnel* of the Brigade, that in order to obtain a relief party, it was found necessary to close the Brigade workshops for the day, and to suspend the training of the drill class. During the height of the fire the West-end district of London was nearly denuded of engines and firemen. Engines were fetched up from points as remote as Greenwich and Battersea on the south, Hammersmith on the west, and Hampstead in the north. Not for the first time the question presented itself, what would be the result if two fires of unusual magnitude were raging simultaneously in London. The crisis would, indeed, be sufficiently severe if one large fire were to prove obstinate, and were to be so prolonged as to exhaust the physical energies of the Brigade. The fire offices, who are so unwilling to enlarge the measure of their support to the Metropolitan Fire Brigade, may be asked to consider wherein their best economy lies—in running the risk of a fire breaking loose and sweeping through a whole district of London, or in contributing on such a scale to the Brigade Fund as shall enable the Metropolitan Board to create a fire establishment more obviously equal to the emergency which may at any time present itself.

The subject we are discussing becomes more threatening in its aspect when we consider certain matters tending to show that London is becoming specially adapted to the production of large and destructive fires. Only one fire in eleven may be classed as "serious," but the actual number is nearly four per week. That which we have more especially to fear is the prevalence of fires not merely "serious," but pre-eminently so. In The Engineer for February 29th, 1884, we dwelt on the peculiar phase which fire insurance had assumed in the metropolis. It will be seen that what we then wrote is emphasised by the facts connected with the great fire in Clerkenwell. The increase of warehouse property in London, and the style which characterises recently constructed buildings of this class, are matters of great moment in reference to the fire risk. The conduct of the insurance companies shows with sufficient plainness what view they take of this subject. It is perfectly certain they do not think London safer than formerly, but distinctly otherwise. Any intelligent person surveying the ruins of the Clerkenwell fire cannot fail to be struck with the complete nature of the destruction brought about by the free use of iron in the framework of the buildings. Acted upon by the contrary forces of heat and water, the girders and pillars have become contorted and wrecked in a manner suggestive of the havoc they must have played in pulling down the structures they were intended to sustain. So with fires of this description generally, where there is much iron, and especially if stone takes the place of brick, the flames do something more than "gut" the building, they "send all to smash." That there shall be a fire of the most violent and mischievous nature is rendered tolerably certain by covering up the interior walls, the girders and the ceilings with match-boarding. This is a capital arrangement for helping the fire along. Equally admirable is the "lift." A little rubbishy fire in the basement takes advantage of the lift, and creates a powerful up-draught, carrying burning flakes to every floor, and giving the flames ready access to the whole of the edifice. For the benefit of the neighbourhood, there are enormous windows front and back; and at every point where light can be got at brickwork and masonry are superseded as much as possible by glass. The vitreous material cracks under the heat of the imprisoned flames, the windows fly to pieces, a tremendous draught is created, and the building glows with furnace heat, while the flames burst forth in huge sheets which speedily crack other windows and threaten the contiguous buildings with like destruction.

The fire-engines arrive, and the extravagant height of the colossal buildings augments the difficulty of extinguishing the fire. Firemen, carrying the hose in their hands, ascend telescopic ladders; but the service is one of particular danger. The ironwork is tugging at the walls, and the latter come crushing down in all directions. At Clerkenwell the jets of water shooting up towards the summits of the lofty structures were blown into spray by the force of the wind, and when the buildings collapsed there was a stampede to avoid annihilation, Captain Shaw himself narrowly escaping a premature burial in the burning *débris*. This is the fashion of a London fire among warehouses and business premises of the modern type. The insurance companies know the danger, and some premises are becoming almost uninsurable, except where the would-be insurer seeks a "non-tariff" office of adventurous type. One tradesmen on the site of the Clerkenwell fire found that the old-established company in which he was insured would not renew his policy for the reason that he was surrounded by so much dangerous property. While he was negotiating with another office the fire took place, and proved how wise were the anticipations of the company which had backed out of the bargain. Such is the state of affairs in the midst of the great commercial capital of the world. Property of untold worth lies at the mercy of a stray match.

TRAMWAY DEVELOPMENT IN LONDON.

The rapid, continuous, and extensive development of tramways is one of the most striking features of modern progress in the metropolis. Except actually on the Thames bridges and in the thickest centres of business, it is now difficult to find a spot to which these tram lines have not extended; and not only do they increase as the population stretches further out in all directions, but in many cases they almost lead the way, and certainly accompany the pioneers in new districts. Whatever objections house holders and tradesmen in some thoroughfares may entertain to them, tramways, like a juggernaut car, advance steadily on, crushing all resistance. In not a few instances the narrowness of the streets along which they pass have at once embarrassed them and justified resentment at their presence; but this difficulty can now be met by powers obtained by the companies last session to widen streets for their own benefit. It must, of course, be admitted that such improvements will also benefit the public, but the possession of this power shows in a strong light the strength of the position these companies now hold. Among the measures passed during the last session of Parliament, and only just printed as a statute, is one which illustrates the energy and ambition of the promoters of tramways. In 1870 the London Street Tramways Company was incorporated by Act of Parliament with a capital of £100,000, with powers to borrow a further sum of £25,000. Further Acts enlarging its powers were obtained in 1873, 1874, 1877, 1879, 1882, and 1884; and this year the company again sought and obtained yet further powers. From time to time during its progress we briefly referred to their Bill, but in its complete form it deserves somewhat fuller notice.

In its preamble the company alleges that the new lines it proposes will be of public and local advantage; that to render certain thoroughfares more suitable for working the tramways, it is expedient that the company shall be empowered to widen and improve them; and that, as single lines are frequently inconvenient and unsafe, it shall be enabled to alter them as may be necessary to double lines. Its prayer being granted the company is—by the London Street Tramways Extensions Act, 1885—authorised to construct the following new tramways: A single line from Southampton-road into and along Fleet-road up to its junction with South End-green; a double tramway in Junction-road, Islington; two double lines in Fortess-road, St. Pancras, in extension of the lines already there existing; single lines down and from Kentish Town-road to High-street, Camden Town, to Clarence-road, and to Hawley Crescent; and a series of lines from Pentonville-road to and along King's Cross-road and Farringdon-road — all these main lines involving numerous short sections and junctions set out in detail in the Act. With a view to these extensions the company is authorised to make improvements in and widen portions of Wharton-street, Clerkenwell, and King's Cross-road, taking land and houses as may be required for the purpose. In respect to the extensions in and along Kentish Town-road, over the canal and railways of the Regent's Canal, City, and Docks Railway Company, special conditions are laid upon the Tramways Company. It is to give a fortnight's notice, accompanied by plans and particulars, to the Canal Company of its proposed work, and if the engineer of the latter company sees reason to fear injury to the bridge and no arrangement is come to between the parties, the matter is to be decided by an arbitrator to be appointed by the Board of Trade. Then the rails are to be laid under the superintendence of, and to the reasonable satisfaction of the Canal Company's engineer, the Tramways Company paying him for such services, and also defraying any extra expense in the maintenance of the bridge caused by the construction of the trams. Further, if the Tramways Company does not begin the works within two days after notice by the Canal Company, and carry through to completion, the latter company may itself execute the work and recover the cost from the owning company. At the same time the rights and powers of the Canal Company to maintain, alter, or repair the bridge are preserved, as are likewise their rights and powers under their Act of 1882 and subsequent Acts, as to carrying out their works thereby authorised—all disputes to be settled by arbitration. If in making street improvements the company requires to alter or divert sewage pipes, it must first provide substitutes; but it may alter the position of any gas or water pipe or telegraph wire tube, on condition of causing as little inconvenience as possible, and paying reasonable compensation for any damage caused.

With regard to land and houses, it is enacted that in addition to the other lands and houses which the company is by this Act authorised to purchase, it may acquire by agreement any lands not exceeding three acres in extent, and may erect thereon offices and other conveniences; and it also receives power to obtain easements. But it may not acquire without the sanction of the Home Secretary twenty or more houses occupied by the labouring class—labouring class being thus defined: It includes mechanics, artisans, labourers, and others working for wages; hawkers, costermongers, persons not working for wages, but working at some trade or handicraft without employing others except members of their own family; and persons other than domestic servants whose income does not exceed an average of 30s. a week, and the families of any such persons who may be residing with them. Further borrowing powers are given, and strong penalties are provided for non-completion and opening within the fixed time, viz., £50 a day for every day after the expiration of two years from the passing of the Act. The penalties to be applied to compensating any persons whose property may have been injured by the construction and abandonment of the works. A penalty is also provided of £5 for every day during which the tramways are not in a safe condition; and the company may be required to adopt such improved rails as the Board of Trade may deem necessary to public safety and advantage. The company is exempted from carrying animals and goods; but on the other hand it may be called upon by the Postmaster General to convey mails, subject to certain limitations as to quantity, regulated by the maximum weight allowed for passengers and the luggage they are entitled to take with them, and such mails must be so carried as not to inconvenience the passengers, and only by a Post-office officer travelling as a passenger. The payment for mail service is to be agreed upon by the Postmaster and the company, or, in in case of dispute, decided by the Lord Chief Justice. This is a proviso not perhaps very likely to come into application, but it is a judicious clause in the interest alike of the public and the company. Finally, the rights of the Metropolitan Board of Works are saved as to suspending traffic for sewer or drain work, and as to stopping up streets, the company being, however, empowered in the last named contingency, to lay down temporary tramways in adjacent roads so long as occasion may require. The Act contains in all 48 Clauses, and received the Royal Assent on July 22nd last, after which date it took force.

OPENING OUT OF THE SILKSTONE COALFIELD IN SOUTH YORKSHIRE.

At the present time the Wombwell Main Coal Company, one of the largest in South Yorkshire, is engaged in solving an important problem which will doubtless inaugurate a new era in connection with the working of the coalfields in that important district, whilst it will open out many thousand acres of coal unequalled for household purposes, and well-known in the London and other markets. Up to a few years ago it was a matter of speculation as to how the Silkstone seam would be found below the Barnsley bed. It is true the seam has been worked for a number of years, but it has only been won at the outcrop and along the fringe of the coalfield which is bounded by throws. About six or seven years ago the Hoyland Silkstone Colliery Company stepped in and sunk to the seam from

the Barnsley bed, where it lies at a depth of from 370 to 380 yards. This important step was followed by the owners of the Barrow Collieries, and in both instances the coal was found of good quality and of the usual thickness. Up to the present time, however, none of the existing collieries, nor, in fact, any company has been bold enough to sink to the seam on the opposite side of the fault from the Hoyland, Silkstone, and Barrow Collieries. The Wombwell Main Company, which has worked the Barnsley seam very extensively for many years at a depth of 225 yards from the surface, 7ft. 11in. in thickness, first resolved to carry down a spare shaft to the Lidgett seam, about 260 yards from the surface. This being found all right and of good quality, it is now sinking to the Silkstone which underlies its extensive coalfield, and which it anticipates meeting with at a depth of about 600 yards from the surface. The importance of the step cannot be over-estimated, as many coal leases include the right to work the coal within a given number of years. It may also be stated that there are four workable seams between the Barnsley and Silkstone seams, two of which the Barrow Company have worked, the Thorncliffe and Parkgate. In addition to these many thin seams are met with in the strata, but will probably be never worked, at least during the present generation, the thickest being under 3ft. In the Barnsley district proper the thick seam is nearly exhausted, there now being a single colliery working at the present time in the borough. Underlying the Barnsley bed the Silkstone coal is known to exist, and as the other coalfields are worked out this will be undoubtedly sunk to, so that the future of the South Yorkshire district is by no means so dreary as it is sometimes painted.

SEWAGE DISPOSAL.

A step in advance has been made by the Corporation of Salford in a matter which is of much importance to local sanitary authorities who treat the sewage of the district by precipitation. At the Salford Sewage Works, which are, we believe, nearly the largest in England, the sludge after precipitation is run from the precipitating tanks into shallow pits, where it dries by exposure to the air; but instead of following the laborious and expensive process of removing the partly dried precipitate to a distance, the authorities have adopted the expedient of burning it. Eighteen months ago this experiment was commenced. At first the material was burnt in heaps, with the aid of a small quantity of the cheapest coal, but this process, though simple, was found not to be sufficiently rapid, and moreover the fires were not unfrequently extinguished by heavy rain. For some time past suitable kilns have been employed, and the Corporation, who are extending the process by erecting additional kilns, will no doubt increase the number should the present arrangement be found insufficient. The kilns, which are somewhat like a lime kiln in shape, are charged with half-dried clods of the mud, a small quantity of coal being necessary when the kiln is first filled to kindle the contents. As the clods dry they burn pretty freely without any further addition of coal, and are kept alight by fresh additions of the partly dried sewage sludge. The sludge from the Salford Works probably contains more carbonaceous matter than would be found in ordinary house sewage, as the refuse from several dye works is discharged into the outfall sewers, and the suspended matter, consisting of fluff derived from the velvet, calico, and other materials which pass through the hands of the dyers, forms a very prominent constituent in the sewage. The ash, which is a fine light brown powder, has no manurial value whatever, containing only a mere trace of phosphoric acid; but although there is no profit to be derived from its sale, which there never is from sewage sludge, there is a considerable reduction in the amount of material to be carried away, as the ash is only one-fifth of the weight of the dry sludge before being put into the kiln. If, therefore, there is no direct profit, there is a substantial saving, and it would appear that local authorities in manufacturing districts, and those who have very cheap fuel in their neighbourhood, would do well to consider whether a similar process to that adopted at Salford might not be used, instead of allowing large accumulations of not very fragrant sewage mud to remain on their works.

THE OLD FOLLY OVER AGAIN.

It is now decided beyond recall that the question of miners' wages is again to be fought this winter. The announcement has scarcely come as a surprise. When the masters succeeded in getting back the 10 per cent. conceded in 1882, the miners' delegates comforted their constituents with the promise that as soon as any improvement took place in the price of coal they would be "at it again." The advent of winter naturally brings an increased demand for house coal, and the first advance, which is usually made in September, is followed by a second in October. This season there has been an increase in values, but it has not been by any means general, nor to the extent secured at the corresponding part of last year. Several leading collieries, including Thorncliffe—which sends the largest tonnage by rail to London—have not made any advance since May, and at other pits coal can still be had at summer prices. There is, therefore, very little margin, if any, for an advance in wages, and certainly none at all to the extent of 15 per cent. The trades union leaders, however, take a wider view of the situation. They admit that coal is too cheap, but they make this the very argument for demanding 15 per cent. Their cure for over cheap coal is heroic. Practically they say to the coalowners, "You cannot give us 15 per cent. on the present price of coal; we therefore propose to throw your pits idle, because you cannot do that which we ask you to do. But we mean to put you in a better position by causing your pits to be stopped, production will cease, stocks of coal will be cleared, and prices will rise. Of course that would be the natural result. But does not the cure seem worse than the complaint? Pits standing mean men out of work; men out of work means misery in thousands of households, starvation for unoffending women and helpless children, ruin and bankruptcy to the village merchant, and far beyond the immediate neighbourhood of colliery districts, poor widows, hardworking clergymen, struggling gentlewomen, thrifty artisans, frugal clerks, and others, who have invested their earnings in colliery companies, suffer in diminished incomes, some in the loss of their entire livelihood, because trade union leaders airily talk of raising the price of coal by ceasing to get any out of the pit. It is sad to find that in these days when the schoolmaster is abroad in every parish, trade doctrines as false as the "Father of lies" himself should be listened to and acted upon season after season in the face of the bitterest experiences not twelve months old.

THE CITY OF LONDON AND COAL.

There has been published a third edition of "An Account of the Duties on Coal," compiled by Mr. T. W. Bunning, secretary to the Northumberland and Durham Coal Trade. There is included in it a statement showing the income derived annually since 1832 from coal duty in London. The net income from the 4d. duty in the year 1833 was £34,004, and it rose with comparative regularity from that sum to £134,572 for the year 1884, whilst in the period between and inclusive of the two years 1861 and 1884, the receipts were £2,356,000. The net income from the duty of 8d. per ton from 1833 and of 9d. per ton from 1861 was as low as £69,000 in 1883, but it rose to £302,000 in 1884. The tax so levied becomes a tax of about 20 per cent. on the value of the coal at the pit mouth, and the consumption of coal in the metropolitan area may be put at about 11,000,000 tons, so that the effect on the users of the tax may in the total be readily appreciated. The tax is levied on an article which is of prime necessity; it is a tax which is levied in a manner to make it extremely oppressive to the manufacturer, and it is levied unequally on the coal, or rather, the equality of the tax on the coal makes it unequal, because there is a greater pressure on the coal which is of the least value, when the tax is the same on that as on the more valuable coal-fuel used by consumers who can afford to pay the price without regard to its extent. The London coal merchants dislike the tax, the users of the coal dislike it, and the producers of the coal at the pits in distant and different districts dislike it; so that there is a consensus of opinion against it on the part of the interested parties. The receivers of the dues very naturally object to their abolition, or rather, they wish to prolong them; and it is as well that the effect of the tax and the unfairness of its incidence, as well as the result of its continuance, should be shown. The period of decision in regard to the prolongation of this tax must now be near at hand, and the nature of that decision will be watched with interest by coal producers and coal users. But it may be said to be on their part a foregone conclusion that the decision ought to be in the direction of the cheapening in the metropolis of what is needful to manufacturers and to every household.

FAIR PLAY IN RETRENCHMENT.

It is noteworthy that the miners, in their efforts to get increased remuneration for their work, are widening the scope of their argument. Told that coal has not increased in value, and that investors in coal concerns are receiving no return for their money, the leaders of the men candidly admit that coal is at an unprofitable price; but they say that their object is to raise the price, and then they turn round and ask, "Why should the miners alone be called upon to keep at low wages?" They remind us that there are many establishments, in addition to colliery companies, where the salaries, fixed at the flood tide of prosperity, still remain the same, although, on the showing of the companies themselves, there is not one-half the work to do. They point to secretaries of coal, iron, and steel concerns, who draw as large sums, and in some instances larger, as they had in 1872. Why should the wages of the workers be always struck at? Why not give the "drones" a turn? No doubt there are many concerns which are still over-manned—where, to put it in the familiar language of the north, there are "cats which catch no mice." In private houses the principals have reduced expenditure all round. It is not so in limited companies. Somehow money goes more freely when a concern is "limited," and salaries of the upper officials remain the same, or go upward, even although the work goes downward year by year. Shareholders meet at their annual meetings to deplore diminishing dividends, which ultimately disappear altogether. They receive a report which gives the baldest details of how the head officials are paid, and generally the subject is not even mentioned. Not one shareholder in a hundred knows what is paid to the important-looking gentleman who seems to exist for the purpose of reading the advertisement summoning the annual meeting; and nobody has the courage, on behalf of weaker brethren there or at a distance, to investigate the expenses of management with a view to see whether the results justify the outlay. The miners ask—and the inquiry seems to apply with equal force to iron and steel houses—why wages should always be reduced where wages are lowest; and what reason exists that there should be no effort of retrenchment at the thick as well as the thin end of the stick?

