A NEW METHOD OF OBTAINING THE STRESSES ON LATTICES.

By William Robertson, C.E.

The evaluation of the stresses in a lattice girder admits of many varied methods of procedure. Nearly every writer on the subject has some favourite system of his own, which he diligently strives to persuade the student is the best to adopt. Not a few of the methods which have from time to time appeared in The Engineer and elsewhere have been demonstrated by an array and manipulation of figures or "tabular numbers," which being added, subtracted, multiplied or divided, as the case may be, ultimately give, if not the exact, yet a near approximation to the value sought. So intricate indeed are some of those methods that they resemble an arithmetical puzzle, and too often the *modus operandi* fatally escapes the memory, so that invariably reference to an example is necessary to ensure the confidence of the student or designer. These methods, besides, look very formidable on paper, and at first sight are not a little embarrassing to the student who is groping his way in the subject; nor are they less irritating to the practical designer, who, as a rule, prefers his scale and compasses to intricate or embarrassing calculations. It appears to me that all the foregoing tabular methods fail in that simplicity which is desirable, from a practical point of view, in dealing with such systems. This complicated treatment arises mainly from the fact that the advocates of such methods are too eager to deduce the "exact mathematical equivalent of the stresses." Within certain limits the attainment of this end may advantageously be neglected. The graphic method, as applied by me, is based upon this consideration; and although exceedingly simple of application to any system of bracing, yet gives so close an approximation to the strictly mathematical values of the stresses that, in ordinary railway girders of, say, 80ft. to 100ft. span of the type shown in Fig. 1, the variation on bars No. 4 and No. 16 is only one and a-half per cent., and that on bars 8 and 12 three per cent. of their true theoretical value. On all the remaining bars there is practically no variation, the exact values being given by scale. In larger spans and with greater ratio of dead to live load, the variation would be still smaller. It is worthy of note, also, that this slight variation is, in all cases, in excess of value; and consequently, as the practical man terms it, "on the safe side." Still further; in any single-system latticing, the diagram gives the exact values throughout. See Fig. 3.

Explanation of method.—I will now show the reader how, for any multiple system of latticing such as Fig. 1, to obtain the maximum values of the stresses on all the bars from a consideration of one brace only. The possibility of this proceeding, I may add in passing, arises from the co-relation of each member to the system as a whole, and therefore also mutually one to another. It is convenient in practice to take as our starting-point the first full-length brace, as No. 2 in Fig. 1. It will be seen from inspection of the figure that the system to which this diagonal belongs carries the weights W_2, W_6, W_{10}, W_{14}. Now, all that is necessary to be known is the proportion of each of those apex loads—live and dead—which the bar No. 2 carries. These values are readily obtained, being equal to the reaction at left abutment, produced by the loads on the system under consideration. The proportion of dead load thus found × co-secant 45 deg.—the angle of inclination of the bar—we take as one value. The proportion of live load thus found × co-secant 45. deg., we take as another value. These two values being obtained, we draw a right line A B, through which we draw vertical lines from the toe—or unloaded end—of each numbered bar as shown. Next, from the point d, where the vertical from the toe of No. 2 bar cuts A B, we set off $d\,e$ = proportion of dead load × co-secant 45 deg.—as before obtained for this bar; also set off $d\,f$ = proportion of live load × co-secant 45 deg.—as previously stated. Thus, since the dead load on each apex of the girder in Fig. 1 is 2·5 tons, we find that the reaction at the toe of No. 2 bar is

$$\left.\begin{array}{l}\text{for } W_{14} = \frac{2}{16} \times 2{\cdot}5 \text{ tons}\\ \quad W_{10} = \frac{6}{16} \times 2{\cdot}5\\ \quad W_6 = \frac{10}{16} \times 2{\cdot}5\\ \quad W_2 = \frac{14}{16} \times 2{\cdot}5\end{array}\right\} = \tfrac{32}{16} \times 2{\cdot}5 = 5 \text{ tons and co-sec. 45 deg.} = 1{\cdot}414$$

Hence $d\,e = 5 \times 1{\cdot}414 = 7{\cdot}07$ tons.

Also since the live load = 5 tons at each apex, or double the dead load, we have only to multiply 7·07 by 2 to obtain $d\,f$ = 14·14 tons. This is all the calculation that is necessary to enable us to construct our diagram of stress—see Fig. 2.

Construction.—Having set off $d\,e$ and $d\,f$ join e to centre of A B at C and produce it till it cuts the curve $f\,b$. The curve $f\,b$ is a parabola, having its vertex at b. Construct a similar figure to right of A B, *i.e.*, make $b\,q = d\,e$ and $b\,g = d\,f$. Join q to C and draw arc of parabola $d\,g$. In practice it will be near enough to make the arcs $f\,p$ and $p\,g$ circular if made to pass through the centre of $h\,i$, the offset from the chord $f\,p$ to the point of tangent h—as shown. In order to effect this construction by circular curve the point p has to be determined by making the centre ordinate $c\,p = \frac{1}{2}\,d\,f$, which is a property of the parabolic arc $f\,b$. Scale the intercepts included betwixt the right lines e C, q C and arcs $f\,p$, $p\,g$ for the maximum stresses on the bars. The triangular figures in the centre of diagram enclosed by producing the right lines e C and q C and the arcs of parabolas produced beyond p give the counter strain on any diagonal whose vertical projection is cut by them. To find the stress on any broken bar, as No. 1, we have only to project the right line C e and the arc $p\,f$ until they cut its vertical projection from toe, as shown.

Single systems—Fig. 3.—It will be necessary to point out that in this figure the method of procedure is identical in principle to the foregoing; but the application of the principle is somewhat simpler. Thus we do not require to find the load on any bar of the system as a starting point; we merely set off at either extremity of span, and not on a line projected from any bar, $d\,e = \frac{1}{2}$ total dead load × co-secant 45 deg. = 7 × 2·5 × 1·414 = 24·75 tons. Similarly $d\,f = \frac{1}{2}$ total live load × co-secant 45 deg. 7 × 5 × 1·414 = 49·5 tons.

The vertical lines representing the bars are then drawn from a point midway between their extremities. With these exceptions the scaling and construction for the maximum stresses is the same as in Fig. 2.

The diagram of stress for the upright struts is the diagram of shear, since co-secant 90 deg. equals unity. Hence, to obtain their values, construct another diagram of stress, making—

$$d^1\,e^1 = \tfrac{1}{2}\text{ total dead load.}$$
$$d^1\,f^1 = \tfrac{1}{2}\text{ total live load.}$$

And proceed as before.

It is to be observed, however, that the verticals in the second diagram representing the struts are drawn in the same positions with reference to span as for the inclined braces correspondingly numbered.

The values of Fig. 3 are scaled, and may be verified by any known means.

Girders of the form shown in Fig. 4.—This class of bracing is treated in all respects the same as the preceding, the two values of $d^1\,e^1$ and $d^1\,f^1$ being—

$$d\,e = \frac{\text{total dead load}}{2} \times \text{co-secant 45 deg.}$$
$$d\,f = \frac{\text{total live load}}{2} \times \text{co-secant 45 deg.}$$
$$\text{And } d^1\,e^1 = \frac{\text{total dead load}}{2} \times \text{co-secant 60 deg.}$$
$$d^1\,f^1 = \frac{\text{total live load}}{2} \times \text{co-secant 60 deg.}$$

The verticals alternately representing the two sets of bars, as in the preceding case, Fig. 3.

Fig. 5 gives the following percentage of excess in the value of the stresses on the various bars of Fig. 1, as determined by the diagram of stress. The ratio of live to dead load being as 2 to 1.

Bars Nos.	Excess per cent of stress.	
1	0·20	under ¼ per cent.
2	nil	
3 and 17	0·24	
4 and 16	1·40	under 1½ per cent.
5 and 15	0·32	under ½ per cent.
6 and 14	nil	
7 and 13	0·48	
8 and 12	3·12	maximum.
9 and 11	0·83	under 1 per cent.
10	nil	

Note.—In any multiple system as Fig. 1, if absolute accuracy be required in the counterbraced areas, tangents

Fig 1.

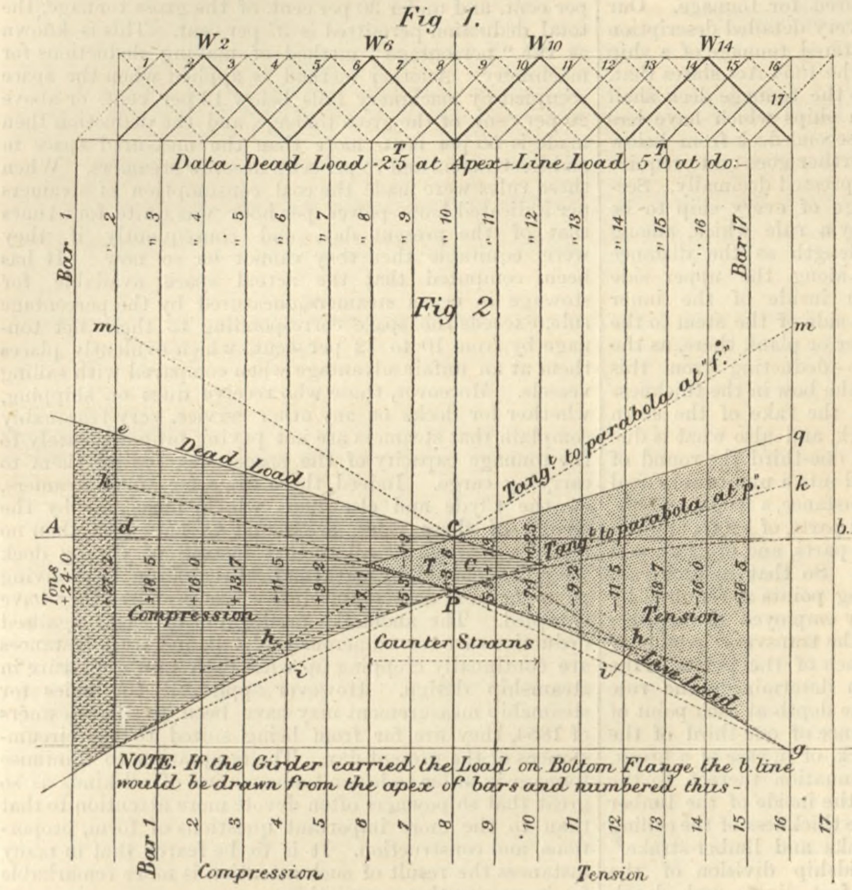


Fig 3.

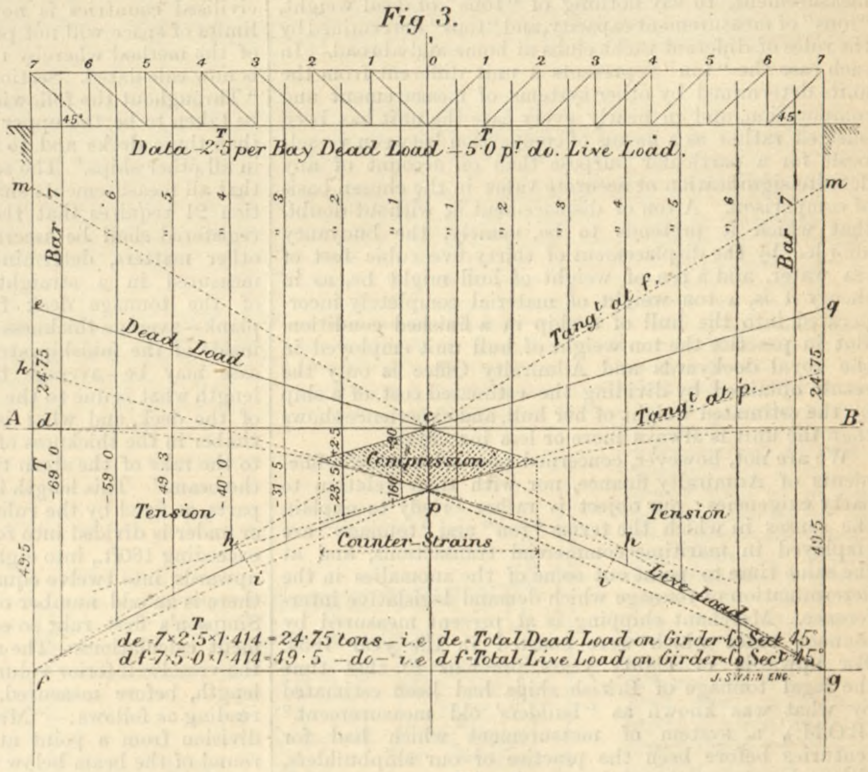


Fig 4.

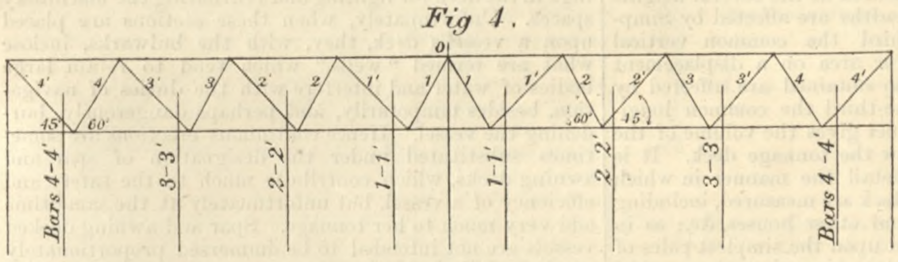
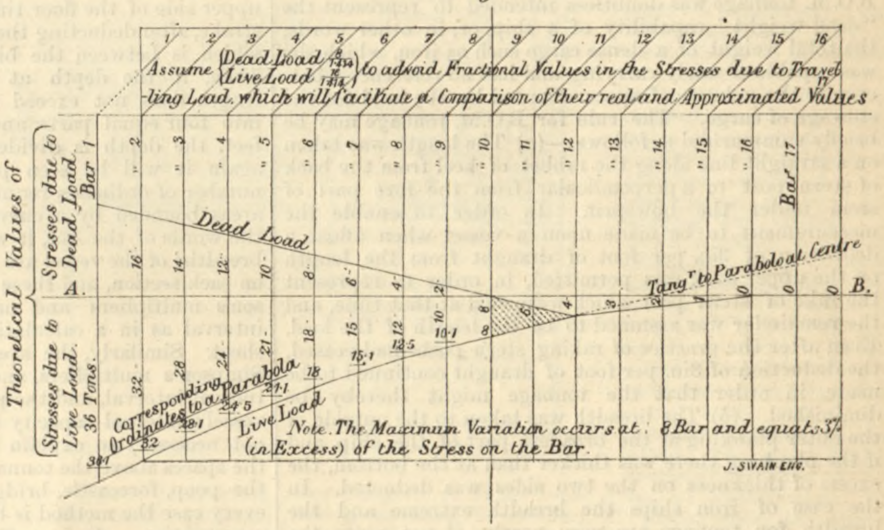


Fig 5.



to the parabolas at centre must be drawn to form those areas, as will be seen from inspection of this figure. The areas shown in Fig. 2 are slightly in excess.

A thorough acquaintance with the method of procedure in the two principal cases, Fig. 1 and Fig. 3, will, I feel confident, enable anyone having the slightest acquaintance with the theory of stress in girders to become thorough master of that hitherto mystifying, and to many plodding students, perplexing problem of lattice bracing.

THE TONNAGE OF SHIPS.

CONSIDERING the many different senses in which the terms "ton" and "tonnage" are applied in relation to the size, burthen, capacity, and taxable dimensions of a ship, it is not to be wondered at that much misapprehension on the subject should exist in the minds of that large proportion of our population which is not habitually occupied with maritime transactions. We hear of "tons" of displacement, of weight of hull, of registered tonnage, of builders' old measurement, and of Thames yacht measurement, to say nothing of "tons" of dead weight, "tons" of measurement capacity, and "tons" determined by the rules of different yacht clubs at home and abroad. In each case the "ton" represents a unit different from the units determined by other systems of measurement and computation, and in nearly every case the unit has been selected rather as a means of comparison between vessels built for a particular purpose than on account of any definite signification or accurate value in the chosen basis of comparison. A ton of displacement is, without doubt, that which it pretends to be, namely, the buoyancy afforded by the displacement of thirty-five cubic feet of sea water, and a ton of weight of hull might be, as in theory it is, a ton weight of material completely incorporated into the hull of a ship in a finished condition. But in practice the ton weight of hull unit employed in the royal dockyards and Admiralty Office is only the result obtained by dividing the estimated cost of a ship by the estimated weight of her hull, and experience shows that the unit is always more or less inaccurate.

We are not, however, concerned now with these refinements of Admiralty finance, nor with their relation to party exigencies; our object is rather briefly to explain the senses in which the terms "ton" and "tonnage" are employed in maritime commercial transactions, and at the same time to point out some of the anomalies in the determination of tonnage which demand legislative interference. Merchant shipping is at present measured by tonnage rules which were enacted in the year 1854. For upwards of eighty years previous to that time the legal tonnage of British ships had been estimated by what was known as "builders' old measurement" (B.O.M.), a system of measurement which had for centuries before been the practice of our shipbuilders, although not sanctioned by any legal enactment. This B.O.M. tonnage was doubtless intended to represent the "dead weight" capability of a ship, or, in other words, the total weight of a dense cargo such as iron, which she was capable of safely carrying, and had no reference whatever to the volume of space afforded by the hold for the stowage of cargo. The rule for B.O.M. tonnage may be briefly summarised as follows:—(*a*) The length was taken on a straight line along the rabbet of keel from the back of stern post to a perpendicular from the fore part of stem under the bowsprit. In order to enable the measurement to be made upon a vessel when afloat, a deduction of 3in. per foot of draught from the length on the upper deck was permitted, in order to represent the rake of stern post which was usual at that time, and the remainder was assumed to be the length of the keel. Even after the practice of raking stern posts had ceased, the deduction of 3in. per foot of draught continued to be made, in order that the tonnage might thereby be diminished. (*b*) The breadth was taken to the outside of the outer planking at the broadest part of the ship, and if the planking there was thicker than at the bottom, the excess of thickness on the two sides was deducted. In the case of iron ships the breadth extreme and the breadth for tonnage are very nearly, if not quite, the same. (*c*) From the length as described in (*a*) was deducted three-fifths of the breadth for tonnage (*b*), and the remainder was styled the "length for tonnage." This length for tonnage was multiplied by the breadth and the product by half the breadth, and, dividing by 94, the quotient expressed the tonnage—B.O.M.

At the time when this rule was devised it was doubtless a fairly correct method of determining the dead weight carrying power of a ship. With vessels whose length is about four times their breadth, and whose mean draught of water is about one-half their breadth, it will be found that this rule gives a carrying power of about 60 per cent. of the displacement, and in the wooden ships of that date this was close upon the margin of buoyancy available for the purpose. There is every reason to believe that the divisor 94 was chosen in order to satisfy these conditions, also that the B.O.M. rule was sufficiently accurate at a time when dead weight capability was regarded as the most equitable basis of tonnage, and when merchant ships were built upon almost the same proportions, and of the same type.

The B.O.M. rule was not, however, adapted to a period of commercial competition and development. As will have been observed, the element of depth was wholly neglected in the calculation, it being assumed, as already explained, that the immersed portion of the vessel would always be equal to about one-half her breadth. The slow growth, and, indeed, almost stationary condition of naval design during nearly a century was followed by rapid advances in mercantile enterprise and a keen competition in the construction and management of ships, so that long before the passing of the Merchant Shipping Act of 1854, it was found that such departures were being made in the proportions of ships from those contemplated by the framers of the B.O.M. rule, that the latter was no longer fairly applicable. In order to get a large carrying power upon a small nominal tonnage, vessels were being made unduly deep and of very full form, so as to become slow, unhandy, and even in many cases unseaworthy. The effect of the rule under the conditions of rapidly increasing trade and commercial competition was, in fact, to deteriorate the quality of our merchant shipping and bring about numerous disasters. Royal Commissions sat from time to time to consider this state of affairs and suggest a remedy. Bills were drafted, and in 1836 an Act of Parliament was passed whereby the tonnage measurement of merchant shipping was based upon internal capacity; but as the rule for the determination of that capacity was unscientific in principle and open to many kinds of evasion, the attention of Parliament was again called to the subject, and another Commission was appointed in 1849. The recommendations of that body were not adopted, but in 1854 a Merchant Shipping Act was passed which included among its provisions the rule for tonnage measurement that had some years before been formulated by Mr. Moorsom, and which is now generally described as the "Moorsom system." This is the rule under which the mercantile shipping of all civilised countries is now measured for tonnage. Our limits of space will not permit a very detailed description of the method whereby the registered tonnage of a ship is now calculated. Section 20 of the 1854 Act states that, "Throughout the following rules the tonnage deck shall be taken to be the upper deck in ships which have less than three decks and to be the second deck from below in all other ships." The section further goes on to require that all measurements shall be expressed decimally. Section 21 requires that the tonnage of every ship to be registered shall be ascertained by a rule which, among other matters, determines the length as the distance measured in a straight line "along the upper side of the tonnage deck from the inside of the inner plank—average thickness—at the side of the stem to the inside of the midship stern timber or plank there, as the case may be—average thickness—deducting from this length what is due to the rake of the bow in the thickness of the deck, and what is due to the rake of the stern timber in the thickness of the deck, and also what is due to the rake of the stern timber in one-third the round of the beam." This length is divided into a number of equal parts, as fixed by the rule. For instance, a length of 50ft. or under is divided into four equal parts, of 120ft., and not exceeding 180ft., into eight equal parts, and of 225ft. and upwards into twelve equal parts. So that in each case there is an odd number of dividing points as required by Simpson's first rule, so commonly employed in displacement calculations. The area of the transverse section of the vessel's interior volume at each of the points in the length, before measured, is then determined—the rule reading as follows:—"Measure the depth at each point of division from a point at a distance of one-third of the round of the beam below such deck, or in case of a break, below a line stretched in continuation thereof, to the upper side of the floor timber at the inside of the limber strake, after deducting the average thickness of the ceiling which is between the bilge planks and limber strake." Then, if the depth at the midship division of the length does not exceed sixteen feet, divide each depth into four equal parts, and, if the depth exceeds sixteen feet, the depth is divided into six equal parts. Thus, again it will be seen provision is made for the odd number of ordinates required by Simpson's rule for plane areas bounded by a curve. Without quoting verbatim the words of the Act, it will be sufficient to say that the breadths of the vessel are measured at the several heights on each section, and these breadths are affected by Simpson's multipliers and one-third the common vertical interval as in a calculation for area on a displacement sheet. Similarly, the areas so obtained are affected by Simpson's multipliers, and one-third the common longitudinal interval, and the product gives the volume of the vessel's internal capacity below the tonnage deck. It is not necessary to explain in detail the manner in which the spaces above the tonnage deck are measured, including the poop, forecastle, bridge and other houses, &c.; as in every case the method is based upon the simplest rules of mensuration. It is sufficient to say that the several volumes in cubic feet are divided by one hundred and the quotient is the registered tonnage of that part of the vessel; the division — one hundred — being doubtless chosen because it was considered to be the volume in cubic feet occupied by an average ton in weight of cargo as stowed in a vessel. Registered tonnage is therefore now determined upon the basis of internal capacity and not upon dead weight carrying capability, as was the case with the B.O.M. rule. The consequence is that an ordinary ship will carry much more than her register tonnage of cargoes having a high specific gravity, which stow closely; while of cargoes which occupy more than 100 cubic feet to the ton, there will be—apart from the deduction in weight for ballasting—a lesser tonnage carried than her register indicates.

But we have not, so far, done adequate justice to the intricacies and refinements of the system of tonnage measurement which still commands legal sanction, nor have we even hinted at the anomalies which, by reason of modern development in naval design, have crept into the application of the tonnage laws. The particulars of measurement already detailed include almost all that apply to sailing vessels; it being only necessary to add that a deduction is allowed for spaces wholly occupied by the crew, provided they do not fall below 72 cubic feet per man, and are properly lighted and ventilated. The total internal volume of a ship between the deck and floors, after allowing for the round of beam and thickness of ceiling, is termed the under deck tonnage. When this has been augmented by the tonnage due to poop, forecastle, and other deck erections, the result is known as "gross tonnage," and when all legal deductions have been made therefrom the result is the "net registered tonnage," which is inscribed with sunken letters on a main hatchway beam. In a sailing ship the only deductions allowed are those for crew space already described; but in measuring the tonnage of steamers much more considerable complications arise in consequence of the rules referring to the deductions allowable in their cases. It has hitherto been considered a fundamental principle in all tonnage legislation that a ship should pay dues only upon the tonnage capacity of such spaces as are used for cargo carrying or passenger accommodation, and consequently upon the introduction of steam navigation a claim was made for deductions on account of the spaces occupied by machinery and coals. The Act of 1854 distinctly specified the deductions to be permitted on this account, and whatever controversy has since arisen in regard to the fairness of tonnage legislation has referred chiefly to the machinery allowances. By the existing law, these deductions are made in one of two ways. The space "solely occupied by and necessary for the proper working of the boilers and machinery" is measured, including the volume of shaft passages, funnel casings, air trunks, &c. If in screw steamers this total is above 13 and under 20 per cent. of the gross tonnage, the total deduction permitted for machinery and coal space is 32 per cent. of the gross tonnage, and in paddle steamers, if the total is above 20 per cent. and under 30 per cent. of the gross tonnage, the total deduction permitted is 37 per cent. This is known as the "percentage" method of making deductions for machinery. Another method is applied when the space occupied by machinery falls below 13 per cent. or above 20 per cent. of the gross tonnage, and the deduction then made is 50 per cent. more than the measured space in paddle steamers and 75 per cent. in screw steamers. When these rules were made the coal consumption of steamers per indicated horse-power per hour was quite four times that of the present day, and consequently if they were equitable then they cannot be so now. It has been computed that the actual space available for stowage in ocean steamers, measured by the percentage rule, exceeds the space corresponding to their net tonnage by from 10 to 12 per cent., which evidently places them at an unfair advantage when compared with sailing vessels. Moreover, those who receive dues on shipping, whether for docks or any other service, very reasonably complain that steamers are not paying proportionately to the tonnage capacity of the spaces devoted in them to carrying cargo. Indeed, there are some small steamers, on the Clyde and elsewhere, which, measured by the second of these rules, are found to have less than no register tonnage at all, so that instead of paying dock dues, they should, by mathematical reasoning, be receiving payment from dock proprietors whose premises they have occupied. The anomalies arising out of these legalised deductions are too numerous to detail, and fresh instances are continually cropping up with each new departure in steamship design. However applicable the rules for steamship measurement may have been to the steamers of 1854, they are far from being suited to the circumstances of the present day. The temptation to minimise tonnage in order to lessen tonnage dues of all kinds is so great that shipowners often devote more attention to that than to the more important questions of form, proportions, and construction. It is to be feared that in many instances the result of such attention is more remarkable for ingenuity than seaworthiness.

The advantages of closed-in spaces on deck must be clearly evident to anyone who has encountered bad weather at sea. Poops and forecastles add to surplus buoyancy, provide shelter to officers and crew, and tend to prevent heavy bodies of water from falling on the deck, while bridge houses afford protection to the openings in the deck for lighting and ventilating the machinery spaces. Unfortunately, when these sections are placed upon a vessel's deck, they, with the bulwarks, inclose what are termed "wells," which tend to retain large bodies of water and interfere with the duties of navigation, besides temporarily, and perhaps dangerously, burdening the vessel. Hence continuous erections are sometimes substituted under the designation of spar and awning decks, which contribute much to the safety and efficiency of a vessel, but unfortunately at the same time add very much to her tonnage. Spar and awning-decked vessels are not intended to be immersed proportionately to their full depth, for they are not strong enough to carry such heavy cargoes, but because the space between the spar or awning deck and the main deck is inclosed it is measured for tonnage, and in this way a safe mode of construction is handicapped. Shipowners often omit to fit bulkheads to forecastles and bridges in order to keep down tonnage, and, by so doing, sacrifice an important source of safety against very common perils of the seas. During recent years some devices in steamship design have been introduced which are noticeable as indications of the way in which the present tonnage rules operate in a direction antagonistic to wise and safe development. Vessels are now being built with long open poops, bridge houses, and forecastles, separated by only a few feet of length, which is covered up by loose plank hatches at sea, so as to give the appearance of a continuous spar or awning deck, without having the continuity of strength and protection such as those erections afford. In this way space is provided for the stowage of cattle and certain descriptions of light cargo, without paying tonnage dues thereon. These instances will, perhaps, be sufficient to show that there is a necessity for amended tonnage legislation, not only in the interests of equity between those who pay and those who receive dues on shipping, but also in the interests of maritime development and the safety of life at sea.

There are certain other features in the question to which we have not so far alluded, among these being the special modes of internal measurement applicable to vessels fitted with water-ballast tanks and cellular double bottoms. When the 1854 Act was passed the water-ballast system had only just been introduced, and the tanks were not then an integral part of the hull. Hence Moorsom's rule was not made applicable to a class of steam shipping which is now displacing all others.

The depth of the tonnage space is taken from the top of the floors—allowing for the thickness of the ceiling—but in water ballast tanks the floors are inside the tanks, and cellular ships have no floors at all, in the strict sense of the term. The tonnage of the former type still includes a portion of space inside the water ballast tank; but, thanks to the intelligent reasoning of Messrs. Denny, the well-known shipbuilders of Dumbarton, the Board of Trade has relinquished all claim to measure the depth of cellular bottom ships below the inner bottom plating. It is difficult to understand why any distinction should be made in the two cases, seeing that the whole question between them is one of arrangement of material, and has nothing whatever to do with space devoted to cargo carrying.

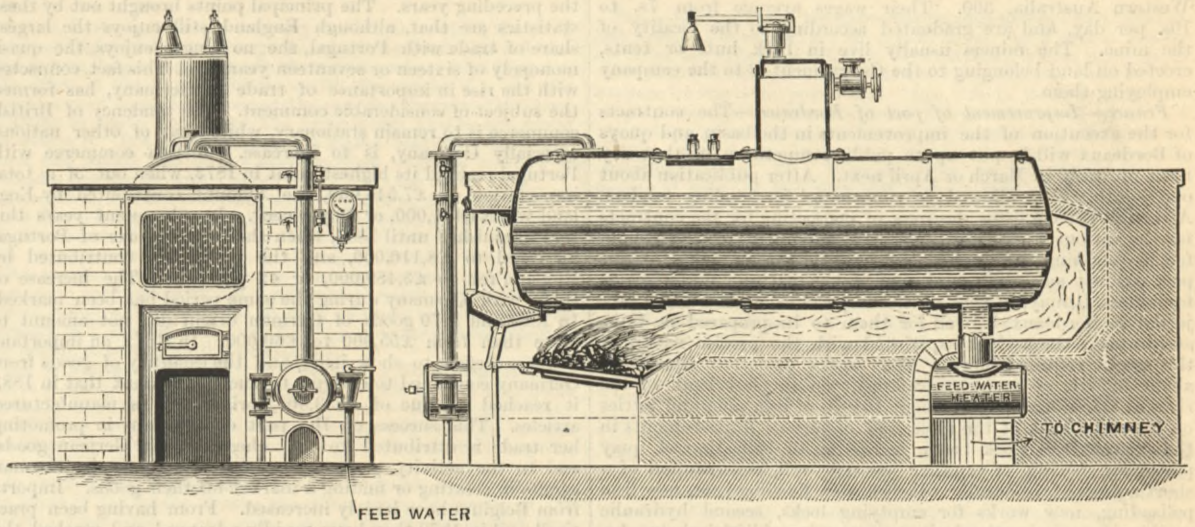
As will be remembered, a Royal Commission was appointed in the year 1881 to consider and report upon the tonnage question in all its aspects. Unfortunately, the Commissioners were not unanimous in their recommendations, and, what was still more regrettable, the wisest suggestions proceeded from a very small minority of their number. Messrs. Waymouth and Rothery appear, indeed, to have been the only two members of the Royal Commission who were either able or willing to extricate their minds from the rut of custom and usage and start from first principles in seeking an equitable solution to the tonnage problem. Mr. Waymouth, the secretary to Lloyd's Registry, thinks that the dead-weight carrying capability of a ship, as determined by the displacement between her draught in the light condition and that when loaded to a suitable freeboard, is the fairest basis upon which to assess her tonnage dues of all kinds, and this displacement he would call her register tonnage. This would put sailing ships and steamers upon a similar footing, seeing that the light condition of the latter would exclude coal, and in neither case would any consumable stores be on board. When Mr. Waymouth made this recommendation the absence of any recognised freeboard tables or authority for assigning freeboards constituted a serious difficulty which has since been removed.

There is no longer any obstacle which should stand in the way of such a wise scheme, and the only objection to its adoption seems to come from those interested in passenger ships which are never loaded to the same extent as cargo vessels. But, as Mr. Waymouth points out, if the carriage of passengers at a light draught was not as profitable as that of cargo at the full draught of water, the passenger trade would not continue under existing conditions. Mr. Rothery, the Wreck Commissioner, in his separate report recommended the adoption of "displacement tonnage" the same as is used by the Admiralty in describing the ships of the Royal Navy. This scheme, too, depends upon the fixing of a load line for each ship, and to that extent is now as practicable as that of Mr. Waymouth. There is much to be said for Mr. Rothery's scheme, which clearly assesses dues on the services rendered to a ship by dock proprietors in affording them water space, rather than on the freight-earning capability of the ship herself as by Mr. Waymouth's and the existing system. Other schemes have been proposed, and the majority of the 1881 Commission suggested a variety of amendments in the existing law, which while in the desired direction are not so radically free from the evils in the present system as seems necessary when any further legislation is attempted.

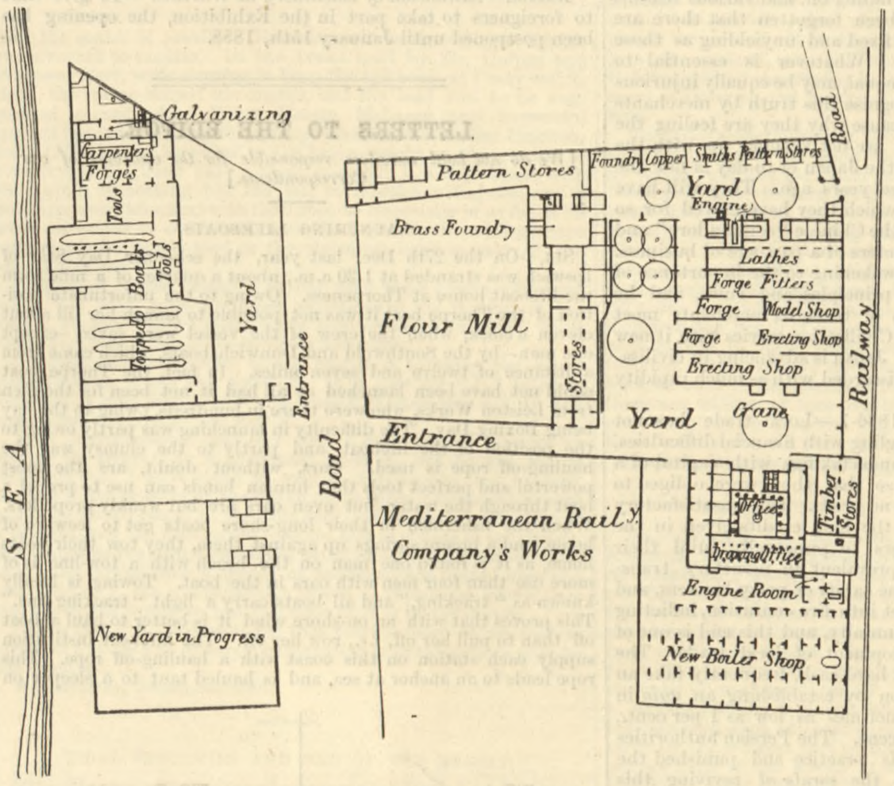
PATTISON'S ENGINE WORKS, NAPLES.

ADJOINING the Mediterranean Railway Company's Granile Works are those of Messrs. C. and T. T. Pattison—shown by the annexed plan—started in 1863 by Mr. John Pattison, and still carried on by him. At present the works cover an area of eight acres and employ a thousand hands, including men, boys, and draughtsmen; but they will employ nearly double the number of hands when the additions in progress are completed. These additions include a new boiler shop, a new erecting-shop, and extensions to the shipbuilding yard. The new boiler shop will be 215ft. long, in three bays, the centre being 50ft. and the others 42ft. wide, which will be served by a 30-ton and two 15-ton overhead steam travelling cranes, made on the spot. The machine tools, partly made by the firm and partly brought from England, are of the most modern description, and include plate-bending rolls, hydraulic rivetter, made at the works, and some large drilling-machines from Messrs. Hunter and Campbell, of Leeds. The works are lighted by a combination of arc and incandescent electric lamps. The drawing-office is spacious, light and airy, the boards being arranged transversely, so as to get the light over the left shoulder. The firm turns out contractors' work in general, mining machinery for Sicily, and appliances adapted to the industries of the country, such as oil and wine presses, the screws of which are cast iron. Although the General Navigation Company—Florio, Rubattino, and Co.— has a yard at Palermo, all its special work is executed at Pattison's, who always have about 100 men at work in Naples Harbour engaged in repairing vessels. The firm has also a very large share of Italian Government work, being able to turn out engines and boilers complete, as well as torpedo boats. At present there are in the shop the compound engines for the Curtatone gunboat of 1100 indicated horse-power; the stroke being 36in., the diameter of the small cylinder 32in., and of the large 54in. The boiler pressure is 90 lb. per square inch. The vessel has three steel boilers, and a single screw. At the shipyard, near the works, the firm is building six of the torpedo boats recently ordered for the Italian navy, and of these everything is made at Naples except the pressure gauges. The boats are of steel, 132ft. long, and are to be launched with steam up and all the crew on board; the engines are triple expansion, and will run at 340 revolutions a minute. The diameters of the cylinders are 15¾in., 23in., and 32⅞in.; the stroke being 15⅝in., and the boiler pressure 180 lb. The exhaust steam passes through the feed-water heater on its way to the surface condenser. The assumed speed is 22 knots in full equipment ready for action; that is, with

PATTISON'S BOILERS.



torpedo launching gear, two machine guns and ammunition, crew, water and stores for twelve days, and coal for 1000 knots at 10 knots speed. The single screw, left-handed and three-bladed, is of manganese bronze and very thin. The dinghies for the torpedo boats are made of zinc, 1 mm. or 0·039in. thick, on the Schichau principle, which consists in forming a timber mould stepped like an ordinary boat, hammering the zinc plates to it and rivetting them together. When painted these boats have all the usual appearance; they are, of course, very light, and are also sufficiently strong and seaworthy. Messrs. Pattison make a speciality of a dredger, of which they have just consigned two to the Italian Government, one on the hopper principle, and the other one of the largest made.



PATTISON'S ENGINE WORKS.

The engraving above shows the firm's type of land boiler, in which the heat of the fire passing underneath and returning through the tubes, passes through a channel containing the feed-water heater, and then up the chimney. All the workmen are Italians, and so are the foremen, with one or two exceptions. The engineer of the marine department is an Austrian, who has been trained at Yarrow's; but the works and shipyard managers, and the foreman boilermaker, are Englishmen, while a great many Swiss are employed in responsible positions.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Australasia—Mining appliances and machinery.—The United States Consul at Sydney reports:—The conditions under which gold is found in Australasia are precisely the same as in other countries. The Australasian metal is believed to be of a higher standard than that produced elsewhere, and in some places—Mount Margan, Queensland—it may be considered absolutely pure. The greater part of the gold obtained in the Australasian colonies is from quartz mining. In Victoria the proportion obtained from that source is about 66 per cent. more than from alluvial digging, that colony in 1885 producing 453,400 oz. from quartz reefs, and 281,818 oz. from alluvial. The Government statist of Victoria states that, in proportion to the number of men engaged in alluvial and quartz mining, the yield of gold from the latter is frequently more than twice as large as that from the former. It must be remembered that only one-fifth of the steam mining machinery of the colony is employed for alluvial workings, the remainder being used for quartz reefs. Quartz mining in New South Wales is not so profitable as in other parts of Australasia. With the exception of a few localities, the mines in New South Wales have not been worked to any great extent. The mining heretofore carried on has been principally confined to the working of river beds and shallow alluvial claims. The poor success which has often attended the working of quartz reefs is attributed principally to inexperience, and to the absence of the right kind of ore separators and other mining appliances. The deepest gold mine in New South Wales is at Adelong, 273 miles south-west of Sydney, and is not more than 900ft. deep. The reef is about 18in. wide, and yields about two ounces to the ton. In Victoria there is a mine 2409ft. deep, and fifteen or twenty others are worked at a depth of over 1700ft. The most productive gold mine in Victoria is that of the Long Tunnel at Walhalla. Since it was found in 1867 the dividends paid to shareholders have amounted to £1,037,800. The quantity of stone crushed was 302,670 tons, and the gold produced was 473,275 oz., or an average of 1·563 oz. per ton. The bulk of the mining machinery and other mining apparatus used in the goldfields of Australasia is imported from Great Britain. Considerable quantities are of colonial make, and a still larger proportion is imported from the United States, and within the last two or three years an impetus has been given to the trade in American mining machinery through the success attending the operation of various kinds of American blasting batteries, ore separators, pumps and pumping gear, quarrying machines, rock drills, smelters, steam engines, &c. Parke and Lacy, of this city, claim to have imported from San Francisco between the 1st of January and the 12th of April, this year, £10,646 worth of mining machinery against £2675 for the corresponding period of last year. The estimated cost of all kinds of machinery and mining appliances used in the goldfields of Australasia is £4,061,195, about one-half of this amount being invested in Victoria alone, where the machinery used in alluvial mining consists of 214 steam engines of 6758-horse power, employed for pumping and winding, 13 boring machines, 4 diamond drills, 512 horse puddling machines, 49 hydraulic hoses, 354 pumps, 107 pulleys or whips, 87 quicksilver and compound cradles, 9 Roots' patent blowers, 12,795 sluice boxes and sluice forms, 145 stamp heads, 138 steam puddling machines, and 144 whims. The quartz mining machinery consisted of 871 steam engines of 19,689-horse power, 31 amalgamators, 169 boring machines, 55 buddles, 17 Chilian mills, 13 concentrating tables, 76 crushing machines operated by other than steam power, 5 diamond drills, 6207 head of stamps, 409 pullers or whips, 30 quicksilver and compound cradles, 7 stone-breakers, 29 water-power winding and pumping machines, 3 Wheeler's pans, and 302 whims. Among the various methods employed in Australia for extracting gold from pyrites is that called the Newbury Vantin system, which is said to have given much satisfaction at Mount Morgan, Queensland, and at Ballarat, Maldon, and Sandhurst, Victoria. The usual mode of crushing the pyrites is adopted to free them from arsenic sulphur and other foreign substances; the calcined pyrites are then mixed with water brought to the consistency of a thin paste, and placed in a revolving iron cylinder lined with lead, where they are mixed with 1 per cent. of chloride of lime, 1 per cent. of sulphuric acid, and rotated at a moderate speed after air has been pumped into the cylinder at a pressure of 60 lb. to the square inch. The metallic gold attacked by the chlorine gas is converted into a chloride readily soluble in water; after the air is blown off, the contents of the cylinder are tipped into a filter consisting of an iron cylinder with a percolating false bottom, out of which the air is exhausted by a vacuum pump, and water being poured freely upon the superincumbent pyrites the result is that this is sucked through with marvellous rapidity, carrying the gold in solution. This proceeding has hitherto occupied about twenty-four hours, but now three washings, taking half-an-hour altogether, are sufficient to treat the contents of the cylinder rotating with a fresh charge. The false chamber is fitted with a series of slanting cross pieces enabling the exhausted solids to be tipped out after being discharged into the bottom receptacle from the upper part of the cylinder. The auriferous stream is rinsed by a pump constructed of composite metal, having no affinity to gold, into a vat where the sediment is allowed to gravitate, and it is then run into another, tested for gold with sulphate of iron, and run through a bed of charcoal, which attracts all the gold in a metallic form and allows the water to escape. The charcoal, when thoroughly impregnated, is brown in colour, and on being gently scraped with a knife shows that it is saturated with gold. The charcoal is then burnt, and the pure gold remains. There were 47,801 miners employed in the various gold fields in Australasia at the close of 1886, Victoria heading the list with 26,194; New Zealand, 11,178; Queensland, 7160; New South Wales, 5911; South Australia, 1190; Tasmania, 868; and Western Australia, 300. Their wages average from 7s. to 10s. per day, and are graduated according to the locality of the mine. The miners usually live in bark huts or tents, erected on land belonging to the Government or to the company employing them.

France.—Improvement of port of Bordeaux.—The contracts for the execution of the improvements in the basin and quays of Bordeaux will be put up to public competition in that city most probably in March or April next. After publication about one month will be allowed to contractors for sending tenders. Although British firms desirous of competing for the contracts for the various works must not be disappointed if they should fail in obtaining the same in view of the strong feeling at this port against according contracts of the nature in question to foreigners, it may, in view of the importance of the works projected at Bordeaux, be well for them to be prepared in time, and to make themselves acquainted with the precise nature of the work required here. The works projected consist in about 5250ft. of stone embankment on the left bank of the river at Bordeaux, and of about 1640ft. of iron piles and jetties on the right bank of the river, and of various improvements in the existing wet dock basin, consisting of ballasting of quay platforms, boring of another artesian well, construction of a short aqueduct, hydraulic winches, new flushing gate, new iron palisading, new works for emptying locks, second hydraulic machine for opening the dock, strengthening of lifting chains, &c.

Japan—German trade with.—The French Consul at Yokohama reports:—The Germans are pressing their goods with extreme activity upon the Japanese market. The German merchants have been essentially practical in their mode of developing trade with Japan, and in directions where other nations leave the field open through lack of enterprise or timidity they push on with complete success. It is useless to send out prospectuses unless travellers are also sent, and specimens ought to be personally brought under the notice of the Japanese consumer by agents provided with the needful authority to form contracts on the spot, while the houses at home who form such contracts and receive orders should see that they are promptly and satisfactorily executed. These are the steps which the Germans take and which lead to their successes in the East.

Japan—Commercial changes.—The United States Consul at Hiogo and Osaka reports:—There is much complaint among the merchants of the East of trade falling off, and various reasons are assigned. It seems to have been forgotten that there are certain laws governing trades as fixed and unyielding as those governing the heavenly bodies. Whatever is essential to success to-day, other things being equal, may be equally injurious to-morrow, and the failure to recognise this truth by merchants dealing with Japan is the true cause why they are feeling the depression complained of. They are not keeping up with the spirit of progress, forgetting that the Japan of to-day is not the Japan of twenty, ten, or even three years ago. They will have to get out of the old grooves in which they have moved for so many years, and remember that the Chinese "compradore" and the Japanese "banto" are characters of a past age of business. The Japanese merchant is fast awakening to the importance of conducting business on modern principles and rules, and he must be met with on the marts of trade as merchants meet merchants in Western countries. Civilisation carries with it new duties, ideas, and responsibilities. Japan is advancing in civilisation, and the old ideas are being discarded with as much rapidity as the old customs.

Persia—Trade in Tabrur in 1886-7.—Local trade has not revived. Native importers, struggling with financial difficulties, attempted to embark in large undertakings with capital of a more or less fictitious character, so that they were obliged to effect quick sales realising little or no profit. This unsatisfactory state of things may be traced to the long credits given in the Tabrur market, failure by debtors to punctually fulfil their pecuniary engagements, abuses prevalent in monetary transactions, which are provoked by the sarafs or petty bankers, and which frequently throw the market into dire confusion, inflicting heavy loss on the commercial community, and this end is one of the chief obstacles to the development of local trade. The sarafs, who are the holders of the hard cash, frequently take an undue advantage of their position by establishing an *agio* in seasons of pecuniary scarcity, sometimes as low as 1 per cent., and at others as high as 22½ per cent. The Persian authorities have at times put a stop to this practice and punished the offenders. There being signs in the sarafs of reviving this practice, the governor-general of this province has announced his intention of again dealing with a question of such vital importance and affording redress. An Austrian merchant from Vienna who brought samples of merchandise to Tabrur last year has opened a Bon Marché in this town for the sale of various articles, but no serious competition with the English import trade has yet set in from the Russian side, nor will any foreign competition injurious to British enterprise take place if our Chambers of Commerce, importers and manufacturers keep in view that to maintain our supremacy in manufactures, and ensure permanent success, superiority of fabric, good execution, durability, fastness of colour, and designs best suited to the Persian market must be brought into combination. The Trebizond-Erzeroum route works fairly well. Freights are comparatively low, and goods in transit generally reach their destination in good condition and punctually. The closure of the Caucasus route to the transit trade has not been so prejudicial to the trade of Tabrur as was at first imagined. Were Russia to rescind this prohibition the preference would be given to the old commercial highway between the Trebizond seaboard and this country. It is premature to form conjectures as to the results likely to follow upon the Exhibition announced to take place at Teheran, in 1888, of Russian manufactures suited to Persian requirements. If such a display of Russian activity in commercial centres of the far East serves to awaken our Chambers of Commerce and merchants to the necessity of quickening the pace of British enterprise in Oriental markets, some advantages—the fruits of experience—will also be reaped on our side. The mission from time to time of competent persons to study the principal markets of Central Asia and Persia would be a step in the right direction. Consuls can but hint at the advisability of such a course. It is for Chambers of Commerce and merchants interested to take the initiative. The imports into Persia from British India amount annually to considerably over a million. The question suggests itself whether an Exhibition at Ispahan or Teheran—whichever be most expedient—of British and British-Indian manufactures suited to Persian requirements could not be opened. Such an Exhibition would doubtless stimulate the trade between our Indian possessions and the southern dominions of the Shah; England and Persia sharing mutual benefits.

Portugal—Trade, 1869-85.—The volume lately published by the Portuguese Government, giving the latest available statistics relating to the commerce and navigation of Portugal, shows a great advance on those previously issued, as it gives full statistical information for the year 1885, and comparative tables for the preceding years. The principal points brought out by these statistics are that, although England still enjoys the largest share of trade with Portugal, she no longer enjoys the quasi-monopoly of sixteen or seventeen years ago. This fact, connected with the rise in importance of trade in Germany, has formed the subject of considerable comment. The tendency of British commerce is to remain stationary, while that of other nations, especially Germany, is to increase. British commerce with Portugal reached its highest point in 1873, when out of a total importation of £7,546,000, the amount contributed by England was £4,461,000, or 59 per cent. In subsequent years this lead diminished until 1885, when the total imports of Portugal increased to £8,110,000, and the proportion contributed by England fell to £3,489,000, or 42 per cent. The increase of trade with Germany during the same period has been marked. In 1869 and 1870 goods of German origin did not amount to more than from £55,000 to £60,000. In 1872 an important increase began to show itself, and the quantity of goods from Germany continued to enlarge to such an extent that in 1885 it reached a value of £833,000, principally in manufactured articles. This success on the part of Germany in promoting her trade is attributed to the cheapness of German goods, and to the activity, perseverance, and zeal shown by German agents in creating or finding a market for their goods. Imports from Belgium have largely increased. From having been practically nil in 1870 they have rapidly advanced and reached the sum of £236,500, almost entirely in metals and woollen goods. Imports from the United States have greatly increased, and that country is now second on the list as regards imports, entirely owing to the large importation of American cereals which has taken place of late years; and in spite of protective duties, has proved very prejudicial to Portuguese agriculture. The figures were:—1869, £308,888; 1885, £1,027,554: increase, £718,666, or 233 per cent. The above remarks as to the fluctuations of trade with different countries apply equally to shipping, but it is misleading to apply too much importance to navigation statistics alone.

Russia.—New customs tariff.—Agricultural implements and machines, exclusive of steam engines not specially distinguished, and models, £6 17s. 9d. per ton; articles of brass, copper, cast and wrought iron, steel and zinc, weighing less than three pounds, each £88 9s. 6d. per ton.

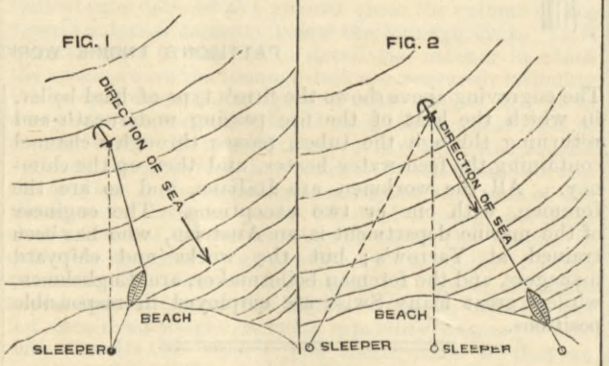
Russia.—Exhibition of machinery at Warsaw.[1]—To give time to foreigners to take part in the Exhibition, the opening has been postponed until January 15th, 1888.

LETTERS TO THE EDITOR.

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

LAUNCHING LIFEBOATS

SIR,—On the 27th Dec. last year, the schooner Day Star of Ipswich was stranded at 1.30 a.m., about a quarter of a mile from the lifeboat house at Thorpeness. Owing to the unfortunate position of the Thorpe boat it was not possible to launch her till about eleven o'clock, when the crew of the vessel were saved—except one man—by the Southwold and Dunwich boats, which came from a distance of twelve and seven miles. In fact, the Thorpe boat could not have been launched at all had it not been for the men from Leiston Works, who were there in hundreds, owing to the day being Boxing Day. The difficulty in launching was partly owing to the position of the lifeboat, and partly to the clumsy way the hauling-off rope is used. Oars, without doubt, are the most powerful and perfect tools that human hands can use to propel a boat through the water, but even oars are but weakly propellers. When the fishermen in their long-shore boats get to leeward of home, and a breeze springs up against them, they tow their boats home, as it is found one man on the beach with a tow-line is of more use than four men with oars in the boat. Towing is locally known as "tracking," and all boats carry a light "tracking line." This proves that with an on-shore wind it is better to haul a boat off than to pull her off, *i.e.*, row her off. The Lifeboat Institution supply each station on this coast with a hauling-off rope. This rope leads to an anchor at sea, and is hauled taut to a sleeper on



the beach, and the rope is afterwards triced up to a mast on the beach. The rope is at *right angles to the beach,* consequently when the sea is either from the right or left, the boat is hauled off nearly broadside to the waves. Therefore, in a heavy sea it is impossible to launch a boat this way, and in a moderate sea the men get drenched, and generally with ice-cold water—not a treat at starting on a winter cruise. If three sleepers were laid on the beach instead of one, the rope could be laid at right angles to the sea and the boat always be hauled off head to sea. The rough sketch I send will explain this better than words. It would be better to have the boat on a carriage, so that she could be taken to the right or left easily. This would not prevent the boat from being launched from skids, which is, I believe, better than launching from a carriage. There is a good road from Thorpe to the northwards for five miles, and if there were hauling-off ropes laid at about two miles apart, and the boat had a carriage, she would be far more useful than she is now.

I may say here that if a lightship were placed on Sizewell bank, with a siren for thick weather, the lifeboat's occupation would be nearly gone. As it is, on a shift of wind to the eastwards, in thick weather, Sizewell Bay is a real death trap for coasters. Wrecks lie so thick that scarcely a day passes in the season without a fisherman getting his net foul of a wreck. I enclose you a cutting from a local paper, that goes far to prove what I have always told you—that, as a rule, naval men know nothing about boats, and inshore tides or winds, and are utterly unfit for authorities on these matters. While we think it is the right thing to save human life, let us do it in a scientific way. Thanking you for your powerful assistance. J. W.

Sizewell, December 19th.

TECHNICAL EDUCATION AND FOREIGN COMPETITION.

SIR,—I should not presume to crave of your kindness to allow me a small corner of your space did I not feel it a sort of duty, as it is a pleasure, to offer my humble testimony and thanks for the inestimable good your correspondent "C." has done to the cause of technical education we have been advocating, by his remarks, and above all by letting the public know the interesting conclusions to which the Commissioners arrived in their report, as quoted by "C."

I may preface my few and unimportant remarks by saying, that I am struck with astonishment and admiration at the accuracy and fulness of all the information obtained by the Commissioners, whoever they may have been, and their really sound remarks on all they have seen and gathered in a single journey to the countries visited; for although, as you know, Sir, I have been in the midst of continental industry for years, and besides, have always taken great interest in the education question in relation to the future trade and industry of England, I do not think I could add anything of much importance to what they have reported or said. "C.'s" few but trite remarks, and what the Commissioners bring forward, seem to my mind to clench the subject, and it now only remains to find means to act on their good and wholesome advice; and if all this had appeared sooner, with the exception of your occasional leaders on the subject—always to the point—all the other writing, talk, and agitation might well have been dispensed with.

To sum up, then, it may be considered settled that we still stand at the head of industrial countries, as I once tried to show before in your columns; that want of technical instruction is not the cause of our foreign trade decreasing; that in higher technical education we are not either behind our neighbours, but that our higher technical schools may require slight modifications to be introduced, but, for mercy's sake, not altogether on continental lines; that more numerous schools, such as now exist, or opportunities for acquiring special knowledge, might, or otherwise must, be provided for the working classes; that, beyond everything else, middle class schools must be provided. I say these should be pushed for—yes, indeed, agitated for—if it is not immediately taken up as it ought to be by the public, because in reality this is the keystone to the whole question; for if these were abundant, cheap, and good, with language made a *sine quâ non,* but of the best—not of the shoddy description too often met with—I conceive that all our education ills would be cured, because commercial education would be grafted easily on this, or any other speciality indeed, for that matter; in fact, a thoroughly broad and good middle-class education would provide the stuff from which to select the proper persons to represent our trade abroad in the most effectual manner.

Nothing would beat languages as part of the necessary middle-class education, for not only would it necessarily give expanded views of things, but to ourselves, as an inventive people, it would be of the greatest possible advantage if everyone could read, understand, and see—in three or four languages—the technical and trade journals of other countries, not alone to know exactly what they were doing, but beyond this to pick up new ideas and improve upon them, and so create new inventions on what they would see. Only those who have had experience of this know how to appreciate it sufficiently. The Commissioners say foreigners learn a great deal from us in this way; I go further, and say all. I once asked the head draughtsman of a large machine factory why he, with his fellows, never invented anything new, the reply being that it was far easier and cost less work to copy from English publications. I do not say we should learn equally as much from foreign ones, as they are half filled with articles and drawings from English sources, yet there is always something to be found for those who are in search of knowledge. Foreigners learn so much more than the general run of Englishmen, because they are continuously fishing for information, if seemingly ever so unimportant, whilst Englishmen—unfortunately, in this instance—have a natural abhorrence of trifling matters, regarding it as gossip, which is quite right in its proper place, but here it is wrong, and nothing ought to be overlooked, if apparently ever so trifling, for this is the way to acquire a wide-spread knowledge.

Abundant, cheap, and good middle-class schools, I repeat, should be the cry of the day, and if Parliament should do something in furtherance of this object, in two or three years' time we should have the parties required, and we need then have no further scares or misgivings about foreign competition arising from too inferior education.

In conclusion, the agitator spoken of by "C." should have added to the remarks of the latter, that the washerwoman's son must have had an education such as is only to be had in England now at a first-class college or university, to be able to pass the examination demanded, before he could become a one-year's volunteer, instead of having to serve three in the ranks. Such a middle-class education as I have in my mind's eye would fit anyone, however, to pass such an examination, if such a one were required in England. U.

Rheinland, December 21st.

THE LABOUR MARKET, FOOD SUPPLY, AND POPULATION.

SIR,—The above subjects are of so pressing a nature as to demand the most serious and national consideration, and this should not be procrastinated.

Having been in business—and still so engaged—extending over the time in which marvellous changes have taken place, matters might be told to the present generation, who know not the tinder box and brimstone match age, and when the old watchmen called the hours of the night and state of the weather.

For instance, the colliery railways were made of wood; the men who laid them were called waywrights; the wood rails were superseded by 3ft. fish-bellied cast iron rails; and these by 15ft. rolled fish-bellied rails. The water pipes were elm trees bored out by long augers. These facts show the primitive state of engineering in what became so soon its centre. What is now designated civil and mechanical engineering was accomplished by millwrights. Such was Smeaton, who built some five windmills here for pumping, grinding, and other works. Apprentices for seven years were paid 2s. a week the first year, and advancing to 6s. 6d. the last year. There were no holidays, unless the time was worked up by overtime. The wages of mechanics were from 16s. to 18s. per week; labourers, 12s. The hours of work were from 6 to 6 for five days, Saturdays 6 to 4, with 1½ hours each day for meals, making 61 hours per week. This state of affairs continued for several years, and these were the general hours and wages of the district. No one complained of the hours being long, or desired them to be shorter. Flour was about 3s. 6d. a stone more or less, and all other things equally dear except meat, which was a little cheaper than at present. Men had more broken time then, which was provided for by them, by clubs or savings, as no assistance was obtained from public subscriptions, soup kitchens, or parish relief, which last was only received by the very old, infirm, or idiotic. The men thought themselves well off; the old men said the times were much better than in their youth.