THE FALL OF THE HUDDERSFIELD STATION ROOF.

It will be remembered that on the 10th August a large part of the ironwork of a new roof of 77ft. 6in. span, and of which sixteen spans had been erected, fell to the ground at Huddersfield station with fatal results. These principals were supported at one end on columns 22ft. in height, and at the other end on the station walls. Four of them had been erected in the yard of the contractors before being sent away, and had withstood the tests. A report to the coroner, Mr. W. Barstow, has been made by Mr. John Waugh, C.E., Bradford, which is accompanied by photographs and lithographs of details. The photographs are interesting as showing the state of the structure after the fall, and of the four tested principals erected in the contractors' yard; but the report does not add much information to that already published, and must be considered unsatisfactory. Some columns seem to have been defective, but other than this Mr. Waugh can assign no reason for the fall except that the principals were erected without any wind or counterbracing, as it was not supposed that it would be necessary when the woodwork was completed. The absence of such bracing is supposed to have allowed the principals to buckle, and consequently to throw strains on the columns, which produced their fracture and the subsequent fall.

ANOTHER INTERNATIONAL EXHIBITION.

A grand banquet given by the Mayor of Liverpool to the Earl of Derby on Tuesday, has given, as it was designed to give, a powerful impetus to the projected international exhibition of navigation, travelling, commerce, and manufacture in Liverpool next year. The present mayor—Mr. Radcliffe—originated the idea, and it was so much to the taste of the Liverpudians, that the Corporation have granted a site of thirty-five acres near the principal railway for the purpose, and a guarantee fund of £50,000 has already been subscribed. It is to be opened in May, and continued for six months, and her Majesty has consented to accept the position of patron. The exhibits will, of course, have reference to the four subjects mentioned gathered from all parts of the world, but several of the most successful features of the Inventions Exhibition will be there displayed. Austria, Germany, France, Belgium, Sweden, and other countries, will be specially represented, and our own Government has expressed great interest in, and promised assistance to the project. If there be a surplus, as the promoters are confident there will be, it will be devoted to the foundation of a school for technical, artistic, and industrial education, with a view to strengthening this country against foreign competition in trade.

THE PROPOSED ADVANCE OF YORKSHIRE MINERS' WAGES.

Acting on instructions from the Council of the Yorkshire Miners' Association, Mr. Pickard has again forwarded a proposed scheme to the masters' secretary for regulating wages in future. He complains that the owners are treating the matter very lightly. He says the owners demur and object to the scheme as being crude and impracticable. Yet he says a scheme was in operation for a considerable time in the West Riding, and gave great satisfaction to the men, although practically dictated by the coalowners. The differences between the old scheme and the one they call crude and impracticable are not great. The new scheme appoints a committee with an independent chairman. The old one had no such provision. The new scheme also provides for an accountant on behalf of the men in cases of necessity only. The old one had no accountant. The miners consider these two extra provisions would help to facilitate business, and give great satisfaction in decisions. The old scheme consisted of a joint committee of coalowners and miners, six representing each body.

LITERATURE.

A Treatise on Friction and Lost Work in Machinery and Mill Work. By Robert H. Thurston, A.M.C.E. New York: John Wiley and Son. 1885. 365 pp.

This is a treatise on friction and lubrication, many subjects being introduced which do not relate to friction in machinery at all, as, for instance, pressure on retaining walls and friction of earth. The author has for years made journal friction and the relative value of different lubricants a special study, and has made machines of a very simple and effective kind for testing oils, which are largely used in America by railways and other large users of lubricants. In the course of his experiments the author has not only obtained new information on a subject in which most engineers have until lately had to follow Morin and one or two other rather early investigators. Professor Thurston has, however, done a great deal to show that there is more reason for reconsideration in some respects of the generally held views concerning friction and lubricants than was generally supposed, and a few years ago published a small book of some value on the subject. He has since then followed up the subject, and produced the present volume, which contains much that is new and presents what was to be found scattered in various places in one volume; but it also contains much that is of very little value to engineers. He treats the subject in eight chapters, namely:—I. Theory of machinery; its friction and efficiency. II. Nature, laws, and theory of friction. III. Lubricants. IV. Lubrication apparatus. V. Chemical and physical tests of oils. VI. Experiments on friction-testing machines. VII. Lubricated surfaces; coefficients of friction; modifying conditions. VIII. The finance of lost work. The first deals with definitions, as preliminary to the dynamics of the subjects as further on treated, and calls for no mention, unless it be to observe that, respecting "forces," the author says that these "acting in machines are distinguished into *driving and resisting forces.*" Some of our readers would, perhaps, object to the latter as forces. In the second chapter, speaking of the difference between friction of rest and of motion, he says, "it is found that a jar, often a very slight one, will convert the friction of rest into the friction of motion." This is hardly paying that respect to exactness of expression or terminology which Professor Thurston would look for in others. The friction of rest is not here *converted* into the friction of motion; but the jar does that amount of work or gives that amount of motion which overcomes the friction of rest. In many places the author speaks of the force of friction, and in dealing with journal friction, says "a journal is a surface of revolution . . . within another surface of revolution called the bearing." From a geometric point of view, either a cylinder or a sphere has a surface of revolution; but it is obvious that this is not the sense in which the author uses this style of phraseology or nomenclature. Of line shafting the author says, "the journals are generally made three or four diameters in length," which cannot be said to be very near the truth; at any rate, we do not see much 3in. line shafting, with either 9in. or 12in. journals, in this country, whatever they may have in the States. A great deal of the "theory of friction" is a mere showy application of algebra to a determination of the pressure per unit of area of different formed bearing surfaces having integral or differential velocities and under different pressures; but no new light is thrown on such questions as those which turn up respecting step bearings or bearings under very heavy pressures, such as those in rolling mills, where it is found that bearings more than about one-fifth or one-fourth the circumference of the journals cannot be advantageously replaced by bearings which fit, say, one-third or nearly half the circumference, such as are used for almost every other class of less heavily-pressed bearings.

On lubricants, the author has brought together a great quantity of useful information from various sources, and much more from his own observation, and it is from this that the purchasers and blenders of oils may learn much. The differences between the values as lubricants of various oils, mixtures, and greases, as used for light and heavy pressures and in large or small bearings, are very exhaustively dealt with, and very numerous sets of experimental figures and curves given. The book would, however, have had greater value if the author had dealt with these questions less from the point of view which would be taken by the seller of the best oils and greases, and more from that of the practical engineer, who wants a digest as to the relative "slippyness" of different lubricants; but who wants more than this—some good information and hints on the best modes of lubricating. Mr. Beauchamp Tower gave more information in this direction in his short papers on the subject than is contained in all Professor Thurston's book. In various parts of the book, and especially in the last part, the author shows that some fearfully bad and unsuitable oils are sometimes used in mills and elsewhere in the States, for he says that from 75 to 100-horse power out of 500 have been saved in some mills by changing the lubricant; in other cases 33 per cent. gain of power made. His conclusions on this subject are in some cases equally startling, and evidently not backed by sufficiently practical experience of some of the questions touched upon.

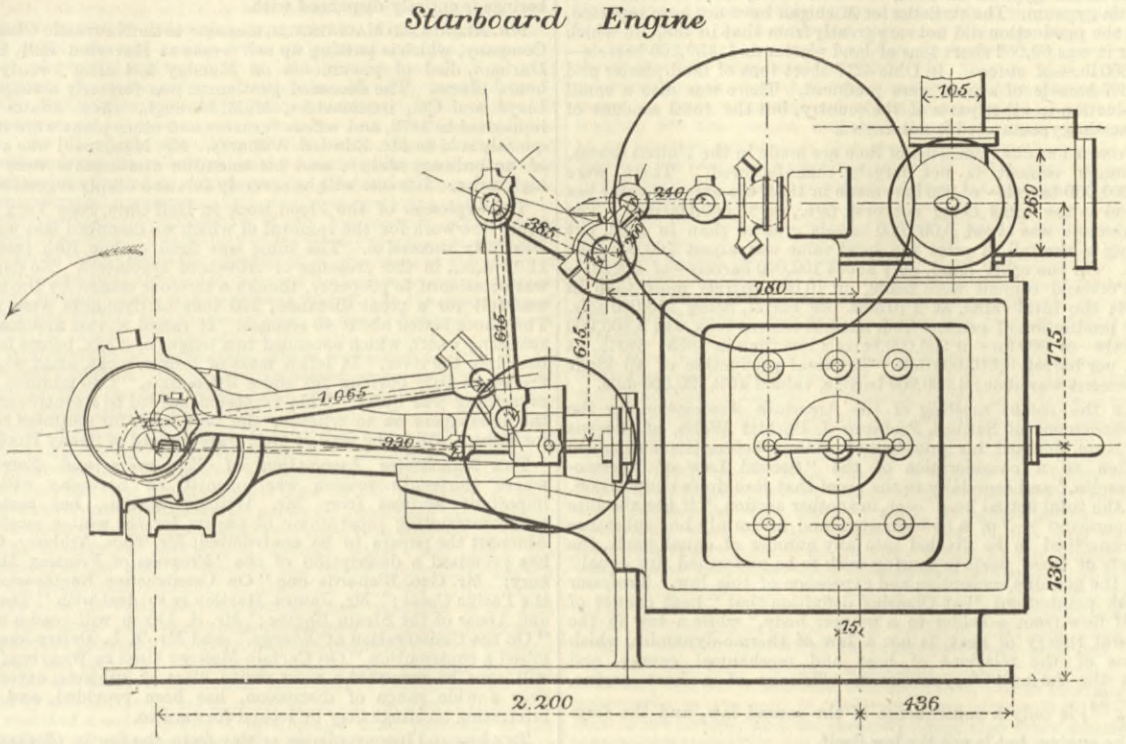
THE ANTWERP EXHIBITION.

No. VII.

In our last impression we gave engravings showing the general arrangement of the boilers and engines of the first-class gunboat Phlégéton, and enlarged views of the boilers, exhibited at Antwerp by Messrs. Claparede and Co., of St. Denis, France. We now give on page 293 engravings of the engines, and on page 295 four enlarged views of the balanced slide valves. As we have already explained, the engines have nothing to do but drive the screw propellers, all pumping work being performed by separate engines. The main engines, as will be seen from page 276, are situated at some distance from the condensers, which are cylindrical brass vessels, about 4ft. 2in. in diameter and 7ft. 3in. long. The air and circulating pumps are fixed at the forward end of the engine-room, also a long way from the condensers, which are steeply inclined to give the water a good lead away. The main engines thus stand between the condenser and its pumps.

The general arrangement of the engines is so clearly shown by our engravings that no special description is needed. The cylinders are jacketted, the outer casting being bushed, the bush being caulked tight with copper rings. The apparently enormous size of the valve chests is explained by the arrangement for balancing, which is clearly set forth on page 295. Figs. 1 and 2 are vertical sections through the valve chests of the large and small cylinders respectively. Figs. 3 and 4 are horizontal sections of the same. We can confine our attention to Figs. 2 and 4, because the valve is less simple than that shown in Figs. 1 and 2. A is the main steam pipe; C is a port face pinned on to the cylinder. The slide B has two ports through it, shown by the dotted lines, Fig. 4. Over the outer ends of these ports slide the Mayer's cut-off plates E E, which can be brought closer together or put further apart by means of the right and left-hand screws F F. The nuts of the screws are kept in place by the bonnets G G. This part of the apparatus works in a cavity made in the main valve, as shown very clearly in both sections. The way in which the cut-off plates are carried will be understood from Fig. 4, and is worth notice. The true back of the main slide is at D. This back-plate is bolted on to the slide valve as shown. The entire weight of the valve is carried on three brass rubbing plates, pinned to three ribs cast to receive them in the inside of the valve chest.

On the plate D is carried a relief ring I I. At L L is a space between the ring and the very short cylinder into which it fits—cast with the lid of the valve chest and bored out—for a packing of gasket, which is pressed down by a junk ring urged inwards by the screws N N, which pass through stuffing-boxes in the valve chest cover, so that they can be tightened up when the engine is at work. These screws take into snugs cast on the inside of the ring in the space J, which is placed in communication with the atmosphere by means of a small cock. This is the balancing space, or that to which steam cannot get access. The valve is kept to its seat by means of the spring R, the tension of which can be regulated by means of the screw S which passes through a stuffing-box U on the lid T. The arrangements for balancing the low-pressure slide valve are nearly the same, modified, however, by the fact that there is no expansion valve. *a* is the steam pipe—that is to say, the exhaust pipe of the high-pressure cylinder. *b* is the exhaust pipe, *c* the double-ported slide valve, *e* a space which can be placed in communication with the condenser. This space is enclosed by the relief ring *d d*; *g* is the ring of packing, *h* the cover, over the relief ring, clearly shown in the side view of the engine given above; *i i* are the screws for acting on the junk ring and tightening the packing *g*; *j j* are stuffing-boxes for tightening the screws, fourteen in number; *m* is the helical spring holding the main slide to its place; *n* is the regulating screw, and *p* the stuffing-box in the lid *o*. Although apparently complex, we understand that this arrangement gives much satisfaction, because it can be adjusted with the greatest ease while the engine is under steam. The valve is always really balanced, which is more than can be said of all slides fitted with relief rings. These rings frequently become jammed, because they have practically little or no motion, and the valve then gets away from them, admitting steam. This cannot take place with the Claparede valve.



SIDE ELEVATION OF ENGINES OF PHLEGETON.

COMPOUND LOCOMOTIVES.

No. II.

In our last impression we stated the nature of the prominent questions to be dealt with in handling the compound locomotive problem in the following words:—(1) Is the compound locomotive more economical in fuel than the simple engine? (2) Is it more economical in repairs? (3) Is it more generally efficient under all conditions of load, fuel, and weather? (4) Does the principle of compounding enable a more powerful engine to be produced than is possible without it? We have glanced, and little more, at the first two questions. We now propose to go more fully into the first, namely—economy of fuel.

No railway man estimates the consumption of fuel in any other terms than those of pounds of coal per train mile, suitable allowances being made for the loads and the gradients. In this country we have at present no experience to guide us but that of Mr. Webb, for Mr. Worsdell's engines have not been long enough at work on the Great Eastern to enable much to be deduced from their performance. According to Mr. Webb's own statement of fuel consumed per train mile, it appears that his compound engines burn rather more coal than Mr. Stroudley's engines on the Brighton line, the loads and speeds being about the same, but the Brighton line being heavier than the London and North-Western, at least as far as the section from Euston to Crewe is concerned. Now it must not be hastily assumed that, although this is the case, the compound engines use their steam without more economy than Mr. Stroudley's engines. In other words, it is quite possible that the *total* horse-power got out of a given weight of steam in the compound engine may be greater than in the simple engine, while the net, or useful, horse-power is less. This is a very important point, and deserves careful consideration. The Webb engine is considerably heavier than the Stroudley engine. This represents so much more load—say, half a coach—not much, perhaps, but still, even half a coach means somewhere about a pound of coal per mile. But there is a speciality about the compound engine which is of more importance than this. From the total work done by the steam must be deducted the useless work done in overcoming back pressure, which cannot in the locomotive be reckoned at less than 17 lb. on the square inch. The trains drawn now by Mr. Webb's compound engines have been worked before by engines with 17in. cylinders, 24in. stroke, carrying about 130 lb. steam. Assuming, however, for the sake of argument, that the compounds of the Marchioness of Stafford class are equal to locomotives with 18in. cylinders, 24in. stroke, we find that the work done in overcoming back pressure is very much greater in the compound than in the simple engine. We are assuming what is not far from the truth, that the diameter of the wheels is the same in both engines. For the sake of comparison, let us take a given piston speed. Let the wheels be 6ft. 6in. in diameter; they will make, omitting small fractions, 258·5 revolutions per mile, or at fifty miles an hour, 215 revolutions per minute. This corresponds to a piston speed of $4 \times 215 = 860$ft. per minute.

Now, the low-pressure piston in the compound engine is 30in. in diameter. Its area is 707 square inches, and $\frac{707 \times 17 \times 860}{33{,}000} = 313$-horse power, omitting fractions; that is to say, that from the total work done on the pistons of the compound engine 313-horse power must be deducted. In the case of the simple engine we have two pistons 18in. diameter, the united area of which is 509 square inches, and $\frac{509 \times 17 \times 860}{33{,}000} = 225{\cdot}5$-horse power. Thus we see that the waste of energy is in the compound engine—313 − 225·5 = 87·5-horse power more than it is the non-compound, simply as a result of the larger size of the piston on which the atmosphere acts. To understand the full meaning of this, let us assume that the gross average pressure is greater in the non-compound than it is in the compound, in the inverse ratio of the total piston areas, the high-pressure pistons being of course neglected in the compound, as the whole power must be referred to the low-pressure cylinder alone. Let the average total pressure in the non-compound engine be 58lb. on the square inch, then we have 707 : 509 :: 58 lb. : 41·7 lb. Then the total power developed by the non-compound engine will be 767-horse power, from which deducting 225·5, we have 541·5 as the net power available for drawing the train and overcoming engine friction and all other resistances save the back pressure. The total power developed in the compound engine will be precisely the same, but the net power will be 454 horses only. In other words, the ratio which the useful work bears to the total work will be less in the case of the compound engine than it is in the simple engine. We can put this in another light, by pointing out that the resistance of the air is a constant quantity, and that the greater the total amount of work done the smaller will be the proportion which the wasted bears to the useful work. We have only, indeed, to cut the working pressure down to a little over 17 lb. on the square inch total, or 2lb. above the atmosphere, to see that the useful work done would be *nil*. This is one reason why so little is gained by working non-condensing engines with high measures of expansion. It may, perhaps, be urged here that under the circumstances Mr. Webb would gain by making his low-pressure cylinder smaller. But to do this would vitiate the whole principle of the compound engine. The high-pressure cylinders are not the measure of the power of the engine. They are merely convenient appliances for expanding steam, and distributing the work done to the wheels. The low-pressure cylinder is the true measure of capacity, and it will be seen that the Dreadnought or the Marchioness of Stafford is on all fours with a simple engine having two cylinders 22⅛in. in diameter. It is true that Mr. Webb uses a boiler pressure of 175 lb., but the work done not being greater, as we have seen, than that performed by engines with 18in. cylinders, the average pressure must be lower than it is in these last, and therefore the ratio of waste must be greater. That is to say, that although Mr. Webb is getting more power out of every pound of steam he uses than could be got in the simple engine, the extra energy is not wholly available for drawing the train, but is absorbed in overcoming useless resistances. As a practical comment on this, we may call attention to the statement recently made in the pages of a contemporary, that the compound engines of the Experiment class with 17ft. of grate and 103ft. of fire-box surface only take the same trains that were formerly worked by the Lady of the Lake class with 15 square feet of grate and 85 of fire-box surface; the consumption of fuel with the latter being 27 lb. per mile, and with the former 26·6 lb. The Experiment has two pairs of 6ft. 6in. wheels, and the equivalent of two 18⅜in. cylinders, and weighs 37·75 tons; while the Lady of the Lake has one pair of 7ft. 6in. wheels, 16in. cylinders, and 24in. stroke. Of course, it is possible that in heavy weather the compound engine makes better time than the Lady of the Lake did, but on this point we have no information.