The long-standing spirit bars had not been introduced. Beer was only drunk by workmen, and comparatively little of that, spirits being only taken on special occasions, and women did not, as a rule, enter the public-house. The introduction of the steam engine, steamships, railways, Free Trade, and the immense increase of textile fabrics and machinery, not only for ourselves but for the world, made an increased demand for labour, and as a natural consequence higher wages were obtained without difficulty according to supply and demand, the masters and men making their own arrangements. The flood of prosperity which came was without precedent to any nation previously, and we, having got the start, except for some small and delicate articles, had command

[1] THE ENGINEER, November 11th, 1887, p. 398.

of all the markets of the world. Then came "trades unions," to act for good or evil, and in some instances for both. The committees and managers soon obtained great power, and they and the men settled the hours of labour and payment, number of apprentices, who should and who should not be employed; leaving to the employers as their part to provide capital, buildings, and machinery, and do their best to obtain orders at a profit with such control as was left to them; and if they could not obtain remuneration they must go down, or abandon the business and let it go into foreign hands, which has been the case in many instances. The wages for many years past have been about double what they were in the early time spoken of, nearly all articles of food and clothing being now about half the price. A very large majority of the men have used their increased means wisely, and well in every respect; but it must also be noted that a large and increasing number, however high the wage may be, spend all, and even anticipate their pay, making no provision for the future, and demanding employment. I may remark that improvidence is not confined to any class.

My object is not to find fault, but to lay facts before all grades of our common country, but more especially the employers and employed, and to look ahead at what we have to meet. The serious thing to my mind is that as the working class have almost unlimited political power, subjects which appear prejudicial to their interests and should be advanced and discussed are studiously avoided, both by the press—except in a few isolated cases—and would-be philanthropists and popularity seekers, who are always going, or pretending to, do so much for the "working classes," but never give them sound advice, which is much needed at this time. Our working classes have for some time had the highest wages in Europe, and the employers have had the command of the markets of the world; but a change has taken place. Other nations as intelligent as ourselves, and fully as well educated, whom we have previously supplied with our manufactures, are rising up with a national and strong desire to improve their condition and supplant us. For many years past our merchants and manufacturers employed the better educated foreigners to conduct their correspondence and travel for them abroad, our young men being unable to do so, and there is now an army of well-trained, suitable men at work, who can speak two or three languages, supplanting us in all directions, and this competition is increasing. Added to this, many of our large manufacturers, with the desire to turn their capital to better account than they can at home, are embarking it with skilled managers to foreign countries, to instruct and employ the clever but hitherto unskilled and low-priced workmen, which will supplant and increase the competition of our more costly labour.

Having brought this narrative down for the last, say, sixty-two years, it is time to review our present and future prospects as a nation. The following figures may not be exact, but sufficient for my purpose:—The population of England, Scotland, and Wales is about 32 millions; Ireland, about 5 millions; together, 37 millions, and we know well at present there is not work for all our workmen to be fully employed, and the population is increasing, after allowing for deaths and emigration, at about 400,000 a year, or 1100 daily. The value of imported food in 1885 was 146 millions; up to this date, 1887, about 155 millions, and the food and raw materials for our manfacturers form the greater part of the amount of our imports, the manufactured goods imported being a small portion. I calculate the food imports in 1900 will be 212 millions. In 1900 the population will be increased at the present rate to a total of 42,890,000. In the above case we would have a yearly increase of labour put on the market, until in 1900 there will be 5,890,000 extra population. If you take one-fifth of the above for men, 118,000, and a quarter more for women, equals 29,500, which together makes 147,500 men and women bread winners; for the extra 5,890,000. How are these to be provided with work, and how will the £212 millions be found to buy the food required. Again, we have more workmen now than we can fully employ; what is to be done with the increasing numbers? Our manufacturers have to compete with other nations rapidly coming up to our standard of work, in many cases they have reached this point, and the worst feature is, the foreign workmen have only about half the wages and work much longer hours, and there is little chance of an early change to any extent in this respect, as their skilled men are rapidly increasing, and will compete with each other for work, and the foreign masters will have to compete with our manufacturers, having their works replete with the best and most costly tools and skilled workmen, so that it may be long before any material increase to their wages can be obtained. This is the opposition our manufacturers have to meet with, short hours and high wages. Many men propose that the hours of labour should be further reduced in order to give employment to those out of work, or with a view to make the articles dearer that higher wages may be obtained. This must obviously defeat itself by not enabling us to compete with our foreign rivals in the world's markets, and so lessen the means of employment at home and buying food. It is said by many workmen that if the masters lose their trade abroad they could follow it wherever it went; this is a great mistake, as in Europe few of our countrymen would get employed, and the wages would be only half of what they get here. Some well-meaning people, and some for popularity, propose technical education as a cure for present and future needs.

Improvements in this direction are extremely desirable, but no such small device can meet the exigences of the case; it is only a drop of water in the bucket. It is well to observe that those countries which are encouraging English capitalists to commence large works, bringing experienced and skilled managers, reserve all the work to be done by their own countrymen. We live on these islands in what has become a very artificial state, owing mainly to the rapid increase of the population, which was considered a test of our wealth and prosperity, but now an embarrassment as to how employment can be found for the increasing numbers, and how are we to increase the goods at a price we can sell them abroad, to obtain the increasing quantity of food required, which we can only get in exchange for what we sell, hence the necessity of not being superseded.

Short hours and high wages may be desirable, and an advantage to many, but not to all. The difficulty is, how are they to be maintained. If we have to sell our manufactures to be able to live, they will have to be made at a price they can be sold at, and if they can only be made at a cost above market price, we will lose our markets, than which nothing can be more serious to our nation. My desire to see my country great, wise, and prosperous has made me make the foregoing remarks with no feeling of hostility to any class; but having a conviction of the necessity of the whole nation reviewing its position and prospects, I have put some of the great points together which occur to me to require consideration, in the hope that they may be useful to the rising and present generations.

December 27th. INDICATOR.

THE R.A.S.E. STEAM ENGINE TRIALS.

SIR,—I am sorry that your correspondent "R." has entirely failed to catch my meaning, and, I think, equally failed to understand what goes on in a brake. He has confounded what takes place in a brake standing with what takes place when it is running. Possibly the annexed sketch and explanation will enable him to understand my meaning. To make matters quite clear, I have shifted the position of the compensating levers C to the horizontal position, which I think he will admit does not alter their mode of action.

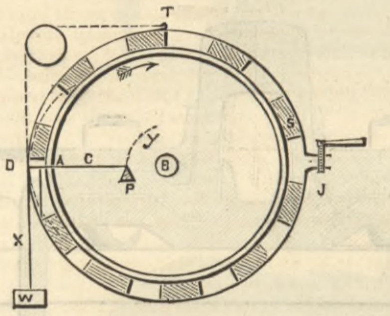
The brake when at rest will tend to pull the wheel round with it in a direction opposite to that of the arrow, and to prevent this rotation either a fixed rest must be placed under the weight or else the weight will fall until the compensating action of the lever C comes into play and prevents a further descent by augmenting the tension of the brake strap. Then C will, by bearing against the stop P, prevent further rotation, and the pressure on P will be as much in excess of the weight W as the distance B D exceeds the distance B P. In one word, the strap and blocks S become part of the wheel, and the action will be just the same as though the weight W were fixed to the wheel rim, and a pin in a spoke pressed on the stop P. So far I am quite agreed with your correspondent "R."

Let us, however, take the ordinary conditions in which the strap has been tightened just enough to carry the load W. Let this load rest on the ground or on a fixed support, and see what happens. The effort of the engine will be to lift the weight W; but this weight cannot from the nature of the case do otherwise than tend in lifting to rotate, not round the brake wheel axis B, but round the centre P. But it will be seen at a glance that for a small distance the dotted line of the arc described with the radius P D coincides practically with a curve struck from the centre B.

Thus, then, the effort of the engine in causing the wheel rim to move through any small distance—say one-eighth of an inch—is to lift the weight W through the same proportionate distance, which will be, of course, a little more than ⅛in., because the distance D B is greater than the radius of the brake wheel; and I think that your correspondent "R." will have to admit that as P is the centre round which the whole system, as I may call it, swings, no pressure on P exerted by C can affect the resistance to the effort of the engine to swing the system round P.

Let us suppose, however, that instead of a fixed stop at P we put in a spring as Messrs. McLaren did, which in this case pulls vertically upwards. In that case the system would no longer swing round P as a centre when the engine started, but round B, because the inner end of the compensating lever would now by the spring be carried up along the line Y.

In the first case, that is with C resting against the fixed stop, the effort of the engine to raise the whole centre of gravity of the system is unassisted in any way. When the spring is used, that spring will, of course, follow the engine effort up, and assist it to



raise the centre of gravity. Its action will be dynamic, as I have endeavoured to explain. In the brake used by Mr. Halpin and Professor Barr, with a spring to keep the tail rope, as I may call it, tight, the spring helped the engine, and the load had to be augmented accordingly. When Messrs. McLaren used horizontal springs instead of a stop the springs performed a similar function, and 114 lb. had to be added to the brake weight on the engine to compensate for their pull. Their so-called R.A.S.E. brake with the springs is nothing but the tail rope brake in disguise, and is not in any way identical with that used at Newcastle in so far as its mode of action is concerned, and the necessity for adding more weight to the brake load is the strongest confirmation of the accuracy of my views.

It goes, of course, without saying that what I have advanced would not hold good for large variations in the position of the weight W; but in brake trials there is no sufficient variation, or at least there ought not to be, to affect the result.

I repeat that the effort of the engine is to swing the whole loaded system round the point P. It is now for "R." to show first that it does not so act; or that if it does any aid to the engine can be given by the stop P.

Your correspondent may say that I have altered matters by moving the levers C to a horizontal position, but he will see on reflection that I have done so only in appearance, not in fact; because if the outside of the brake strap were cylindrical a cord might be wound round it, and this cord led off in any direction at a tangent, and the load would operate just as it does in my sketch. Thus, suppose the cord X instead of being attached to the brake strap at D to be carried over a pulley as shown by the dotted lines and made fast at T, the compensating levers C remaining where they are, the action would be just the same as it is in my sketch.

I hope that "R." will now see that there is more to be said in favour of a static and dynamic explanation of brake actions than he has supposed. R. A. S.

Westminster, December 26th.

TIDAL ESTUARIES AND BAR OF THE MERSEY.

SIR,—Those of your readers who have visited Rhyl, New Brighton, Southport, and Morecambe Bay, have no doubt noticed large accumulations of blown sand, but even they may not realise the magnitude of the accumulations until they learn that between the Ribble and the Mersey is a tract of several square miles below the level of high water of spring tides. This tract is protected from the sea by flood gates, embankments, and the fringe of sand hills on the coast. This fringe extends from the Mersey to the Ribble, and some of the hills attain an altitude of 50ft. to 60ft. or more above high water. In addition the coast keeps steadily advancing westward, and has done so for some centuries. The sand is to a considerable extent covered with towns and habitations, the residents in which may be said to dwell upon Irish soil, if the suggested drift across the Irish Sea be well founded.

As the tidal range in the northern basin varies very greatly, low water at the entrance of the Mersey is 4ft. lower than it is at Holyhead, and 10ft. lower than it is at the Mull of Cantire, and the question arises—Whither does the ebb from the Mersey escape? How is the apparent anomaly to be explained? That it does escape every one knows, but the condition implies an amount of resistance which will tend to augment the deposit of sand and silt. At the mouth of Morecambe Bay, and in the Mersey at Liverpool, the ebb is yet lower than at the mouths of the Dee, Mersey, and Ribble.

The top of the sandbank which forms the bar of the Mersey is ten feet below low water springs, but on each side the water rapidly deepens to six, seven, and eight fathoms, with a bottom of sand, the thickness of which is unknown; all over the northern basin the soundings give sand, occasionally varied with shells and stones on the British side, and mud on the Irish. These features of tide and sand do not appear encouraging to those who would maintain a deep water entrance to the Mersey by dredging, with or without the aid of permanent works. The depth of foundation for masonry is wholly indefinite, and the drift of sand, subaqueous and subærial, is incessant.

The late Mr. George Rennie proposed to construct a breakwater along the north-eastern margin of Burbo bank and sands, hoping thereby to secure a sufficient scour for the maintenance of a deep water channel. His general idea of the construction was to use a double row of piles, arranged in pairs, trestle fashion, cased with planking or iron plates, and loaded along the feet of the piles with blocks of rubble. In conversation, Mr. Rennie expressed a wish to reserve the closing of the Rock channel to be determined by experience; as also the length of the breakwater. Like many other engineers, Mr. Rennie did not seem to realise the difference between tidal and non-tidal rivers; and that a regimen suitable for the Danube or Mississippi would not answer, where the direction of the stream is reversed three times in thirteen hours; whereby the silt removed by one stream may be brought back by the reverse; thus imitating the endless task of Sisyphus. JOSEPH BOULT.

Liverpool, December 26th.

SIR,—A letter under the above heading appears in THE ENGINEER last week. I have read it over several times, but I cannot clearly see what the writer is driving at. He evidently knows more about tides than most people do, but his knowledge is not practical. I suppose he wants to prove that "the tide in itself is pure and simple force, and not the movement of large masses of water." I am not a learned man, but I have read something of potential kinetic, energy, &c., and they seem to me modern, "caloric, centrifugal force," &c. Whether tides are movements of large masses of water or not, they will move vessels and other heavy bodies; and in this way they are chiefly interesting to the engineer and seaman.

To the southward of the parallel of Scilly the tides of the channel and offing blend together, and cause the direction and force of the stream to be continually changing. From this rotary motion of the stream it has been said that a vessel cannot be carried far in any direction. This is not the fact, for a vessel is carried in a straight line to the south and west while the water is rising at Dover, and to the north and east while it is falling at that port. Yet in the Channel the flood stream varies in shore considerably. Your correspondent is in error in stating that the southern stream ceases off Holyhead. There are three streams from the south. The middle stream, which flows to the north as far as the Point of Aire and then turns short round. The west stream runs past Arklow at a great rate—four knots—but the water neither rises or falls (how about the "force" there)? The east stream travels to the north by Cardigan Bay, turns sharp round by the Skerries, and helps to fill the Dee and Mersey. There are three streams from the north, two of which lead into Morecambe Bay, which is the great receptacle for tides and sand, and force, too, for aught I know. But all this has little to do with the bar of the Mersey. I believe that all bars are owing to the wind and waves, and not to tides—though a high tide may quite change a bar or a beach. And here I would beg your correspondent not to say "high tide," when he means "high water." A high tide is an abnormal thing, high water is a normal occurrence. Nothing tries the patience of a fisherman more than a visitor asking him when it is "high tide."

But to leave my birth-place, near the mouth of the Mersey, and come to this Suffolk coast. Five miles from here is the tiny little hamlet of Dunwich, once a bishopric and the capital of East Anglia. This little village is all that remains—or rather is all that the sea has left—of the great town; yet here, five miles to the southward, the beach is gaining greatly, while two miles to the south of us, Thorpe is in danger of being washed away.

High tides account for this—abnormal tides. High tides scarcely ever occur at the springs, nearly always at the neaps. A gale of great violence from the north blows at the neaps for several days, high tides result, the "gravity" tide is at its weakest, and the wind will not let the tide ebb, but it flows, and an abnormally high tide takes place, and down goes more of Dunwich and Thorpe cliffs. An abnormal tide is a "wind tide."

For miles along this coast two shoals run parallel to the shore, they always keep the same distance apart, and from the beach, no matter whether the beach gains or loses. It is the opinion of beachmen that they are formed by the waves. These men also think that river bars are formed by the waves, as the bars vary greatly with the prevailing winds. At the mouth of the small rivers on this coast the bars vary almost every week. In 1804 there was a seven fathom channel into Harwich. In 1826, owing to the removal of cement stone, the shingle blocked up the passage till there was only 11ft. on the bar. Dredging operations have increased the depth of water to 17ft. The tides on this coast are very simple in their action, and very complicated in the Irish Channel. As a rule we have far more surf on the Suffolk coast than we have at the mouth of the Mersey. Some days at Sizewell there are millions of tons of shingle, and at other times there is not enough to fill a ballast bag. Tides cannot account for this; there is no doubt it is owing to certain winds. J. W.

Sizewell, December 28th.

THE EXPLOSION ON BOARD THE S.S. ELBE.

SIR,—Though Mr. Adamson's—manager to Messrs. Oswald, Mordaunt, and Co.—suggestions do not seem to have met with general adoption, I question if the weight of evidence does not support his view, especially in the absence of positive direct proof to the contrary. In America considerable attention has from time to time been paid to the effects of water hammer, not always with the most satisfactory results. It would seem water hammer occurs in pipes oftenest from steam impinging therein on water. It may be observed (1) the branch from P. A. boiler—p. 522—seems to be in a curious position if it was intended water hammer should not take place in some adjacent part of the main pipe, and not necessarily on the weakest part of the length of pipe. (2) So stupendous are some of the effects of water hammer said to be in long lengths of pipe, that the high value of 1130 lb. per square inch would be but a trifle compared with the forces which would have to be withstood, seemingly quite as much from the outside as from the in. T. P. WILLIAMS.

December 26th.

COPPER AT HIGH TEMPERATURES.

SIR,—Since the lamentable Elbe catastrophe the behaviour of copper at high temperatures has been attracting considerable attention, and some very interesting experiments on this subject have been carried out by Messrs. Kirkaldy and others. It would, Sir, I am convinced, be a matter of widespread interest if any of your readers who have any recent information on the strength of copper pipes at high pressures, the strength of copper at high temperatures—say, 200 deg. Fah. and upwards—the strength of copper after it has been heated and worked, &c., would make the same known through the medium of your valuable paper. If any of your readers could give me any information on the above subject, or could inform me where I could obtain such information, I should feel greatly obliged. LESLIE S. ROBINSON.

Engine Works, Dumbarton, December 27th.

GAS *v.* STEAM ENGINES.

SIR,—Intending to increase and enlarge my smith's and other shops, with machinery therein, will any of your readers kindly give me from personal knowledge their practical experience as to the relative value and cost of working per day of twelve hours, with gas at 5s. per 1000ft., a gas engine 12 to 16 nominal horse-power, compared with steam of equal power. Also, if they can do so, I should like the same information as regards petroleum engines compared with both the above—which class of machinery gives the greatest wear and tear, and costs most to keep up in an efficient state. I trust to receive replies in your paper to my inquiry. H. E. C.

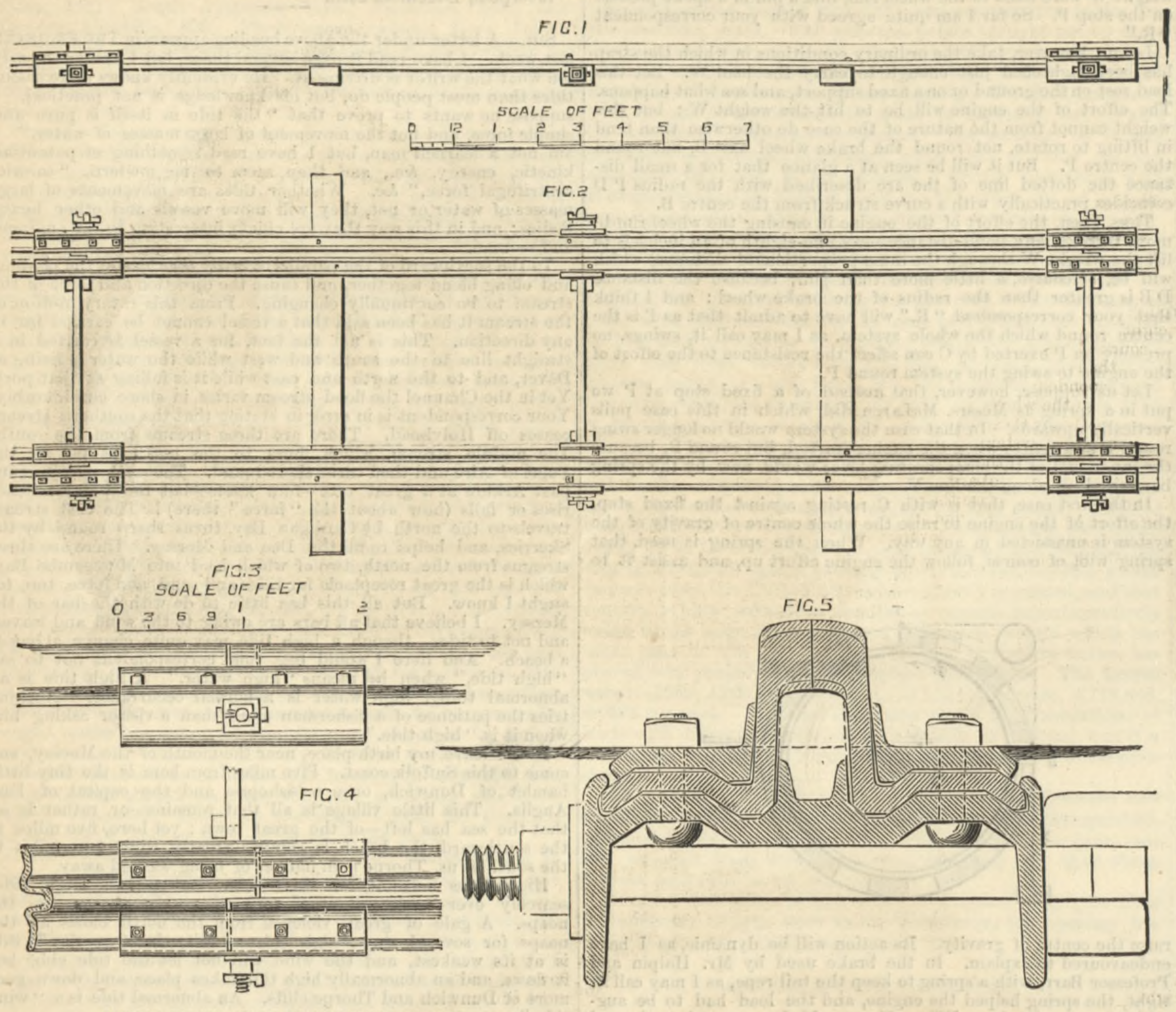
December 28th.

FREE TRADE AND NO TRADE.

SIR,—Will some of your free trade correspondents be good enough to inform me why it is that, now our exports are in excess of our imports, trade, generally, is improving in the country? If free trade axioms are right, this matter wants immediate and urgent attention; as if import means profit and export loss, the sooner our exports are reduced and the trade from the country brought to limits that shall not exceed our imports, the better. With improving business—from a free trade point of view—we are drifting quickly on to ruin at present. G. FREDK. RANSOME.

Liverpool, December 27th.

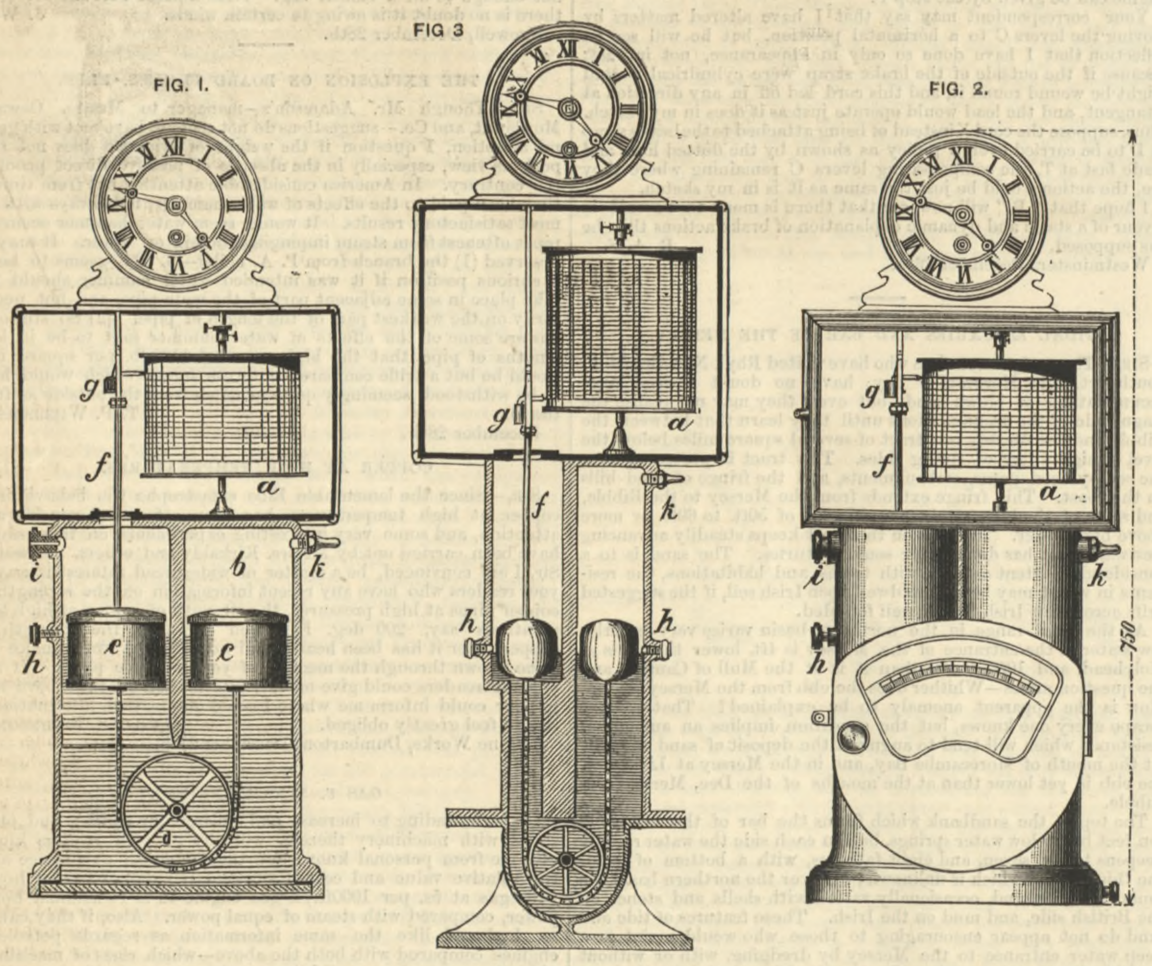
QUELCH'S METALLIC PERMANENT WAY.



QUELCH'S PERMANENT-WAY.

The accompanying engraving illustrates a form of permanent-way for which Mr. Quelch, of Darlington, has been awarded a bronze medal at the Paris Railway Exhibition. In his description of it he says the use of longitudinal metallic sleepers has proved that a continuous width of from 10in. to 11½in. is sufficient, and with these cross binders are placed every 10ft. to keep the gauge and the cant usually given to single-webbed rails; and in some cases tie rods are also used, for the particulars of which see The Engineer of June 25th, 1886. It may therefore be safely assumed the same width will be sufficient for this rail, and it is a very convenient width for packing. This arrangement and the great strength of the rail will, it is claimed, ensure stability and safety, and the joint will be sufficiently strong to prevent undulations. The advantages claimed are the same as those known to belong to both longitudinal and cross-sleepered railways, and in particular absolute immunity from the danger of the rails or joints breaking, and the practicability of scarfing the ends of the rails.

THE "OCHWADT" SELF-REGISTERING METER.



THE "OCHWADT" SELF-REGISTERING METER.

The meter illustrated in the accompanying engravings is for use in mines, gas works, and factories. It is made by Mr. Julius Pintsch, and is introduced into this country by the Maritime and General Improvement Company. The meter shows the amount of either depression or pressure in any stream of gas or air, and also supplies a written record of the pressures by means of an automatic marking apparatus either inside the works or at any point in the pipe connections throughout a town.

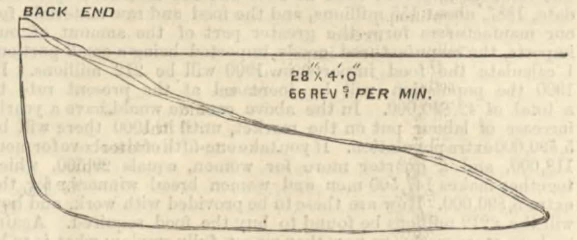
As will be seen from the drawing, the meter is constructed on the principle of utilising the movement obtained from the constant striving of any fluid—in this case water—displaced by pressure, to return to the same level, in two pipes in communication with each other, this movement being communicated to two floats, and from these, by means of a chain and pulley and a spindle, to the register scale. Should it be required to keep a written record, the motion is registered, on the paper in the case fitted to the upper part of the instrument, by means of the writing apparatus. On the top of the meter an eight-day clock is placed, which turns the drum *a* once round in twenty-four hours. Round this drum is fastened a paper on which horizontal lines, representing the various pressures, are intersected by vertical lines representing time.

When it is required, as in mines or factories, to work the apparatus to gauge the depression existing in the air passages, the form shown in Figs. 1 and 2 is used, in which the exhaustion of the air in *b* causes the fluid to rise, and with it the float *c*, whilst the fluid and float on the other side drop in the same proportion. This motion is transmitted on the one hand by means of the wheel *d* to the register spindle, the hand of which shows at the same instant the pressure on the scale in millimetres of water column; on the other hand, by the sinking of the float *c*, the spindle *f* is drawn downwards, and through this motion the writing apparatus *g*—a small glass tube filled with colour—is moved over the paper tablet in such a manner that the line drawn by the pen indicates the variation of the pressure in millimetres, at whatever time of the day or night it took place. The water level is regulated by means of the screw at *h*; the apparatus is filled through *i*, and the vacuum or pressure transmission takes place by connecting *k* with the pipe system.

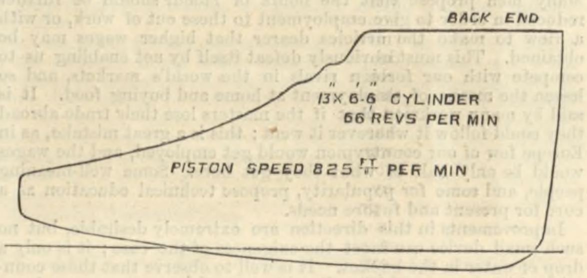
The apparatus affords an absolute check upon the driving of the fan engines. In order to exercise a still stricter control over the engine driver, in the case of his running more or less than the prescribed number of revolutions per minute, as well as to report immediately any such irregularity to the head office, a simple electric battery can, if desired, be placed in the same case as the writing apparatus, and kept under lock and key, connecting it with an alarm bell in the office by means of wires. This apparatus, which has thus far been considered as a gauge for measuring and registering depression, can easily be adapted for use in gasworks as a pressure meter, Figs. 3, 4, and 5; the construction remaining exactly as that shown in Figs. 1 and 2, with the exception only that the height of the water chambers varies according to the pressure desired, the chain connecting the floats with the wheel being reversed, and pressure taking the place of the suction at *b*, whilst the zero mark is placed at the bottom of the scale instead of at the top. For exhaust work the chains are fastened to the wheel, as shown in Fig. 1, the zero mark, instead of being at the top, being placed in the middle of the scale.

SELLER'S PATENT COMPOUND ENGINE.