To sum up, we have, we think, proved that in non-condensing engines, such as locomotives, it is quite possible to reduce average pressures by means of expansion to such a point that no economy worth having is realised, because we have at the same time, in order to obtain this low average pressure, to greatly increase cylinder capacity. But cylinder capacity being—other things being equal—the measure of the dead or useless resistance overcome, the amounts of useful and useless work will continually approach each other as the average steam pressure is reduced, until they may coincide if expansion is pushed to extremes. It may be argued that, regarded from another point of view, the difficulty may be overcome by using higher boiler pressures, keeping the cylinder capacities and the average pressures what they are now, but getting an increased range of expansion due to the higher initial pressure. But to say nothing of the fact that this would lead to safety-valve loads which would render the use of very heavy boilers a necessity, the fact would remain that each pound of steam discharged up the chimney would carry away as much energy as it does now. In theory less steam would be wanted, it is true; that is to say, a less weight of steam at the same pressure would be sent into and out of the cylinder at each stroke; but practice seems to point in a different direction, because cylinder condensation comes into play. On this view of the matter we may have more to say at another time.

We have already alluded to goods engines, and before going further it may be well once more to point out that the case which they present for consideration is different from that of the express engine. Goods engines always run now with a higher average pressure than passenger engines, and when ascending inclines the steam follows the piston nearly full stroke, and the noise of the exhaust resembles the firing of artillery. There can be no doubt whatever that this type of locomotive presents admirable opportunities for compounding, because even with the additional cylinder capacity thus obtained, the average pressure on the pistons must remain high. It has always seemed to us a strange thing that compounding a goods engine was not first tried. Probably the idea that because the driving wheels are small, the average pressure must be small too has operated; but the loads drawn are so heavy that the resistances met with by goods engines are greater in very many cases than those overcome by express engines at speeds twice as high, when, as we have pointed out, great expansion becomes a necessity, in order to get rid of the waste steam.

An Indian Village at the Albert Palace. — Those who have recently visited the Albert Palace will have noticed the preparations in the nave for a further novelty. This, we understand, is to be a *gaum*, or village, to practically illustrate the arts and sports, and varied amusements of *gaum* life in India. For this purpose about fifty skilled artisans and entertainers are now on their way to this country. They will practically show us, in workshops as much like their own as skill and experience can make them, the modes in which they carry on their interesting and important industries. There will be wood carvers, metal workers, mat makers, shawl weavers, carpet weavers, rug makers, and workers in many other handicrafts for which India has long been famous, and for many of which she has attained an undisputed pre-eminence.

RAILWAY MATTERS.

The Transcaspian Railway is now open for regular traffic as far as Araman, which is 120 versts from Askabad. It is intended to collect about 4000 more labourers to push on the work.

The scheme for amalgamating the Scinde and Punjaub, Punjaub and Northern Indus Valley, and Scinde and Pishin Railways, thus uniting the whole frontier system under one management, will have effect from January 1st, under Colonel Conway Gordon as manager. There will be several deputies controlling various sections of the system.

The German Society of Mechanical Engineers offers a premium of 1000 marks—nearly £50—for the best plan for a boiler shop in which sixteen locomotive boilers can be constructed at once; also a premium of 300 marks—£15—for the best essay on the subject, "What Method of Tire Fastening on Railroad Rolling Stock is Best, according to Present Experience."

That portion of the Barry Railway between Havod and Llantwit was commenced on Tuesday last. It consists of six miles of double line with a tunnel, near Treforest, 1300 yards long through Pennant rock. All the latest rock-boring appliances are to be used in its construction. This contract is in the hands of Mr. John Mackay, of Cardiff and Hereford.

The steam tramway engine has its enemies as well as its friends in Birmingham. "A memorial objecting to the use of steam upon the Bristol-road tramways line," our Birmingham correspondent says, "has been influentially signed, and from what I hear the protest seems likely to produce the desired effect. The Public Works Committee, I believe, will advise the Town Council that the cable system should be laid on that line instead of the steam locomotive."

The following from the *Railroad Gazette*, headed, "Took His Own Dividend," may afford a hint in this country: "The only stockholder who ever received any dividend from the old Farmington—Conn.—Canal has just died. The President told him that there was no dividend and no prospect of any, and jestingly advised him to go home and mow the tow-path. He did so, taking a 20 per cent. dividend in hay from the eight miles of unused tow-path, and this he went on doing with perfect complacency thereafter."

A few days ago some daily papers circulated a report to the effect that a serious accident had happened at one of the Forth Bridge pier caissons, causing the death of four men. Until this very valuable newspaper report had reached the bridge engineers nothing was known of any mishap, and on inquiry it appears that what happened was, that in filling concrete through a 12in. tube into the working chamber the men put in too much, and jammed the bottom door or flap valve. The released air shot out the concrete, but no one was injured.

At a special meeting of directors of the London and North-Western Railway Company, held at Crewe last Friday, the question of putting the whole of the workmen on short time was considered. A notice was afterwards issued stating that the company had for some time been keeping on their full strength in the locomotive works with the hope that trade might revive, but in consequence of the continuance of commercial depression, they were compelled to reduce the working hours of their *employés*. The works will, therefore, be closed altogether on Saturdays, and until after breakfast on Mondays. This notice affects over 6000 men.

In No. 73 of the *Journal of the German Railway Association*, it is reported that "special trials made on the Swiss Lake Valley railway for the directors of the Waldenburg railway, with the continuous and automatic friction brakes—Heberlein—with which the whole rolling stock of the first-named line is fitted, gave the following as the maximum results, with the rails in ordinary condition and with all the wheels under brake power:—First, at a speed of 25-30 kilos.—18-22 miles—down an incline of $35\frac{0}{00}$—1 in 29—stopped in 35 metres—38 yards. Secondly, at a speed of 25 kilos—18 miles—on the level, stopped in 20 metres—22 yards. It should be remarked that 18 miles an hour is the maximum speed allowed on road railways such as the Swiss Lake Valley line.

On the 10th inst. the 4.32 p.m. train from London to Doncaster, on the Great Eastern Railway, narrowly escaped being wrecked between the stations of Murrow and French Drove. A passing goods train had cast a wheel, which had fallen right across the metals upon which the express was travelling, at the rate of sixty miles an hour. Directly the obstacle was perceived the Westinghouse brake was applied, and the train being brought to a stand it was found that the engine had been thrown from the line, and that a serious calamity had only just been averted by the promptness of the brake. This is the fifth or sixth accident of a similar character on the same railway within a few years, in which disastrous consequences have been averted by the same means.

An exhaustive series of statistics on the wear of rails on the railroads of the German Railroad Union, embracing the Dutch, German, Belgian and Austrian roads, shows rather irregular results as to wear of head, ranging from 1 mm.—$\frac{1}{25}$in—for 1·919 million tons carried up to 1 mm. for 22·111 million tons carried. The first result was attained on grades of from 1·7 to 2·5 per cent., and on track with curves as short as 600ft. radius—9 deg. 33 min. curve—and the latter with 0·5 per cent. grades and 2 deg. 30 min. curves. On track with curves of 3 deg. and grades of 0·33 per cent. a wear of 1 mm. per 12·535 million tons was found, and with 0·5 per cent. grades and 6 deg. curves a wear of 1 mm. per 9·481 tons was found. The *Railroad Gazette* remarks that the result as to wear showed that the wear per million tons carried, as a general rule, decreased as the head wore down. This applies not only to straight lines, but also to curves.

The *Railroad Gazette* record of train accidents in the States in August contains brief notes of 38 collisions, 50 derailments and 4 other accidents; a total of 92 accidents, in which 37 persons were killed and 172 injured. Nine collisions, and 14 derailments caused the death of 1 or more persons; 14 collisions, 9 derailments and 1 other accident caused injury but not death. In all, 23 accidents caused death and 24 lesser injuries, leaving 45 or 49 per cent. of the whole number, in which there was no injury serious enough for record. The 38 collisions caused 12 deaths and 96 injuries; the 50 derailments killed 25 persons and injured 75, while in the 4 other accidents only 1 person was hurt. Twenty-eight of the persons killed and 52 of those injured were railroad employés, who thus made up 76 per cent. of the killed, 30 per cent. of the injured, and 38 per cent. of the whole number of casualties. As compared with August, 1884, there was an increase of 3 accidents, a decrease of 1 killed, and an increase of 60 persons injured.

Tests of automatic couplers have several times been made in the United States, and recently a very extensive test has been made at Buffalo. At this last test twelve couplers were selected for adoption as follows, those in italics being those which are now recommended for the first time; and those in ordinary type those which have been heretofore recommended:—Of the "vertical plane" type: Cowell's, *Dowling's*, Hien's, Janney's, *Thurmond's*, and *Titus and Bossinger's*. Of the link type: Ames, Archer, Gifford, *Marks*, *McKeen*, Perry. The *Railroad Gazette* says:—"How far the Buffalo tests have advanced us toward a final decision it is as yet too early to surmise. Many will wonder why certain couplers were both omitted and excluded from the Buffalo list, although few might agree in the couplers which caused their wonderment. This is to be expected; but of one thing we may be certain, that the approved list must be brought down to one or two, or three at most, before the question can cease to be a living one, and that even then the couplers which stood nearest to the favoured ones and were all but admitted to the haven of public favour will be very apt to play the part of Banquo's ghost, unless the machinery of selection involves some mode for laying all the more promising competitors quietly away in their graves, with the approval and consent of their owners."

NOTES AND MEMORANDA.

In Greater London last week 3247 births and 1603 deaths were registered, corresponding to annual rates of 32·6 and 16·1 per 1000 of the population.

The deaths registered in 28 great towns of England and Wales last week correspond to an annual rate of 17·6 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year.

In London 2491 births and 1309 deaths were registered last week. Allowing for increase of population, the births were 164 and the deaths 146 below the average numbers in the corresponding weeks of the last ten years. The annual death rate per 1000 from all causes, which had been 13·8 and 16·0 in the two preceding weeks, further rose last week to 16·7.

The production of crude petroleum in the United States in 1884 was 24,089,758 barrels of 42 gallons each, of which the Pennsylvania and New York oil fields produced 23,622,758 barrels. The total value, at an average spot price of 85c., was 20,476,294. As compared with 1883 the production was 689,529 barrels greater; but the total value was 5,263,958 dols. less, the average spot price having fallen from 1·10 dols., or 25c. per barrel.

As an illustration of the quantity of coal required to thrash a given quantity of corn, it may be mentioned that Messrs. E. R. and F. Turner, Ipswich, have recently received the following from a user of one of their engines:—"We have just finished thrashing four wheat stacks = 360 sacks, in four days, with 1 ton 1 cwt. of coals, with the engine we had from you in 1878." This is 6·53 lb. of coal per sack of wheat, or, at 20s. per ton, 0·698d., or say 0·7d., per sack. We are not informed what thrasher was used.

In the Atlantic States, from Maine to Virginia, 65,000 long tons of plaster and 60,000 tons of stucco—total, 125,000 tons—were made from gypsum in 1884, of which nearly all was from Nova Scotia gypsum. The statistics for Michigan have not been reported, but the production did not vary greatly from that in 1883, in which year it was 60,082 short tons of land plaster and 159,100 barrels—of 300 lb.—of stucco. In Ohio 4217 short tons of land plaster and 20,307 barrels of stucco were produced. There was also a small production in other parts of the country, but the total amount of domestic gypsum used is not known.

Considerable quantities of lime are made in the United States, although cement is not largely manufactured. There were 37,000,000 barrels—of 200 lb.—made in 1884, the average value per barrel at the kilns being not over 50c., or 18,500,000 dols. The production was about 5,000,000 barrels greater than in 1883, but owing to the fall in price the total value was about 700,000 dols. less. On the other hand, only about 100,000 barrels—of 400 lb.—of Portland cement were made, or 10,000 barrels more than in 1883; the total value, at 2·10 dols. per barrel, being 210,000 dols. The production of cement from natural cement rock was 3,900,000 barrels—of 300 lb.—or 200,000 barrels less than in 1883; worth, at 90c. per barrel, 3,510,000 dols. The total production of all kinds of cement was about 4,000,000 barrels, valued at 3,720,000 dols.

At the recent meeting of the American Association for the Advancement of Science, Professor J. Burkitt Webb, of Stevens Institute, devoted his presidential address before the mechanical section to a consideration of the "Second Law of Thermodynamics," and especially to the proof that Rankine's enunciation, "if the total actual heat"—or, in another section, "if the absolute temperature"—"of a homogeneous and uniformly hot substance be conceived to be divided into any number of equal parts, the effects of these parts in causing work to be performed are equal"—is the genuine conception and expression of this law. Professor Webb pointed out that Clausius' definition that "heat cannot of itself flow from a colder to a warmer body," while a law in the general theory of heat, is not a law of thermo-dynamics, which treats of the relations of heat and mechanical energy, and that the formula for maximum efficiency of a heat engine, $\frac{T - T_1}{T}$, is only a consequence of the second law, and the form of the engine, but is not the law itself.

In a paper on "The Action of Water on Lead Pipes," by C. Schneider, in the *Rep. Anal. Chem.* 10, 158, the author says:—The soft water of the river Bober, supplying the town of Sprottau, and although containing only traces of sulphuric acid and calcium salts, dissolves considerable quantities of lead from new lead piping. A new lead pipe, 20 metres long, was filled with Bober water, and left to stand forty-eight hours; the amount of lead dissolved was found to be 0·502 gramme per hectolitre. Difficultly soluble deposits, which form a protecting layer on the insides of the pipes, are thrown down in a short time, not, however, under a period of twenty-four to twenty-six hours. Hard spring water, containing in a hectolitre 106·0 grammes of non-volatile constituents, 10·5 grammes of sulphuric acid, 14·44 grammes of chlorine, 11·20 grammes of lime, and no inconsiderable quantity of nitric acid, dissolved a quantity of lead amounting to 0·351 gramme per hectolitre. The *Journal of the Society of Chemical Industry*, referring to the paper, says:—The author considers that even a small quantity of carbonic acid, accompanied by dissolved air, is sufficient cause for the solvent action of a water upon lead pipes.

At a recent meeting of the Académie des Sciences M. de Boutarel read a paper on "Paper and the Industries connected with it," in the course of which he quoted some statistics as to the rapid increase in the quantities of pens, paper, pencils, &c., which are manufactured in Europe and the United States alone. M. de Boutarel says that the manufacture of paper, which at the beginning of the century was practically *nil* in the United States, now amounts to 500,000 tons per annum, and that it is just double this figure in Europe, the value of the straw, rags, and other materials used in the manufacture of the paper being about £20,000,000. M. de Boutarel estimates the value of these 1,500,000 tons of paper when manufactured at £40,000,000, the note-paper being calculated at 120,000 tons, worth £6,400,000. M. de Boutarel estimates the value of the steel pens manufactured annually at £800,000, while the number of heliotype plates may be safely estimated at 3,000,000, thirty Paris houses alone turning out 900,000. M. de Boutarel gives the number of lead pencils made every year, and though some of his figures can only be conjectural, they no doubt represent very fairly the enormous capital employed in these industries.

It appears that although the Admiralty is careful to test their chain cables, their hawsers and other hemp ropes are taken on the faith of the manufacturers. In view of the value and importance of a good rope, it is, therefore, to be deplored that hitherto there has been no simple and ready method of detecting the presence of an inferior fibre like Sisal in a rope presumably made of pure Manilla hemp. The difficulty of detection has now been overcome, it is said, by Messrs. Frost Brothers, the rope manufacturers, of Shadwell, by a test simple and easy of performance. It is thus described as seen by a writer in the *Times*:—Messrs. Frost produced three pieces of 3in. rope, one made from pure Manilla hemp, one from pure Sisal, and one from an equal mixture of Manilla and Sisal, the fibres having been carefully intermixed before the yarns were spun. Each of the ropes untwisted, and from a strand of each was taken a piece of the yarn about 6in. in length. Each piece of yarn was untwisted and separated into loose fibres, which were separately rolled between the palms of the hands, producing three balls of fibre each about the size of a large walnut. These three balls were then placed on an iron fire shovel and each lighted and thoroughly burned out. There were then three piles of ashes of perfectly dissimilar appearance. The Manilla hemp produced an ash having a dull grayish-black appearance; the Sisal hemp left an ash of a whitish-gray colour, while the combined Manilla and Sisal fibre gave a grizzly white and black ash, reminding one of nothing so much as a man's beard when turning from black to gray. The presence of the two fibres was distinctly apparent by the different colours of the ashes.

MISCELLANEA.

At a meeting of the Shrewsbury Town Council on Monday, the Mayor announced that a comprehensive and valuable scheme for supplying the town with water would be shortly brought before the Council.

At the monthly meeting of the Sanitary Assurance Association on Monday, it was resolved to arrange for another series of free lectures on sanitary subjects during the coming winter. Prof. Roger Smith, F.R.I.B.A., will deliver one of the series.

The strike in the cotton trade would seem to be approaching a close; although most of the leading companies are still firm in insisting upon the full 10 per cent. reduction in wages, some of the Oldham mills have been restarted on the operatives' terms.

A Brussels correspondent writes:—It is stated that the Cockerill Company at Seraing, which was founded by the Englishman whose name it bears, but which is now a purely Belgian enterprise, has obtained from the Midland Railway Company an order for 10,000 steel sleepers.

The preliminary lecture of a course "On Science of Construction," was delivered gratis at Exeter Hall on Friday last, by Mr. T. G. Gribble, A.M.I.C.E., Metropolitan Board of Works. The lecture was well attended. The course itself commences to-night, Friday. We believe particulars may be obtained from the Secretary at Exeter Hall.