On p. 540 we illustrate a new form of compound engine made by Messrs. Bradley and Craven, of Wakefield. The engine has two cylinders, in which the pistons move in opposite directions, and there are no dead points, and the action is such that it is claimed that continuous expansion is got with one crank. The high-pressure cylinder is 13in. diameter by 6ft. 3in. stroke, the piston being connected by means of cast steel twin unequal beams, with gudgeons cast solid to keep them tight, the long ends being connected to the high-pressure piston-rod crosshead by two adjustable links, thus securing a very high rate of piston speed with the smallest possible diameter of high-pressure piston and valves, keeping down friction and losses from port and end



clearance space to a minimum. The short ends of the beams are connected to the same crank pin as the low-pressure piston, giving opposite piston travels, and the exhaust steam having simply to pass through grid ports direct into the low-pressure piston, the high-pressure cylinder is drained at each stroke. Expansion is in a sense continuous, the steam finally escaping to the condenser through Corliss valves, which also drain the low-pressure cylinder each stroke. The twin beams are set at such an angle that the engine will start with the crank in any position, no barring being required, and will creep round under steam at the rate of 3¼ revolutions per minute.



The engine has now been at work nearly fifteen months, giving, we understand, the greatest satisfaction, doing the work with a 40-horse power Lancashire boiler; firing being quite easy with common slack. The patterns are arranged for a third cylinder being attached on the tandem principle, and connected to the low-pressure piston-rod, working the steam three times over, or by connecting a pair of coupled twin engines quadruple action can be adopted. We give copies of original indicator diagrams, which were taken under regular working conditions; only about one half of the intended load is yet coupled up. When the remainder of the load is added, it is intended to increase the steam pressure to 70 lb.

ATKINSON'S "CYCLE" GAS ENGINE.

We illustrate on page 537 one of Atkinson's patent "Cycle" gas engines of eight nominal horse-power, as manufactured by the British Gas Engine and Engineering Company. Some time ago we published the particulars of a brake-test made by Professor Unwin, of one of Atkinson's 4-horse power "Cycle" engines.[1] This test showed a remarkable advance in gas engines, more particularly as regards the improved utilisation of the heat of combustion of the gas. These engines have now been further developed, and have proved most satisfactory in regular work. We understand that up to and including the 6-horse power size, the arrangement of the 4-horse power as then illustrated is retained as being the most suitable, the crank shaft being thus at a convenient height for starting, and the engine not being too high for any ordinary room; the 8-horse power size and upwards, however, have been designed in a different manner, the crank shaft and fly-wheels being placed at the bottom, and the cylinder inclined so as to lead to the vibrating link, as will be seen in the engravings. The engine is thus very compact, and the heavy weights are at the bottom so as to give stability, a matter of considerable importance in a large engine.

It will be remembered that the peculiar arrangement of link work used enables the single-acting piston to make four strokes in

[1] The Engineer, vol. lxiii., pp. 361 and 380.

ATKINSON'S "CYCLE" GAS ENGINE.

THE BRITISH GAS ENGINE AND ENGINEERING COMPANY, ENGINEERS.

FIG. 1

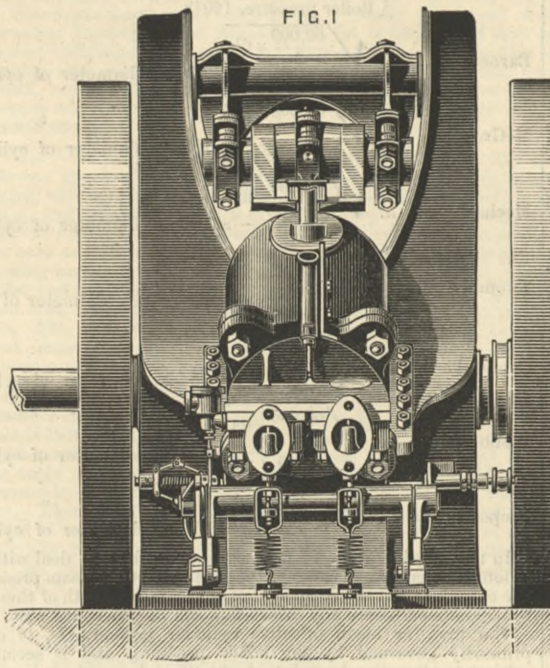
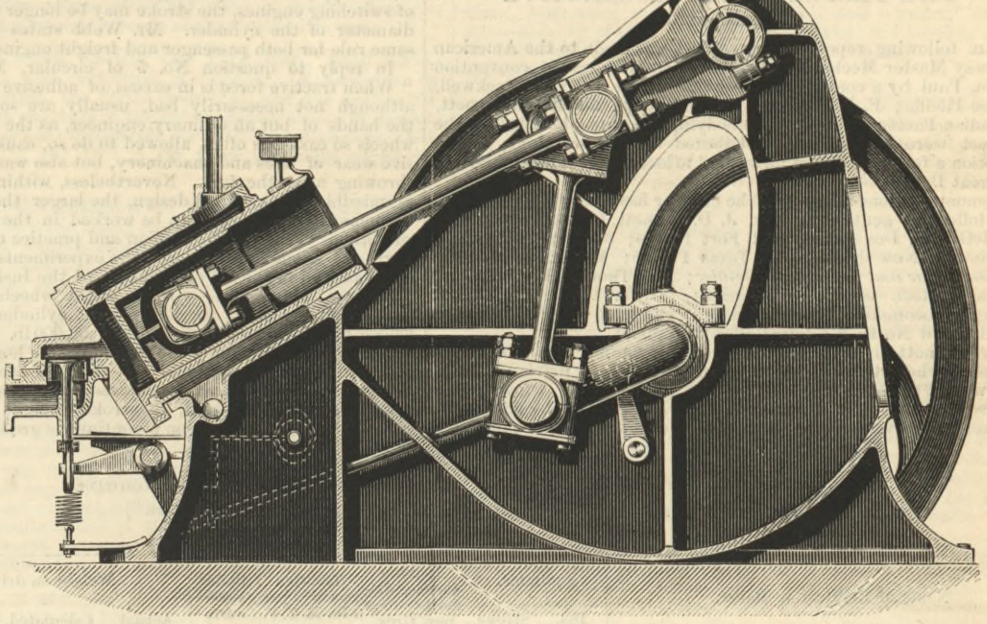
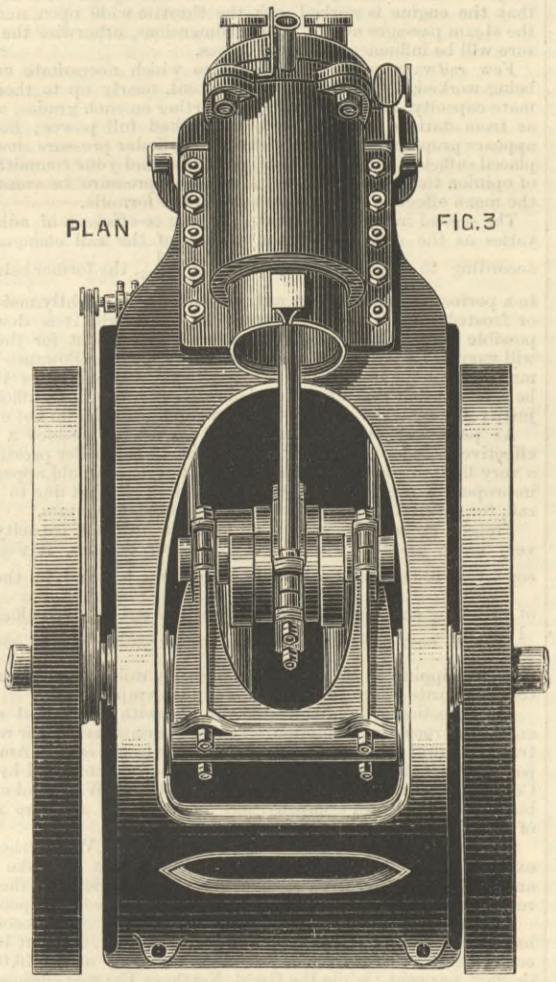
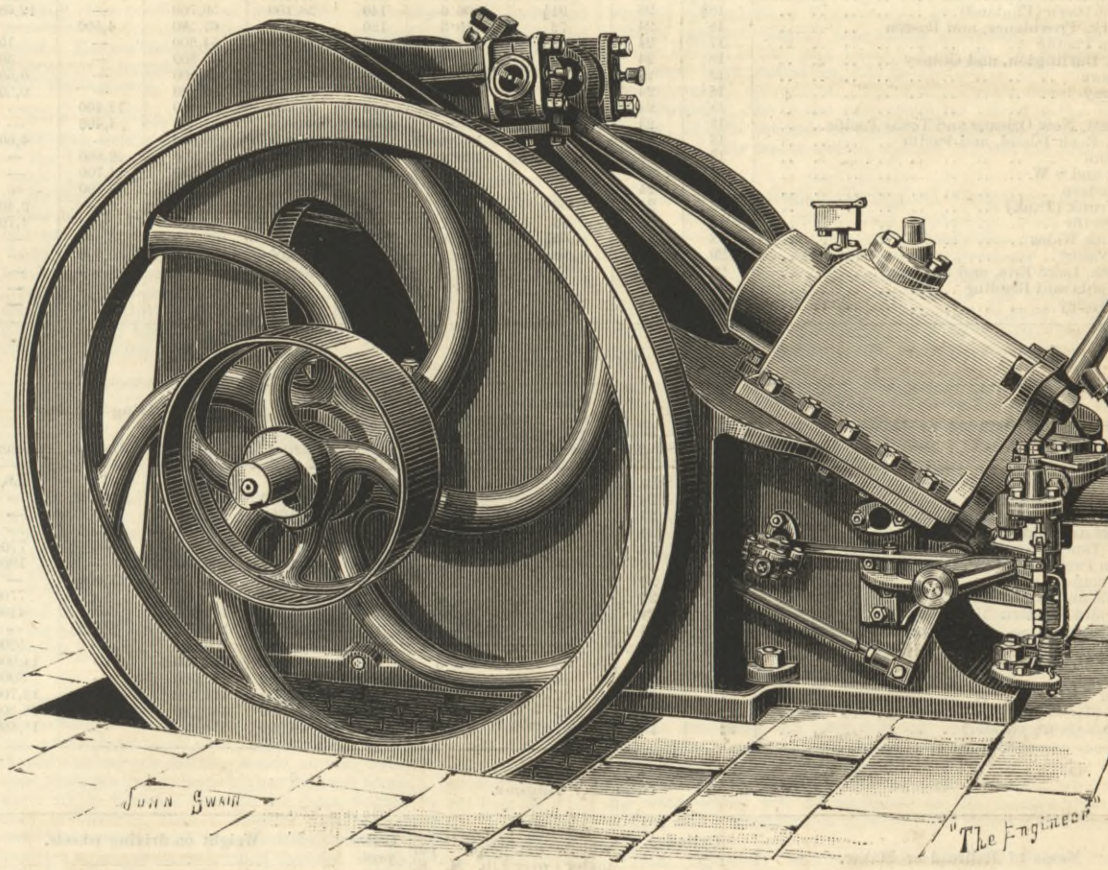


FIG. 2



PLAN FIG. 3

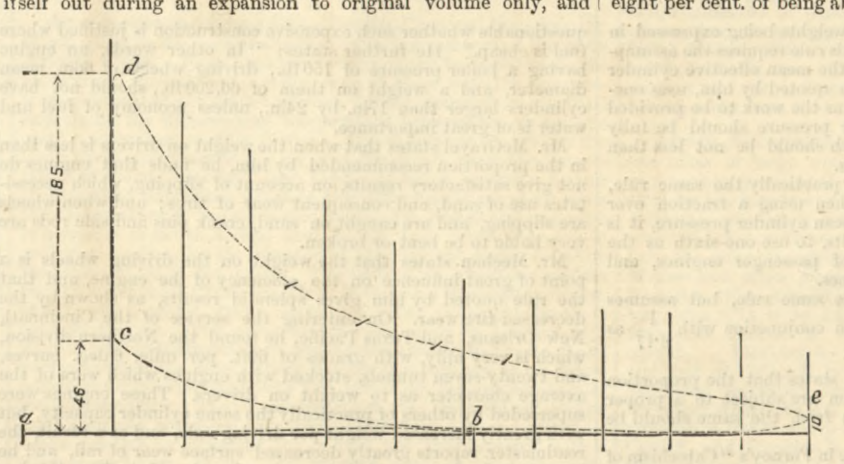




the cylinder for each revolution of the crank shaft. The relative lengths of these strokes will be seen on reference to the accompanying diagram, which was taken by a Crosby indicator from an 8-horse power engine. At the point *a* of the diagram the piston is at the extreme inward position, and the clearance space at this time is made as small as possible, thus completely driving out the residuum; a suction stroke is then made from *a* to *b*, during which an uniform mixture of gas and air are drawn into the cylinder; the piston then returns, compressing the combustible mixture from *b* to *c*, the pressure rising, in the diagram shown, to 46 lb. per square inch above the atmosphere. Ignition now takes place, and instantly sends the pressure up to 185 lb. to the point *d*; the working stroke now takes place from *d* to *e*, the expansion curve keeping throughout considerably above an adiabatic curve struck from the point *d*; from *e* to *a* the exhausting stroke takes place, thus completing the "cycle" and one revolution.

Up to the point in the expansion curve opposite *b*, the diagram can be compared to the usual gas engine diagram—that is to say, from an engine such as the "Otto," or "Clark's," which expands to original volume only. This portion of the diagram gives a mean pressure of 71·4 lb., with 40 lb. pressure in the cylinder at this time of expansion to the original volume, thus comparing very favourably with them, and showing that the gas is, up to this point at any rate, burned with equal if not superior advantage. In the "Cycle" engine, however, the working stroke is then only half completed, as the expansion is continued until there is only 10 lb. pressure in the cylinder, beyond which it is obviously useless to go; the mean pressure of the last half of the diagram is 22·6 lb. This is 31·6 per cent. of 71·4, and therefore it is reasonable to suppose that this engine will give 31·6 per cent. more power for the same amount of gas, which coincides pretty accurately with the results of Professor Unwin's trial. The mean pressure for the whole stroke is 47 lb. We are informed that the diagram illustrated was taken during a brake test, which, with a perfectly new engine, gave a brake horse-power for 20·5 cubic feet of London gas—a result of which we think the British Gas Engine Company have every reason to be proud.

Mr. Atkinson, who has been working hard in this field for seven years, informs us that his company intend specially directing their attention to the manufacture of larger engines, to which his system is specially adaptable. There are two reasons which have hitherto practically prevented gas engines of large powers from working satisfactorily. The first is that when the residuum is left in the cylinder, the engine, after working some little time at full power, gets very hot, and the charge before compression is heated to such a degree that when compressed it is hot enough to fire itself prematurely; the second is that in such a large bulk the gas has not time to burn itself out during an expansion to original volume only, and



remains burning during the exhaust stroke until it fires the fresh incoming charge. The former difficulty he gets over by driving out the residuum completely, and the latter by carrying the expansion to any desired extent, so as to ensure the gas being completely burned, and the contents of the cylinder cooled down below ignition temperature by the continued expansion. In this connection also, an impulse being obtained every revolution at once divides the charge into two, as compared with the Otto cycle, and the charge is further reduced owing to its volume being smaller still; that is to say, a charge of a certain capacity in one of his engines will give more actual power than can be obtained in any other engine, and therefore the shock per ignition is reduced in the same proportion.

It will be seen that the initial pressure on the piston does not come directly on the crank shaft, but is transmitted directly to the centre of the vibrating link, which has a very large bearing of white metal the full width of the engine. The action of the toggle motion is such that for the first eight-tenths of the working stroke the turning moment on the crank pin is within eight per cent. of being absolutely uniform; this is a very important feature in these engines, as, combined with the impulse every revolution, it gives remarkably regular running, and reduces friction, as well as wear and tear in the crank-pin and main bearing journals. These engines—excepting the 1-horse power size and under—are constructed with two fly-wheels of equal weight, one on each side of the engine, so that what little wear of the brasses there is is always uniform and the crankshaft cannot wear out of truth.

The ignition in these engines is effected in a very simple and certain manner. A piece of wrought iron pipe is screwed into the end of the cylinder, and open to the ignition space, the outer end being closed up; a sliding chimney surrounds the ignition tube, and is fitted with an atmospheric burner which keeps the tube red hot; the compression in the cylinder forces some of the charge into the tube, which is ignited as soon as it comes into contact with the red-hot portion, the timing of the ignition being regulated with the greatest accuracy by sliding the chimney higher up or lower down the ignition tube—see Fig. 4.

Owing to the certainty of the ignition, combined with the small amount of charge requiring to be compressed, these engines are very easily started. A man can easily start this 8-horse power size by turning it round through half a revolution; in fact, there would not be the slightest advantage in attaching a self-starting apparatus to it. Mr. Atkinson has, however, a self-starter, which has been at work for some years with some of his other types of engines of large powers, and can also be applied to the "Cycle" engine.

THE PROPORTION OF LOCOMOTIVE CYLINDERS.

The following report on this subject was made to the American Railway Master Mechanics' Association at their recent convention at St. Paul by a committee consisting of Mr. Charles Blackwell, Union Pacific; F. L. Wanklyn, Grand Trunk; and T. E. Barnett, Canadian Pacific. Circulars embodying questions bearing on the subject were printed and distributed by the secretary, and in addition a few copies were forwarded to locomotive superintendents of Great Britain.

Communications in reply to the circular have been received from the following gentlemen: Mr. J. D. Barnett, Grand Trunk; Mr. J. McGrayel, Des Moines and Fort Dodge; Mr. James Meehan, Cincinnati, New Orleans, and Texas Pacific; Mr. Angus Sinclair, *National Car and Locomotive Builder*; Mr. Thomas B. Twombly, Chicago, Rock Island, and Pacific; Mr. S. G. G. Copestake, Glasgow Locomotive Works, Scotland; and from Mr. F. W. Webb, London and North-Western Railway, England.

Mr. Barnett gives the following rule for finding the diameter of cylinder, when stroke of piston, mean diameter of driving wheels, and weight on same, also boiler steam pressure, are known, viz.: the square root of the adhesive power, multiplied by the mean diameter of drivers, divided by the mean effective cylinder, pressure pressure, does not exceed the adhesive power under the most favourable circumstances.

Mr. Barnett considers that no deviation should be made from the rule, whether the engine in question be for passenger, freight, or switching service. Mr. McGrayel recommends the co-efficient for adhesion to be one-sixth for passenger and one-seventh for freight and switching engines. Mr. Copestake says that the rule should apply to both passenger and freight engines, but in the case of switching engines, the stroke may be longer in proportion to the diameter of the cylinder. Mr. Webb states that he adopts the same rule for both passenger and freight engines.

In reply to question No. 5 of circular, Mr. Barnett states: "When tractive force is in excess of adhesive weight, the results, although not necessarily bad, usually are so, if the engine is in the hands of but an ordinary engineer, as the engine slipping her wheels so easily, is often allowed to do so, causing not only excessive wear of tires and machinery, but also wasting the steam and throwing away the fuel. Nevertheless, within the narrow limits permissible in locomotive design, the larger the cylinder the more economically the engine can be worked in the matter of fuel consumption. This was the opinion and practice of M. Marie, of the Paris and Lyons Railway; and the experiments then carried out—and recorded in the "Proceedings" of the Institute of Mechanical Engineers, May, 1884—with an eight wheels coupled passenger engine, on mountain service, having cylinders 19½in. by 26in., wheels 49⅔in. diameter, with about 58,000 lb. on drivers, show a consumption of 2·88 lb. of fuel per indicated horse-power or 3·27 lb. per actual horse-power, and but 30 lb. of wet steam per horse-power developed. This was achieved with steam at 128 lb. pressure, cutting off at 19 per cent. of stroke—weight of train 163½ tons, speed 17½ miles per hour, on a continuous grade of 1 in 53½. It is

CYLINDER CAPACITY AND ADHESIVE WEIGHT OF VARIOUS MODERN LOCOMOTIVES.
(Accompanying Report on "Proportions of Locomotive Cylinders.")

Passenger Engines.

Name of Railroad or Maker.	Cylinder.		Driving wheels, diameter over new tires.	Tractive power per 1 lb. M. E. P.	Boiler pressure.	Weight on driving wheels.			
	Dia.	Stroke.				Actual.	Calculated.	Excess.	Deficiency
	In.	In.	In.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Belgian State	17½	24	79	90·8	142	64,300	43,900	20,400	—
New York Central	17	24	70	101·3	145	52,200	49,800	2,400	—
Chicago, Burlington, and Quincy	17	24	69	102·8	140	53,600	48,900	4,700	—
Chicago, Rock Island, and Pacific	17	24	66¼	105·0	150	52,500	53,300	—	800
Brooks - 1883	17	24	67	105·9	140	48,000	50,400	—	2,400
Great Northern (England)	18½	28	91½	106·6	140	38,100	50,700	—	12,600
New York, Providence, and Boston	18	24	72	110·3	180	72,000	67,500	4,500	—
Northern Pacific	17	24	62	114·6	140	54,400	54,500	—	100
Chicago, Burlington, and Quincy	18	24	69	115·2	140	54,500	54,800	—	300
Lake Shore	18	24	69	115·2	180	64,000	70,500	—	6,500
Old Colony	18	24	69	115·2	175	61,700	68,200	—	6,500
Mason	18	24	68	116·9	140	68,000	55,600	12,400	—
Cincinnati, New Orleans and Texas Pacific	18	24	68	116·9	140	60,000	55,600	4,400	—
Chicago, Rock Island, and Pacific	18	24	66¼	117·4	150	55,000	59,600	—	4,600
Caledonian	19	26	78	120·3	160	68,200	65,400	2,800	—
Glasgow and S W.	18¼	26	73½	120·3	140	62,000	57,300	4,700	—
Great Eastern	18	24	64	124·4	140	65,000	59,200	5,800	—
Grand Trunk (Tank)	17	24	56	127·3	140	57,200	60,600	—	3,400
Union Pacific	18	26	63	138·1	140	61,000	65,700	—	4,700
New South Wales	18	26	60½	142·8	130	79,000	63,100	15,900	—
Lehigh Valley	20	24	68½	143·3	130	73,400	63,100	10,300	—
New York, Lake Erie, and Western	20	24	68	144·4	140	95,300	68,700	26,600	—
Philadelphia and Reading	21	22	68½	144·8	140	71,900	68,900	3,000	—
Lehigh Valley	20	24	62	158·7	160	90,000	86,300	3,700	—

Freight Engines.

Name of Railroad or Maker.	Cylinder.		Driving wheels diameter over new tires.	Tractive power per 1 lb. M. E. P.	Boiler Pressure.	Weight on Driving Wheels.			
	Dia.	Stroke.				Actual.	Calculated.	Excess.	Deficiency
	In.	In.	In.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Great Eastern (England)	17½	24	58	130·1	140	82,000	65,800	16,200	—
Brooks—Mogul	18	24	55¾	143·3	140	72,500	72,500	—	—
Baltimore and Ohio	19	24	60	148·1	140	87,400	74,900	12,500	—
Brooks—Ten-wheeler	19	24	55¾	159·7	140	73,100	80,800	—	7700
Canadian Pacific	19	22	51	160·5	160	90,900	92,800	—	1900
Union Pacific	20	24	58	171·4	140	105,600	86,700	18,900	—
Louisville and Nashville	20	24	51	193·9	150	97,000	104,700	—	7700
Norfolk and Western	20	24	50	197·9	140	96,000	100,100	—	4100
Pennsylvania	20	24	50	197·9	140	100,600	100,100	500	—
Northern Pacific	20	24	49	202·1	140	97,000	102,200	—	5200
Dübs (for Brazil)	20	24	48	206·5	140	89,500	104,400	—	14,900
St. Gothard	20·47	24	46	226·0	149	114,000	122,000	—	8000
Southern Pacific	21	36	57	286·0	130	121,600	134,300	—	12,700
Decapod (Baldwin)	22	26	45	289·3	140	128,000	146,300	—	18,300
Johnston's (four cylinder)	22	18	57	314·6	140	140,000	158,800	—	18,800

Switching Engines.

Name of Railroad or Maker.	Cylinder.		Driving wheels dia. meter over new tires.	Tractive power per 1 lb. M. E. P.	Boiler pressure.	Weight on driving wheels.			
	Dia.	Stroke.				Actual.	Calculated.	Excess.	Deficiency
	In.	In.	In.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
Brooks	17	24	48	149·2	140	66,000	79,900	—	13,900
Union Pacific	18	26	52	168·5	140	87,700	90,200	—	2500
Norfolk and Western	19	24	50	178·6	140	94,900	95,600	—	700

NOTE.—In calculating weight for adhesion, the M. E. C. P. assumed to be 85 per cent. of boiler pressure, and coefficient for passenger, freight and switching engines $\frac{1}{4}$, $\frac{1}{4\cdot25}$, and $\frac{1}{4\cdot5}$, respectively.

multiplied by the length of stroke, all weights being expressed in pounds and measurements in inches. This rule requires the assumption of a co-efficient for adhesion, also of the mean effective cylinder pressure. Mr. Barnett, in the example quoted by him, uses one-fifth as the co-efficient, and states that as the work to be provided for is the maximum, the mean cylinder pressure should be fully nine-tenths of the initial pressure, which should be not less than 7 per cent. below the full boiler pressure.

Mr. McGrayel states that he adopts practically the same rule, but his experience teaches him that when using a fraction over 50 per cent. of boiler pressure, as the mean cylinder pressure, it is necessary, in order to obtain good results, to use one-sixth as the co-efficient for adhesion, in the case of passenger engines, and one-seventh for freight and switch engines.

Mr. James Meehan reports using the same rule, but assumes 90 lb. as the mean cylinder pressure, in conjunction with $\frac{1}{6\cdot17}$ as co-efficient for adhesion.

Mr. Angus Sinclair gives no rule, but states that the proportion of cylinder and the elements of adhesion are subject to a proper ratio, and that any material deviation from the same should be considered a mechanical blunder.

Mr. Thomas B. Twombly uses the rule in Forney's "Catechism of the Locomotive." Multiply the total weight on the driving wheels, in tons of 2000 lb., by five and then by the circumference of drivers, in inches, and divide by four, the quotient being the cubical contents of each cylinder. This rule requires modification to suit the higher boiler pressures now used.

Mr. Copestake uses the same rule, and assumes one-fifth as the co-efficient for adhesion, but uses 63 per cent. of boiler pressure as the mean cylinder pressure. He makes no allowance for wear of tires and takes the diameter of wheels over the tires when new.

Mr. F. W. Webb has no fixed rule, but in ordinary practice adopts a 24in. stroke of piston, and arranges the diameter of cylinders so that the tractive power at starting, with full boiler questionable whether such expensive construction is justified where fuel is cheap." He further states: "In other words, an engine having a boiler pressure of 150 lb., driving wheels of 66in. mean diameter, and a weight on them of 66,200 lb., should not have cylinders larger than 17in. by 24in., unless economy of fuel and water is of great importance."

Mr. McGrayel states that when the weight on drivers is less than in the proportion recommended by him, he finds that engines do not give satisfactory results, on account of slipping, which necessitates use of sand, and consequent wear of tires; and when wheels are slipping, and are caught on sand, crank pins and side rods are very liable to be bent or broken.

Mr. Meehan states that the weight on the driving wheels is a point of great influence on the efficiency of the engine, and that the rule quoted by him gives splendid results, as shown by the decreased tire wear. On entering the service of the Cincinnati, New Orleans, and Texas Pacific, he found the Northern division, which is very hilly, with grades of 60ft. per mile, 6 deg. curves, and twenty-seven tunnels, stocked with engines which were of the average character as to weight on drivers. These engines were superseded by others of practically the same cylinder capacity, but with greatly increased weight per driving axle, and as a result, the roadmaster reports greatly decreased surface wear of rail, and he himself finds the wear of tires much reduced. He believes this has been attained by reduction of slipping, on account of increased weight on drivers.

Mr. Twombly states that engines in which the ratio of weight on drivers to tractive power is above the average, give better results, the wear and tear of machinery being less, and life of tires prolonged.

Mr. Copestake says he generally takes the ratio of cylinder and adhesive power about equal, but if anything, would give an excess, not exceeding 10 per cent., to the adhesive power.

To illustrate the difference in cylinder dimensions, when calculated by the various rules recommended by the gentlemen who have expressed their views on the subject, the following figures are of interest:—

Data: Passenger engine. Stroke of piston, 26in. Mean diameter of driving wheels, 61in. Weight on drivers, 60,000 lb. Boiler pressure, 160 lb.

Barnett ... ... $\sqrt{\dfrac{\frac{60,000}{5}\times 61}{134\times 26}} = 14\cdot5$in. diameter of cylinder.

McGrayel ... ... $\sqrt{\dfrac{\frac{60,000}{6}\times 61}{85\times 26}} = 16\cdot6$in. diameter of cylinder.

Meehan ... ... $\sqrt{\dfrac{\frac{60,000}{6\cdot17}\times 63}{90\times 26}} = 16\cdot2$in. diameter of cylinder.

Twombly ... ... $\sqrt{\dfrac{\frac{60,000}{2000}\times 5\times 198}{4\times 26}} = 16\cdot9$in. diameter of cylinder.

Copestake ... ... $\sqrt{\dfrac{\frac{60,000}{5}\times 63}{101\times 26}} = 16\cdot9$in. diameter of cylinder.

Webb ... ... $\sqrt{\dfrac{\frac{60,000}{3\cdot7}\times 63}{160\times 26}} = 15\cdot67$in. diameter of cylinder.

Proposed rule ... $\sqrt{\dfrac{\frac{60,000}{4}\times 61}{136\times 26}} = 16\cdot1$in. diameter of cylinder.

In the consideration of this subject, one has to deal with two indefinite quantities, namely, the mean effective steam pressure in the cylinders and the coefficient of adhesion, and both of these have to be assumed before any calculation can be proceeded with.

The first, or mean effective cylinder pressure, is, of course, primarily governed by the boiler pressure, and is secondarily subject to alteration by point of cut-off and speed—it is assumed that the engine is worked with the throttle wide open, and that the steam passages are of proper dimensions, otherwise the pressure will be influenced by these causes.

Few railways are free from grades which necessitate engines being worked, to a greater or less extent, nearly up to their ultimate capacity, and in the event of starting on such grades, as well as from stations generally, of being worked full power; hence it appears proper that the mean effective cylinder pressure should be placed sufficiently high to cover such cases, and your committee are of opinion that 85 per cent. of the boiler pressure be considered the mean effective cylinder pressure in the formula.

The second indefinite quantity, or the co-efficient of adhesion, varies as the condition of the surface of the rail changes, and according to Molesworth, from $\frac{1}{3\cdot7}$ to $\frac{1}{11\cdot2}$, the former being due to a perfectly clean and dry rail, the latter to a slightly moistened or frosted rail. In different parts of the world it is doubtless possible to find places where the average co-efficient for the year will vary to such an extent as to warrant special allowance being made to suit the circumstances; but in the United States it may be safely stated that exceptional climatic peculiarities, sufficient to justify any material deviation from a standard rule, do not exist.