A very ingenious joint, specially designed for repairing pipes in fuel economisers, has just been patented by Mr. Thos. Sykes, of Manchester, and Mr. Arthur Lowcock, of Shrewsbury. The chief feature of this joint is its extreme simplicity. By means of a metal conical wedge, which, when the pipe has been put in position, is dropped in over the conical turned end of the pipe and hammered down until the pipe is firmly wedged, the joint can be completed in a few seconds, and the usual caulking with iron borings is entirely dispensed with.

Mr. Archibald Macdonald, manager to the Newcastle Chemical Company, which is putting up salt works at Haverton Hill, South Durham, died of pneumonia on Monday last after twenty-four hours' illness. The deceased gentleman was formerly manager to Lloyd and Co., ironmasters, Middlesbrough, whose affairs were liquidated in 1879, and whose furnaces and other plant were subsequently sold to Mr. Edward Williams. Mr. Macdonald was a man of no ordinary ability, and his scientific attainments were of a high order. His loss will be severely felt and deeply regretted.

The explosion of the Flood Rock in Hell Gate, New York Harbour—the work for the removal of which we described last week—was fully successful. The mine was fired on the 10th inst., at 11.13 a.m., in the presence of crowds of spectators. No damage was occasioned to property, though a tremour caused by the shock was felt for a great distance; 140 tons of dynamite were used. The shock lasted about 40 seconds. It raised a vast mountain of sparkling water, which ascended to a height of 200ft. before falling back into the river. It left a mass of broken rocks, amid which a fire broke out, burning for some little time. Two minutes later everything was quiet. This explosion has led to a controversy in the newspapers as to whether the best route for steamers bound for Europe will be by way of Hell Gate instead of Sandy Hook.

The Manchester Association of Employers and Foremen, whose thirteenth session was opened on Saturday with an important address from Mr. William Mather, has arranged a very interesting programme of papers for the winter meetings. Amongst the papers to be contributed, Mr. Thos. Ashbury, C.E., has promised a description of the "Progress of Printing Machinery;" Mr. Geo. Richards one "On Constructive Engineering on the Pacific Coast;" Mr. James Hartley is to deal with "The Use and Abuse of the Steam Engine;" Mr. S. Dixon will read a paper "On the Conservation of Energy," and Mr. T. L. Daltry has promised a contribution "On Certain Motions Used in Weaving." It will thus be seen that a most varied class of subjects, extending over a wide range of discussion, has been provided, and very interesting meetings may be looked forward to.

The loss and inconvenience arising from the fire in Clerkenwell is likely, says the *Daily Chronicle*, "to be considerably increased by the fact that nearly all the safes have failed to preserve their contents. Up to the 13th inst. twelve safes have been opened, and the contents of eight of these found absolutely destroyed, and of the remaining four injured. The fire was not a severe trial for the safes, being of very short duration. Most of the safes were of the common cheap kind. Other safes had to be opened, but there was little hope that they will show any better result." The extent of the iron book-box manufacture, as distinguished from iron safe manufacture, is little known by the public. These things called safes are made in hundreds of small shops and railway arches in London and elsewhere, where a useful article could not be made any more than a good Lancashire boiler could be made in a tinman's shop.

At the monthly meeting of the Council of the Railway and Canal Traders' Association, held on the 7th inst., at the offices, Eastcheap-buildings, E.C., the necessity of improving our inland navigations and the vital importance of cheaper transit to the Midland districts were considered, when it was resolved:—"That a letter be written to the corporation of Peterborough urging the necessity of improving the river Nene navigation to that town, apart from the necessity of preventing the flooding of the fenlands, and that a similar letter be sent to the Severn Commissioners, urging that the proposed deepening of the latter navigation—at very small cost—between Gloucester, Worcester and Stourport, be proceeded with; and further, that a memorial be sent to the Royal Commission on Trade, expressing the opinion that trade in England is most unfavourably affected by the inadequate and restricted condition of our inland navigations."

Mr. Donald C. Grant, one of the Forth Bridge staff, is bringing out a new form of signal for use at sea to indicate to other ships the direction of movement of the helm, so as to avoid collision with ships close up. He does not propose to supersede the side lights at present employed, but only to supplement them. The officer on watch is supplied with a couple of signals small enough to be carried in a breastcoat pocket of ordinary capacity. Should he wish to indicate that his vessel is on the port tack, he takes a signal—with a round handle and coloured red—from his pocket and fires it by giving it a slight tap. The result is a brilliant red light. After this light has burned for about thirty seconds it explodes a small maroon, the report of which can be heard a mile off; and after this the light continues to burn for another thirty seconds. The process of firing the starboard tack signal is, of course, the same, the result being a green light, but in this case the handle is square, this difference of form making it easy in the dark to distinguish the right signal to be employed.

At the meeting of the Metropolitan Board of Works on Friday last, the report of the Bridges Committee referred to the condition of the Albert Bridge, and showed drawings of proposed works for strengthening the bridge, and recommended that the same be approved, and that an advertisement be issued, inviting tenders for the execution of the works, such tenders to be sent in on the 17th December next. The wire cables used in the construction of the bridge had, it was said, given way, and it was desirable that the works should be at once undertaken to make the bridge safe. It was stated that there was a general impression in Chelsea that the bridge was in a very dangerous state, and that the danger had not arisen because of the breaking of the cables, but was caused by the insecure state of the foundations. Sir Joseph Bazalgette said there was no immediate danger if heavy vehicles did not pass over the bridge. He thought, however, that immediate steps ought to be taken. The recommendation was carried by 23 votes to 8. It appears that some of the strands of the suspension cable—it is hardly a rope, for the wires are not twisted or woven in any way—have not received any load, and have buckled and broken, but it is thought that the cable is far above its necessary strength.

TECHNICAL EDUCATION AND FOREIGN COMPETITION IN THE ENGINEERING TRADES.

The thirtieth session of the Manchester Association of Employers and Foremen was opened on Saturday with an important address from Mr. William Mather, C.E., on "The Relation of Technical Instruction to the Progress of Engineering and Kindred Trades in the Future," before a large audience of engineers, held in the lecture hall of the Manchester Technical School. The chair was occupied by the president of the Association, Mr. Ald. W. H. Bailey, who, in his introductory remarks, observed that in looking at the various educational institutions, and what they were doing for the district, no thoughtful man could doubt that there was an enormous amount of waste energy going on in their midst, by the introduction of many subjects which were utterly useless as a training for successful competition with our foreign rivals, whilst matters of vital importance to our industrial development and progress were comparatively neglected. In the pages of one of their trade journals—he thought it was The Engineer—he had read a paper on the use of the steam engine, in which the writer pointed out that whilst there were certainly engines working with a consumption of 2 lb. of coal per horse-power per hour, there were at the same time engines working with a consumption of 20 lb. of coal per horse-power per hour—which clearly proved that everyone did not buy in the cheapest market, but very frequently only where they could get the cheapest materials. Technical education would do away with such ridiculous anomalies, and would enable men to economically employ the powers at their disposal.

Mr. W. Mather, in the course of his address, said it was with pardonable pride, though not unmixed with some vainglory and occasionally with ignorance of the world beyond our shores, that some Englishmen referred to the great achievements of the mechanical trades during the last fifty years, notwithstanding that Great Britain had been notorious for the want of a common school education system the greater part of that period, whilst as to science and art, the training had only been accessible to a small minority of those engaged in industrial occupations. Our progress in the past clearly did not spring from widespread intelligence as the result of general education, nor had the possession of general education, in some other countries in Europe, together with highly organised schools of science teaching, enabled them yet to surpass us in mechanical inventions and machine construction, out of which all industries and manufactures lived and moved and had their being; but we could point to the fact that steam and its properties, which had for generations been known to philosophers and experimentalists, was developed into a mighty power by the mechanical contrivances of our countrymen not specially learned or scientific. The history of the family of metals showed that until quite recent times the treatment of ores was not the result of profound chemical knowledge, yet the materials produced were in quality for their kind not surpassed to-day. In the first dawn of the railway system the pioneers were, in the educational sense, of uncultured minds, yet they struck out, with wonderful prescience, the true method of instruction, which remained to this day of universal adoption. In the application of steam to ships it could be shown that the first practical and commercial results were due to men whose training was not of a character which we should call scientific, nor yet equal to that of many men who preceded them in trying to make steam navigation possible. The rise and progress of the great textile industry, so far as spinning and weaving were concerned, had been mainly due to men of self-education or men comparatively unacquainted with scientific methods of investigation and discovery, though some highly cultured men contributed to the infinite number of mechanical devices which had made the machinery of the textile industries marvellous in productive power yet simple in construction. In machine tools the development, though slow at first, after the introduction of steam power had been prodigious in recent years, displaying wonderful ingenuity, with correct principles of construction and workmanship of surpassing skill and accuracy. Agriculture machinery, which in its effect upon the well-being of the human race, ranked next to benefits conferred by railroads, was also an achievement of our own race, though the result of a wider spread of intelligence than prevailed at the time when railroads were started. In mining, although the field was enormously large, mechanical ingenuity had not replaced the manual work, which was carried on still at great risk and under conditions that leave much to be desired on humanitarian grounds, if not to render the operations more profitable; yet the number of men known to fame in connection with mining, whose education was acquired under the greatest difficulties, was quite considerable—proving that in this, as in all the scientific industries, we had achieved pre-eminence without a system of scientifically training men in great numbers to occupy the leading positions in our vast industrial undertakings. But though we must admit that this was all true enough in the past, and more particularly in the earlier stages of our industrial development, yet, if we had time to refer to biographical records, we should find that scientific knowledge had, in some irregular fashion, percolated into the minds of men possessing remarkable natural gifts of observation, instinctive perception, and reflection. These faculties grasped the phenomena of nature, sought, by crude methods probably, for the laws which produced them, discovered the great underlying causes of effects around them, and thus, by a process painfully slow and roundabout, at last struck upon a great truth which brought to light and to the use of man a little more of that infinite wisdom of the Creator of which we were ever invited to partake. The characteristics he had named were essentially Anglo-Saxon, coupled with others equally important, namely, great energy, endurance, perseverance, and, generally speaking, great physical powers. Such qualities in our forefathers, when once steam power became a practical reality through the labour of Watt, quickly led them on to see that man was no longer to be a beast of burden, but a living soul. The vast stores of mineral wealth were unlocked by this new agency, which multiplied the power of man a thousandfold. The abundance of material made experiment easy, and waste brought no fear of want. Then the demand for each successful contrivance that replaced human drudgery and increased man's control over the forces of nature speedily converted our country into the workshop of the world. Practice led towards perfection in the long run, however blundering and ignorantly and wastefully the progress might be achieved; skill of hand, experience, wealth, developed the practical knowledge which led up to new discoveries, and the British race, though negligent of scientific culture and methods, utilised and applied science in a certain degree for its profit upon its own resources and for the benefit of mankind, long before other nations awoke from the sleep of ages or had emancipated themselves from the yoke of oppressors. Now, however, other nations were approaching us in the cheapness of their productions, in the excellence of their workmanship, the originality of their designs, the boldness of their conceptions and economy of materials, notwithstanding the enormous advantages we possessed. Was it not, therefore, time that those who were engaged in the mechanic arts should ask themselves whence came the rapid development of their less fortunate neighbours? How was it we were talking to-day about "holding our own" and "still keeping the lead," when a few years ago we were not conscious of competitors, and scarcely condescended to notice the changes that were reducing the distance between us and those who entered the field long after us, and heavily handicapped? He was aware there was a Jingoism in the mechanical and engineering trades, just as in politics; and the reliance upon past achievements, with the present enormous display of our skill in every branch of mechanical industry, measured both by quantity and quality of production, tended to somewhat undue exultation. But exultation for the present did not cover all that we needed to look after for the future. Moreover, looking to a certain class of engineering work, it was annoying to notice the vast undertakings of the Continent, where some years back we possessed supreme sway, which were now being carried out entirely by local engineers, chiefly with native materials, and altogether from original designs. The piercing of the Alps in several places by the Italians, French, Germans, and Swiss, under difficulties of great magnitude and only possible by mechanical contrivances of the most ingenious description, and at a most moderate cost, was a suggestive example of progress. Railway progress since the French and German War had been enormous all over the Continent, involving the erection of bridges which displayed the very best skill and highly-developed scientific knowledge. In the empire of Russia, the whole railway system, amounting to upwards of 20,000 miles, had been laid out and constructed, and all rolling stock supplied from local or continental sources, with only a trace of English engineering to be seen here and there, although in rails, which was almost a raw material, we had been largely drawn upon. We were bound to admit that in locomotive and stationary engine building, also in machine tools, our neighbours approached us more nearly to-day than ten years ago, and yet we possessed all the essential material conditions or natural gifts and advantages that could never be, practically speaking, reduced or taken away. The answer to the question, How was it other countries were so rapidly approaching our level? was to be found in the following conditions:—Because their scientific knowledge and general mental training, plus somewhat inferior physical qualities in their people, meagre natural resources, and limited markets, with protective tariffs and little accumulated wealth, were very nearly equal to superior energy and physical qualities in our people, enormous natural resources, world-wide markets, and great distributing power, with free trade, plus our scientific knowledge and general mental training. This equation was capable of being reduced to simplex terms. Let them take away what they might truly call the natural gifts from both sides, the irregularity of which was a matter of fact, statistics showing the foreigner's poverty and our plenty; they had then remaining on the one side and on the other the factors of scientific knowledge and mental training. Out of these factors alone, therefore, the approach to equality which they had granted must be made. As it had been admitted that Great Britain was immeasurably superior in resources, they were bound to admit that on the foreign side they were greatly superior in scientific and mental training, in order to account for the inequality that now existed. Mr. Mather then at considerable length described what was being done on the Continent in the promotion of scientific, technical, and manual training for the people, and laid down in detail the system he would have adopted in this country. In conclusion, he said that had we been more wisely governed in times past our people would have had less competition to-day, for our natural gifts, with widespread scientific and artistic culture, would have retained industries that had gone, and immensely developed and cheapened the production of many that already existed. Our working people, able and skilled as they were, would have been classified by a natural law, according to their natural abilities, into trades best fitted to bring out their capacities. All men employed in mechanical pursuits would gravitate to them by a process of filtration through the various schools. Work would be dignified and honourable more than ever we had felt it to be when followed with cultivated intelligence, and the rewards of merit and industry would have been enhanced. It might be, indeed he believed it would be, in the future that employers and capitalists would not derive such large profits as in the past from the staple trades of the country, but working men and able foremen would secure more regular employment. This was as it should be. What did it matter if a few mansions the less existed and luxuries were reduced, if the homes—the comfortable, healthy, contented homes—of our workpeople were increased ten-fold. Did we not long for the time when there should be no more crying in our streets and misery at our doors, and when the garners of all should hold enough for the simple wants of life. Such a time could only come by the lifting up of the whole people to the level of their mental endowments, in the cultivation of which we should find that alone true progress lay, and upon which our future prosperity depended. The relation, therefore, between education, manual, scientific, and technical, and our professions and all trades, was as intimate and inseparable as the soul to the body, if we were to hold the first rank in the future; and he earnestly hoped that every member of that society would, in his day and according to his powers, promote those measures that would bring such education within the reach of the humblest class in every part of this great country.

A vote of thanks to Mr. Mather for his address, moved by Mr. Thomas Ashbury, C.E., and seconded by Mr. John Craven, then brought the proceedings to a close.

AMERICAN NOTES.

(From our own Correspondent.)

New York, October 3rd.

The American Government is endeavouring to ascertain through its consular service what opportunities there are in remote countries for American exports. A great deal of matter has been submitted which has been distributed to manufacturers and others interested, but little of it is of the practical kind that can be made available. Some of our foreign countries are recommending the creation of courts in oriental countries similar to those organised in Great Britain, in order to guarantee to American citizens doing business therein the same rights enjoyed by British subjects. Several other suggestions are made which involve a radical departure from previous American methods. There is not much probability of serious attention being given to trade in the far East instead of being directed for the present to Central and South American markets.

The New Orleans Exposition opens in a few days under better management, and with better prospects of accomplishing the result originally contemplated. The exhibits will be larger, more varied, and fuller, representing both the Central and South American facilities. Great dissatisfaction was created last year by the inefficient management, but these evils will be remedied, and exhibitors are earnestly invited to attend.

In financial circles everything continues smooth, and money is abundant at a low rate of interest. The banks are in good condition and anxious to run good security. The opposing forces are preparing to fight the question of tariff reduction and silver coinage in Congress. The East favours a suspension of coinage, while the West is strongly in favour for it. The probabilities are that a compromise will be agreed upon, in which the tariff men and the silver men will come first, although a very strong element will insist upon a fight to the end. Compromise measures are popular in American Congress, and it is probable that political considerations, as well as commercial, will bring about a temporary adjustment between the contending forces.

The steel rail agents report the probabilities for a heavy demand for steel rails in this market next spring. Several meetings of capitalists have been held here and in Boston within two weeks, for the purpose of completing organisation for the construction of roads. A very large amount of mileage is projected, enough to give a boom to the American iron trade if one-half of it was undertaken. Everything depends upon the growth of traffic. The existing mileage is abundantly sufficient for present traffic requirements. Agents have sold this week 15,000 tons of rails at 29 dols. to 30 dols. Heavy sales are looked for during the next thirty days at these figures. All kinds of iron and steel material are in fair request. The Pennsylvania pipe mills are overcrowded with orders, mainly for supplying pipes to convey natural gas from wells to mills. Prices are creeping up. All the sheet iron makers of Pennsylvania are also well supplied with business, and the nail mills are barely able to meet the demand. The blast furnace interests throughout the country have succeeded in advancing prices 25 to 50 cents per ton; but the blowing on of a number of furnaces will likely cause a depression.

The volume of business in textile manufacturing is larger than it has been for three years, due partly to the very low prices prevailing and to the natural expansion of demand. A great deal of machinery is being made, and, in fact, nearly all the textile machinery manufacturers have three months' orders ahead. There is a probability of a settlement of all railroad differences between the Trunk lines, the outcome of which will be an advance in rates, and more confidence in the inauguration of important railway enterprises next spring. The smaller industries are in a healthy condition. There is a heavy demand for small motive power from 1 to 20-horse power, and machine shops and foundries are increasing the labour force gradually.

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

(From our own Correspondent.)

The accounts brought to 'Change in Birmingham to-day—Thursday—and in Wolverhampton yesterday, indicated that the sheet makers have most benefitted as the result of the quarterly meetings. The order books of these firms now present a capital appearance, many of them being filled up to the end of the year, and others being beyond that time. Merchants and consumers are still offering to place contracts forward considerably beyond the date which makers will allow. For such business makers demand prices which purchasers are unprepared to give.

Hard sheets of 24 gauge are priced at £6 15s. to £6 17s. 6d. and upwards, and soft sheets of similar gauge at £7 to £7 2s. 6d. per ton, delivered in Birmingham. Hard sheets of 27 gauge are £7 15s. to £7 17s. 6d., while sheets of 20 gauge are £6 10s. to £6 12s. 6d. and £6 15s., according to individual makers.

The New Side Ironworks, Walsall, have been re-started upon sheets, in consequence of the improved trade, after having stood for nearly three months. Messrs. J. Lysaght will, it is understood, start their new Osier Bed Ironworks very shortly.

The demand for galvanised sheets keeps up, makers being busy on South American, Australian, New Zealand, and Indian account. Full work is now assured up to Christmas. Firms in the Association state that the declared advance is being generally obtained, but firms outside the Association are less positive upon the score of price. An attempt was made by some members of the Association last week to obtain the declaration of a second 5s. advance; but the majority overruled this attempt, not deeming it wise to travel upwards too fast; £11 to £12 is quoted for 24 gauge, Liverpool.

The galvanisers regard with much dissatisfaction the proposal of the Government of South Australia to impose an import tariff of 30s. per ton on plain galvanised sheets, which have hitherto been admitted duty free.

There is no diminution in the activity among the makers of thin sheets and tin-plates, and orders are being freely filled on home and export account. Buyers seem anxious to cover their requirements for some time ahead, and prices are firm. John Knight and Co. quote working-up sheets £10 10s., single gauge; soft steel sheets, £12 10s.; and charcoal sheets, £19 10s. The extras for doubles on the two first qualities is 20s. per ton, and for trebles 40s. per ton. As to charcoal sheets, the full 30s. and 60s. extras are demanded as aforetime. Crown bars the firm quotes £7 10s.; plough bars, £9 10s.; and charcoal bars, £15 10s. Crowther Brothers quote singles £10 10s., £11, £12, and £13, according to brand; semi-charcoal, £14; and charcoal, £15. Steel sheets they quote £11, £12 10s., and £13 10s., according to brand.

On Wednesday a boiler explosion, which resulted in the death of one man and injury to six others, occurred at the Shropshire Ironworks, Hadley, near Wellington. The boiler was one of a number in the forge department, and was built up of two tubes. The shells were carried a distance of 100 yards. The boiler was only started last week after a rest of several months, and had recently received a thorough overhauling.

Sales of South Staffordshire and East Worcestershire tin-plates are taking place freely at 6d. per box advance on three months ago, while on some of the current business 1s. per box advance is being obtained. Cookley coke plates are quoted 19s. per box; I.C. charcoal second quality, 20s.; and first quality, 22s. Makers here remark that the circumstance that the Welsh Tin-plate Association should have come to the conclusion that after the end of this year a stop week of one in six, instead of as now one in four, will be sufficient to effect their object, is undoubted testimony to the considerable reduction in stocks which has already been effected.

Messrs. Jno. Knight and Co. hope to commence operations in six or eight weeks at their new site at Brierley Hill, to which they are removing from near Kidderminster.

Marked bars remain at £8 2s. 6d. to £7 10s., and we are not now likely to see any alteration this year. It was with the opening of February, 1883, that £7 10s. last became the universal standard for such iron. At that date Messrs. W. Barrow and Son took the initiative in officially reducing the £8 standard which for a good time previously had been openly undersold to the extent of 10s. by the New British Iron Company and Messrs. Phillip Williams and Sons. When Messrs. Barrows once set the lead the other houses quickly followed. Messrs. Williams' quotation for best mitre bars to-day is £7 5s., and for Wednesbury Oak bars £6 per ton.

Strip iron is reported to be in slightly better request, and on the Dudley side of the district orders for tire and shoe iron have been received in better volume from Australia.

Steel of local manufacture is being put upon the market in increasing quantities, and is being bought up in the form largely of billets and blooms for rolling down purposes. Basic Bessemer blooms and billets are abundant at £4 15s. to £5 per ton, bars £6 to £6 5s., best boiler plates declared to be equal to soft steel £8, and best sheets £9 per ton.

Orders for wire rods are on the increase for home consumption. Some makers report this week that they have booked good lines. Forward inquiries are also upon the market. Orders are, however, still irregular, and some of the makers are anything like full. Rolled wire rods for local consumption are quoted £6 10s. delivered Birmingham, and drawn £7 10s. per ton. Export qualities are cheaper than the above.

The pig iron trade, after the big buying of several weeks ago, has gone quiet. "Consumers cannot always be buying," is the expressive remark of sellers this week. Hematite contracts have been entered into in some cases up to the end of 1886, but business so far ahead is exceptional.

The Tredegar brand of hematites is quoted 53s. delivered, and a second quality is offered at 44s. Barrow hematites are quoted 53s. to 54s. for forge, and 56s. to 57s. for best foundry. Ulverstone hematites are quoted 54s., and Carnforth 54s. to 55s. The price is, however difficult to get for other than small lots, although for No. 1 foundry the same brand has this week fetched 56s. 9d. per ton.

Native all-mines keep at 57s. 6d to 60s. as the quotations for hot-blasts, but 55s. regulates much of the business doing. The Lilleshall Iron Company, like the Earl of Dudley, are now blowing three furnaces. Native forge iron is quoted 45s. to 46s., native made pigs from Northampton ores 39s., and grey forge pigs 34s. down to 32s. 6d. Midland pig prices are unchanged.

Further work on account of the Indian railways is in the market.

A somewhat increasing trade is being done with the Argentine Republic in boilers, engines, lathes, and other machine tools. This part of South America seems likely to become a market of growing value for machinery of the descriptions indicated. Railway, mining, and road-making tools are also going out in large bulk.

Hardware prices are still complained of all round. Plenty of firms might be much busier if they did not refuse numbers of offers which reach them daily. Some select makers of tinned hollowwares are quite busy on colonial account, and here and there overtime has lately been made.

The Wolverhampton Chamber of Commerce have sent a long series of replies to the circular of the Royal Commission on Trade. The main matter upon which they lay stress is that of excessive railway rates and charges.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron trade of this district remains in pretty much the same condition as reported in my last week's "Notes," and the quarterly meetings have only afforded further evidence that the recent spurt has completely died away. In pig iron there is really no business of any weight doing, and the late quoted rates, although they are still nominally adhered to generally, can scarcely be said to represent the present actual basis of values in the market. When any offers are made, and these are comparatively few, they are at price s pretty much the same as those which makers were taking prior to the recent advance, and here and there a disposition is being shown to entertain offers at under current rates. The market has, however, not returned to that condition of almost hopeless depression into which it had fallen a couple of months back, as makers in most cases have still orders on their books for the next two or three months sufficient to relieve them of any great anxiety for the present; but prospects in all the large iron using branches of industry are very discouraging, consumers buying only very sparingly to cover actual requirements, and generally there is a disposition to wait for a return to about old rates, which buyers evidently regard as inevitable. Hematites have also lost what little buoyancy they seem to have received, and for these prices are almost as low as ever. Manufactured iron, which really never got up in price, except as regards some qualities of sheets, has again settled down to the low rates which have been an almost unvarying basis of prices for nearly the whole of the past year, and in the manufactured steel trade there is a generally extremely depressed tone only relieved by a moderate amount of activity in the demand for boiler plates. The condition of the engineering trades remains unchanged, slackness characterising most of the large works throughout the district in nearly all branches; the completion of old orders still keeps some of the works fairly employed, but it is only here and there in specialities that anything like activity is being maintained.

The Manchester iron market on Tuesday brought forward only a very limited weight of business. Lancashire pig iron makers reported a few offers at under their quoted rates, which remain at 39s. to 39s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester; but in district brands, for which quotations range from about 38s. 6d. to 39s. 6d., less 2½, delivered here, there seemed to be little or no business stirring. There is certainly no buying going on at makers' quoted rates, and sellers, both of local and district brands, in some instances seem prepared to come down about 6d. to 9d. upon late prices to secure orders. In outside brands there is also a disposition to accept low offers, and the best-named brands of Middlesbrough foundry are to be got at about 41s. 6d. net cash, delivered equal to Manchester. Hematites are again to be bought at as low as 51s. 6d., less 2½, for good foundry qualities delivered into this district, but the average quoted price remains at about 52s. 6d., less 2½. In manufactured iron a moderate hand-to-mouth business is reported at about £5 5s. for bars, £5 15s. for hoops, and £6 15s. to £6 17s. 6d. for local made sheets delivered into the Manchester district, and most of the forges in the district are being kept on about full time. North-country plates are offered here at very low figures, and are to be got without difficulty at about £5 5s. per ton delivered into this district.

The condition of the coal trade continues generally very unsatisfactory. Even for house fire coals there is not more than a moderate demand for the time of the year, and since the commencement of the month there has been a decided falling off. Most of the collieries are kept on about full time, but the output is generally quite sufficient to meet requirements, and there is comparatively very little coal being filled up out of stock. Common round coals are still very bad to sell for ironmaking and steam purposes, and engine fuel continues a drug in the market, with stocks of slack accumulating rapidly at most of the collieries. For house fire coals prices are about steady at a small advance upon last month's rates, the upward movement not having gone beyond 6d., but in other descriptions of fuel they continue as low as ever, and slack is pushed for sale at excessively low figures. At the pit mouth best coal averages 9s. per ton up to 9s. 6d.; in some instances seconds house coal about 7s. 6d., and common house fire qualities about 6s. per ton; for steam and forge coals not more than about 5s. 6d. is being got; burgy, 4s. 6d. to 4s. 9d., with ordinary qualities of slack to be bought in bulk for prompt delivery at from 2s. per ton, although for some of the best sorts from 3s. 6d. to 4s. per ton is quoted.

In the shipping trade business is generally quiet, and for good qualities of steam coal delivered at the high-level, Liverpool, or the Garston Docks prices do not average more than 7s. to 7s. 3d. per ton.

The agitation for an advance of wages in the coal trade now waits for the next move on the part of the men. The circular sent out requesting an advance of 15 per cent. having met with the only response that could be expected, the men have to consider whether they shall take any further measures to secure the object they have in view. That they are likely to resort to a strike seems altogether out of the question; working short time appears to be most in favour, but it would seem to be scarcely requisite to organise a special combination to effect a restriction of the output, which the necessities of trade will of themselves probably render imperative.

Barrow.—The experience of the past few weeks in the hematite pig iron trade of this district has justified the anticipations indulged in some time ago that during the autumn months of this year there would almost be a complete absence of activity in demand. It is noteworthy that a firmer tone sprang up a week or two ago in the hematite trade, and that makers found themselves in a position of not having a great deal of iron to sell, owing to the reduction in the output of the furnaces, and the consequent diminution of the amount of pig iron for sale over and above that required to meet current contracts. There is no change to note in the attitude of foreign users of iron, their wants being still very few in number, and as a whole, limited in extent. The business doing in Bessemer iron is quieter than it would be if steel-makers themselves used any quantity of this metal, but they themselves are short of orders, and are working in all departments short time. The output of rails and all classes of railway material is comparatively small, and the orders in hand are inconsiderable and unimportant. The work in hand in respect to steel for merchant purposes of every description is comparatively slight, and the only department in which there is even a semblance of activity is that of tin bars. The shipbuilding trade is not supported by any active demand. Very few inquiries are being made for new ships or steamers, and the competition for these is very active. The profits now made by shipbuilders are comparatively *nil*, and their yards are very indifferently supplied with work. The work in the hands of engineers is for the moment very considerable, owing to the fire which took place at the shipyard at Barrow a few weeks ago. This has necessitated a transfer of several heavy marine engineering jobs from the large shipbuilding yard at Barrow to several minor works in the town. Ironfounders are doing but a limited trade. Iron ore is in quiet request at easy rates. Coal and coke are in short demand at easy rates. Ship-p ng is again very quiet.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

September gives us some idea of the export trade for the year, the third being usually the crucial quarter for that portion of the business. An analysis of the Board of Trade returns shows that September has been about as unsatisfactory a month as any that have preceded it. The exports decreased rather over 9 per cent., and the imports slightly over 7 per cent., compared with the corresponding month in each of the two preceding years. Hardware and cutlery, as compared with September, 1884, shows a decrease, the respective values being, last month, £252,159 and £264,301. Bar, angle, and bolt iron has fallen from £177,505 to £160,738; hoops, sheets, and plates, from £327,198 to £317,124; steel rails has increased from £189,444 to £208,863; railroad material of all sorts has decreased from £327,198 to £317,124; unwrought steel has fallen from £93,444 to £91,201. For the nine months the values for 1884 and 1885 come out thus:—Hardware and cutlery, £2,367,943 and £2,102,813; bar, angle, and bolt, £1,412,456 and £1,230,308; hoops, sheets, and plates, £2,764,714 and £2,419,285; steel rails, £278,506 and £2,200,778; railroad of all sorts, £3,166,282 and £3,074,152; unwrought steel, £856,959 and £738,837.

In hardware and cutlery the decreasing markets for the nine months are—Russia, from £32,823 to £30,601; Germany, from £128,549 to £118,821; Holland, from £72,228 to £56,370; France, from £112,618 to £100,273; Spain and Canaries, from £71,262 to £57,645; the United States, from £255,697 to £217,123; Foreign West Indies, from £34,721 to £27,264; Brazil, from £129,555 to £97,230; British North America, from £103,806 to £87,056; British Possessions in South Africa, from £49,923 to £46,223; British East Indies, from £205,135 to £188,948; Australasia, from £447,575 to £459,035; and other countries, from £647,061 to £537,012. Only one market has increased, the Argentine Republic from £75,990 to £79,147. Unwrought steel has been exported during the nine months ending last September to the value of £738,837, against £856,969 for the corresponding month of 1884. France shows a decline from £85,241 to £70,628; the United States from £229,102 to £166,386.

Steel rails show the most astonishing fluctuations. For the nine months Spain and Canaries fell from £63,712 to £19,490, while Egypt rises from £23,678 to £122,830. The United States market drops from £83,720 to £26,035, and Mexico from £13,131 to £3128; Brazil, from £164,914 to £76,989; the Argentine Republic, from £285,353 to £119,216; Chili and Peru diminish by one-half; while British North America advances from £220,339 to £365,350, and British East Indies from £344,188 to £680,521. Australasia also shows a decided improvement, both for the month and for the nine months, the value to September last being £470,848, against £332,422 for the nine months of 1884.

A noticeable feature of the return is the fact that a marked decline is shown in values—more marked even than in quantities. Iron and steel have increased in bulk exported by nearly 12,000 tons, while the value is less by nearly £300,000. This proves that prices are still tending downwards in iron and steel and other goods.

An increase of 10,000 tons is reported in the quantity of coal forwarded from the Yorkshire collieries to Hull. For the nine months, however, there is a decrease of nearly 25,000 tons when compared with the corresponding period of 1884. In exports there has been an increase of about 1600 tons for the month, and over 22,000 tons for the nine months. The tonnage sent to Hull last month reached a total of 137,568, against 133,808 tons in September, 1884. Trade with the Baltic ports is again falling off; North Russia, with 35,000 tons, takes about one-third of the entire quantity exported—more than double the weight sent to that market in September, 1884. The collieries on the new Hull and Barnsley line are making progress; New Oaks, which has a direct siding to the new line, sent 2360 tons against 264 tons in September last year; Carlton Main, which has also direct communication, increased from 2352 tons to 3808; Monkton Main, from 768 to 2416 tons; Wombwell Main, where the Silkstone bed is being sunk to, from 360 tons to 1528. Frystone, Denaby, and other collieries are still suffering from the stoppage and strike of the early part of the year. Allerton Main is at the head of the list for the month with 10,720 tons; but Manvers Main, for the nine months, shows the largest total—67,792 tons.

The South Yorkshire Coalowners' Committee met at Sheffield on Tuesday, when they had before them the request of Mr. B. Pickard, the miners' secretary, for an interview with fifteen of a deputation, to consider the demand for 15 per cent. advance in wages. The Committee were asked to convene a general meeting of the coal-owners to consider the question; but this they have declined to do, on the ground that the condition of the coal trade does not warrant any advance in wages, and that no useful object would therefore be served by calling the coalowners together. With regard to the other portion of their request, to deliberate about the regulation of wages for the future, the coalowners intimate that they are quite willing, as they always have been, to consider a scheme for the regulation of wages in the future by the adoption of a sliding scale. It is expected that West Yorkshire coalowners will join South Yorkshire in stubbornly resisting this fresh effort to disturb the coal trade as it was quietly recuperating from the effects of the disastrous strike in the early part of the year.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland pig iron trade is in much the same condition as it was last week. The market held at Middlesbrough, on Tuesday, was very quiet and lifeless, neither buyers nor sellers caring to do business, either for prompt or forward delivery. Merchants offered small lots of No. 3 g.m.b. for prompt delivery, at 32s. 4½d. per ton, and in one or two cases they accepted 32s. 3d. Makers would not sell at these prices. Several of them are designedly keeping out of the market, whilst others will take nothing below 33s. per ton. The demand for forge iron continues poor, but the price remains at 31s. 6d. per ton.

Warrants are still firmly held, and the price quoted by most holders is 33s. 6d. per ton.

The stock of pig iron in Messrs. Connal's Middlesbrough stores is gradually increasing. During the week ending Monday last 3347 tons were sent in, raising the total to 105,045 tons.

Shipments are fairly satisfactory, being about the same as last month. Up to Monday night 32,629 tons of pig iron had been sent away, 13,990 tons being for Scotland, and 8600 tons for Germany and Holland.

There is no improvement whatever in the finished iron or steel trades, and no alteration in quoted prices. The greater part of the work done by plate-makers now is for girders and bridges, there being very little required for shipbuilding purposes.

The net average selling price of No. 3 g.m.b. during the three months ending September 30th last was only 32s. 8·6d. per ton, being 1s. 10½d. less than the previous quarter. The wages of iron-stone miners will be reduced ¼d. per ton, and other classes of men employed at the mines will be reduced from 2 to 2½ per cent.

In the Northumberland coal trade, the net average price realised for coal during June, July, and August, was 4s. 11¾d. per ton. Under the sliding scale colliers' wages will remain unaltered during the next three months.

The value of goods exported from Middlesbrough last month, exclusive of coal and coke, was £167,507, being a decrease of £34,665 in comparison with September, 1884.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow iron market has been comparatively firm in the past week. Warrants are well held, and when they have been required by operators they have repeatedly been difficult to obtain. A moderate inquiry is reported for pigs for shipment. The shipments of last week aggregated 9250 tons, compared with 11,296 in the preceding week and 11,661 in the corresponding week of 1884. To Canada increased quantities continue to be sent, while there has been a slight improvement in the consignments to the United States. The output of pigs is steadily maintained without change. During the week 1517 tons were added to the stock in Messrs. Connal and Co.'s Glasgow stores.