As passenger engines are worked so as to produce a mean effective cylinder pressure of 85 per cent. of the boiler pressure for a very limited fraction of their total mileage, it would appear not improper to use the co-efficient one-fourth, or that due to a dry rail, for calculating the proportions of passenger engines.

Freight engines being worked to their ultimate capacity to a very much greater extent than passenger engines, it would be consistent to increase the co-efficient to say $\frac{1}{4\cdot25}$, and in the case of switching engines, generally worked full stroke, a co-efficient of $\frac{1}{4\cdot5}$ would be required to obviate the excessive use of sand, to prevent slipping on the more or less greasy rail generally encountered in yards where this class of engine is employed.

An inspection of tabular statement herewith shows that among engines of recent construction very great variations in their relative tractive power and adhesive weight exist. In the case of American passenger engines, and using the formula recommended by your Committee, it is found that the N. Y., L. E. and W. Mogul engine, built by the Baldwin Company, has an excess of adhesive weight of 26,600 lb., or 38·7 per cent.

The eight-wheeled engine built by the Mason Works shows an excess of over 12,400 lb., or 22·3 per cent.; while the Lake Shore and Old Colony eight-wheeled engines are deficient in the same respect to the extent of 6500 lb., or 9·2 and 9·5 per cent. respectively.

Among foreign passenger engines, the Belgian State locomotive has an excess of adhesive weight of over 20,000 lb., or about 46·5 per cent.; the New South Wales Mogul an excess of nearly 16,000 lb., or 25·2 per cent.; while the Great Northern Express engines, with 91½in. driving wheels, are deficient to the extent of 12,600 lb., or over 24·8 per cent.

Among freight engines of American build, the variations are not so great. The Union Pacific Wooten Consolidation engine has an excess of 18,900 lb., or 21·8 per cent.; the Baltimore and Ohio Mogul an excess of 12,500 lb., or 16·7 per cent.; while the Baldwin Decapod shows a deficiency of 18,300 lb., or 12·5 per cent.

Of foreign freight locomotives, the six wheels coupled engines of the Great Eastern Railway has an excess of 16,200 lb., or 24·6 per cent., while the Dübs consolidated engine, built for Brazil, has a deficiency of 14,900 lb., or nearly 14·3 per cent.

Of switching engines, the Brooks six-wheeled switcher has a deficiency of 13,900 lb., or 17·4 per cent.

Your Committee recommend, for general purposes, the use of the following formula:—

$$\frac{d^2 \times S \times P \times 0\cdot85 \times C}{D} = W$$

D = diameter over tires when half worn.
d = diameter of cylinder.
S = stroke of piston.
P = boiler pressure.
W = weight on driving wheels.

C = co-efficient for adhesion: $\frac{1}{4}$ for passenger engines. $\frac{1}{4\cdot25}$ for freight engines. $\frac{1}{4\cdot5}$ for switching engines.

Should extreme economy in fuel and water consumption be considered imperative, and of greater importance than additional cost of superheaters and steam jacketted cylinders, and maintenance of same, a considerable increase of cylinder power would be admissible, so as to allow the average work to be performed with a correspondingly earlier cut-off and greater ratio of expansion.

The unsatisfactory results, however, obtained with the ordinary link motion from the wire-drawing of steam, when cut off much earlier than at 25 per cent. of the stroke, point to the desirability of using some other type of valve motion, when the extreme practice above referred to is contemplated.

Your Committee beg to thank members of the Association and others who responded to the circular for information used in the preparation of this report, which is respectfully submitted.

CHARLES BLACKWELL,
F. L. WANKLYN,
J. D. BARNETT. } Committee.

RAILWAY MATTERS.

IT is stated that the Wagner Palace Car Company will build a factory on the thirty acres of land between the Spuyten Duyvil and Port Morris Railroad and the property of the New York and Haarlem Railroad Company, on what was lately known as Sherman-avenue and 153rd-street, recently purchased from Cornelius Vanderbilt for 203,000 dols. It is understood that extensive buildings will be erected there for the construction of sleeping and palace coaches. These buildings will, when completed, become, it is expected, the manufacturing centre of the sleeping car company's operations, and its principal shops will be located there.

THE New York Central and Hudson River Railroad has followed the lead of the Pennsylvania by inaugurating steam-heated vestibule-car service for its limited New York-Chicago trains, and this week gave a complimentary trip to Albany and back to railroad and newspaper men to inaugurate the service. The cars are all new, and the train consists of a luxurious parlour smoking car with bath-room, barber shop, writing desks, buffet, books and periodicals, with a baggage compartment in the forward end, a handsome dining car, two sleepers and two parlour cars. The cars are of enormous length, some 75ft., 53ft. between truck centres; so long, the *American Engineering News* says, as to scrape some of the tunnels slightly.

THERE is a mammoth turntable in operation at the Meadows shops of the Pennsylvania Railroad. The diameter of the table is 193ft. It is run by a 5-horse power engine having an 8in. by 14in. cylinder, and supplied with steam from a vertical boiler. The table is automatically locked wherever it is stopped, and is released by a steam appliance that is under the control of the engineer. There are forty tracks leading off from the pit, and in the centre of each there is a number. When a locomotive is on the table, the number of the track on which it is to run is called out, and the motor drives the table around until the number shows through a little square window placed in the side of the engine house; the engineer then stops and the table is automatically locked. A long Pullman car can be turned, or a locomotive and a Pennsylvania standard car at the same time. A complete revolution can be made in twenty-five seconds.

THE *Railroad Gazette* thus describes an apparatus that might find application on our tram cars. "The 'short line' trains of the Chicago, Milwaukee and St. Paul, running between St. Paul and Minneapolis, are provided with a useful contrivance to keep passengers from slipping under the wheels. A stout wooden lattice hangs from the body of the car to just below the level of the station platforms, which it barely clears. Between the cars are canvas aprons. It would take great ingenuity and trouble for a man to get any of his members entangled with the running gear. For trains of the sort, running short distances, through populous neighbourhoods, and often at low speed, and especially in a region where platforms must often be icy, the device must be a valuable one. Under such conditions people are often tempted to board a train while it is in motion, and it is difficult to prevent such attempts. But every railroad man knows that few people can safely get on a moving train, even when it is going very slowly. For trains running long distances the protective device is not applicable, as it would interfere with inspection of the running gear, but the Chicago, Milwaukee and St. Paul only uses it on suburban trains."

IN 1879, there were in Germany twenty-four towns possessing collectively 300 miles of street-tramways in operation. These numbers had increased at the end of last year to 55 towns with 651 miles, of which 4 miles 52 chains—the line from Frankfort-on-Main to Offenbach—is worked by electricity, while the remainder employs about 10,000 horses and 75 locomotives. In Berlin there were, in 1879, 95½ miles open; the number of passengers carried being 39,641,430 per annum, and receipts, £276,267. In 1886 the mileage had increased to 163, the number of passengers to 96,854,438, and the receipts to £600,072. In Charlottenstrasse, between Leipzigerstrasse and Kronenstrasse, the cars follow each other at 56 seconds intervals, and at one point near the Rathhaus, every 38 seconds. At the intersection of Leipziger and Charlottenstrasse, there is a car crossing every 18 seconds, and at the Spittelmarkt crossing, one in every 21 seconds. Little or no wood is now used in the permanent-way in any of the important thoroughfares, as it is of essential importance to minimise interference with the street traffic by repairs of the line; and special care is taken as to the strength and durability of the permanent-way at such busy crossing-places as those referred to above.

DESCRIBING what might have been a very serious accident at Newry Station, owing to the failure of the brakes, the *Belfast News Letter* says:—"When the 3.25 train from Belfast was approaching the Edward-street Railway Station, the brakesman attempted to put on the vacuum brake, but it would not act, and the engine driver seeing this at once shut off steam, and sounded the steam whistle. The officials and those at the station became greatly alarmed, and as the train dashed through the station at great speed great consternation prevailed. The first obstacle that came in the way was the large iron gate at the crossing at Edward-street, and the engine, striking it, smashed it into pieces, two of which struck a farmer and his horse, which were standing close to the gates at the time. The engine next came in contact with the gate on the other side of the road, and it too was smashed into splinters. Fortunately," the *News Letter* says, "an engine, which was waiting to convey the carriages to Warrenpoint, was standing on the line a short distance from the Monaghan-street crossing, and when the two engines collided, the train was brought to a stand. None of the passengers were injured in any way, indeed some of them were not aware that anything had gone wrong. The stoker had one of his hands cut by a piece of the broken gate. The gate man at Edward-street had a marvellous escape. A piece of the broken gate struck him on the leg, but he was not severely injured. The farmer's horse was struck on the head, and the farmer himself on the body, but were only slightly injured."

THE ceremony of turning the first sod of a railway to be known as the Stratford-on-Avon, Towcester, and Midland Junction Railway, was performed on the 14th inst. The total length of the line is about 10½ miles, and it is contemplated it will be completed about the close of 1888. Mr. Saul Isaac, of London, who, with his brother, Major Isaac, was connected with the construction of the Mersey tunnel, is the contractor or financier; and Messrs. Baldry and Yerbergh the sub-contractors, each of whom is represented by Mr. Beverley Griffin, who was engaged as engineer of a section of the East and West Junction Railway, and who has recently completed the Metropolitan extension to Rickmansworth. The capital of the company is stated as £200,000. The rails will be of steel, with new patent chairs and wood sleepers. The engineers are Messrs. Liddell and Richards, of London, and they are represented on the work by Mr. E. Richards. The line will form a connecting link from Olney on to Stratford-on-Avon, and thence to Worcester, when the projected line between Broom Junction and that town is completed, and it is anticipated it will now speedily be commenced. When completed, there will then be about sixty miles of railway, which will open up a good agricultural and mineral district. Sir Thomas George Fermor Hesketh, Bart., of Easton Neston, is the chairman of the Stratford-on-Avon, Towcester, and Midland Junction Railway Company; and the project is well supported by the inhabitants of Towcester and the district, as it will open up communication to a much greater extent, and thus, it is presumed, largely benefit the town. When the line is completed, it is understood it will be worked by joint committees in connection with the East and West Junction Railway Company, and each will contribute to the success of the other.

NOTES AND MEMORANDA.

OVER seventy-three millions sterling were at the close of 1886 invested in authorised works for the supply of gas in this country.

THE English gasworks in the year 1886 used 8,658,000 tons of coal, from which they obtained 87,931,537,000 cubic feet of gas, supplied by means of 19,443 miles of mains—about the same length as the railway mileage of the United Kingdom.

DURING the week ending the 17th inst., 2516 births and 1622 deaths were registered in London. Allowing for increase of population, the births were 230, and the deaths 236, 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 23·0, 21·1, and 19·5 in the three preceding weeks, was last week 20·1.

A NOTE on the rotation of a copper sphere and of copper wire helices when freely suspended in a magnetic field, by Dr. R. C. Shettle, was recently read before the Physical Society. The author exhibited the apparatus with which his experiments "on the supposed new force" were made, the results of which were published in the *Electrician*, vol. xix. Dr. Hofford has recently made similar experiments, using brass discs, and his results seem to point to "dia-magnetic non-uniformity" of the discs as the cause of the phenomena he observed.

A USEFUL liquid cement or gum may be made as follows: To make one gallon of the gum, about one and a-half gallons of water, 3 lb. of glue, 4 oz. of borax, and 2 oz. of carbonate of soda, or an equivalent of any other alkali, are taken. The glue and alkaline salts are dissolved in the water by heat, and the solution is kept at a temperature a few degrees below boiling point for five or six hours. The *Scientific American* says, continued application of heat renders the gum permanently liquid at the ordinary temperature. After allowing the sediment to settle, the clear liquid is evaporated to the required consistency.

AT a recent meeting of the Paris Academy of Sciences a paper was read "On the Expansion of Compressed Fluids, and especially on that of Water," by M. E. H. Amagat. The compressibility and expansion of water, ordinary ether, methylic, ethylic, propylic, and allylic alcohols, acetone, chloride, bromide and iodide of ethyl, sulphide of carbon, and chloride of phosphorus, have been studied between zero and 50 deg., and from the normal pressure up to 3000 atmospheres. For all except water, which behaves exceptionally, the coefficient of expansion diminishes with increased pressure, the decrease being still very perceptible at the highest point. The coefficient of water increases very rapidly at first, but afterwards diminishes gradually, disappearing altogether towards 2500 atmospheres.

THE well-known electrician, Professor Weber, of Göttingen, celebrated his jubilee as Honorary Doctor of Medicine of the University of Königsberg on Wednesday, when the University presented him with a new and splendidly illuminated copy of his diploma. The Vice-Rector, in his speech of congratulation, spoke of Professor Weber as not merely a great scientist, a deep thinker, and a sagacious and daring experimenter, but also as "one who at a critical time did not hesitate to stand up for truth and right at the risk of sacrificing everything." This was a graceful reference to the fact that the old Professor was one of the famous "Göttingen Seven," who in 1837 were expelled from the University for their protest against the violation of the Constitution by King Ernest of Hanover.

A NEW pyrometer, by E. H. Keiser, is described in the *Journal of the Chemical Society*. An air bulb made of hard glass or of metal, and having a long capillary neck, is connected by a narrow bore rubber tube with an inverted burette; this latter is placed in a wider tube containing water, and closed with a cork and stopcock at the bottom. The two halves of the apparatus having acquired the temperature of the room t, the water is adjusted to the zero mark and the apparatus connected together. The value of the constant c for the apparatus is determined by heating the bulb to 100 deg. C., and noting the increased volume of air V in the burette, and using the formula $t' = t + V/c - V/273 + t$. The bulb being then heated to any other temperature t' this may be calculated by the above formula. The author makes no correction for the moisture of the measured air, and takes no precautions as to the dryness or moistness of the air in the bulb.

THE following interesting observations with regard to the mobility of loess have been made by M. Potanin during his last journey through the region south of the Ordos. As wind steadily moves the shifting sands, so also water steadily moves the loess, transporting it from higher to lower levels. The underground water which filtrates through the loess, begins by making in it a kind of cavern; then a circular crevice appears on the surface over the cavern, and a cylindrical vertical hollow, which soon becomes a deep well, is formed through the thickness of the upper layers of the loess. The whole surface of the loess deposits is dotted with such wells, very dangerous to cattle. By-and-bye the formerly cylindrical well begins to extend in the direction in which the underground water flows, and a narrow ravine grows until it joins the main valley. Then masses of loess continually fall down into the ravine, increasing its width. The fall of these masses is favoured by the numerous crevices in the loess, and it is so frequent that natives warn foreigners not to approach the borders of a ravine. Of course the fallen masses are further dislocated by water, and the loess is thus steadily transported at a remarkable speed to lower levels.

AT a recent meeting of the Berlin Physical Society, Dr. Stapff spoke on his measurements of the temperature of the earth in South Africa. From his observations on the temperature in the St. Gothard Tunnel, and a comparison of these with the temperatures observed at the earth's surface, he had deduced an empirical formula for the difference of temperature between the air and the earth: according to this formula, the difference is greater the lower the temperature of the air, and disappears when the temperature of the air rises to 11 deg. Cent. It hence became a matter of interest to determine whether the difference is negative when the temperature of the air is very high. Dr. Stapff had made use of a sojourn in South Africa, near Whale Bay, while engaged in geological studies, for the purpose of carrying out observations on the temperature of the earth. The district in which he worked lies in the Tropic of Capricorn, about in the same meridian as Berlin, and the soil is sandy with a current of water running beneath it towards the sea. The observations were made in borings with English mining-thermometers, which were allowed to remain about twelve hours at the depth where the temperature was to be determined, thus insuring that they had taken up the temperature of the surroundings. The measurement of the temperature at the earth's surface presented very great difficulties, and was only rendered possible by covering the bulb of the thermometer with a layer of sand 5 cm. thick. The greatest depth at which the temperature of the earth was measured was 17 metres. From the determinations thus made it appeared that the temperature diminished down to that depth, a result undoubtedly dependent upon the fact that the measurements were made during the hottest part of the year. The speaker found that the depth down to which the temperature varies with that of the air is about 13·6 metres, the temperature at this depth being about 25 deg. Cent. The changes in temperature of the earth were very considerable, greater than those of the air, amounting in the sand to some 30 deg. to 40 deg. Cent. His measurements, however, did not show any negative value for the difference in temperature of the air and earth.

MISCELLANEA.

THE Board of Works, Dublin, has granted a loan of £20,000 to the Limerick Harbour Board, for carrying out the proposed improvement at the dock.

A NEW monthly trade journal, called, "Electrical Plant, a Monthly Register of New and Second-hand Electrical Plant, Apparatus, and Fittings, for Sale and Wanted," has been established by Messrs. Wheatley Kirk, Price, and Goulty. At first its contents were almost confined to the register, but it is now appearing with descriptive text and notes.

THE arbitrators in the Bolton engineering strike have not been able to agree as to a basis of wages, and the services of Mr. Pope, Q.C., borough recorder, have been secured as referee. He is expected to give his decision about the middle of January. The settlement of the Blackburn dispute depends upon this decision. The men are at work pending the result.

THE South Wales Board for Mining Examinations has received a communication from the Home-office to the effect that under the new Mines Act it is desirable, on the ground of economy, that examinations for both first and second-class certificates should be held together. The Board, however, objects, and has appointed Sir W. T. Lewis to represent its views to the Home Secretary at an early date.

THE Admiralty have decided to build a number of new composite sloops of the Buzzard type to replace the sloops of the Daring class which were built about fourteen years ago and have become obsolete by lapse of time. The proposed vessels will have a displacement of 1040 tons, and will be fitted with machinery of 2000-horse power. Their armament will consist of eight 5in. steel breech-loading guns, four 45in. Gardner guns, and four 1in. Nordenfelt guns. They are estimated to steam 15 knots an hour.

SOME excellent samples of hard wood for street paving have been sent us by the Australian Hardwood Paving Company. They are of blue gum and red gum, and their texture and hardness and toughness make them most desirable materials for street paving, especially where traffic is heavy. Their resistance to wear has been proved by years of use in Sydney, and they not only resist wear, but they are not affected by dampness. The first cost is higher than for deal, but the ultimate cost is very much less than for this wood.

A LARGE increase, says *Indian Engineering*, in the exports of coal from Raneegunge, which rose to 783,517 tons in 1886-87, against 635,921 tons in the preceding year, is attributed to the revival in the jute trade in Calcutta, to an increase in the lime and brick industries, and to the use of this coal by some of the steamship companies. There was a great development in the lime industry, due to the resumption of works in the Kidderpore Docks; 611,051 maunds of lime were exported from Raneegunge during the year under notice, against 304,034 maunds in the preceding year.

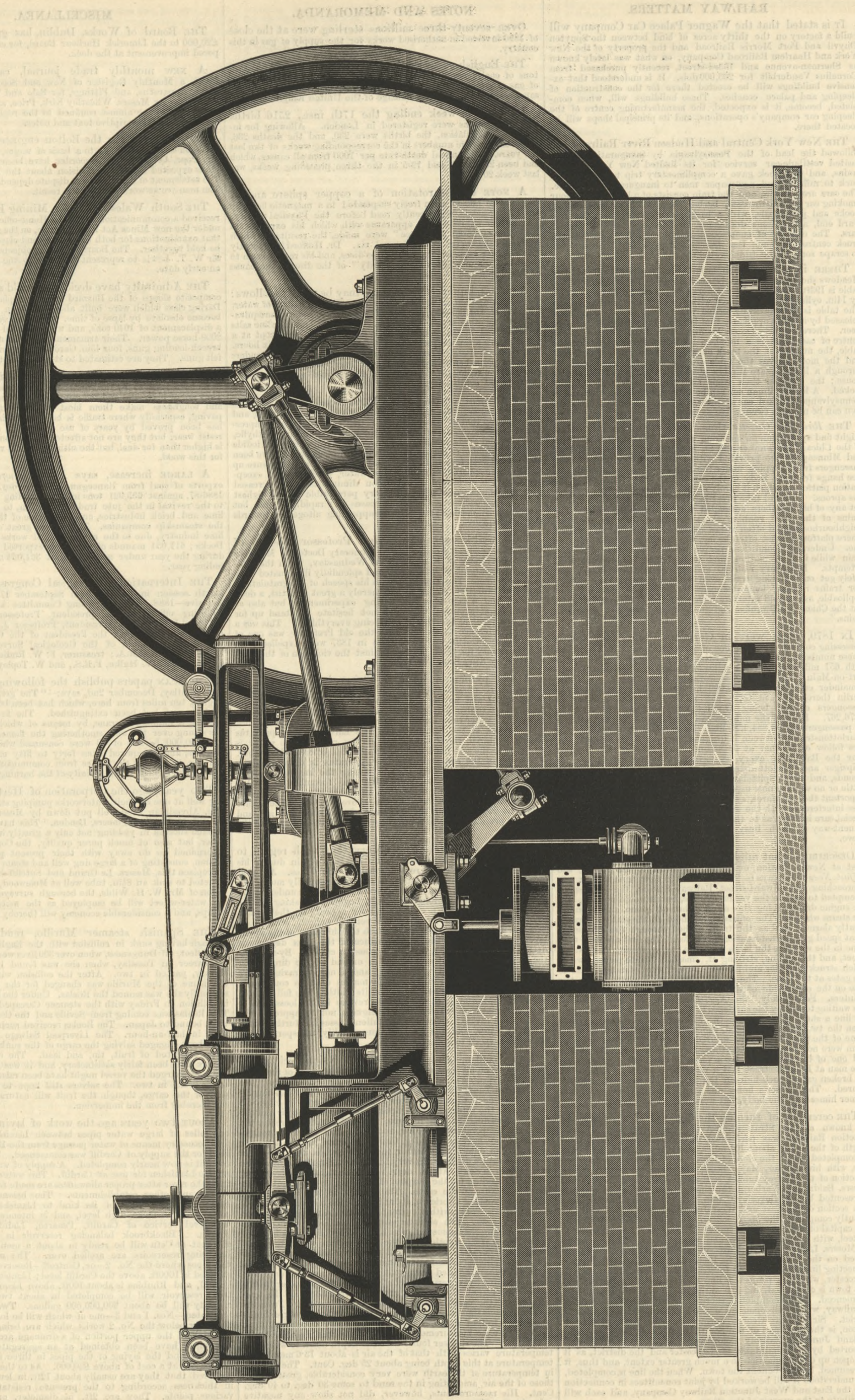
THE International Geological Congress will hold its fourth session in London from September 17th to 22nd—both inclusive—1888. The Organising Committee has nominated the following officers:—Hon. president, Professor T. H. Huxley, D.C.L., LL.D., F.R.S.; president, Professor J. Prestwich, M.A., F.R.S.; vice-presidents, the President of the Geological Society, the Director-General of the Geological Survey, and Professor T. McK. Hughes, M.A.; treasurer, F. W. Rudler, F.G.S.; general secretaries, J. W. Hulke, F.R.S., and W. Topley, F.G.S.

AMERICAN papers publish the following:—A telegram from Findlay, December 2nd, says:—"The great oil well fire at Cygnet, ten miles from here, which has been burning for the past week, has at last been extinguished. The fire was put out by building a mammoth crane, by means of which an immense cup was swung over the well, smothering the flames. It is estimated that 350,000 barrels of oil were consumed while the fire was in progress, and it required from forty to fifty men, working night and day, to prevent the flames from communicating to the village of oil tanks located in the vicinity of the burning well."

TWO years ago the Corporation of Hertford replaced a dug well at one of their waterworks pumping stations by having a 7¼in. Abyssinian tube well put down by Messrs. Le Grand and Sutcliff, hydraulic engineers, London. This having proved such a decided success in yielding not only a greatly increased supply of water, but also of much purer quality, the Corporation has now determined to do away with their present principal pumping station, consisting of a large dug well and steam pumping engines. To replace this, Messrs. Le Grand and Sutcliff have just been instructed to sink an 8½in. tube well at Molewood, under the supervision of Mr. W. H. Wilds, the borough surveyor, where an existing water-wheel will be employed as the motive power for the pumps, and a considerable economy will thereby be effected.

THE Spanish steamer Murillo, rendered notorious through having sunk in collision with the English emigrant ship Northfleet, off Dungeness, when over 300 lives were lost, terminated her career on Tuesday, when she was found lying sunk in the Mersey, parted in two. After the collision with the Northfleet the name of the Murillo was changed for the Huelva, and subsequently she was named the Roelas. Under the latter title she was in collision on Friday with the steamer Cascapedia in the Mersey. The Roelas was coming from Seville and the Cascapedia was outward bound to Japan. The Roelas received such injuries that she sank in half-an-hour. The Liverpool Salvage Association have since been engaged salving the cargo of the sunken steamer. The cargo consisted of fruit, tin, and lead. The operations of the salvors had been fairly satisfactory, and it was hoped that after being discharged the vessel might have been raised, but she afterwards broke in two. The salvors still hope to raise the greater part of the cargo, though the fruit will naturally have suffered considerably from the immersion.

ABOUT two years ago the work of laying down thirty-one miles of large water pipes between Llanishen and Cwmtaff, as a necessary means of water passage from the Breconshire watershed for the supply of Cardiff was commenced. The whole line of conduit is now nearly completed. A supply of water could now be sent to Llanishen for use at Cardiff. This water could be taken from the river after proper allowances are made for Cyfarthfa Steel Works and other establishments. The balancing reservoir at Rhubina, the nearest of its kind to Llanishen, is practically complete. It is at high level, and is intended for the future high-level service of Cardiff, Penarth, Llandaff, and Whitchurch. Blackbrook balancing reservoir is nearly finished, and that at Cefn will be ready in about a month. These three balancing reservoirs are arched over. The upper section of the pipes where the No. 2—or Cantreff—Reservoir is being constructed is 1000ft. above the Cardiff level; Llanishen is 150ft. above Cardiff, and Rhubina is about 100ft. above Llanishen. The Cantreff reservoir will be completed in about two years, and its capacity will be about 300,000,000 gallons. Two others are contemplated—Nos. 1 and 3—one of which will be located above and the other below the No. 2 works, which are being constructed at the root of the upper portion of a drainage area of 4000 acres. The pipes have been obtained at an aggregate cost of about £120,000, and the laying of the pipes in three sections has been carried out at a cost of above £30,000. As to the pipes, it may be observed that they are usually about 12ft. in length. They vary in thickness according to the pressure resistance required at various points. They are 2ft. in diameter, and weigh about 1½ tons each.



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(*For description see page 536.*)

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

MEETINGS NEXT WEEK.

ROYAL INSTITUTION.—Tuesday and Thursday, January 3rd and 5th, at 3 p.m.: Lecture on "The Sun, Moon, Planets, Comets, and Stars," by Sir Robert Stawell Ball, F.R.S.

GEOLOGISTS' ASSOCIATION.—Friday, January 6th, at 8 p.m., at University College, Gower-street, W.C. Paper to be read:—"On the Occurrence of Gold in North Wales," by T. A. Readwin, F.G.S.; illustrated by specimens, &c.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, January 4th, at 7 p.m., at the Town Hall, Westminster: Ordinary meeting. Paper to be read and discussed:—"Salmon Passes," by Mr. A. Fairlie Bruce, A.M.I.C.E.

THE ENGINEER.

DECEMBER 30, 1887.

THE UNITED STATES NAVY.

WE have already considered at some length in our impression for December 9th the annual report for 1887 of the Chief of the United States Bureau of Steam Engineering, but something remains to be said concerning it. Mr. Melville is very anxious that the Bureau should become in a sense a research institution, and there is a good deal to be urged in favour of the scheme. It is indisputable that our own Admiralty with all its defects and blunders of administration, has obtained for the nation and supplied a great deal of valuable information. We may point, for example, to the late Mr. Froude's experiments; and this knowledge has been got by a species of research, and has been of considerable value to the shipbuilders and engineers of Great Britain. Mr. Melville would, however, it seems go much further than we have gone. He mentions a great number of subjects on which information is wanted; such, for instance, as the most efficient amount of heating-surface for a given power at a given rate of combustion with forced draught; the ratio of the volume of the combustion chamber to the volume of the gases passing through it in a given time; the best form and dimensions of high-speed blowing-fans; the absolute and relative economy of triple and quadruple expansion engines at various pressures, with and without steam jackets, and with both dry and superheated steam; the strength of various full-sized forms in cast and forged steel, and in various high-strength alloys, under various conditions of working and cooling; the strength of large specimens of thick steel boiler plate to determine how close to finished dimensions it may be safe to shear the plates; the strength of rivetted joints in very thick steel boiler plates; the potential and economical performance, and the endurance of various recently introduced boilers of the coil, pipe, and tubulous types; the most efficient proportions of high-speed screw propellers for given powers and speed. "All these questions," says Mr. Melville, "lie, in great part, beyond the range of theory, although certain data, when obtained, can be applied by theoretical methods to cases differing considerably from those of the experiments. It is much cheaper to spend a comparatively small amount of money in making such experiments in a scientific manner than to follow blindly in the wake of what somebody else is said to have done, and to find too late that our efforts are not as successful as expected."

The passage which we have quoted might form the text for a little treatise. Much may be said, both for and against it. We may take it that Mr. Melville knows pretty nearly all that is known in the United States concerning the subjects for research which he names; and if this is true it would appear that they have a great deal to learn at the other side of the Atlantic. It does not appear to be possible, for instance, that any system of government inquiry can add materially to the knowledge already possessed in this country concerning the relative economy of compound and triple-expansion steam engines. There is not a large owner of cargo steamers trading to New York, Montreal, &c., who could not supply Mr. Melville in half an hour with all the information he can require on this subject. British marine boilermakers of eminence know all that is to be known concerning the behaviour of rivetted joints in thick steel plates. Certain of the other subjects named are no doubt worth further investigation; but we cannot help smiling when we see how modest is the sum Mr. Melville thinks will suffice for carrying out the experiments which he suggests. "It would be difficult," he says, "in the present case to specify in detail just what amount would be needed for each individual experiment, and I would, therefore, recommend that an appropriation of 25,000 dols. be asked for, to be expended in such a manner as the Department may direct." Five thousand pounds sterling would not suffice in this country to settle satisfactorily more than one, or, at most, two, of the multifarious points he has suggested; and it is to be regretted that he has not given his readers a single hint as to how economy and efficiency in experimental research are to be combined. We have never succeeded in managing the combination in this country, and probably never shall.

It was formerly a subject of complaint with naval engineers in this country that the military element of the service interferes too much with matters which it does not understand. There was a story told of the days before the Russian war concerning the captain of a frigate who, coming on board rather suddenly, ordered steam to be got up in half an hour, no fires being alight at the time, and the water in the boilers cold. When the chief engineer told the captain it was impossible to obey such an order, the captain replied that he would give him three dozen for impertinence. This is no doubt a gross exaggeration, but things very closely akin to it have been done. We have changed all this; and if an engineer in the British Navy does not lie quite on a bed of roses, it is at least certain that his value on board a ship is understood and his importance recognised. In the United States Navy, however, it seems that there is still a great deal of friction between the engineers and the officers representing the military element. The Bureau of Steam Engineering tries to take care of the machinery under its charge. "The issue of an order by a Bureau becomes farcical," says Mr. Melville, "when there are no adequate means of enforcing its observance; it is much like the enactment of a law without an accompanying provision for a penalty for its infraction. Among other abuses of this kind I may mention the case of an order of the Bureau, of long standing, that boilers must not be filled with water for trimming ship; also an order limiting the minimum time in which steam should be raised. There are but few ships in commission to-day on board of which one or both of these instructions is not at some time or other deliberately disregarded, and the lives of the boilers thereby shortened. I would suggest, as an aid in remedying this state of affairs, that military traditions and customs be so far set aside as to require the chief engineer of each ship, whenever he is ordered to disobey the instructions of the Department, to immediately make a special report of the same direct to the Bureau, at the same time giving a copy of the report to his commanding officer, so that if an emergency existed which would justify the overstepping of the limits of his instructions, he may be enabled to explain it to the Department. I would also recommend that this Bureau be allowed to communicate directly, in all technical matters, with its representatives on board ship, thus insuring a much more satisfactory knowledge of the state of affairs than is now available at the Department." Here, we think, Mr. Melville has gone a little too far. No captain would, we fancy, sail with an engineer who was practically independent of him to a large extent; and no English engineers, at all events, would consent, if they could help it, to send in reports to the Admiralty which were likely to call down censure on their captains. It is difficult to draw the line, but for the good of the service it would be better that a boiler should be injured now and then rather than that the engineer should be called upon to play the invidious part suggested by Mr. Melville.

Concerning the condition of the United States Navy Mr. Melville has very little to say. It can hardly be otherwise, seeing how insignificant an affair the United States Navy is. Take, for example, the following extract from the report:—"The only armoured vessels that we now possess in a state of completion are the old single-turret monitors. They are, to be sure, of antiquated type, but would have to be depended upon in case of a declaration of war before other coast defence vessels are built. They are slow, but for a small outlay could be given fair speed by fitting the boilers with forced draught applied directly to the ash-pits, and substituting surface for jet condensers in such vessels as are fitted with the latter. These changes could be made for 5000 dols. on each of the five vessels now having surface condensers, and for 10,000 dols. on each of the eight others, provided, however, that the work could be concentrated at one navy-yard, as the re-duplication of the additional machinery would tend to economy. Two of these monitors need new boilers, which would cost 40,000 dols. for each vessel. If we were possessed of other vessels for coast defence, I would not recommend spending a dollar on any of these old craft; but under the circumstances, to add to our security until better vessels can be built and equipped, I would recommend that the above-mentioned changes be made, and that a sum of 185,000 dols. be appropriated for this purpose."

It really seems almost incredible that a country so enormously wealthy as is the United States should have suffered its Navy to fall so low. It is a positive fact that if the United States got into a difficulty to-morrow, say with Russia concerning Alaska, or with Spain concerning Cuba, there would be nothing to prevent New York being bombarded, or a ransom claimed that would quickly give the country the blessing of a national debt. The facts are very well understood in the United States, and time after time warnings have been uttered, yet all to no purpose. One would have imagined that the Alabama taught a lesson never to be forgotten; but this is not the case, and the United States possess no armour-clads but the few old monitors referred to by Mr. Melville.

We hoped to find some authoritative information in Mr. Melville's report concerning the new ships added to the United States' Navy; but it does not contain a syllable. It does contain some information showing how curiously far behind England the United States are in means of making marine engines. Passing to vessels under contract, Mr. Melville tells us exactly how much progress has been made with the machinery of Cruiser No. 2. The designs for these engines were obtained from Messrs. Hawthorne and Co., of Newcastle-on-Tyne; the contractor is the Union Ironworks Company, San Francisco. "The following changes in design have been proposed by the contractors and approved:—The inner stern-tubes to be made of composition instead of cast steel. The details of main valve-gear changed so as to give more port opening and a better distribution of power in the two cylinders. Additional ties between the reversing cylinders and the reversing quadrant bearings. Pitch of screw-thread on connecting-rod bolts to be less than specified. Shells of condensers to be of sheet copper instead of sheet brass, as it was impossible to obtain the latter of sufficient size." Of course Messrs. Hawthorne specified nothing that could not be had in this country. The change from cast steel to "composition" that is a kind of brass, is suggestive when taken with the following passage, referring to Cruiser No. 3, the machinery for which has been designed by Messrs. Humphrey, Tennant, and Co.:—"Condenser shell plates are planed and are being fitted. Air pump pistons nearly finished. Owing to the failure of steel castings for crank shaft pillow blocks and bed-plates, no advance has been made with these parts. The following changes in the design have been proposed by the contractor and approved:—Diameter of main boiler tubes—outside—reduced from $2\frac{1}{2}$in. to $2\frac{1}{4}$in., and the number of tubes increased from 868 to 948. The cast steel main crank shaft pillow block frames to be cast in four parts for each engine instead of two, on account of the difficulty of casting. The cylinder linings changed from cast steel to cast iron. Manhole frames on boilers to be made of cast instead of plate steel. Crank shaft pillow block frames changed to facilitate casting, the first casting having been condemned as defective. Condenser tube sheets changed from cast Muntz metal to composition. Naval brass to be used in place of Tobin's metal. Crank shaft pillow block frames again changed to facilitate casting, the second attempt at casting having failed." From all which it would appear that they do not know how to cast steel in the United States yet.

ELECTRICAL TRAMWAYS AND RAILWAYS.

ELECTRICAL tramway and railway development seems to be passing through a stage which resembles in several respects the early days of railways, and the amateur engineer plays no insignificant part in it. Some real work is, however, being done; and after the amateur has, by reason of his usually unbounded assurance or enthusiasm, caused the expenditure of large sums of money in showing as much how not to do it as how to do it, thoroughly competent men will no doubt find the matter sufficiently developed to make capitalists look at the matter seriously and employ thoroughly competent men to take it up. Until recently, and in a very few cases, electrical propulsion on tramways has not been sufficiently promising to invite men who are usually well engaged to touch it, for they have not time to devote to the conversion of capitalists from patronising semi-belief into active support. There is no phrase so common with those who know very little of electrical applications as that "Electricity is in its infancy," and so long as this is the general untaught belief it is not promising for the railway and tramway engineer. There is, however, always a number of capitalists amongst the amateurs; and they believe more or less readily in the amateur who assures them that the infant, being a modern one, carries a very old head on its young shoulders. These capitalists spend their money, though they do not always get their choice; but hope is always strong in the amateur's breast, and he does not despair. Apart from his own loss of money he does and has done good, and electrical tramway haulage is no doubt further advanced to-day than it would have been without him. Able men have in some cases already been called in; that which is possible has already been to a great extent shown by what has been found impossible, and it is not too much to say that electrical propulsion has now reached a stage that makes it quite certain that it has a place in the list of available means of commercial haulage.

At the last three meetings of the Institution of Civil Engineers a paper by Mr. Edward Hopkinson, A.M.I.C.E., M.A., has occupied attention and discussion. More particularly it described the Bessbrook and Newry tramway, which in some respects might be called a railway, and a line which probably would have been made and worked by steam if water power had not been available. It was designed for the haulage of heavy goods as well as for passenger traffic, and has run over 40,000 train miles. The length of the line is rather more than three miles, with an average gradient of 1 in 86, the maximum gradient being 1 in 50. According to the conditions of the contract ten trains were to be run in each direction per day, providing for a daily traffic of 100 tons of minerals and goods, and capable of dealing with 200 tons in any single day, in addition to the passenger traffic. The electrical locomotive was to be capable of drawing a gross load of 18 tons on the up journey, in addition to the tare of the car itself and its full complement of passengers, at an average speed of six miles per hour, and a load of 12 tons at an average speed of nine miles per hour. Also, the cost of working, as ascertained by six months' trial, was not to exceed the cost of steam traction on a similar line. The line was formally taken over by the company, as having fulfilled the conditions of the contract, in April, 1886, and has since been in regular daily operation. It is worked entirely by water power, for which we believe £12 per month is paid, the generating station being adjacent to the line at a distance of about one mile from the Bessbrook Terminus. There are two generating dynamos driven by belting from the turbine shaft. The turbine can develope 62-horse power, and each dynamo is intended for a normal output of 250 volts, 72 ampères, though they are capable of giving a much larger output. The current is conveyed to the locomotive cars by a central conductor of steel, of channel section, carried on wooden insulators nailed to alternate sleepers, except for a short distance where it crosses a country road at an angle, and an overhead conveyance is employed. Under average conditions of working the total electrical efficiency is shown to be 72·7 per cent., the losses being distributed thus:—Loss in generator, 8·6 per cent.; loss in leakage, 5·7 per cent.; loss in resistance of conductor, 6·6 per cent.; loss in motor, 7·7 per cent. The friction of the bearings in both generator and motor, and the power lost in the driving gear, are excluded from these results. The cost of haulage per train-mile is shown to have been 3·3d. over one period of five months, when the goods traffic was light, and 4·2d. when the goods traffic was heavier—the water power costs £12 per month. Since the opening of the line, the locomotive cars have registered a train mileage, as above stated, of 40,000 miles, and the tonnage has exceeded 25,000 tons, and the number of passengers 180,000.

As this line is in active work and is operated by a few unskilled men, it may be assumed to have demonstrated some of the practical possibilities in this direction, especially as £12 per month would pay for a good deal of the coal necessary for the whole work, if water power were not used. The line is more of the character of a railway than a tramway, and it is of short length, but it affords most valuable information of what may be done for working branch lines and metropolitan lines. The electromotive of to-day may be looked upon as in a measure analogous to the locomotive of the Rocket days, its weight and power being small, and most of its details in an experimental stage; but with increased size and strength of electromotive confidence may dictate the remark that the system will probably develope in a very few years to the position of one in every way capable of conducting metropolitan railway traffic, especially as it may develope either by the use of several motors in a train, converting several carriages into electromotives, or by increase in mechanical fitness and powers of one electromotive taking the place of the locomotive. It is worthy of remark that with all the present available knowledge of practical mechanics, with all the scientific teaching, with all the wealth of precedent, most of those who have been working on the electromotive have proceeded just as the locomotive makers did in the days of Stephenson and others, and it is almost amusing to hear how much is made, for instance, by the electromotive people of having found a suitable pitch chain for driving purposes, when a little more practical knowledge of what has been done would have given them success in this direction from the first.

For street tramways it is perhaps doubtful whether practical and commercial success is as near realisation, at all events for such crowded streets as those of our great towns. Independent cars or independent electromotives carrying their electric supply in secondary batteries must, it would at present seem, be used. The use of a central rail or of the ordinary rails as conductors cannot so well be called upon, or, if practicable as far as it is affected by ordinary traffic, be depended upon as commercially available. Secondary batteries are, however, not yet all that is desirable for the purpose, although they are much better able to withstand the heavy jolting inseparable from tramway working than they were. This, however, is not the only question upon which their application depends, though it is in some cases the chief one. The commercial efficiency of strong secondary batteries has to be considered, as well as the time occupied in charging and changing the cells, while the present rate of discharge makes a large weight of battery necessary. Even in these directions, however, considerable practical information is now available, a good deal of experience has been obtained, and altogether electric propulsion is now to be placed amongst the means available under suitable circumstances, and these are not very few or far between, although they are not as universal as some enthusiasts believe.

THE MALIGAKANDA RESERVOIR.

NECESSARY references to one authority and another have caused seven months to elapse since the report was made by the Commissioners appointed to enquire into the causes of the several mishaps which have occurred to the Maligakanda reservoir at Colombo, Ceylon, before that report was submitted to the Legislative Council of the Colony and so made public property. During that interval we have on several occasions dealt with the subject; and, so far as the information at our disposal admitted, we have endeavoured to surmise what the nature of that report would be. Of course, when so doing we could only refer to the several hypotheses which appeared to afford some possible explanation of the very extraordinary and unusual repetitions of failure experienced at this reservoir, the leading features of which work we have before described. In these articles we adopted as our own particular theory of the cause of failure the sliding of the main impounding wall over the material upon which it was built. The grounds for our coming to that conclusion we fully detailed at the time we advanced our proposition, and it is not therefore necessary that we should now recapitulate them.

It is satisfactory to find that in the fullest possible measure the report of the official Commission bears out all that we wrote in advance of its conclusions being made public; but we much regret to find that the report very seriously impugns the professional proceedings of the engineer in charge of the work. It is but fair, however, to that gentleman to state that, according to information reaching us, the views of the Commission which are adverse to him, do not receive adoption by the principal engineering authority responsible for the design of the work and for his selection as its superintendent. Primarily of course, and as has been admitted by all concerned, leakage under the walling led to the results which have occurred. The main question calling for inquiry and decision was as to how that leakage arose. Various conjectures have been put forward to account for it, that, as we understand, receiving adoption by the chief engineering authority being the unequal contraction and expansion due to the admission of water of a temperature much below that of the concrete walling, heated as the latter had been by exposure to the fierce rays of a tropical sun. While admitting that concrete was not so free as had generally been held to be the case from liability to contraction and expansion, we, in our previous articles on the subject, expressed the view that such a theory of the cause of the leakage could scarcely be tenable in this instance. We find that the report under reference supports that opinion, evidence received by it going to show that the temperature of the water was as nearly as possible on an equality with that of the concrete. This theory seems to have been completely disposed of and refuted by the inquiries of the Commissioners. They find that the flooring was sunk too low, it being, as we gather, in some places below the level of the foundation of the main walls; also that it was too light to afford full guarantee that it would not sink under the pressure with every shrinkage of the material on which it was laid; and, further, that the concrete of which it was composed was imperfect in its constituents and permeable by water.

We need scarcely point out how grave is the indictment contained in the last sentence of the foregoing paragraph. Even if judgment had been in fault as to the thickness to be given to the concrete flooring, that error would be as nothing compared to the grave charge that the material itself was permitted to be bad and untrustworthy. The gentleman responsible for the character of the concrete, was known to have been possessed of exceptional experience with regard to that material, and we can hardly realise—as we believe his superiors wholly refuse to do—that he can be justly charged with such a neglect of what was perhaps his most important function. But *ab initio*, with respect to this work, there appears to have been a great mistake made in the selection of its site; a mistake which may perhaps, according to the Commissioners' report, fully account for all that followed without insistance upon the charges above detailed. We have previously said that the material of the hill upon which this impounding reservoir was built is what is locally termed "cabook," a species of laterite affording good material for building upon if it be of sound quality throughout its mass. The report would seem to charge the engineer that he did not sufficiently ascertain whether in this case such quality was present, and that he too readily assumed it to be so when reporting to his superior charged with the preparation of the design. It is even stated that no borings were made before so reporting, reliance having been placed on the pits and wells in the hill due to old workings in it. The borings that have now, but too late, been made, reveal that at a depth of 12ft. the cabook was found "to have assumed the condition of kirimeti or kaolin." It was on such material, at the depth of the aforenamed 12ft., that the foundations were laid, and when cabook has asumed such a condition it is most untrustworthy. It does not appear, to judge by the report, that there has been any subsidence of the foundation, but the conclusion adopted is that very slight leakage would render unsound cabook so slippery that no masonry upon it could be stable.

Now, the concrete floor as at first laid was but 12in. thick; the depth of water upon it was 40ft. Under the pressure due to such a head of water it is extremely probable that the unsound cabook, when compressed, would yield somewhat, and permit the slight flooring above to crack. We need, we think, go no further into the question as to the causes which may have led to the leakage to which the failure of the work is primarily due, although the report goes very fully into other hypotheses respecting it. Once the water, from whatever cause, reached the kaolin—for it was undeserving the name of cabook—upon which the walling was founded, it is easy to understand that nothing but very deep and numerous footings could prevent that tendency to slide which we have before assumed to have caused the rupture of the main walling. We learn from the drawings available to us that no such footings were provided. The engineer designing the work appears to have relied exclusively on the adhesion between the concrete and the sound cabook upon which he had been led to believe his walling would be built. When therefore all that quality of adhesiveness was destroyed by the water percolating through the cracks in the flooring, there was nothing to arrest the forward movement of the wall due to the great pressure of the head of water behind it. That the walling did so slide is the conclusion of the Commission; and the report further states that the walling, on being released from the pressure, sprang back once more almost into its normal position, permitting the cracks through which the water had poured so freely almost entirely to close up again. The report follows so closely our own previously recorded arguments that it reads in a great measure almost like a recapitulation of our own articles upon the subject; but it will scarcely be fair to come to a final judgment until we have been afforded opportunity of reading what has to be urged in opposition to the views of the Commission, by the gentleman whose course of action it condemns.

COMPOUND ENGINES.

ALTHOUGH the results obtained with triple expansion engines are in a high degree satisfactory, it is very probable that the limit of excellence has not yet been reached. Unfortunately the conditions under which marine engines are worked are unfavourable to scientific investigation. The most careful, and even costly, experiments are carried out in the shape of progressive speed trials, but no one seems disposed to expend a few pounds in settling questions of vital importance connected with the working of the engines propelling the ship tested. Thus, for example, it is not too much to say that no one knows with any approach to certainty how much water a pound of coal can convert into steam in the normal marine boiler; nor can any one tell what weight of feed-water is needed per horse-power per hour. More or less good guesses are made no doubt; but after all they are but guesses, and with conjecture exact science has nothing to do. It seems to us very remarkable that not one of our great shipbuilding firms has ever turned its attention in this direction. Perhaps the idea is entertained that nothing would be gained by an inquiry of the kind, a conclusion which certainly does not commend itself to us. A direct result of the ignorance resulting from the absence of experimental data is that we have no reason to conclude that even the best engines running are the best that can be made. Indeed, we believe that it may be shown that this is not the case, and that the system, or want of system, by which triple expansion engines are made can only give the best economical results by chance, and never with any approach to certainty.

The conditions under which steam is worked in the compound engine are necessarily peculiar. In the single-cylinder engine with an early and sharp cut-off, it is known that the smaller the clearance the better. The steam required to fill the clearance space does no work at the higher pressure. Its duties only begin when the admission valve closes and expansion commences, and the whole of the work done in thrusting it out of the boiler is lost. If the engine did not work expansively the clearance steam would represent a total loss. It is always the practice of the best makers accordingly, to reduce clearance to the smallest possible limits; and this rule can, of course, be observed with the high-pressure cylinder of a compound engine; but it cannot be observed with the low-pressure cylinder. That draws from an intermediate receiver, and during the whole time that the admission port is open the steam is expanding almost precisely as it would expand in a single-cylinder engine with ports so small that wire-drawing took place. The back pressure in the high-pressure cylinder is a variable quantity. At the moment the exhaust port opens there is the lowest pressure in the receiver, and the back pressure drops. The steam valve of the low-pressure cylinder being then closed, the pressure rises in the receiver until about half-stroke, when the pressure in the receiver is at a maximum. The low-pressure crank then turning the dead point, the low-pressure cylinder begins to take steam, and the receiver pressure falls. The result is the characteristic curve of the exhaust line on high-pressure cards. At first sight then it seems obvious that the cut-off should take place as early as possible in the second cylinder, in order to eliminate the loss caused by the virtual clearance constituted by the intermediate receiver. But it must not be forgotten that what may be good for the low-pressure cylinder may be bad for the high. Too early a cut-off in the former may bring about undue back pressure in the latter. There is some fixed relation between the pressures, points of cut-off, and capacity of the intermediate receiver which will secure a better economical result than any other. But this must be settled for every engine, or every group of similar engines, on the basis of the working conditions of the engine or group of engines, and it does not admit of extended generalisation. There are besides two factors in the problem which must not be forgotten. The first is, that it is desirable that the same power as nearly as may be should be developed on both cranks; the second is, the peculiar and as yet not well understood influence exerted on the quality, as we may phrase it, of the steam by the dimensions of the intermediate receiver. Now, as to the first point, we are strongly of opinion, and we know that many highly competent engineers agree with us, that far too much importance is attached to getting the same work done on each crank. We hold that within reasonable limits it is a matter of no consequence whatever that this object should be secured. It is certain that it is not worth the coal the securing of it costs in only too many cases. We find, indeed, engineers altering points of cut-off, receiver capacities, dimensions of cylinders —anything and everything, in short—without the least regard for economy and pointing proudly to engines which develope to within a small fraction of the whole power, the same power on each crank; and all the time it may be a fact that the turning moments on the crank cheeks are far more variable than there would be in engines designed with more regard for economy of fuel, and less for equalisation of power. Of course what holds good of the ordinary two-cylinder compound also holds good of a treble-cylinder engine.

Concerning the influence of the dimensions of the intermediate receiver on the economy of the compound engine much remains to be learned. Indeed, the subject has hardly as yet received any attention whatever. Our own experience goes to show that when the receiver is so small and the setting of the valves so arranged that the exhaust line of the high-pressure cylinder is curved upwards, great economy results; and the reason appears to be that the rise of pressure and temperature in the intermediate receiver dries the steam, and it accordingly works with greater efficiency in the low-pressure cylinder. A suggestive and interesting example of this is supplied by one of the engines, Mr. Cooper's, tested at Newcastle last summer. It was patent to everyone that the exhaust from this engine was very wet; water came out of the chimney in fine spray, and it was thought by some that the boiler was priming. It was not as a matter of fact. When Mr. Cooper had taken his engine home, like a wise man he experimented with it, and by partially filling up, and so reducing the space in the intermediate receiver, he effectively dried his steam and augmented the economy of his engine. The high-pressure cylinder is 6in. and the low 9in. diameter, with a stroke of 11in., and the intermediate receiver space was 875 cubic inches, or more than twice that in Messrs. McLaren's engine. It was 2·8 times larger than the capacity of the high-pressure cylinder, and more than 1·25 times larger than the low-pressure cylinder. The diagrams taken from this engine were, however, very good, especially the low-pressure cards, and we have no doubt that had the steam gone dry into the low-pressure cylinder, instead of wet, the result obtained would have been far better than it was, viz., 3 lb. per indicated horse-power per hour. The cylinders are unjacketted, and the evaporation of the boiler was 10·75 lb. per 1 lb. of coal, or about 20 per cent. less than that of the best engines.

In the triple-expansion engine we have two receivers to deal with, and so far therefore the conditions are more unfavourable to economy than they are in the compound engine; but this is more than compensated for by the higher pressure and greater range of expansion under favourable conditions. In the compound engine we always find some water, however little, in the low-pressure cylinder at the beginning of the stroke; but in well-designed triple-expansion engines it is usually impossible to detect a trace of moisture in the low-pressure cylinder; indeed, when the indicator cock is opened the steam sometimes issues from it so dry as to be almost invisible—in marked contrast to the high-pressure cylinder, in which, for some wholly unexplained reason, the condensation is always enormous.

The most prominent defect about the low-pressure cylinder in triple-expansion engines is that there is often considerable back pressure, due to the difficulty of working in ports and passages of sufficient dimensions to suit the great size of the cylinder without at the same time making the slide or piston valves of huge proportions. An instance came under our own observation, namely, in which, while the vacuum was 27½in. the back pressure amounted to no less than 3½ lb. That is to say, the vacuum in the cylinder was 7in. less than that in the condenser. As the total average pressure in the low-pressure cylinder was only 9 lb., it will be seen how great was the loss. It represented, in this case, 50-horse power out of a total of 400. The pressure in the last cylinder of a triple expansion engine is so low, and the piston is so large, that the loss caused by a bad vacuum or contracted ports may easily become very great indeed. A difference of a pound or two between the actual and the possible is much more serious than appears at first sight. It might almost be said—"Take care of the low-pressure cylinder and the high pressure will take care of itself."

A NEW WATER SCHEME FOR HALIFAX.

DURING the next session Parliament will have to deal with several Bills for improving existing water supply systems in various parts of the country. If for no other reason, the continually growing demands of large centres for water, both for domestic and manufacturing purposes, would render fresh powers necessary; but the serious drought suffered by many districts during last summer has alarmed the public and created cause enough by itself for obtaining more adequate supplies. Among those who mean to take time by the forelock, and safeguard themselves against the evils of future drought, are the municipal authorities of Halifax. For thirty years they have had the control of their water supply, and hitherto have been remarkably well off in that respect, but increasing requirements and the fear of drought have impelled them to secure additional sources. In 1868 they obtained an Act for carrying out what was called the Walshaw Dean scheme, but believing that scheme would not be required for many years to come, they allowed it to lapse. They now intend to ask Parliament to re-authorise that project. At present, the supply for Halifax is gathered from five different valleys, and concentrated at Ramsden Wood reservoir, whence it is distributed among a number of subsidiary or service reservoirs in the town. The several storage reservoirs will hold about 1,200,000,000 gals., and there are also service reservoirs which will hold about 60,000,000 gals. It was originally estimated that the works would yield six and a-quarter million gallons per day, besides compensation water, but this calculation had to be reduced by several considerations to five and a-half million gallons per day. Mr. George H. Hill, C.E., who has been consulted on the question, expresses the opinion that the existing works in time of drought will not provide more than four and a-half million gallons, or at the best, if the whole of the water can be impounded, about five and a-half million gallons. That has not been possible heretofore, and is not likely to be possible; but even so, Mr. Hill anticipates that in fifteen years from six and a-half to seven million gallons per day will be required, owing to increasing demands by householders, by manufacturers, and by various Local Board districts which depend upon Halifax for their water. Last summer the town had to be put upon a reduced service, and up to quite recently the effects of the drought had not been entirely overcome. In the new, or rather the revived, scheme it is proposed to construct three new reservoirs, which, it is calculated, will be able to receive from the new drainage area sufficient water to provide two and a-half million gallons per day, in addition to compensation water, and in that way the Corporation expect, with the existing supply, all the water that will be required for their extensive district for many years to come.

EXTENSION OF THE MERSEY RAILWAY.

SURELY, if somewhat slowly, the Mersey Railway is being extended in a manner anxiously anticipated ever since the Mersey Tunnel was opened by the Prince of Wales nearly two years ago. In some directions grave difficulties have arisen to cause delay; but gradual progress has been made, and one important extension has now been completed. Hitherto people having to travel between Liverpool and various parts of the Wirral district have only been able to do so by a circuitous and slow process. For example, to reach West Kirby or Hoylake—two suburbs largely inhabited by Liverpool business men—they had to cross the river before the tunnel was made by boat to Woodside, then proceed for three miles to the old Docks station at Bidston, and thence take the train, the whole journey occupying a length of time altogether out of proportion to the distance. The opening of the tunnel was the first step towards improving this inadequate service, and now passengers will be able to go direct by rail from Liverpool to West Kirby or Hoylake in half-an-hour, which means a substantial gain in time and in comfort. Some time ago a line from Birkenhead to West Kirby, by way of Parkgate and Hooton, was opened; but as the joint railway companies owning that line have not been able to arrange for running powers through the Mersey Tunnel, the value of that railway is comparatively small. The Mersey Railway extension commences at the company's Hamilton-square station, Birkenhead; and after passing on to the Park, proceeds to the Park joint station at Duke-street. Here the Wirral Railway Company takes up the work, and carries on the line to the north end of Birkenhead, where its station supersedes the old docks station, which in future will be used as a siding. Thence the extension is carried on to Wallasey, and ere long it will be continued to New Brighton, to which valuable waterside suburb of Liverpool there is at present no direct access save by steamboat. When that has been effected branches will be thrown out on either side of the system—to such places as Seacombe, for instance—and gradually the Wirral district will be covered by a long and much-needed network of railways, greatly contributing to the convenience of Liverpool men and the benefit of the whole region. In making the portion of this extension from Hamilton-square station to Birkenhead Park unexpected difficulties were experienced, owing to the existence of a bed of quicksand running for some distance along the route. This section therefore had to be excavated and constructed by a number of shafts sunk from the surface of the street. During this work a good deal of property was injured by the subsidence of the ground, and this cost the company a large amount for compensation, in addition to the extra cost of making the line under these circumstances.

THE PARKES SMELTING PROCESS.

A METHOD of treating the concentrated pyritic products obtained in the working of gold and silver bearing quartz has lately been perfected by Mr. Alexander Parkes, the well-known inventor of the process of desilvering lead by means of zinc, which has now almost entirely replaced the Pattinson process both in Europe and America. These concentrates, which even in their most enriched forms are very siliceous, contain iron pyrites, and other sulphides and arsenides so intimately associated with the gold and silver, that they can as a rule only be very imperfectly reduced by amalgamation, even after undergoing a preliminary calcination. Mr. Parkes proposes to treat them by a concentrating fusion resembling the Swansea coarse metal process, for which purpose they are fluxed in a reverberatory furnace, without previous calcination, with a mixture of ferric oxide, lime, sulphate of soda, fluor spar, and carbon, the ore and fluxes being finely reduced and intimately mixed. The charge is completely melted in about three hours and a-half, giving as products slag and regulus. The latter, which is exceedingly fluid, is essentially ferrous sulphide, and contains practically the whole of the valuable contents of the ore, while the slag, from the diversity of the fluxes employed, being comparatively low density, and fusing easily, is sufficiently free from interspersed regulus to be regarded as clean, and may be thrown away. The regulus contains a small quantity of sulphide of sodium, and falls to powder when damped with water, in which state it is subjected to a partial calcination until about half the sulphur is expelled, when it is run down with lead in order to collect the gold and silver for cupellation. The latter stages of the process may, however, be varied according to circumstances; the essence of the method being the retention of the whole of the original sulphur in the material, and utilising it as a vehicle for the collection of the metallic contents, instead of getting rid of it by a preliminary calcination. The process has been carried on experimentally for some time at East Greenwich, where a large number of samples of refractory concentrates from many of the principal gold and silver producing localities in America and Australia have been treated with considerable success, the assays of the slags made by Messrs. Johnson, Matthey and Co., showing that very complete separation has been effected in most cases. The first practical trials of the method are to be made in New Zealand under the personal supervision of the veteran inventor, now in his 74th year, who sails for that colony in February next.

THE LOSS OF MERCHANT SHIPPING.