Business was done in the warrant market on Friday at 42s. 10d., 43s. and 42s. 7½d. cash. On Monday there was a good demand at 42s. 7½d. to 42s. 8d. cash. There was also a good business on Tuesday at 42s. 7d. to 42s. 9d., closing at 42s. 7d. cash. Business was done on Wednesday at 42s. 6d. to 42s. 5d. cash. To-day—Thursday—the market was depressed, with business at 42s. 6d. to 42s. 4d. cash.

In some cases the market values of makers' pigs are a shade lower, the current quotations being:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s.; No. 3, 44s.; Coltness, 49s. and 45s. 6d.; Langloan, 47s. 6d. and 45s.; Summerlee, 47s. 6d. and 43s. 6d.; Calder, 51s. 6d. and 43s. 6d.; Carnbroe, 45s. 6d. and 43s.; Clyde, 46s. 3d. and 42s.; Monkland, 42s. 9d. and 40s. 6d.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 42s. 9d. and 40s. 6d.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. and 43s. 6d.; Glengarnock, at Ardrossan, 46s. and 42s.; Eglinton, 42s. 3d. and 39s. 6d.; Dalmellington, 43s. 6d. and 40s. 6d.

Messrs. Thomas Edington and Son, of the Phœnix Ironworks, Glasgow, have obtained the contract to supply 480 tons of cast iron pipes for Lockerbie Waterworks, the price being £2203.

The want of employment at the Johnstone Engineering Works has induced the employers to give notice of certain modifications in the system of paying for overtime. Hitherto it would appear that overtime has been remunerated somewhat liberally at these works, and now that orders are difficult to obtain, it is hoped that the operatives will accept the modifications proposed without opposition.

The past week's shipments of iron and steel manufactures from Glasgow included two locomotives and tenders, valued at £5000, for Bombay; a small steam launch, worth £500, for Monte Video; £21,500 worth of machinery, including sugar-crushing plant to the value of £9000, for Trinidad, £4000 ditto to Berbice, and £2720 ditto to Antigua and Jamaica; £3880 steel goods, and £34,200 general iron manufactures to different parts of the world.

In the Scotch coal trade there has been rather less doing in the past week. The shipments embraced 17,000 tons despatched from Glasgow, 10,647 from Grangemouth, 9827 from Troon, 7070 from Ayr, 6131 from Leith, 1915 from Irvine, and 737 from Greenock. There has been in recent years a very large decline in the exports of coals from Greenock, which is considered very unfortunate in view of the fact that enormous extensions of the harbour accommodations are now in course of being carried out. For the twelve months ending with 7th September last the shipments of coals at Greenock were in the aggregate only 68,471 tons, whereas in the corresponding twelve months of 1881-82 they amounted to 135,737 tons. This extraordinary decline is attributed to the want of facilities by the railway companies in the shape of low rates of carriage. Over the whole of the Scotch mining districts there is now evidence that the demand for shipment of coal is materially slackening for the season. The northern ports of Europe will shortly be closed, and a very important outlet thus cut off until the spring.

The resolution of the coalmasters of the West of Scotland, adopted a fortnight ago, not to employ any extra men when individual collieries were on strike, has been most effectual in putting an end to the practice adopted by the union of shutting certain pits until their demands should be conceded. The prices are low all over, and unless they can be advanced through an extra demand on account of cold weather, the masters declare that they will not be in a position to advance the miners' wages.

It is reported that the Broxburn Oil Company is likely to abandon the trial lease it obtained some months ago on the Earl of Hopetown's estate, in consequence of not being satisfied with the quality of the shale disclosed by boring operations. The company is said to have secured a lease of a shale field in Linlithgowshire, which belonged to the late Earl of Selkirk.

Mr. A. C. Thomson, the new manager of the Lanark Oil Company, has effected great improvements in the works both at Tarbrax and Lanark, and in consequence of these it is expected that the company will be more successful in the future than it has been in the past.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The great coal sinking at Ynysybwl has been carried forward another stage. Having gained the 4ft., the sinkers next proceeded to try for the 6ft., and this they succeeded in winning a few days ago. The 6ft. 9in., as the seam really is, is good hard coal, and regarded as of splendid quality. The Messrs. Beith having arched this over, went on with their sinking, and won another seam 6ft. 6in. also excellent coal, and they are now working with increased zeal for the 9ft. If this be gained, as anticipated, in about 30 yards, Messrs. Davies and Co. will have the largest area of the best coals in the district.

The sinking at another important colliery in the Taff Valley, that of Ynyscadndwg, is proceeding vigorously, and this week a rider was struck, so it is conjectured that the 4ft. seam is not far off.

There have been few periods in our coal history when coal winning was so successful, and, strangely enough, few when times are so unmistakably bad. House coal is beginning to look up. Present figures are 8s. 3d. for No. 2, and 8s. 9d. for No. 3. Pit-wood is in moderate demand, from 16s. to 16s. 6d. per ton. Iron ore dull, and small in quantity.

Messrs. Crawshay have secured the contract for supplying the Pacific Steam Navigation Company at Liverpool with their requirements there, and the Bute, Merthyr, and Lewis's, Merthyr, for the f.o.b. requirements at Cardiff and Newport. The Glamorgan, Rhondda Valley, has also been fortunate in getting a coal contract for Bombay. The Dowlais coal trade is not so brisk, on account of the idleness of the colliers. The company hold good orders, but the men are so slow in resuming work at the beginning of the week that serious delays take place. The company will now take active steps, and twelve men have been summoned as a first batch.

The iron trade shows no improvement, and the certainty of a reduction is now admitted at Cyfarthfa, Dowlais, Tredegar, Rhymney, Ebbw Vale, and Blaenavon. The figure will probably not exceed 5 per cent., and this will be serious to one class.

The ruling price for labourers' wages in the ironworks is 1s. 10d. per day, and few of the best tradesmen get more than 25s. a week.

Stocking is carried on to a great extent, and I note that at Cyfarthfa in particular, where an immense stock of pig has been gathered, steel rails are now being laid by in considerable numbers. I regret to state that one of the managers, Mr. Leybourne, was seriously injured in the steel works on Tuesday.

One important cargo of steel rails left Newport for the Cape last week.

Never since the combination, says an authority, is the tin trade so healthy. This is the case all over the district; orders are coming in well and quotations are firm. At Swansea, stocks are sinking fast, production being less than demand. Buyers are placing freely at improved figures, especially for Siemens steel plates, which are now worth 15s. 6d. Coke tin is in strong demand at 14s. 6d.; 800 tons of plates left Swansea for Halifax this week. Briefly, I do not remember for a long time such an animated condition of this important trade.

Strong hopes are held out of a fusion between the Rhymney and Taff Vale lines. This I have long and persistently advocated in this column for the good of all concerned, and it seems most probable that in despite of the opposition of the Rhymney chairman it will be carried.

In the local press fusion also between the Great Western Railway and the London and North Western Railway is being advocated as the best way of lessening expense and improving dividends.

Mr. W. T. Lewis is expected to return to Wales in the course of another week.

NEW COMPANIES.

THE following companies have just been registered:—

Clarke, Johnson, and Co., Limited.

This company proposes to trade as patent agents and agents for the purchase, letting, and sale of inventions, whether patented or not. It was registered on the 5th inst. with a capital of £50,000, in £25 shares, with the following as first subscribers:—

	Shares.
F. C. Hoyle, 4A, Benhill-road, Sutton, cashier	1
Alfred Gardner, 19, West-road, West Ham, clerk	1
C. W. Phillips, Sidcup, Kent, land agent, &c.	1
E. J. Pearson, 105, Morning-lane, Hackney, reporter	1
J. W. Hutchinson, 431, Kingsland-road, draughtsman	1
J. H. Waldock, 19, Summer-road, Peckham, law writer	1
E. J. Wills, 15, Swan-street, Great Dover-street, shorthand writer	1

Most of the regulations of Table "A" of the Companies' Act, 1862, apply to the company.

Birmingham Warehouse Company, Limited.

This company proposes to trade as general merchants, factors, and commission agents, and will take over the business carried on by Joseph Peverelle and John Hawkesford at Halifax-buildings, Pershore-street, Birmingham, wholesale hardware merchants and general fancy goods importers. It was registered on the 6th inst. with a capital of £20,000, in £5 shares. An agreement of 30th ult. regulates the purchase. The consideration for the goodwill is £450. The plant, trade utensils, stock-in-trade, goods, and other effects will be taken at a valuation, to be made by Mr. William Fletcher, 23, Edgbaston-street, Birmingham. The subscribers are:—

	Shares.
*J. D. Porta, Princes-street, Shrewsbury, general merchant	50
*Henry Wareing, 13, Francis-road, Edgbaston	50
*William Ramsden, Pershore-street, Birmingham	20
*J. Peverelle, Pershore-street, Birmingham, hardware merchant	20
*J. Hawkesford, Pershore-street, Birmingham, merchant	20
W. H. Bulpitt, Camden-street, Birmingham, tin-plate worker	5
J. Lyne, 12, Pershore-street, Birmingham, manager	5

The number of directors is not to be less than three nor more than five; qualification, 20 shares; the first are the subscribers denoted by an asterisk. Rumuneration, £100 per annum to the chairman, and £50 per annum to each director; also 10 per cent. of net profits remaining after payment of 7½ per cent. upon the ordinary shares.

Blyth Dry Dock Company, Limited.

This company was registered on the 7th inst. with a capital of £15,000, in £10 shares, to purchase from Mr. Francis Whitehead the lease of the Blyth Dock, with all appurtenances belonging thereto, and to carry on business as shipbuilders, repairers, and owners, engine and boiler-makers, dry dock and slipway owners, &c. The subscribers are:—

	Shares.
*John Dent, jun., Custom House-chambers, Newcastle, shipowner	1
*J. D. Milburn, Queen-street, Newcastle, shipowner	1
*W. R. Smith, Bridge-street, Blyth, bank agent	1
J. R. D. Lynn, Bridge-street, Blyth, solicitor	1
F. Whitehead, Stanley-street, Blyth, engineer	1
W. Whitehead, Waterloo, Blyth, ironmonger	1
D. T. Hobkirk, Jesmond, Newcastle, clerk	1

The number of directors is not to be less than three nor more than five; qualification, £500 of nominal capital; the first three subscribers are appointed directors. Remuneration, £100 per annum, and a further sum of £10 per annum for each £1 per cent. dividend above £10 per cent. per annum.

City of Para Tramways Company, Limited.

On the 6th inst. this company was registered with a capital of £125,000, in £10 shares, to acquire a concession from the Government of the Province of Pará, Brazil, for the construction and working of tramways in the City of Pára, or the neighbourhood thereof. The subscribers are:—

	Shares.
Emil Josaphat, 11, Duke-street, London Bridge, wine merchant	1
J. G. B. Elliot, 103, Forest-road, Dalston, accountant	1
J. A. Eaton, C.E., 49, Starch-green-road, W.	1
A. Thorne, 38, Old Jewry, accountant	1
A. Challenor, 10, Gray's-inn-square, secretary to a company	1
S. Samuels, 18, Old Broad-street, stockbroker	1
E. H. Margetti, Park-hill, Clapham Park	1

The number of directors is not to be less than four nor more than seven; qualification, shares or stock of the nominal value of £200; the subscribers are to appoint the first, and may act *ad interim*; remuneration, £800 per annum.

Greystone Manganese Works, Limited.

This company proposes to acquire and work the Greystone Manganese Mines situate in the parish of Lezant, Cornwall. The locality in which the property is situate being within the jurisdiction of the Stannaries Courts, the company was registered at Truro on the 7th inst. with a nominal capital of £3000, divided into 20 shares of £100 each, and 1000 shares of £1 each. The subscribers are:—

	Shares.
W. Glenn Spence, 32, Shawbury-road, East Dulwich, commercial traveller	1
James Simpson, 2, Frederick-terrace, East Dulwich, share dealer	1
W. Reynolds, East Dulwich	1
W. H. Dutton, East Dulwich	1
S. Smith, 34, Shawbury-road, East Dulwich, builder	1
H. W. Filkin, Albany-road, Camberwell, engineer	1
W. H. Simmonds, Albany-road, Camberwell, commercial traveller	1

The number of directors is not to exceed seven nor to be less than two; the subscribers are to appoint the first; qualification, shares of the nominal value of £100. The remuneration of the directors will be determined by the board, subject to confirmation at the ordinary annual meeting.

Gokak Water Power and Manufacturing Company, Limited.

This company proposes to carry into effect an unregistered agreement between James George Smith, Charles Douglas, and Magnus Mowat of the first part, Walter Mardon Ducat of the second part, Andrew Hay of the third part, and the company of the fourth part, and any supplementary or additional agreements with the Secretary of State for India in Council. It further proposes to acquire water rights, and to construct waterworks in India, and also to carry on business as cotton growers and spinners, millers, warehousemen, weavers, and agriculturists. It was registered on the 2nd inst. with a capital of £100,000, in £10 shares, with the following as first subscribers:—

	Shares.
*A. H. Campbell, White Lion-court, Cornhill, merchant	1
*Quintin Hogg, 23, Rood-lane, merchant	1
*J. Parker Smith, Jordan-hill, Renfrewshire, barrister	1
J. G. Smith, Union Bank-buildings, Liverpool, merchant	1
M. Mowat, 47, Granville Park, Blackheath, merchant	1
A. Hay, Henrietta-street, Cavendish-square, exchange broker	1
T. Brocklebank, Molyneux, Taylor, and Co., Exchange-buildings, Liverpool	1

The number of directors is not to be less than three nor more than ten; qualification, 100 shares; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

La Guaira Harbour Corporation, Limited.

On the 6th inst. this company was registered with a capital of £300,000, in £20 shares, to acquire a concession dated 21st May, 1885, and ratified 25th June, granted by the Government of Venezuela to Messrs. Punchard, McTaggart, Lowther, and Co., of 151, Cannon-street, for (amongst other things) the construction, equipment, and working of a harbour and harbour works at La Guaira. The subscribers are:—

	Shares.
Gilbert K. Trench, C.E., 60, Princes-street, Edinburgh	1
W. H. Jeffers, 37, Parkholme-road, Dalston, accountant	1
Major-General E. Beresford, Bay's-hill, Cheltenham	1
L. A. Golla, C.E., 61, Abingdon Villas, Kensington	1
Lieut.-Colonel C. Wolesley Cox, Army and Navy Club	1
H. J. Carnegie Williams, C.E., 2, Yelverton Villas, Twickenham	1
H. Lee Smith, Whitehall Club, M. Inst. C.E.	1

The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first and may act *ad interim*; qualification for subsequent directors, 25 shares; remuneration, a sum equal to £500 per annum for the chairman, and £250 per annum for each other director.

Mapperley Colliery Company, Limited.

This company proposes to acquire the Mapperley Colliery, Derby, with the machinery and effects of the same, and certain coal and other mining rights, &c., situate in the townships or parishes of Mapperley, Stanley, and Smalley, in the county of Derby, and also certain lands and cottages at Stanley-common and Ilkeston, and the stock of a farm called Stanley Farm. It was registered on the 5th inst. with a capital of £20,000, in £10 shares. The subscribers are:—

	Shares.
*H. Simpson Gee, Leicester, manufacturer	100
W. H. Walker, Birstall Hall, Leicester, retired manufacturer	100
*G. H. Hodges, Oadby Frith, Leicester	100
George Pearce, M.D., Leicester	100
S. Stephens, Bankart, Leicester	100
E. Knapp Fisher, Market Harborough, ironmaster	100
G. Toller, jun., Leicester, solicitor	30

The number of directors is not to be less than three nor more than six: qualification, 50 shares; the first are Messrs. G. E. Checkland, of Desford, Leicester; Horace Cullen, of Copthall-court, E.C., and the subscribers denoted by an asterisk.

THE RAILWAY WORKS OF THE UNITED KINGDOM. — CAPITAL AND EXPENDITURE.

THE returns recently issued of the aggregate capital and expenditure on British railways, brought down to the present year, show an outlay almost fabulous in this important department of engineering construction. The authorised capital of the forty-two chief lines open for traffic was, at the time the returns were made up £742,417,327, of which sum £547,590,701 is represented by stocks and shares, and £194,826,626 by loans and debenture stock. The created capital amounts to £722,964,915, or to within about 2½ per cent. of the sum authorised by the several companies' Acts of Parliament. The aggregate length of these forty-two railways is 17,280 miles, and to this mileage has to be added 232 miles, the total length of nine other minor lines, the capital and expenditure on which are not given in the returns. The total length of railways in the United Kingdom now open for traffic is thus 17,512 miles, which will shortly be still further increased on the completion of the several new lines in different parts of the country now in course of construction. What may be classed as the fifteen leading lines represent £644,246,356 of the total capital of the forty-two chief lines above mentioned, leaving £78,718,559 as the created capital of the remaining twenty-seven lines of lesser length. The fifteen leading lines have an aggregate length of 13,475 miles, an analysis showing that as regards mileage the Great Western Company stands at the head, whilst the London and North-Western Company has the largest amount of capital, being £101,771,907, with a mileage of 1794 miles. As regards capital, the Midland Company is next in amount, with £76,549,267, and 1270 miles of railway. The capital of the Great Western Company is £75,108,424, and its length of railway 2300 miles. Then follows the North-Eastern, with a capital of £57,650,895, and 1536 miles of railway; the Great Eastern, capital £41,087,103, and 919 miles of railway; the Caledonian, capital £39,342,700, and 772 miles; the Great Northern, capital £35,380,050, and 949 miles; Lancashire and Yorkshire, capital £41,852,949, and 496 miles; North British, capital £33,576,211, and 984 miles; London and South-Western, capital £29,455,931, and 818 miles; Manchester, Sheffield, and Lincolnshire, capital £27,248,627, and 291 miles; London, Chatham, and Dover, capital £25,634,008, and 176 miles; London and Brighton, capital £23,768,899, and 455 miles; South-Eastern, capital £21,915,824, and 385 miles; and Glasgow and South-Western, capital £13,921,570, and 338 miles.

Turning to the general expenditure we find that the total outlay in the construction of works on the forty-two lines of railway down to the period already referred to was £628,267,516, of which £521,192,056 was expended on the fifteen leading lines above enumerated, the amount of capital outlay on the London and North-Western line having been £93,648,577; on the Midland line, £75,400,732; the Great Western, £73,021,660; the North-Eastern, £57,683,854; the Lancashire and Yorkshire, £39,267,505; the Caledonian, £39,162,742; the Great Eastern, £37,156,789; the Great Northern, £35,167,228; the North British, £33,140,692; The London and South-Western, £26,911,870; the Manchester and Sheffield, £26,464,875; the London, Chatham, and Dover, £25,798,783; the London and Brighton, £23,282,242; the South-Eastern, £22,323,707; and the Glasgow and South-Western line, £12,760,800. In cost of construction the three lines immediately within the Metropolitan district have been the most expensive, the Metropolitan line, with a capital of £11,918,113 and 19¾ miles of railway, having cost an average of £560,000 per mile; the Metropolitan District line, with a capital of £8,169,444 and 13 miles of railway, £645,000 per mile; and the North London line, with a capital of £4,229,166 and 12 miles of railway, £360,000 per mile. The construction of the purely metropolitan portions of the several great lines having their termini in London has been almost equally costly, especially the expenditure on the Great Eastern, London and South-Western, London, Chatham, and Dover, London and Brighton, and South-Eastern lines.