WHILST the shipbuilding world has benefitted by many orders of late, it must not be forgotten that there is on the other side a continuing loss of vessels, so that there is the need of the building of many steamships to replace the tonnage lost. In four of the latest months of the present year the loss has been respectively 33,728 tons; 31,398 tons; 38,251 tons; and 46,837 tons, or a little more than 150,000 tons for the four months. This is at the rate of 450,000 tons yearly; and these months cannot be said to include any of the winter losses. They were months, during which the additions to the registry by building and purchase were in the total 151,927 tons—or fully a thousand tons more than the losses. The additions, however, are for the summer months when building is most active; and thus it may be fairly believed that at the present time when building is contracted, and when the loss of tonnage is naturally the heaviest, there will be a loss in excess of the tonnage added to the register. It should not be forgotten that the figures we have given, both of loss and addition, are for the United Kingdom and the Colonies, and represent all classes of shipping. The steam tonnage occupies a different category; for it may be well believed that the tonnage of the steam fleet is increasing, whilst that of the sailing fleet is diminishing, so that the carrying capacity of the fleet is not to be measured exactly by the numerical or even the tonnage condition. But there is a fact often lost sight of—that the steam tonnage, if carrying more whilst at work, entails the corresponding fact that whilst idle in harbour there is a larger portion of the tonnage idle; indeed it may may be doubted whether the carrying power of the steamer over a given period is so much greater than that of the sailing vessels as had been supposed. We must expect, too, that the loss of steamships will grow, for the steam fleet has year by year a portion of older vessels, and therefore more subject to some of the ailments of age. Hence we may fairly conclude that there will be for a long period to come an increasing work for the shipbuilder and the engineer in the replacement of losses, apart from the orders that may be given to extend the fleets.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE.—CHANCERY DIVISION.

December 21st, 1887.

(*Before* MR. JUSTICE KAY.)

THE BRISTOL TRAMWAYS COMPANY (LIMITED) *v.* GRINDELL AND KENT.

THIS was a case of great importance to tramway companies. It was a motion on behalf of the plaintiff company to restrain the defendants, a firm of car and omnibus proprietors, from running their vehicles over the plaintiffs' tramway. The plaintiff company had obtained the usual provisional order of the Board of Trade to enable them to lay down and work tramways in the city of Bristol and the neighbourhood. The capital was originally £50,000, which was subsequently increased to £150,000. Their tramcars were stated to be of a peculiar patented construction, the wheels being placed underneath the body of the car, and without the ordinary flange, so that they ran in a grooved rail. The gauge was only 4ft. 8in., instead of the ordinary omnibus gauge of about 5ft. 10in. The plaintiffs complained that on the 5th inst. the defendants commenced running on their tramway a line of cars or omnibuses with wheels specially constructed for that purpose, and they accordingly now moved for an injunction as above stated.

Mr. MILLAR, Q.C.—with whom was Mr. Bradford—for the plaintiffs, contended that they were entitled to the exclusive use of their tramway, and referred to section 34 of the Tramways Act, 1870, which enacts that "The promoters of tramways authorised by special Act and their lessees may use on their tramways carriages with flange wheels or wheels suitable only to run on the rail prescribed by such Act, and subject to the provisions of such special Act and of this Act, the promoters and their lessees shall have the exclusive use of their tramways for carriages with flange wheels or other wheels suitable only to run on the prescribed rail."

Mr. Justice KAY: You have the ordinary wheels, without a flange, so that they might run anywhere, the only peculiarity being the difference of gauge. Do you come within the section? According to your contention the word "only" must be struck out of the section.

Mr. MILLAR: The defendants are using our rails, without in any way consulting our convenience or paying us a single shilling, notwithstanding that under powers granted by the Legislature we have expended large sums of money on our undertaking.

Mr. Justice KAY: You may have a strong case at the trial to show that your wheels were constructed on purpose to run on rails, and are thus within the words, "wheels suitable only to run on the prescribed rail." I would suggest to you that the motion should stand till the trial.

Mr. MILLAR having assented to that course,

His LORDSHIP made an order accordingly.

THE COLONIAL COLLEGE OF HOLLESLEY BAY.—The Colonial College at Hollesley has just concluded its first session. The operations thus far have been very successful. There is every indication of the college developing as time goes on, until it has become one of the most important and valuable institutions of the kind in the kingdom. In it and upon the lands connected with it practical information on every subject of use to intending young emigrants is imparted. There are at present about forty pupils, which is the most that can be accommodated at the present time, but there is a long list of applicants waiting for admission as soon as the required accommodation can be provided. Mr. Girling, builder, of Ipswich, is now carrying out a large building contract. The first "speech day" took place on Wednesday, and the proceedings were of the most interesting character. Among the gentlemen present were Mr. Frederick Young, vice-president of the Royal Colonial Institute; Sir Farquhar Shand, late Chief Justice of Mauritius; General Lowry, C.B., member of the Council of the Royal Colonial Institute; Mr. W. N. Waller, Mr. James Thomson, of Melbourne, Commissioner of the Melbourne Centennial Exhibition, 1888; Mr. James Edward Ransome, patron of the college; and Mr. Robert Bond, one of the directors. Mr. Robert Johnson gave a number of interesting details connected with the year's operations at the college. Adverting to the highly appreciated lectures of Dr. J. E. Taylor upon geology, Mr. Johnson said the pupils had, perhaps, no conception of the value instruction upon this subject might be to them in after life. Though it might be impossible for a pupil during two years' residence to become an accomplished farmer, geologist, veterinary surgeon, or engineer, yet he might, nevertheless, acquire such an insight into the elements of all these branches of learning as would be invaluable to him hereafter, and enable him to follow up any particular line that might lie before him in one or other of the Colonies. The lectures upon these subjects had been followed up by practical work on the farms. They had done some valuable work in forestry, and the veterinary department had been also particularly well done. The pupils had also been very attentive in the minor industries, especially smith's work and carpentering.

RADIAL DRILL AND MILLING MACHINE.

MESSRS. HETHERINGTON AND CO., MANCHESTER, ENGINEERS.

Fig. 1

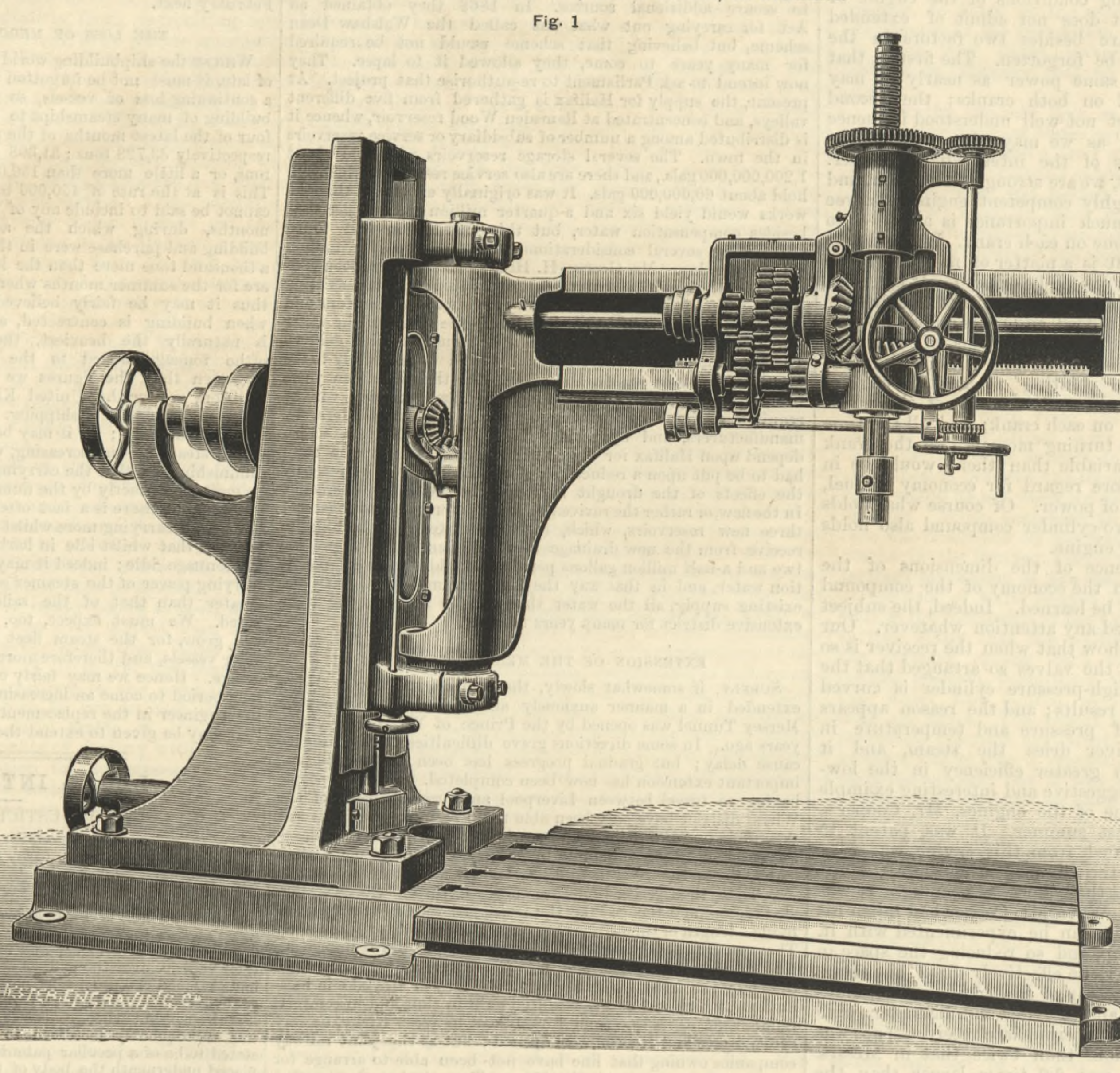
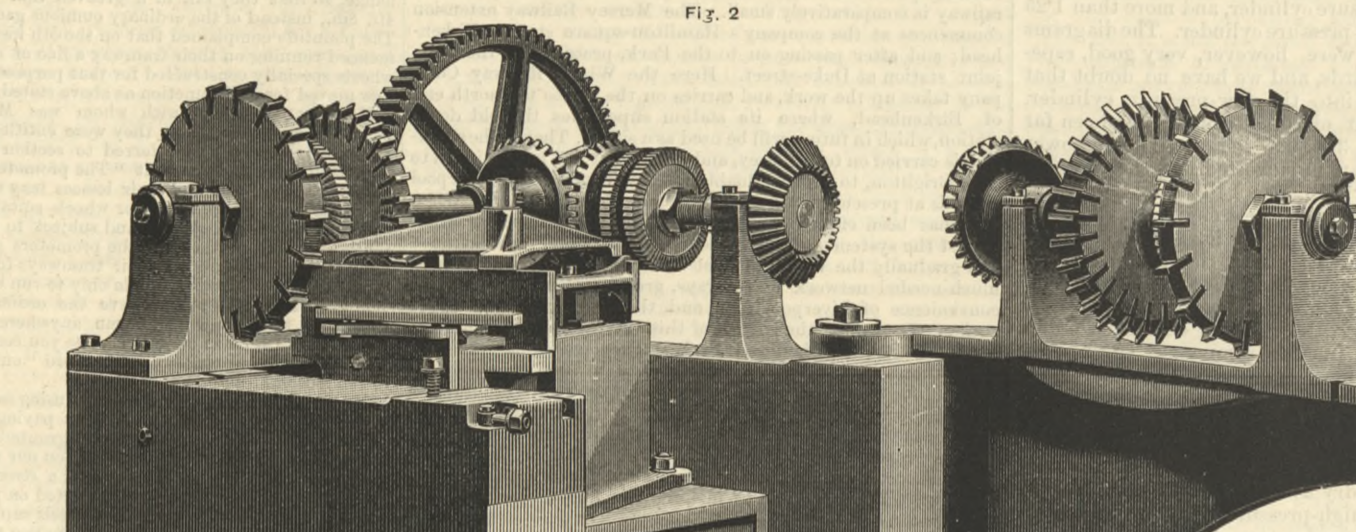


Fig. 2



VISITS IN THE PROVINCES.

HETHERINGTON AND CO.'S MACHINE TOOL WORKS.

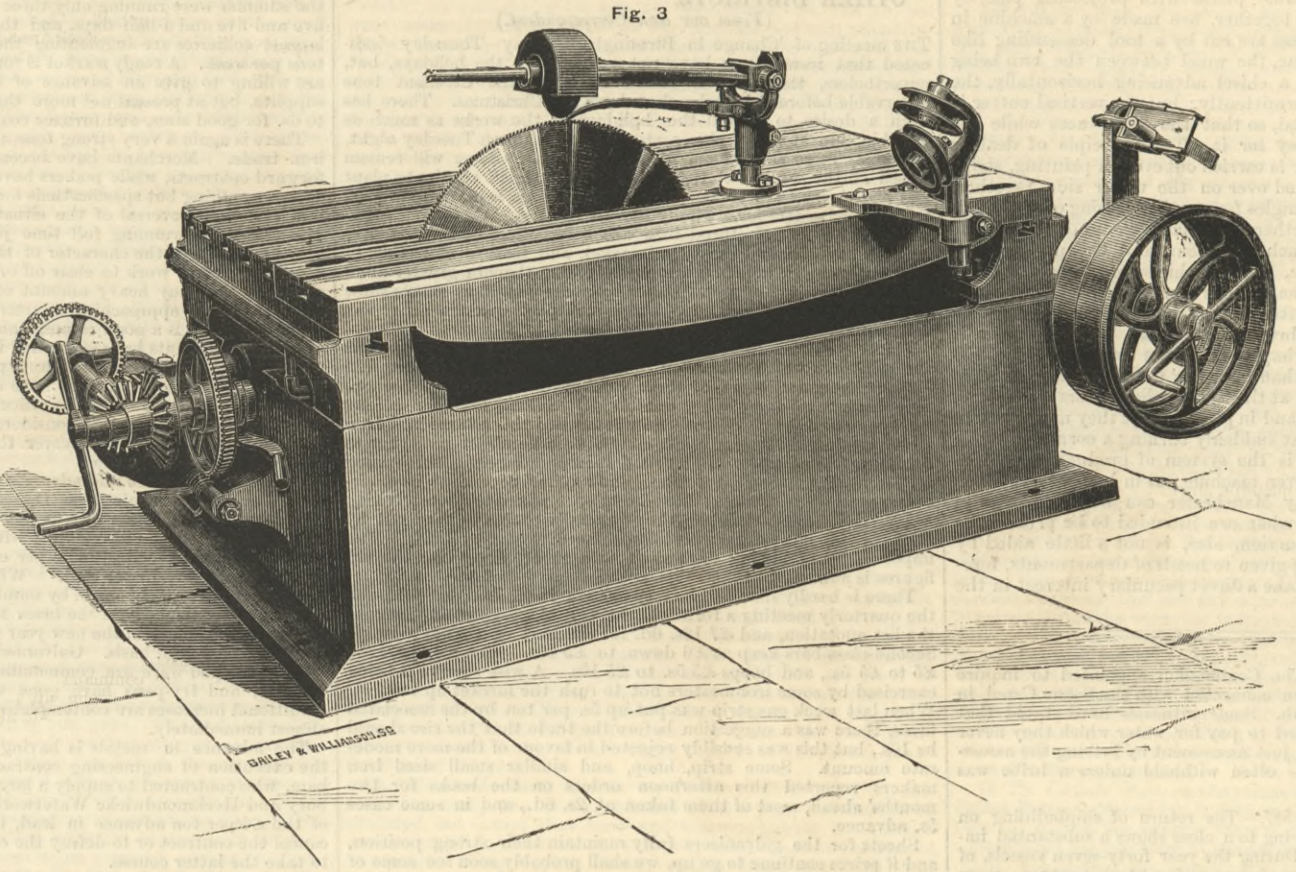
IN connection with the Manchester meeting of the British Association we visited Messrs. Hetherington and Sons' Vulcan Works for producing cotton machinery and recorded the results of our observations. A branch of these works for making tools so grew in importance that seven years ago it was found necessary to carry it on as a separate concern. Accordingly, an old cotton spinning and weaving mill in Pollard-street, the street in which the original works are situated, was converted into an engineering shop called the Ancoats Works, and carried on by a branch of the firm under the style of Hetherington and Co. A steam hammer was erected in the forge; but soon an injunction was obtained against it by an adjoining publican, on the ground that the vibration caused his beer to thicken and turn sour. Some Olivers, and a modification of the Ryder forging machine, which is made by the firm, are now all the assistance rendered by power to the smiths and hammermen. These works, which relieve the others when hard pressed for work, now employ about 200 men.

The speciality of the firm is overhead travelling cranes, some 30-ton examples of which they have supplied to the Horwich works of the Lancashire and Yorkshire Railway Company, while others are in use at their own works, the driver's seat being suspended so that he has a clear view of the shop. The larger sizes have built-up fish-bellied steel girders with steel ends running on the side rails; while the smaller have rolled steel joists trussed with cast iron ends. Indeed, steel enters largely into the composition of these cranes, the distinctive feature of which is that all three motions, viz., travelling, cross traversing, and hoisting, are given by belts on the driving head at one end. A special saddle is made for actuating the rising and falling bearings as the carriage passes them in its cross traverse.

The joists for the smaller cranes are sawn off to dead lengths in a machine, shown by Fig. 3, which is made currently at the works. The saws, obtained from Sheffield, are ground with a slightly hollow face, so that the edge is a little thicker than the rest of the plate; and this is all the clearance afforded, because the teeth are not set out, nor are they sharpened right and left, but straight across. The saw revolves in a trough of soapy water, the circumferential speed being 40ft. or 50ft. a minute,

JOIST SAWING MACHINE.

Fig. 3



The table, with T grooves for clamping down the work, is all in one casting, except that portion resembling the firebars of a locomotive, which is removable for taking out the saw. The saw carriage is made to travel longitudinally by a worm worked by mitre pinions off the pulley shaft, and a stop, adjustable according to the work, reverses the motion on the cut being completed. The saw then runs back at a quick speed until knocked off by a fixed stop at the back end of the machine. The teeth are sharpened by an emery-wheel attachment, the wheel being brought down by a hand lever, while the saw is rotated by hand, a pawl allowing one tooth to pass at a time. This saw will cut a steel joist 12in. by 6in. in ten minutes, the ends requiring no subsequent filing or other finishing.

A smaller and cheaper saw, capable of cutting a joist up to 9in. by 6in., has been brought out by the firm during the present year, and is finding much favour. The work is clamped down on the bed, while the saw, hung in a swing frame, is brought down upon it and fed by a hand lever, the saw being rotated by gear from the shaft, which serves as the pivot of the swing frame and carries the driving pulley. In this case the saw is kept cool and the edge lubricated by soapy water delivered by a small centrifugal pump, driven by a cord off the main gear. The stream of water is also sufficient to rotate the saw slowly, one tooth being released at a time by a pawl, when being sharpened by an emery wheel attachment, in which the wheel is brought down between the teeth by direct pressure overcoming the resistance of a spring which tends to hold it clear of the teeth.

The works are rather cramped for room, so that the brass-foundry is on an upper floor off the ironfoundry. The moulding sand is sifted in a sifter, hung loosely by four rods, and made to vibrate by a crank at the end of a suspended vertical shaft rotated by mitre gear and a belt-driven countershaft. Hay and straw bands for covering core tubes are twisted in a simple belt-driven machine—made by this firm—which has self-acting motions for winding and laying the ropes on the barrel, from which, when full, the coil is drawn off. As there is no room for putting down new machines, the firm sometimes finds it necessary to enlarge those already erected. It is thus that the bed of a long planing machine has been extended by bolting on to it an additional length of rack; and another planing machine has been widened by bringing the standards further apart and piercing the cross-beam.

The best and most useful boring machine in the shop has a large bed, but slightly raised above the floor level, and cast with T-grooves crossing one another so as to form squares like a chess-board; and to this bed are bolted the standards of the machine whenever they may be required for the work in hand, as well as the work itself. In some of the radial drilling machines the arm swings completely round the standard, and in others the table is made to swing, giving a wide range. In the larger sizes of radial drilling machines the gear is removed from the back to near the tool-holder, as shown by Fig. 2, as it was found that the transmission of increased power at correspondingly slow speed involved too great torsion of the shafts and strain on the mitre gear. Accordingly the fast speed is retained until close upon the tool, when the parts for reducing it, with corresponding increase in power, are made very strong. The engraving represents a double-geared machine with a 7ft. arm, radiating in a complete semicircle, and admitting 5ft. 6in. under the spindle. The arm has a vertical traverse of 2ft. by power, and a steel screw gives a variable self-acting feed of 15in., a special arrangement of nuts taking up all drop.

Fig. 3 shows a special milling machine, made for the Crewe works of the London and North-Western Railway Company, for finishing at one operation eight different faces on the quadrants —shown in the figure—used in working the signals. The quadrants are placed in the chuck on the rising and falling table, which is provided with self-acting feed motion, when a special grip chuck plate is placed on the quadrant and locked by a cam nut. The side or swinging front is then swung round, closed and locked up, bringing the mitre pinions into gear. The casting is fed through the cutters by the self-acting feed motion, and thus all the quadrants are made interchangeable.

MESSRS. THOS. ROBINSON AND SON, ROCHDALE, AND MESSRS. PLATT, BROS., AND CO., OLDHAM.

THE following is from notes taken during visits to the works mentioned, during the recent meeting of the Iron and Steel Institute at Manchester:—

On the second day of the meeting, after luncheon at the Owens College, by invitation of the Reception Committee, the members divided into two groups, one party proceeding to visit the works of Messrs. Beyer, Peacock, and Co., and those of Messrs. Daniel Adamson and Co. To the former of these we have already devoted an article about a year ago, and therefore may merely remark here that there are at present in the shops some locomotives for a mountain line in South America, $2\frac{1}{2}$ miles long, and with a gradient of 1 in $12\frac{1}{2}$, to be worked by a rack rail. They have four outside inclined cylinders using steam at boiler pressure, two of them occupying the usual position and the other two superposed.

The larger body of members proceeded by special train, placed at their disposal by the Lancashire and Yorkshire Company, to Rochdale, where they were entertained at luncheon by Messrs. Thomas Robinson and Son. They then made an inspection of the works, which, in addition to the speciality of the company—wood-working machinery—of which it is the largest manufacturer, now turn out a considerable number of roller mills for making flour on the Hungarian system. As we have already described these works in detail, we will now only glance at one or two points of interest which we noticed during the very hurried run through the shops. In the machine shop is the first hollow lathe made by Craven Brothers, for turning the throws of cranks. The chilled steel rolls for roller mills are finished by emery grinders, two of which travel backwards and forwards horizontally, at the same time revolving rapidly, while the roll revolves slowly on its horizontal axis. The rolls for breaking down the corn are fluted, with a slow spiral of different degrees of fineness, in a special fluting machine generally resembling a planing machine, the roll making the desired amount of turns on its horizontal axis, through the action of a worm and wheel. The gear communicating the motion was, however, carefully boxed in, and on being requested to remove it, the foreman said, "Not upon any consideration." The "creepers" or Archimedean screws for feeding the wheat up to the rolls, &c., in the different milling operations, are made very economically. First, a square piece of sheet iron is centred and placed between the centres of a disc-shearing machine, which cuts it round. A hole is punched in the blank by a hand press; and then a small sector is cut out of the annular-shaped disc, and four small holes adjacent to it are punched at one operation under a power press. The attendant then just opens the now separated ends of the annular disc by hand, giving it roughly the helical form, which is completed and perfected between dies in a power press. The end of one helical element is then united to that of another by rivetting to them a plate terminating in a pin, which is inserted in a hollow shaft, thus completing the "creeper" to any length desired. Much interest was also caused by a packing-case making machine, got out by the company. A kind of crown wheel is fed with wire nails, six of which are allowed to fall down spouts on opening a slide, so as to take their places for being driven through a side and into an end of the packing-case placed under them in the proper position. Depressing a treadle then brings six punches down on the nails, which are guided so as to enter the wood straight. In this way one corner of the box is nailed up, the rest being done successively in the same manner.

Leaving Messrs. Robinson's, the special train took the visitors on to Oldham, where they had just about an hour and a-half clear for a rush through the Hartford Ironworks of Messrs. Platt Brothers and Co., which are among the largest, if not absolutely the largest, of their kind in the world, covering twenty acres of ground, and employing at least 5000 hands. A visit to such a gigantic establishment under these circumstances is little better than a farce. While the body is tired by the rapid march and getting up and down stairs, the mind is bewildered with the vistas of frames, piles of pulleys, cams, &c., and maze of belting, without the opportunity of fixing any detail, much less studying the why and the wherefore. Besides the five or six thousand men employed at the Hartford works, which turn out machines for spinning and weaving wool and cotton, there are about three thousand at the old works near the Werneth station, where machines for opening and preparing the cotton are principally made. The forge, where finished iron is made, though not nearly the whole 160 tons which are consumed every week, and the collieries, employ at least another thousand; and then there are works where bricks are made from semi-dry clay by patent pressing machinery, so that the company employs altogether from ten to twelve thousand men. According to the official notes furnished to members of the British Association, these works produce preparing, spinning, and doubling —or twisting—machinery for cotton, wool, worsted and silk, as well as weaving machinery for the same fabrics, with the addition of linen and jute. They are also largely engaged in the construction of combing, roving, spinning, and weaving machinery for the special manufacture of soft worsted fabrics on the French system. It may be added that a great many machines are exported, chiefly to Japan, for dealing with flax and silk.

Notwithstanding the large area of ground covered by the works, the shops are several storeys high, communication being afforded by lifts as well as by staircases. Double swing doors give access from one shop to another, the halves rising on circular inclined planes, so as to fall to of themselves. Each shop is driven by a separate engine. In the foundry, where, on account of the vast amount of repetition, plate and machine moulding are largely resorted to, beams extending the whole breadth of the shop are raised and lowered by hydraulic power for carrying castings and foundry boxes, which run along them on rollers after the manner of overhead tramways. In the forge are several drop hammers for stamping small parts; and keys or spanners are pressed out of the hot plate. The cast iron frames of machines have their ends, where fitted to other frames, faced to dead lengths, often several together, by milling machines, the cutters of which have teeth both on their sides and periphery, so as to make cuts at right angles to one another at the same setting. This principle of machining as many parts simultaneously, and on as many faces as possible, is carried out to the fullest extent; and a great deal of self-acting machinery is used which "knocks off," or throws the tool out of gear automatically, as soon as the desired cut is completed. The teeth of spur wheels are cleaned out by a fast-running emery wheel, the spur wheel rising and falling automatically on each space between the teeth coming successively in front of the emery wheel.

The draw rollers for slubbing, intermediate, and roving frames, which extend the whole breadth of a shop, are often 60ft. long, but are made in lengths of about 18in., and fitted together. The round bars are first milled to dead lengths, several together; and then a square is cut at one end and corresponding socket at the other, for fitting the lengths together. Two sides of the square are cut together by a slotting machine with two tools set the required distance apart. For the socket, round holes are drilled in the other end, and are afterwards made square in a special machine. Several lengths—eight or ten, perhaps—are mounted together on a horizontal wheel, revolving intermittently, having above it, and opposite to the centres of the lengths, a series of square punches gradually increasing in size up to that desired. The wheel is supplied by hand with a length, which, by the first descending punch, has four grooves cut in the round hole, just beginning the square. By a partial turn of the wheel the length is passed on to the next punch, which deepens the grooves, and so on, until the hole assumes a completely square section. But, in the meantime, other lengths have been fed into the revolving wheel until all the punches are acting simultaneously; and, as each hole is perfected by the last punch, the length is removed and a fresh one substituted. The lengths are then turned and afterwards grooved or fluted in another special machine like those for planing, six rows of four lengths each being placed together on the travelling table. A spindle at the end of each row carries a ratchet-wheel, with pawl, for causing the partial rotation after each cut, one spindle projecting beyond the other in length, so as to economise room in breadth. The cutting tools are like those of a planing machine, but wide and narrow, on account of the fineness of the grooves. In the latest machines, the cutting nose is formed at the front of one tool, and at the back of the next, and so on alternately, with the object of distributing the strain due to the six cuts over a larger area, and therefore make better work than if all the cutting were done along one transverse line.

In the extensive timber department there is a horizontal reciprocating saw, with teeth set so as to cut at both the forward and the backward stroke, worked direct from the engine combined with it, for ripping up logs; and similar work is performed by a pair of thick circular saws with coarse teeth, set vertically one above the other, and which revolve only just clear of each other. One sawing frame had as many as forty saws set in it, for cutting very thin stuff. The timber is, of course, sawn up as it comes in. The planks and boards are then stacked, lying flat one over another, but with battens between them to admit the air, in sheds which are heated in winter by exhaust steam. The weight of the superincumbent mass effectually prevents any tendency to warp, except in the uppermost, which, however, are generally the thickest planks. For making the tenons and mortises of the carriages of slubbing, intermediate, and roving frames, there is an ingenious machine with two small horizontally revolving circular saws, which are made to rise and fall, travel longitudinally, and traverse transversely as required. The recesses to receive brass plates with projecting pins, by which the parts are fitted together, are made by a machine in which the sides of the recess are cut by a tool descending like that of a mortising machine, the wood between the two being removed at one stroke by a chisel advancing horizontally, the board travelling along intermittently; but the vertical cutter is in advance of the horizontal, so that the latter acts while the former is preparing the way for it. The principle of dealing with several parts together is carried out even in painting, strips being laid alongside, brushed over on the upper side together, and then turned at right angles for another passing of the brush over all those surfaces together. The manufacture of the various machines is reduced to such a system, and the parts are so accurately fitted to gauge, that machines are rarely erected before being sent off. The various parts are packed in cases, being secured by blocks, after having been immersed in pure melted tallow if small, or brushed over with that substance if large. No better idea, perhaps, could have been afforded of the magnitude of these works than by seeing the army of men leave their work, which they did at the time of the visitors' departure, who were warned not to stand in places where they might be run down by the human torrent suddenly turning a corner.

So perfectly economical is the system of production, and so large the number of any given machine put in hand at one time, as to make it evident why Manchester can hold her own in cotton machinery against what are intended to be prohibitive tariffs. Economy in production, also, is not a little aided by every encouragement being given to heads of departments, foremen, and leading hands to take a direct pecuniary interest in the business.

Irrigation in India.—The Commission appointed to inquire into the system of irrigation connected with the Soane Canal, in Behar, is now sitting at Arrah. Some witnesses have stated that the cultivators were compelled to pay for water which they never used, that others escaped a just assessment by bribing the assessing officers, that water was often withheld unless a bribe was forthcoming.