AMERICAN TEA TRAINS.

THE third Transcontinental Tea Train over the Denver and Grande road, consisting of fifteen cars, passed through Pueblo at eight o'clock, on the morning of September 4th. A fine piece of switch work was done by the railroad boys when it arrived; they changed engines, changed cabooses, and added three more cars of freight to the train all on the wing, not stopping the train at all, which kept on running through the town at a rate of not less than twelve miles an hour. The manner in which this work was performed was as follows:—An engine was held ready on the main track, while the incoming engine was cut off and switched on to a side track, allowing the cars to run up to the fresh engine, which started up and allowed them gradually to come together. The caboose was dropped off, and the third engine was ready on another side track and overtook the train after it got past the switch, and attached three cars and a new caboose while all were in full motion. This was done under the supervision of the yard master, Sam Stewart, late of the O. and M. Railway. These three tea trains, of which the one just described was the third, have caused large mention among the men here. The men at Grand Junction and Salida did the yard work in from five to twelve minutes, and telegraphed to Pueblo, "How is that?" This put the Pueblo men on their metal, and the second train was stopped in that city only 1 min. 40 sec., and the third train is recorded as having arrived and departed at 8 a.m., not showing any stop at all.

The train was brought to Pueblo by Engineer Hill and Conductor Harrison, having come from Salida, ninety-seven miles, in 3 hrs. 27 min. It was taken north by Engineer Daley and Conductor Wilds, and reached Denver, a distance of 120 miles in 6 hrs. 20 min. This freight was transferred at Denver to the B. and M. cars at the rate of 10 min. to each car.

The second train consisted of twenty-five carloads of tea on the way from San Francisco to New York, valued at nearly a million of dollars. It made the trip over the entire length of the Denver and Rio Grande Railway, Ogden to Denver, including the mountain divisions between Grand Junction and Canon City, over grades of 211ft. to the mile at the rate of twenty miles an hour.—*American Journal of Railroad Applicances.*

THE COAL-FIELDS OF THE NORTH OF FRANCE — For the first time since 1849 the output of coal from the mines in the North of France shows a decrease, the total for 1884 having been 9,430,000 tons, as against 10,050,000 tons in 1883, this being equivalent to a diminution of rather more than 6 per cent. According to the returns which have come to hand for the first six months of the present year this decrease is likely to be still more marked, and at the same time there has been a falling off in the quantity of coal imported, amounting to about 11 per cent. for last year. According to the returns published by the Minister of Public Works, the number of miners employed in the Northern coal mines is 47,152, out of a total of 113,000 for the whole of France. The amount of money paid annually to them in wages is £5,080,000, this being equivalent to £49 for each man, but while in some of the Southern coal mines, notably in the department of the Gard, the wages amount to £51, they fall as low as £43 10s. in the Nord. This sum does not include indirect additions to wages, such as house rent at a reduced rate, medical relief, coal, &c., which cannot well be put into figures. The average cost of raising the coal is as nearly as possible 5s. a ton for the whole of France, but while it is as low as 3s. 10d. in the basin of the Allier and 4s. 2d. in the Pas de Calais, it reaches 6s. 6d. in the coal mines of the Gard. The average annual output of each workman is 263 tons for the whole of France, being 320 tons in the department of the Aveyron, 293 tons in the department of the Gard, and only 287 tons in the Pas de Calais. Many of the French coal mines appear to be worked at a loss, for the official returns for 1883 state that while 190 realised a total profit of £1,712,287, the 125 others showed a loss of £253,722. This leaves a balance of £1,458,565, which represents a net profit of about 4½ per cent. on the capital invested.

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.

6th October, 1885.

11,851. CLIP or FASTENER for BRACE-ENDS, &c., S Taylor, Manchester.
11,852. EXTINGUISHING FIRES, W. Black, Leicester.
11,853. SECURING HANDLES to BRUSH HEADS, W. G Richard, Leicester.
11,854. STEEL, B. D. Healey, Liverpool.
11,855. CORSET FASTENERS, F. R. Baker, Birmingham.
11,856. COMBINED DRESS SUSPENDER and BUTTON, F. R. Baker, Birmingham.
11,857. CORSET FASTENERS, F. R. Baker, Birmingham.
11,858. ADJUSTABLE TENSION SADDLE for BICYCLES, &c., F. W. Bagshaw, Sheffield.
11,859. HOLDERS for PLATES, &c, G. E. Morgan, London.
11,860. KNIFE-CLEANER, J. E. Hayward, Birmingham.
11,861. ELECTRIC GLOW LAMPS, J. Swinburne, Brockley.
11,862. PREVENTING WASTE in TAPPING BEER CASKS, &c., W. P. Ingham, Middlesbrough.
11,863. PROPELLING SHIPS, &c., F. W. Richardson, West Hartlepool.
11,864. BOILING SIZE UNDER STEAM PRESSURE, A. Hitchon, Accrington.
11,865. AUTOMATICALLY CLOSING, &c., the DOORS of RAILWAY CARRIAGES, C. H. Crowther, London.
11,866. TAPS for LIQUIDS, A. and W. England, London.
11,867. BOTTLE OPENER, H. Youle, Sheffield.
11,868. LUBRICATORS for STEAM ENGINES, G. Fletcher, Halifax.
11,869. ALARM APPARATUS for TRAM-CARS, W. Elges and J. Riedel, London.
11,870. PREVENTING NUTS from WORKING LOOSE, E. Beaven, London.
11,871. CAMERA LUCIDA, E. de Pass.—(*J. Vesque, France.*)
11,872. REMEDIAL FOOD for MAN and ANIMALS, T. Welton, London.
11,873. BATH for ANNEALING STEEL, R. W. Taynton, London.
11,874. PORTABLE and SUSPENDING CANDLE LAMP, B. Wecksler, London.
11,875. HOLDER for SUPPORTING SMALL SAUCEPANS, &c., OVER the TOPS of LAMP or GAS CHIMNEYS, H. H. Leigh.—(*A. Champagne, France.*)
11,876. CARBON FILAMENTS for ELECTRIC LIGHTING, T. V. Hughes and C. R. Chambers, London.
11,877. NAILMAKING MACHINES, A. M. Clark.—(*F. A. and F. C. Gleason, United States.*)
11,878. SPINNING RINGS and TRAVELLERS, H. L. Hayden, London.
11,879. METAL-COVERED ELECTRICAL CONDUCTORS, J. Tatham, London.
11,880. UTILISING LEATHER WASTE, J. W. Davies London.
11,881. NEEDLES and SHUTTLES of SEWING MACHINES J. Colquhoun, Glasgow.
11,882. SELF-ACTING VALVE or VENT APPARATUS, Sir W. Vavasour, London.
11,883. VELOCIPEDES, H. F. Napper, London.
11,884. WITHERING and DRYING LEAVES of PLANTS, &c., J. A. R. Main and J. Dick, Glasgow.
11,885. VALVE GEAR for STEAM ENGINES, W. H. Wheatley and J. W. MacKenzie, London.
11,886. AUTOMATICALLY DELIVERING GOODS in EXCHANGE for COIN, W. W. Meadows, London.
11,887. ELECTRIC SIGNALS, J. J. Rathbone, London.
11,888. ROTARY ENGINE, G. Kingdon, F. C. Simpson, and J. B. and E. F. Denison, London.
11,889. MEASURING CARPETS, &c., W. R. Lake.—(*E. H. Eisenhart, United States.*)
11,890. TREATING VENEERS, H. J. Haddan.—(*H. J. Harwood, United States.*)
11,891. PISTON PACKINGS, H. J. Haddan.—(*G. Delagneau and J. H. Graham, United States.*)
11,892. DECORTICATING RAMIE, &c., H. J. Haddan.—(*J Breuer, France.*)
11,893. SPANNERS, W. Martin, London.
11,894. CUTTING PUNCHES, &c., A. J. Boult.—(*L. B. Benton, U.S.*)
11,895. CAR AXLE BOXES, R. Brewer and C. M. Zeh, London.
11,896. AXES, W. C. Kelly, London.
11,897. HALTER, HARNESS, and other CHAINS, A. W. Cox, London.
11,898. TELEMETERS, W. P. Thompson.—(*C. L. Clarke, United States.*)
11,899. BAKING SUGAR, WAFER CAKES, &c., G. S. Baker, London.
11,900. KEYBOARDS for MUSICAL INSTRUMENTS, A. J. Boult.—(*W. T. Weir, U.S.*)
11,901. LATCH LOCKS, G. H. Chubb and G. G. Exton, London.
11,902. CORSETS, G. F. Redfern.—(*Messieurs Pomeyrols, France.*)
11,903. AUTOMATICALLY ALLOWING ESCAPE of GASES, G. F. Redfern.—(*A. Lamart, France.*)
11,904. PORTABLE MUSIC DESK, T. W. Snagge, London.

7th October, 1885.

11,905. GENERATING STEAM, W. F. Goreham and W. W Hewitt, London.
11,906. PICKER PROTECTOR for LOOMS, R. Mason and T. Parker, Accrington.
11,907. SAFETY GUARD for TRAMWAY ENGINES, I. F Cutler and W. P. Green, Bradford.
11,908. FISHING REELS, S. Allcock.—(*T. B. Mills, New York.*)
11,909. FOLDING TABLE and WASHSTAND, W. H. and B. Jones, Wolverhampton.
11,910. PLANING MACHINE for ANGLE BARS, D. D. White, Drypool.
11,911. DELIVERY of PREPAID GOODS, F. C. Lynde and J. Lees, Manchester.
11,912. CROCHET NEEDLES or HOOKS, Z. Shrimpton, Redditch.
11,913. SOLID PARALLEL VICE with TAPER MOTION, J. S. L. Ashforth, Sheffield.
11,914. BOOT PROTECTORS, J. Blakey, Halifax.
11,915. CORRECT METHOD of HOLDING the HAND when PLAYING the VIOLIN, G. A. Chanot, Manchester.
11,916. WASHING or RINSING MACHINE, H. A. McFar lane, Glasgow.
11,917. CHILLS and MOULDS, J. Whitley, Leeds.
11,918. TERRY-WEAVING, E. T. Broadhurst and E. Smith, Manchester.
11,919. FIGURED CLOTH, J. Kirkman and W. Tristram, London.
11,920. PURIFIER or SEPARATOR, J. G. Walker, Glasgow.
11,921. TRAIN SIGNALLING APPARATUS, S. S. Robertson and W. R. Lester, Glasgow.
11,922. STEAM TRAP, H. Grunow and T. H. Hodge, London.
11,923. CARVING KNIVES and FORKS, F. Crockford, Sydenham, and C. Hickson, Sheffield.
11,924. EXTERNAL SCREW STOPPERED BOTTLES, &c., H. Brecknell, London.
11,925. LAMPS, A. J. Boult.—(*W. Henschen and Co., Wurtemberg.*)
11,926. SMOKING PIPES, M. E. Wittenberg, Liverpool.
11,927. ROLLERS for WINDOW BLINDS, H. Horsfield, Glasgow.
11,928. LUBRICATORS, J. S. Dunn, Glasgow.
11,929. BALL CASTORS, H. Greene, W. Box, and the Patent Ball Castor Company, London.
11,930. TOPOGRAPHICAL and INFORMATION PLACARDS, A. J. Maffuniades, London.
11,931. SLIDE RESTS for LATHES, P. P. Huré, London.
11,932. FASTENING for WEARING APPAREL, A. Köhler, London.
11,933. SLIDES and PASSAGES of GAS MOTOR ENGINES, C. D. Abel.—(*Gas-Motoren-Fabrik-Deutz, Germany.*)

11,934. Opening or Closing Fanlights, J. Gillespie and J. T. Pennycock, London.
11,935. Yeast, W. S. Squire, London.
11,936. Harmonical Supports, N. E. Simoutre, London.
11,937. Cricket Balls, J. G. Heard and J. J. Lane, London.
11,938. Weaving Rugs, W. H. Gladding, London.
11,939. Chimney Ventilator, S. Chandler, sen., S. Chandler, jun., and J. Chandler, London.
11,940. Opening Doors of Buildings in Case of Fire, W. Petty, London.
11,941. Preparation of Oxides of Iron, P. C. Bunn, London.
11,942. Transparent Blocks of Ice, E. L. Pontifex, London.
11,943. Resistance Pyrometer, E. Hartmann and W. Braun, London.
11,944. Utilising the Force of Moving Weights, E. Edwards.—(*F. Tessier, France.*)
11,945. Injectors, E. Edwards.—(*J. Thiry, France.*)
11,946. Closing the Mouths of Bottles, E. Edwards —(*A. Signoret, France.*)

8th October, 1885.

11,947. Twist-lace Fabrics, F. and H. Simpson and E. Harris, London.
11,948. Renewing Strainer Plates for Straining Paper Pulp, H. J. Rogers, Watford.
11,949. Spindles for Knobs, &c., J. H. Starling, Birmingham.
11,950. Fire-irons, R. Pickin, Birmingham.
11,951. Fast and Loose Reed for Weaving Looms, T. Singleton, Halifax.
11,952. Railway Wagon Couplings, &c., J. Coghill, Glasgow.
11,953. Ascending Chimneys, R. W. Anderson, Liverpool.
11,954. Fastenings for Boots, &c., J. Smith, Stoke-upon-Trent.
11,955. Links for Fastenings, E. F. Haynes and T. F. Ford, Birmingham.
11,956. Automatic Coupling Buffer, E. Morris and T. Foster, Manchester.
11,957. Laying Telegraph Wires, W. A. Jamieson.—(*R. W. Jamieson, Canada.*)
11,958. Bolting Breech-loading Guns, W. P. Jones and H. Scott, Birmingham.
11,959. Folding Tripod Stands, A. W. Dolland, London.
11,960. Loom Temples, J. Parkinson, Bradford.
11,961. Sheet Iron Travelling Trunks, J. G. Carrick, Glasgow.
11,962. Producing Cast Metal, &c., J. Richardson, Glasgow.
11,963. Rotary Pumps, A. C. Henderson.—(*E. Marchand, Egypt.*)
11,964. Ivory Porcelain, E. Powell, F. and J. W. Bishop, and J. Stonier London.
11,965. Ornamental Porcelain and Earthenware, E. Powell, F. and J. W. Bishop, and J. Stonier, London.
11,966. Stoppering Metallic Vessels, &c., J. King, London.
11,967. Christmas Cards, W. R. Ryland, London.
11,968. Feeding Bottles for Children, &c., S. J. Pocock, London.
11,969. Covers for Cans, F. H. Freeth and S. J. Pocock, London.
11,970. Producing Alcohol, W. P. Thompson.—(*C. Ordonneau, France.*)
11,971. Kettle, G. F. Andrews, London.
11,972. Boots and Shoes, C. Jackson, Nottingham.
11,973. Hats, C. Jackson, Nottingham.
11,974. Floor-coverings, C. Jackson, Nottingham.
11,975. Bearings for Machinery, C. Jackson, Nottingham.
11,976. Making Hardened Asbestos, C. Jackson, Nottingham.
11,977. Rubbing and Tempering Metallic Rods, &c., W. A. Bindley, W. J. Gell, and A. F. Boham, London.
11,978. Jacquard Apparatus, F. S. Beard, London.
11,979. Forks and Tongs for Domestic Uses, F. Fidler, Sheffield.
11,980. Lamp Chimneys, H. H. Doty, London.
11,981. Rotary Motor, H. A. Lumley, London.
11,982. Making the Outer Part of Match-boxes, P. Jensen.—(*Aktiebolaget Göranssons Mekaniska Verkstad, Sweden.*)
11,983. Stopping and Unstopping Bottles, C. S. Marriott, London.
11,984. Travelling Cars, W. G. Wright and J. Hall, London.
11,985. Cutting, &c., Curved Surfaces, Josef and Jan Fric, London.
11,986. Shirts, J. C. Rogers, London.
11,987. Apparatus for Cutting Rack Teeth, R. E. B. Crompton, London.
11,988. Combination of Soap with Permanganate of Potash, J. L. Sabunjie, London.
11,989. Apparatus for Controlling Horses, J. L. Hale, London.

9th October, 1885.

11,990. System of Practical Mechanics, W. Golding, Moss Side.
11,991. Buffers for Weaving, J. W. Crother, Halifax.
11,992. Heating Vessels, E. Taylor, Alsager, near Stoke-on-Trent.
11,993. Sieving Raisins, J. Vaughan, Bristol.
11,994. Water Motors, S. S. Allin, London.
11,995. Fasteners for Fanlights, W. Sanderson and T. A. Moffitt, London.
11,996. Filters, E. M. Knight, Halifax.
11,997. Tree Guard, G. S. Cole, Cirencester.
11,998. Saws, G. Gray, T. Gray, and J. Hemens, Sheffield.
11,999. Perambulators, J. Aylward, Coventry.
12,000. Lamps, H. Vogt and G. Bernstein, London.
12,001. Carbons, J. Swinburne, Brockley.
12,002. Dyeing, &c., Hanks, J. Robertshaw, Manchester.
12,003. Slate Pencils, J. S. Hughes and W. Hughes, Portmadoc.
12,004. Grain, &c., Elevators, W. G. Herbert, Liverpool.
12,005. Telegraphic Address Book, S. Reid, Newcastle-on-Tyne.
12,006. Toy Tops, C. S. Snell, London.
12,007. Safety Valves, C. S. Snell, London.
12,008. Hydraulic Valves, C. S. Snell, London.
12,009. Swimming Apparatus, S. F. Smith and D. Waude, London.
12,010. Cutting Tools, C. S. Snell, London.
12,011. Eliminating Snow from Cold Air, W. P. English, London.
12,012. Parlour Lawn Tennis, J. Devonshire, London.
12,013. Automatic Brake, R. Maynard, London.
12,014. Gilding Glass, J. Pratt, London.
12,015. Dynamo-electrolytic Battery, R. Eisenmann, Berlin.
12,016. Indicators for Water Gauge Glasses, W. Barry and G. W. Jones, London.
12,017. Forcing Machine, J. Richards, London.
12,018. Insulator, J. E. Spagnoletti, London.
12,019. Holophotal Projectors, R. E. B. Crompton, London.
12,020. Pianoforte Actions, F. Stevens, London.
12,021. Removing Scum from Steam Boilers, T. Elcoate, Liverpool.
12,022. Double Truss, Salmon, Ody, and Co., London.
12,023. Waterproof Material, W. L. Wise, London. —(*J. Hofmeier, Austria.*)
12,024. Arm-pit Dress Shields, J. C. Mewburn.—(*J. L. Martiny et Compagnie, France.*)
12,025. Melton Hood for Horses, T. Segger, London.
12,026. Copper Tubes, S. Walker, London.
12,027. Basket of Babies' Carriages, W. Arendt, London.
12,028. Shutter for Photographic Cameras, E. F. Gange, London.
12,029. Plug Stoppers, E. E. Hanslow, London.
12,030. Supply of Oil to Lamps, W. Higginbotham, London.
12,031. Spring Brackets, F. W. Cocks, London.
12,032. Umbrellas, Sunshades, and Walking Sticks, G. Pickett, London.
12,033. Jet, &c., Bracelets, T. and J. W. Wilson, London.
12,034. Hydraulic Cranes and Lifts, G. G. Picking and W. Hopkins, London.
12,035. Vinegar, G. G. Picking, W. Hopkins, J. and J. Dore, London.
12,036. Spirits, G. G. Picking, W. Hopkins, J. and J. Dore, London.
12,037. Preparing Wheaten Meal, A. B. Lester and A. Meaby, London.
12,038. Setting out and Testing Valves, G. Sellers, London.
12,039. Taking Indicator Diagrams from Engines, G. Sellers, London.
12,040. Pitch and Driving Chains, W. Hult, London.
12,041. Knotter Machinery for use in Making Paper, A. Sheldon, London.
12,042. Steering Gear, F. B. Shuttleworth, London.
12,043. Sewing Machines, M. R. Pryor.—(*Parrott and Co., United States.*)
12,044. Treating Flax, &c., G. F. Redfern.—(*C. de Baillencourt, France.*)
12,045. Ventilating Apparatus, J. Gilmore and W. R. Clark, London.

10*th October*, 1885.

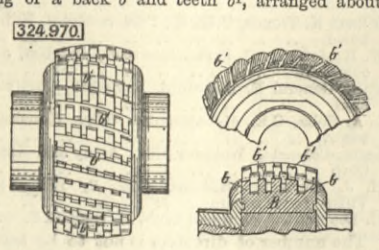
12,046. Producing Designs upon Surfaces, H. Lee, Leeds.
12,047. Sign and Advertisement Boards, E. Croft, London.
12,048. Metallic Bedsteads, &c., J. Talbot, Birmingham.
12,049. Clipping Tickets, W. Smith, London.
12,050. Coupling and Uncoupling Railway Vehicles, T. F. Barlow, W. Schofield, and J. Royston, Manchester.
12,051. Boxes, J. Magill, Manchester.
12,052. Checking the Consumption of Liquids or Solids, E. E. Evans, Stroud.
12,053. Gauging Sheets, Bars, &c., W. H. M. Neave, Sheffield.
12,054. Looms for Weaving, W. J. Monk, Manchester.
12,055. Washing Wool and other Fibres, W. H. Greenwood, Bradford.
12,056. Ventilating Apparatus, T. G. Normanton, Barrow-in-Furness.
12,057. Spinning and Doubling Cotton, T. Ashworth, Manchester.
12,058. Yeast, W. S. Squire, London.
12,059. Coke Ovens, M. B. Parrington, London.
12,060. Disinfecting, &c., Powder, E. Foster and W. H. Bibby, Preston.
12,061. Beaters or Guard Rollers of Carding Machines, W. H. Greenwood and F. D. Farrar, Bradford.
12,062. Window Sash Fasteners, W. Yates, Bucks.
12,063. Sodic Bichromate Constant Current Electric Battery, F. S. Fowler, Haslemere.
12,064. Two-wheeled Vehicles, S. Adams, Birmingham.
12,065. Boiling and Heating Water, E. O. Eaton, London.
12,066. Crucible Cast Steel Wagon Cradles, R. Baxter, Linlithgowshire.
12,067. Hat Irons, E. E. Atkins, Birmingham.
12,068. Diamond Junctions for Drains, F. Armstrong, Dumfries.
12,069. Stamping Headings of Woven Fabrics, A. Whowell, London.
12,070. Metallic Drums or Casks, &c., J. and E. Harper, Birmingham.
12,071. Pneumatic Railway Station Name Indicators, W. Tilley, Birmingham.
12,072. Transporting Self-binding Reapers, P. Buchan, London.
12,073. Printing the Fabric known as Leather-cloth, W. Oppenheimer, London.
12,074. Composition and Decomposition of Compound or Complex Bodies, J. G. Lorrain, London.
12,075. Apparatus for Copying Letters, H. C. Capel and W. Gaskill, London.
12,076. Bottling Aerated Liquids, F. Trotman, London.
12,077. Equalising or Finishing and Polishing Tubes, &c., J. Wetter.—(*C. Golay, France.*)
12,078. Utilising the Pitching, Heaving, and Rolling Motions of Ships, W. L. Wise.—(*J. F. Bonnaterre and —. Avon, France.*)
12,079. Overcoats, &c., W. Abbott, London.
12,080. Washing Casks, &c., H. J. West, London.
12,081. Type Cases, S. P. Wilding.—(*J. Holeiter and W. Strasser, Switzerland.*)
12,082. Machine Bands, Straps, or Belting, J. T. Humphrey, London.
12,083. Ploughs, J. Huxtable, London.
12,084. Dynamo-electric Machines, J. and E. Hopkinson, London.
12,085. Wicks and Burners for Lamps, V. A. Vivis and A. Missal, London.
12,086. Apparatus for the Reception of Coin and the Automatic Delivery of Goods in Exchange, C. H. Russell, London.
12,087. Apparatus for the Reception of Coin and the Automatic Delivery of Goods in Exchange, C. H. Russell, London.
12,088. Manufacturing Screws, H. H. Lake.—(*H. A. Harvey, United States.*)
12,089. Stoppering Bottles or Jars, T. Matthews, London.
12,090. Roundabouts, F. Savage, London.
12,091. Providing Free Ingress and Exit from Buildings, P. Viani, London.
12,092. Cough Mixture, T. Needham, Halifax.
12,093. Looms for Weaving, F. W. Jepson, Halifax.
12,094. Gill Fallers, E. Clarkson, Halifax.
12,095. Hoists, F. Stones, Halifax.
12,096. Regulating the Force of Electric Currents, C. J. Bosanquet, W. Cameron, and W. A. Tomlinson, Lincoln.
12,097. Rivetting Stand, W. J. Brown, Northampton.
12,098. Drain Bends, &c., W. Bruce, Edinburgh.
12,099. Sash Fastener, W. M. Simons, Nottingham.
12,100. Steaming and Cleansing Casks, H. Scorror, Yorkshire.
12,101. Curling Tongs, L. Zervas, Germany.
12,102. Newspaper Pasting Appliance, A. Martin and W. Coleman, Plymouth.
12,103. Corset, H. R. James, Landport.
12,104. Railway Wheels, J. Clark, Birmingham.
12,105. Tool Holders, J. Barker, Manchester.
12,106. Electric Apparatus for Reproducing Characters, &c., T. Tubini, London.
12,107. Fustian Cords, J. Schofield and J. E. Bentley, Manchester.
12,108. Actuating Fire-bars, T. Milburn, C. W. Haydon, and E. Mundy, Manchester.
12,109. Distribution of Sand, J. T. M. Hircock, Birmingham.
12,110. Telephones, R. H. Ridout, London.
12,111. Earth Plates, E. H. Morton, Liverpool.
12,112. Guards for Carving Forks, W. Townsend, London.
12,113. Clips, T. M. Lowcock, London.
12,114. Metallic Spokes for Wheels, E. Leadbeater and B. Platts, London.
12,115. Stair Rod Clips, E. Chadwick and E. Chadwick, London.
12,116. Coupling Apparatus, G. Turner, London.
12,117. Frames of Umbrellas, B. E. Midgley, Halifax.
12,118. Tiles, G. M. Garrard, Westminster.
12,119. Fastening for India-rubber Belts, D. Wilson, Waterford.
12,120. Reversing Valve Gearing of Steam Engines, J. Thom, and D. J. Howells, Barrow-in-Furness.
12,121. Cleaning Pipes for Smoking, H. Hall, Chiswick.
12,122. Looms, J. T. Lishman, W. W. L. Lishman, Bradford, and W. R. Bootland, Silsden.
12,123. Screen for Coal, &c., H. W. Lewis and G. W. Wilkinson, London.
12,124. Fuel, W. Smith, London.
12,125. Register for Room-to-room Communicator, E. C. Murray, Walthamstow.
12,126. Mineral Waters, W. Lascelles-Scott, Forest Gate.
12,127. Transmitting Motion, M. Pearson and S. Reid, London.
12,128. Ornamentation of Glass, &c., E. Lee, Leeds.
12,129. Illuminating Gas, G. E. Davis, London.
12,130. Washing Plates and Dishes, R. Bird, London.
12,131. Boots and Shoes, H. J. Haddan.—(*Chevron et Cie., France.*)
12,132. Concentration of Sulphuric Acid, S. B. Bowen, London.
12,133. Operating Machines, J. G. Lorrain, London.
12,134. Thrashing Machines, J. Goucher, London.
12,135. Extinguisher for Lamps, H. Nicoll, London.
12,136. Bottling Beer, &c., E. R. Southby and W. T. Ramsden, London.
12,137. Plates, R. A. Hardcastle, London.
12,138. Dust Bin, A. H. Williams, London.
12,139. Dust Bin, A. H. Williams, London.
12,140. Welding Cast Steel in Bars, K. Küpfer, London.
12,141. Treating Phosphatic Slags for the Recovery of Valuable Materials, H. Brunner, Liverpool.
12,142. Apparatus for Receiving Coin, &c., C. H. Russell, London.
12,143. Apparatus for Exhibiting Wares in Shop Windows, B. Meinert, London.
12,144. Means for Guiding Perambulators, &c., J. Fox, London.
12,145. Automatic Equalisers for Carding Engines, J. Ladley, London.
12,146. Burning Oil in Lamps, &c., J. B. Scammell, London.
12,147. Keyless Repeating Watches, C. H. Golay, London.
12,148. Lock, W. J. Holman, London.
12,149. Leather Boots, A. M. Clark.—(*G. Agnew, United States.*)
12,150. Boxes, E. A. Jahncke and H. W. Herbst, London.

SELECTED AMERICAN PATENTS.

(From the United States' Patent Office Official Gazette.)

324,970. Rotary Cutter, *Andrew J. Wilbur, Boston, Mass.—Filed June 22nd*, 1885.

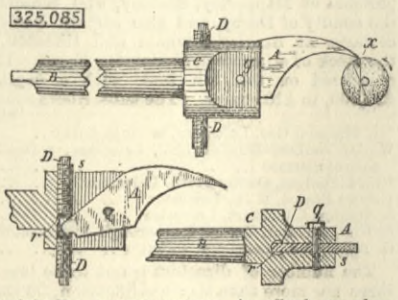
Claim.—The series of blades B B¹, each blade consisting of a back *b* and teeth *b*¹, arranged about a



hub so that the teeth of one blade cover the openings between the teeth of the next adjacent one, as set forth.

325,085. Turning Tool, *Henry W. Hubbard, Aurora, Ill.—Filed February 9th*, 1885.

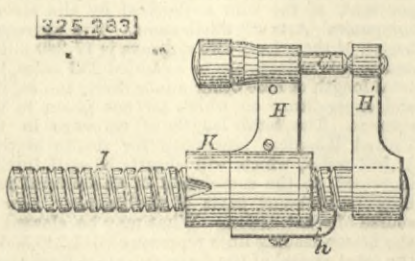
Claim.—(1) An adjustable turning tool comprising a blade A, having an edge *x*, in combination with a rotary holder upon which the turning tool is pivotally mounted, and adjusting means, substantially as described, upon the holder to adjust the turning tool to various positions with relation to the holder and work, as set forth. (2) An adjustable turning tool A, comprising a blade having the sides of the body



excentrically concavo-convex, to afford an edge *x* toward its forward extremity, and provided with an opening *t* toward its rear extremity, in combination with a holder B, provided with a head C, having a slot *s* to receive the rear extremity of the tool, and openings coinciding with the opening *t* in the adjusted tool, containing a set screw *q*, and a longitudinal opening *r*, along the base of the slot *s*, containing adjusting screws D and D¹, the whole being constructed and arranged substantially as described.

325,233. Micrometer Calipers, *Merrick M. Barnes, Boston, Mass.—Filed February 4th*, 1885.

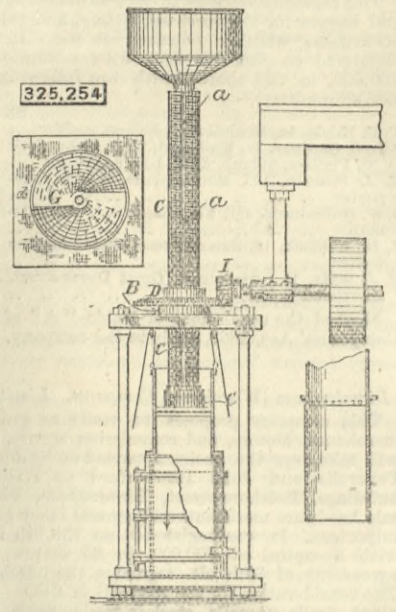
Claim.—(1) In a micrometer caliper of the character herein described, the combination, with the calipering device and its anvil mounted upon standards, either of which is movable relatively to the other, of a graduated shifting screw adapted to alter at pleasure the field of action of the calipering screw relatively to its anvil by shifting one of the said standards, all substantially as herein set forth. (2) A micrometer calliper having its calipering screw carried upon a shifting arm and its calipering anvil mounted upon a



fixed arm and provided with a graduated shifting screw, whereby the shifting arm may be moved or shifted a regulated distance toward or away from the fixed arm, all substantially as herein set forth. (3) In a micrometer calliper, the combination of the fixed arm H¹, carrying an anvil, the movable arm H, carrying a calipering screw C, the screw I, nut K, and tail *h*, all substantially as herein set forth.

325,254. Packer for Bran and other Articles, *Samuel T. Lockwood, Chicago, Ill.—Filed December 17th*, 1884.

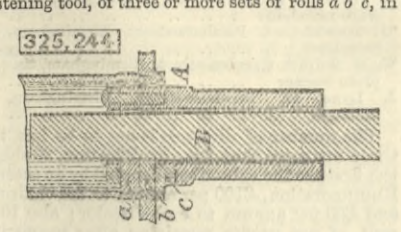
Claim.—(1) A packer adapted for feeding and packing the bran or other material by means of a rotative tubular screw or feed tube turning in a screw-threaded bearing and carrying an auger-like device for ejecting and compressing the bran or other material. (2) The combination, in a packer, of a rotative tubular screw or feed tube, an auger-like device in connection with and carried by the said tube, a fixed screw-threaded bearing for the said tube, and a driving or rotating wheel splined to the said tube. (3) The combination, in a packer, of a rotative tubular screw or feed tube, a fixed screw-threaded bearing for the said tube, a tubular extension clasped to the lower end of part of the said tube and capable of turning thereon, the wings F F, carried by the said extension, and the auger-like device G, carried by the said feed tube, substantially as and for the purposes specified. (4) The combination, substantially as specified, in a packer, of the rotative tubular screw or feed tube C, carrying an



auger-like device G, and having therein one or more grooves or channels *a a*, the fixed block or screw-threaded bearing B, the wheel D, having therein one or more ribs *a*¹ *a*¹, entering the said groove or grooves, and a rotary driver or pinion I engaging the wheel D, for the purposes set forth.

325,244. Tube Expander, *Harrison Hays, Portland, Me.—Filed April 10th*, 1885.

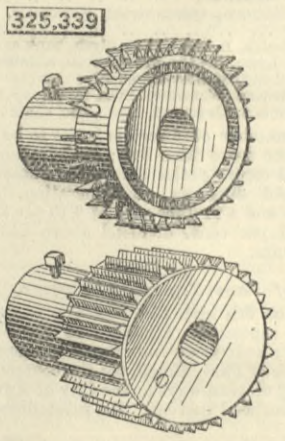
Claim.—The combination, in a steam-boiler-tube-fastening tool, of three or more sets of rolls *a b c*, in a



stock A, with a tapering mandril B, having a hole or holes in its largest end for the purpose of inserting a rod to revolve the tool, all as shown, described, and specified.

325,339. Feed Roll, *Philip Hanavan, Oakland, Cal. —Filed June 1st*, 1885.

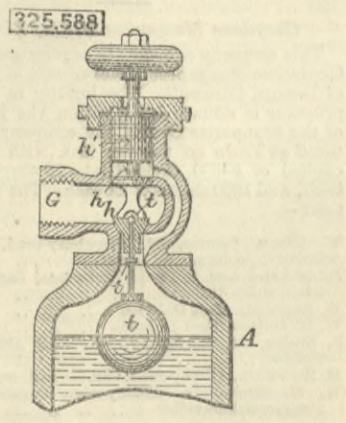
Claim.—(1) In a feed roll for wood-working machinery, the roll having the independent adjustable flat-edged teeth projecting around its periphery, and having their inner ends secured by a filling of fusible metal poured into the channel between and around the independent teeth, substantially as herein described. (2) In a feed roll for wood-working machinery, the hub having a rim or flanges with their intervening channel, in combination with independent adjustable teeth or plates set into the rim



and a filling of fusible metal poured in and around said teeth, whereby they are held, substantially as herein described. (3) In a feed roll for wood-working machinery, a hub having a rim or flanges projecting therefrom, and having holes or indentations in its sides, in combination with independent radially-placed teeth or plates having openings, perforations, or indentations within the channel, and a filling of fusible metal surrounding said teeth, substantially as herein described.

325,588. Apparatus for Raising Water, *Cuthbert Burnett, Hartlepool, Durham, England.—Filed April 17th*, 1885.

Claim.—(1) The combination, in a steam vacuum pump, of the valves *h*, the steam pipe G, vessel A, and connections, the float *t*, stem *t*¹, passing through the



tubular stem of the lower valve *h*, and the valve *t*² at the upper end of the stem, substantially as set forth. (2) The combination, in a steam vacuum pump, of the valves *h*, the steam pipe G, vessel A, and connections, the float *t*, stem *t*¹, passing through the tubular stem of the lower valve *h*, the valve *t*² at the upper end of the stem, and the piston *h*¹ upon the stem of the upper valve *h*, substantially, as set forth.