Wear Shipbuilding in 1887.—The return of shipbuilding on the Wear for the year drawing to a close shows a substantial improvement over last year. During the year forty-seven vessels, of 85,214 tons, besides an iron barge and a steel pontoon, were launched, these figures showing an increase of eight vessels and 28,744 tons over 1886. The return for this year is also above that of 1885, but it also falls short of 1884 to the extent of some 14,000 tons, while it is not half the tonnage of the years 1882 and 1883, these latter having been the most prosperous years in the history of Wear shipbuilding. Of the vessels launched this year, thirty-one were of steel, fifteen of iron, and one of iron and steel. The tendency to replace iron by steel, in the same way as iron supplanted wood, therefore continues. Of the firms who did work this year, Messrs. Doxford launched the largest vessel yet built on the Wear, besides a torpedo boat and a cruiser; Mr. James Laing launched a large steamer for the Beaver Line Company: Messrs. Boolds and Sharer launched another large steamer for a Spanish firm; and Messrs. J. E. Thompson and Sons launched vessels for Spain, Australia, and other places. The following are the builders' returns for the year:—

	Vessels.	H.P.	Tons.
J. L. Thompson and Sons	11	2,440	21,823
James Laing	8	11,660	17,809
Short Brothers	6	920	10,160
Boolds, Sharer, and Co.	1	450	4,030
W. Doxford and Sons	6	1,823	13,163
Bartram, Haswell, and Co.	1	300	2,745
S. P. Austin and Son	1	130	1,663
J. Blumer and Co.	2	270	2,863
Osbourne, Graham, and Co.	1	120	1,150
W. Pickersgill and Co.	2	—	2,733
Sunderland Shipbuilding Company	7	665	5,245
Strand Slipway Company	1	150	1,830
	47	18,928	85,214

A Remarkable Achievement in Railway Construction.—The work which Messrs. Sheppard and Winston have done for the St. Paul, Minneapolis, and Manitoba road this year stands immeasurably, both in its entirety and in the magnitude of the records for individual day's works, ahead of any former railroad building that the world has seen. It is almost improbable, too, that the favourable conditions will ever again unite to enable the record of this summer to be broken. The entire length of the line from Minot to Great Falls is 549·75 miles—roughly, 550 miles. Of this, five miles had been laid last year, and it was at Coulee, five miles west of Minot, that construction commenced on April 2nd last. It was then asserted that Great Falls would be reached before the end of October, but the prophecy was only half believed. The feat, however, has been accomplished with about two weeks to spare. The following figures show how the work has progressed from month to month, being the distance of the end of construction from Minot on each of the dates named:—April 2nd, 5 miles; April 30th, 35·1 miles; May 31st, 111·1 miles; June 30th, 191·7 miles; July 31, 292·3 miles; August 31st, 407·5 miles; September 30th, 509·3 miles. In the four summer months, therefore, 400 miles of track were laid all but 1·3 miles. The largest month's record was that of August, when the interruption from rain was very slight, and when 115·2 miles were laid between the 1st and 31st. From April 2nd to May 3rd track-laying was at a standstill, owing to the graders having been caught up. Short delays from the same cause again occurred on May 10th and June 5th. After the last-named halt, the graders succeeded in keeping out of the way of their pursuers. The largest record of any week of seven days was from August 6th to 13th inclusive, where 32·5 miles were laid, or an average of 4·6 miles a day. The largest individual day's work was that gigantic record of August 11th, when 42,300ft. were laid between daybreak and dark, the end of the track being 325·6 miles from Minot in the morning, and 333·8 miles from Minot at night. It is claimed that even that record would have been exceeded and the round nine miles would have been reached if an accident had not happened to one of the iron cars. The second greatest day's record was on June 16th, when 38,000ft. were laid, from 241·7 miles west Minot to 248·9. Both of those records are far ahead of the Canadian Pacific's biggest day's work, which—6½ miles—has hitherto stood as the accepted marvel of fast track-laying. The average force employed was about 6600 men and 3000 teams, with ten iron cars. The difficulty of keeping such an army in provisions at a point so far from the base of supplies has, of course, been enormous, and most of the time the contractors have had three steamboats at work on the Missouri river carrying supplies up to various points ahead of the advancing forces, where supply depôts were established before their arrival. The stories which were circulated early in the year to the effect that work would go on night and day were so far from true that the track-layers have only worked one ten-hour shift each day through the summer. The graders, on striking difficult places, had sometimes to work harder, relieving each other in short four and six-hour shifts, so as to keep a full force at work throughout the twenty-four hours. The necessity for this, however, has only occurred at rare intervals. For the most part the grade is very easy, a stretch of 400 miles through the Missouri and Milk river valley having a maximum grade of 20ft. At one point, where the Teton river comes within 1200ft. of the Missouri, a short stretch of temporary track has been put down. For the rest of the distance the road is a permanent and splendid piece of railroad building.—*North-western Railroader.*

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

(*From our own Correspondent.*)

The meeting of 'Change in Birmingham to-day—Thursday—indicated that ironmasters have not yet finished the holidays, but, nevertheless, there was a continuation of the excellent tone observable before the works shut down for Christmas. There has been a desire to curtail the holidays at the works as much as possible, and at a few places steam was got up on Tuesday night, and many more started on Wednesday night. Some will remain closed all the week, but these are cases in which repairs to plant and machinery have to be carried out. There is no necessity on the score of orders for a wholly idle week.

Orders for manufactured iron are being offered in abundance. Makers have control over the market, and instead of having to seek for business, inquiries are now reaching them in greater numbers than they will accept. Other branches as well as sheets show this improvement; bar, hoop, strip, and plate makers all report more doing.

Prices are rising in proportion to the demand: 5s. advance was the minimum which unmarked iron makers would to-day accept in Birmingham, and some of them quoted 10s. advance. A more independent spirit is being exhibited by sellers than for a long time past, and plenty of business was refused this afternoon. Iron merchants are undecided what course to take about notifying to consumers an advance. If marked bars showed an equally-rising tendency at the moment to sheets and other unmarked iron, circulars would—merchants state—be at once issued by them advising a 10s. rise. Such circulars they generally prefer to have out by January 1st, but on this occasion some delay seems likely. The impossibility of buying unmarked iron at anything like the old figures is admitted by all.

There is hardly likely to be any change in marked bar prices at the quarterly meeting a fortnight hence. At present £7 remains the list quotation, and £7 12s. 6d. for the Earl of Dudley's make. Second-class bars keep at £6 down to £5 10s. Common bars are £5 to £5 5s., and hoops £5 5s. to £5 10s. A wise reserve is being exercised by some ironmasters not to rush the mrrket up too fast. When last week gas strip was put up 5s. per ton by the associated firms, there was a suggestion before the trade that the rise should be 10s., but this was sensibly rejected in favour of the more moderate amount. Some strip, hoop, and similar small sized iron makers reported this afternoon orders on the books for two months' ahead, most of them taken at 2s. 6d., and in some cases 5s. advance.

Sheets for the galvanisers fully maintain their strong position, and if prices continue to go up, we shall probably soon see some of the works which are now idle again on. A few firms are quoting £6 15s. for forward delivery of 24 gauge, though others are content to remain at £6 10s. It is striking testimony to the excellence of the quality of Staffordshire-made sheets that American galvanisers, who have of late visited this district, left behind orders for Staffordshire iron to be shipped to Philadelphia, declaring that they could not get any such sheets in their own country. No less surprised, too, were they at the splendid surface given to Staffordshire galvanised sheets. In this department also the Americans admitted that they were completely beaten by local producers. The Americans desired to put much of the blame upon the quality of the spelter with which they have to deal; but it is somewhat difficult to see why they should not get equally good supplies with ourselves if they would only pay the price.

Galvanised corrugated sheets were very strong in price this—Thursday—afternoon, makers stating that they had information from reliable sellers that the price of spelter will go up to £30 per ton. Consequently, they were very cautious how they acted. Good brands of 24 gauge were quoted £14 in cases delivered in the Thames for the Australian markets; and 26 gauge, £15 10s. Not only in the Australias, but the Cape and South America are both buying well, and makers have abundant works upon the books.

Circulars have been issued by certain of the best thin sheet makers for stamping and working-up purposes, formally withdrawing all quotations and announcing that new business must be subject to prices quoted against specification. Read between the lines, these circulars certainly mean the rise of 10s. to 20s. per ton which I intimated last week. In other branches of the manufactured iron trade, too, new business is now a matter of arrangement between buyer and seller on the day of receipt of inquiry, and in numerous cases sellers decline to keep open their offers unless accepted by return of post.

A report is current that the extensive Bromford Ironworks, Oldbury, late the property of Messrs. J. Dawes and Sons, will be restarted by a new proprietary early in the new year. Further particulars are awaited with interest. It was stated some little while ago that the works had been purchased by a local capitalist, who intended to utilise them for sheet manufacture.

Steel prices are advancing, yet in some quarters there is considerable competition for the orders for steel now appearing upon the market, and there is a jealousy amongst sellers as to the exact prices at which they are doing business. New firms, anxious to obtain custom, are willing to accept prices which buyers certainly consider favourable but until the product of such firms has been proved reliable, there is great disinclination by consumers, who have once found a source of supply where quality can be relied upon, to enter into any new associations.

Questioning is still going on among some of the consumers of steel as to the quality of certain of the metal which they are now receiving in the shape of boiler plates. I am told that some of the material proves upon being worked to be very faulty, and by no means wholly trustworthy. It is not surprising that buyers who are getting material of this sort should express their conviction that the days of iron will again assert themselves.

Steel-plating bars of Welsh and Shropshire manufacture, which up to a while ago might have been had at a minimum of £4 15s., are now a minimum of £5 to £5 2s. 6d., and considerable quantities of this material are being bought by the cultivating and edge-tool makers. They state, however, that much of the steel of this sort now being offered will not harden, and that its more correct designation would be iron rather than steel. Plating bars of Sheffield make are £6 per ton upwards. Makers will supply such steel with any point of carbon which consumers desire, a circumstance which is a very great advantage, and which commands a market for the material where other steels are inadmissible. The price of iron plating now used for the welding on to them of cast steel is £5 10s., but the demand is not large.

Owing to the interference of the holidays there has not been a great deal of business done this week in pigs, but the market continues very strong, and is wholly in the hands of sellers. Available supplies are short, particularly of imported irons, and consumers have constantly to telegraph to obtain deliveries. Vendors remain very indifferent about booking further contracts, and it is only as a favour that buyers can get orders for some brands accepted. There is much more eagerness on the part of consumers than of holders to do business. Some agents for imported brands made some very big sales during the month now closing, and principals prohibit further transactions. Numerous brands were this—Thursday—afternoon as they have been for two or three weeks past, still off the market, and there was some excitement among buyers. January is anticipated with a certainty of higher rates. Lincolns are quoted 41s. 6d to 42s. 6d., delivered to consumers here, with only small supplies, and good Northampton and Derbyshie pigs quoted 40s. to 41s. Local makers are meeting with a big demand at stronger prices for all descriptions. Second and third-class sorts, however, chiefly benefit. Best part-mines are 40s. to 41s. 6d., and cinder-pigs 32s. 6d. to 33s. 9d. nominal. Messrs. Alfred Hickman and Sons, of the Springvale blast furnaces—the largest pig-makers in Staffordshire—are making something like 1600 or 1700 tons a-week.

Hematites keep very strong, and prices are up 4s. per ton compared with a month or so ago. Forge sorts from the West coast are 55s. to 56s. delivered here.

The better tone noticeable in coal is upheld. Collieries which in the summer were running only three days a week are now running five and five and a-half days, and the management at some of the largest collieries are augmenting their production by 2000 to 3000 tons per week. A ready market is found for the fuel. Ironmasters are willing to give an advance of 3d. to 6d. per ton for prompt suppiies, but at present not more than this. Forge coal is 5s. 6d. to 6s. for good sizes, and furnace coal 7s. to 8s.

There is again a very strong tone about the North Staffordshire iron trade. Merchants have become absolutely eager to place forward contracts, while makers have developed a disinclination to accept anything but specifications for immediate execution. This is a complete reversal of the situation as it was until recently. The works were running full time just before Christmas, but, as may be gathered, the character of the improvement in itself prevents any active work to clear off orders. It is altogether not at all likely that any heavy amount of business will be nogotiated until after the approaching quarterly meetings have been held. However, there is a good colonial and country demand, and such orders as merchants have succeeded in placing are of very satisfactory extent. In some cases iron prices are a little increased; and they are firmer than they have been of late. Bars are quoted £5 to £7; plates, £5 to £5 15s.; sheets (24-gauge), £6 10s.; angles, £5 5s. to £6. Pig iron is in considerably improved request, and by some sellers is quoted 1s. dearer than recently. Ironstone, too, occupies a stronger position.

Hardware prices are still advancing. The following circular has been issued:—"Birmingham, December 22nd.—At a meeting of brassfounders, held this day, it was resolved that a reduction of 5 per cent. be declared, making, with the previous reduction, 7½ per cent.; and an increase of 5 per cent. on the net, making with previous increase, 15 per cent." With the opening of next week announcements will be made by numbers of other hardware manufacturers—particularly in the brass trades—of specific advances in prices, and business in the new year will certainly have to be done upon this advanced basis. Galvanised iron-plate goods and bright tinned stamped ware are commanding from 7½ to 10 per cent. on the net, and fry-pans have gone up 15 per cent. on the net. Additional increases are contemplated in all three of these branches almost immediately.

The advance in metals is having remarkable influences upon the execution of engineering contracts. Mr. Small, of Birmingham, who contracted to supply a large iron aqueduct for the Dewsbury and Heckmondwicke Waterworks Board, had, in consequence of the £4 per ton advance in lead, to request the Board either to cancel the contract or to defray the extra cost. The Board agreed to take the latter course.

Mr. T. E. Walker has been appointed chairman of the Patent Shaft and Axletree Company, in place of Mr. Thomas Walker—deceased—and Mr. Richard Williams deputy-chairman.

A special meeting of the members of the South Staffordshire and Worcestershire Institute of Mining and Mechanical Engineers was held last week at Mason College, Birmingham, to consider the advisability of removing the home of the Institute from Dudley to the College. Mr. C. H. Treglown presided over a large attendance. After a long discussion the following resolution was unanimously passed:—"That the proposal of the Council of the Mason College to find the South Staffordshire and Worcestershire Institute of Mining and Mechanical Engineers a room in which to hold their ordinary, annual, and Council meetings, with accommodation for their properties, books, &c., under the draft agreement, be accepted."

The Midland Counties Miners' Federation, which held a half-yearly conference at Walsall on Monday, was described by its president as having been solidified during the year, and as having attained some force and influence. The president suggested various improvements in the Mines Regulation Bill. He would compel the owners to provide legs and catches where the men got on and off the cage; the miners objected to the lives of men being endangered by an engine-winder being kept on duty twenty-four hours at a time; and they wanted to put a stop to that great source of the degradation of the miner—the payment of wages at a public-house. Mr. Edwards proceeded to insist upon the necessity for combination and organisation. The consideration of the resolutions of the National Conference was referred to the Council.

At a special meeting of the South Staffordshire Mines Drainage Commissioners, on Friday, Mr. E. L. Beckwith was re-elected a commissioner and Mr. Henry Smith—who has resigned his position as secretary—was appointed honorary secretary.

Important progress has been made with the Compressed-Air Power Works during the present week. The works on the site being nearly complete, and a large quantity of material for the main laying provided, the money deposit required by the Corporation was on Thursday paid over to the borough treasurer by Mr. Bennett, the secretary, and on Friday morning the official order to commence laying mains was received from the borough surveyor. Within a couple of hours of receipt of the order the men were at work on the first section of the main in Artillery-street and Wolseley-street. The engine work is also rapidly progressing, Messrs. Fowler and Co.'s men have been for some days engaged upon the erection of the first of the 1000-horse power air-compressing engines. Prior to being sent off from Leeds, this engine was tested under steam at Messrs. Fowler's works by Mr. Sturgeon, the engineer of the company, Professor Henry Robinson, the consulting engineer, and Mr. Wilson, of Belfast, who made the detailed designs of the engines. The trial was in every respect satisfactory, and some idea of the perfection of the work and the equal balance of all the moving parts may be formed from the fact that the engines were run nearly up to full speed, and worked with great steadiness, although only resting on the timber haulks on which they were erected, without any bolting down.

An air-compressing engine of about 200-horse power has been already erected, and is in readiness to supply the first customers of the company as soon as the mains come within reach of them. The gas producers for working the boilers, and most of the boilers, are fixed and ready for working. The secretary, Mr. A. S. Bennett, solicitor, Waterloo-street, has received many applications for the new power from intending customers, and the total amount now applied for considerably exceeds 4000-horse power.

The Wolverhampton Corporation were summoned on Friday by Isaiah Lindope, engineer, New-street, Shiffnal, for not having sufficient attendance on a steam roller propelled within the borough. The summons was taken out under the Locomotive Act, 1865, which laid down that a steam locomotive roller should be in charge of at least three men. The Town Clerk appeared for the Corporation. Evidence showed that the steam roller, in charge of only two men, was at work in a road temporarily closed to traffic. The Town Clerk urged that as the Corporation had power to close the road, all persons found there were trespassers. The road would not, therefore, come under the operation of the Locomotive Act. The Stipendiary said there was no precedent which would assist him in giving a decision. His own opinion, however, was that, while the roller was at work on roads closed to the public, the Locomotive Act did not apply, but it no doubt did apply to a roller going over the high road between the depôt and the place of work. The summons was dismissed, and notice of appeal was given.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The year is closing very much as it opened, with advancing prices and a generally hopeful tone as regards the outlook for the future. Between the opening and the close, however, the greater portion of the past year has been characterised by unsatisfactory, and for the most part unremunerative, trade in nearly all branches directly connected with the engineering and the iron and coal industries; and again, as in several preceding years, the industrial operations of the past twelve months will leave behind them only very discouraging results. The special features during the year now closing, and for which it will perhaps be the most remembered, have, however, been the numerous holiday and other celebrations of one sort or another which during the summer and autumn were an almost constant source of diversion from ordinary business occupations. They commenced with the opening of the Manchester Exhibition and the Royal visit, then followed the Queen's Jubilee, the Manchester and Liverpool Agricultural Society's Show, the meetings of the British Association, the Iron and Steel Institute, and of numerous other less important associations, together with the usual extended holidays of Easter and Whitsuntide, which with the attractions of the Exhibition have formed a combination of influences which for the time being caused quite a dislocation of the usual routine of business operations.

In the engineering branches of industry operations have during the past year for the most part been carried on under generally unsatisfactory conditions to the employers. There has been a very fair amount of work doing, but only in quite exceptional cases, and, as a rule, only on what may be termed special work has there been sufficient to give full employment, and the result has been a constant keenness of competition to secure any orders coming upon the market that has kept prices down at an excessively low point, which, to a very large extent, has left little or no appreciable margin over the actual cost of production. Some indications of improvement during the earlier portion of the year seemed to hold out a prospect of better trade, which, however, was not realised. At low prices there was a very fair weight of orders in the market, and most of the works got tolerably busy; stationary engine builders, machine toolmakers, and boilermakers, were generally well supplied with orders, whilst machinists were also for the most part tolerably well engaged, the only important branch of industry which did not seem to partake in the increased activity being locomotive building, which has all through the year been in a very depressed condition. This improvement was reflected in a steadily decreasing number of members on the books of the trades union societies in receipt of out-of-work support, and a very restless feeling sprang up amongst the men with regard to wages, and there was a general strong desire to go in for a return of the reduction which was taken off at the commencement of last year. This culminated in the Bolton strike, a disastrous and fruitless struggle, extending over upwards of six months, which, so far as the engineering trades of Lancashire are concerned, will be the most memorable incident of the year. This struggle entailed an outlay in trades union funds and voluntary subscriptions of something like £25,000 in supporting the men on strike; whilst in consequence of riots and a persistent course of intimidation pursued against the men engaged from outside districts, the Borough of Bolton was put to a special expenditure of £8000 in maintaining a force of military and extra police for the preservation of order in the town. In addition to this there was the cost to the employers of importing workmen and providing food and accommodation for them inside their works, and the loss to the industrial interests of the town, anything like an accurate estimate of which is, of course, impossible. The whole result obtained by the men after this costly struggle was to have their claim for advanced wages referred to arbitration, which from the first the employers were willing to concede. Another important incident during the year has been the decision of one of the oldest firms in the district—Messrs. Sharp, Stewart, and Co., the well-known locomotive builders—to remove to Glasgow, and the arrangements for which have now been practically completed. The commencement of actual operations for the construction of the Manchester Ship Canal, although not yet sufficiently developed to have any marked effect upon local industries, is nevertheless the starting point which must inevitably lead up to a considerable accession of work to this district that will spread over many branches of trade, and to the expenditure of a large amount of capital in this immediate neighbourhood that cannot fail to give a stimulus to local industrial activity, the want of which has long been severely felt. Altogether, the year closes with a more hopeful feeling, and although there is no present tangible improvement in trade locally sufficient to place the Lancashire engineering industry on a healthy or even satisfactory footing, in other important centres there is increasing activity, especially in shipbuilding, which, if continued, must extend its influence to other branches and lead to an increased amount of work being given out to boilermakers, engineers, and machine tool makers in this district.

In the pig iron trade the year opened with a strong upward tendency in prices, and general anticipations of improved trade. During January there was an advance of 2s. to 3s. per ton in local and district brands, quotations getting up to 40s. and 41s. for Lancashire, 39s. 6d. to 40s. 6d. for Lincolnshire pigs and foundry, and 43s. 6d. up to 45s., in some instances, for Derbyshire foundry iron, less $2\frac{1}{2}$, delivered equal to Manchester. There was, however, no appreciable improvement in the local iron using branches of industry to back up these advanced prices, which simply had the effect of checking further business, and before buyers could be again induced to enter the market for any weight of iron, prices had to recede to perhaps the lowest point that has been known in the market for many years past. About the end of the first half of the year, when Lincolnshire iron could be bought at about 36s. to 36s. 6d. for forge, and 37s. for foundry, and Derbyshire foundry at 39s. 6d. to 40s., with local brands quoted at 38s. 6d. and 39s., less $2\frac{1}{2}$, delivered equal to Manchester, there was considerable buying; and again in the commencement of November heavy buying set in, when prices had receded to as low as 35s. and 35s. 6d. to 36s. 6d. for forge and foundry Lincolnshire, which, backed up by a strong upward movement at Glasgow and Middlesbrough, enabled sellers of the low-priced district brands in this market to put up their prices about 2s. to 2s. 6d. per ton; and the year closes quotations very firm at 38s. 6d. to 39s. 6d., less $2\frac{1}{2}$, for Lancashire, and 37s. 6d. to 39s., less $2\frac{1}{2}$, for Lincolnshire forge and foundry, delivered equal to Manchester, and only a very limited weight of iron offering at these figures, makers being mostly so fully sold well into next year that they are indifferent for the present about further orders, and in many instances have practically withdrawn quotations from the market.

Makers of hematites also commenced the year in a fairly strong position; some large sales had been made on American accounts, and during January there was a steady advance in prices, until for mixed parcels they touched 60s. and 61s., less $2\frac{1}{2}$ per cent., delivered in the Manchester districts; but as there was nothing in the home trade to maintain these prices, the cessation of American inquiries which followed soon brought about a reaction. Right on to the end of the second quarter of the year there was a steady downward movement in prices until they touched about 50s., less $2\frac{1}{2}$, delivered, and special sales were made at even under this figure. The re-sale of speculative lots was probably one principal cause of the very low point to which prices were forced, and when these had been cleared off, the market took a steadier turn, makers' quotations getting to an average basis of 52s. and 53s., less $2\frac{1}{2}$, from which there was practically little or no variation until the close of the year, except that for quantities there were still sellers prepared to take about 50s. per ton. To give more strength to the market a restriction of the output was decided upon, and the blowing out of furnaces commenced in November, and a hardening of prices followed until makers' quotations got up to about 55s., less $2\frac{1}{2}$, delivered in the Manchester district; and although there is no large amount of buying going on at these figures, they are, with the close of the year, being very firmly held to.

In the manufactured iron trade makers commenced the year with a very fair amount of work in hand, but the advance in pig iron placed them in the difficult position that whilst there was plenty of opportunity of doing business at old rates, buyers were not disposed to pay advanced prices commensurate with the increased cost of the raw material, and the result was that except at prices which makers at the moment did not feel themselves justified in accepting, there was only a very limited trade to be done. The opening prices for the year were on the basis of £5 for bars, £5 5s. for hoops, and £6 15s. for sheets, delivered in the Manchester district; an advance of 5s. per ton was attempted, but makers were content if they could get 2s. 6d., and this was only maintainable on hoops and sheets for a short period. As the year advanced the demand for all descriptions of finished iron slackened off, and with forges getting short of work makers were compelled to seek after new orders at low prices, until they got down to £4 15s. and £4 17s. 6d. for bars, £5 and £5 2s. 6d. for hoops, and £6 5s. to £6 7s. 6d. for sheets delivered in the Manchester district, with only a slow business possible even at these figures. The shipping season brought a temporary recovery to the market, with a slight advance in prices, but when this was over there was a return to about old rates. Makers close the year in much the some position as they commenced, there is again a strong upward movement in raw material beyond any corresponding advance makers are able to get for their finished goods, and although there is plenty of disposition to buy for forward delivery, it is not at prices that are satisfactory to makers, who have not been able to put an advance of more than 2s. 6d. per ton upon the minimum prices they were taking before the upward movement commenced in pig iron.

In the coal trade, except that the protracted winter season at the commencement of the year gave for the time an extra stimulus to the demand for house fire coals, exceptional depression and excessively low prices have been the main feature nearly all through. The lower classes of round coal for iron making, steam, and general manufacturing purposes have been more or less a drug nearly the whole of the year; and 5s. to 5s. 3d. per ton may be said to represent the full average price that has been obtainable at the pit-mouth, and both on the railway contracts for locomotive fuel, and the usual gas coal contracts, the tendency of prices has been, if anything, to get under even the very low figures that were taken last year. For engine classes of fuel there has also been, if anything, less than an average demand, and prices have practically been stationary all through the year, at about 3s. 6d. and 3s. 9d. for good qualities of slack, 2s. 6d. to 3s. for common, and 4s. 6d. to 4s. 9d. for burgy at the pit mouth. The year closes with the house fire coal trade in almost the unprecedented condition of practically summer prices having had to be taken nearly all through the winter; where advances have taken place they have not exceeded 3d. to 6d. per ton, and for house fire coals prices generally are 6d. to 1s. per ton under those that were being got at the close of last year.

The Manchester iron market on Tuesday, which may be considered as really the closing market of the year, was fairly well attended, but except that here and there moderate transactions were reported in renewals of contracts, there was no business of any weight doing, buying of any weight being practically over until after the turn of the year. There was, however, a strong tone all through the market, and where prices were quoted they were at the full recent advance, there being, in fact, less disposition on the part of makers to sell than there was on the part of consumers and merchants to buy, and generally there seemed to be a very healthy outlook for trade during the ensuing year.

Tuesday's Manchester Coal Exchange was only thinly attended, and there was not much actual business done; the tone of the market was, however, if anything rather firmer, and there is the prospect that with the commencement of the new year there may be some slight advance in prices.

Barrow.—Although this has been a holiday week, a fair amount of business has been done in both the iron and steel trades, and as the demand is steadily maintained, both for prompt and forward deliveries, the year closes with a very good prospect for the continuance of the improved activity which set in some six weeks or two months ago. Pig iron is very firm in tone, and large parcels have been changing hands at 47s. per ton for mixed numbers of Bessemer pig iron, net at makers' works or f.o.b. No. 3 forge and foundry iron, which is used for general purposes, is still quoted at 46s. 3d. per ton. Makers are still well supplied with orders, and only a small proportion of their furnaces is out of blast. The probability is that with the new year some of the furnaces now out of blast will be relighted, as stocks, which are still heavy, are being reduced appreciably. In the steel trade the improved demand for ship plates is fully maintained, and local makers are putting into use some new rolling mills recently put down for the production of plates, angles, and other classes of shipbuilding metal. The value of plates is steady at £7 5s. per ton net f.o.b. Steel rails are in good demand at £4 2s. 6d. for heavy sections, and £4 7s. 6d. for lighter sections. There is a far larger output of steel at the present time than at any previous period in the history of the trade. The business doing in shipbuilding is on the increase, and some important transactions are pending. I am at length officially in a position to report that the work of reorganising the Barrow Shipbuilding Company has been practically completed. The first step in this direction has been the appointment of Mr. Bryce Douglas, for many years connected with Messrs. John Elder and Co., Fairfield Shipbuilding Works, Glasgow, as managing director of the corncern. Mr. Bryce-Douglas will be associated in the company with gentlemen of equal eminence in the shipbuilding and engineering world, and it is, I believe, contemplated to introduce other departments into the concern, so as to make the yard not only one capable of producing ships and steamers of all tonnages, but also other features intimately associated with the fitting and completion of war ships. It is fully expected that with the New Year a much better trade will spring up in these trades in Barrow, and in all probability before the spring sets in both the shipbuilding and engineering industries of the town will be briskly employed. The Whitehaven Shipbuilding Company has booked a new order for the construction of a sailing vessel of upwards of 2000 tons. She will be the largest sailing ship yet built in Cumberland. Finished iron quiet. Iron ore in good demand at from 9s. 6d. to 13s. 6d. per ton net at mines. The coal and coke trades are busier and a firmer tone is reported. Shipbuilding is better employed than is usual at this period of the year.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

ON the 24th, Christmas Eve, the work of the year practically ended in the Sheffield district. The holidays, which extend into January of 1888, are being utilised for stock-taking and for making repairs to machinery. In the lighter industries it has been possible, particularly in cutlery, to get the year's orders well through before the machinery stopped running. This desirable result was achieved mainly through the earlier receipt of the "fall" requirements from the United States and Canada, which came to hand quite a month earlier than in 1886. In this way the business has been done more comfortably, and though the goods needed have mainly been finished, there is abundance of work with which to begin the New Year. This remark applies with equal force to plated goods, edge tools, mining appliances, as well as the smaller articles such as spades, shovels, picks, &c. The German demand for high-class edge tools is briskly maintained, one large firm having recently received orders from German factors to a very large extent.

During the year which is closing the demand for tires, axles, springs, locomotive parts, &c., has been steady, and towards November important enough to affect prices. Buyers, however, have had the advantage of unprofitable prices until the last few weeks. Owing to the advances in hematite iron and the active demand makers are full, and quotations are now higher than at any time during the year. An event of the year is the completion of the huge hydraulic forging press at the Atlas Works, which is now engaged on heavy forgings for the Admiralty vessel Melpomene, including hollow shaftings 50ft. long. Mr. Purves patent ribbed flue, taken up by the Atlas Works, has developed into a formidable competitor with the corrugated, and become an important branch of manufacture. Nearly 500 of these furnaces have been already ordered under Board of Trade and Lloyd's survey, and the plant is being extended to enable fifty furnaces to be turned out per week. In armour the year has been quiet. Our Admiralty have only two armour-clads building at the yards, the Nile and Trafalgar, and two by contract—the Sanspareil, by the Thames Iron Company, London, and the Renown, by Sir W. G. Armstrong, Mitchell, and Co., Newcastle. Russia has been our only foreign customer, and it is expected that a goodly share of the work for the new fleet Spain intends to build will come to Sheffield. The battle of projectiles *versus* plates has raged fiercely during the twelve months. Makers of steel-faced plates are satisfied, as far as tests and experiments have gone, that their plates present the greatest resistance to penetration by the excellent projectiles now made. Steel shells have of late been ordered in large quantities from Sheffield firms by our own Government.

Denaby Main Colliery was the scene of a most disastrous fire on Christmas morning, by which 1500 men and boys have been deprived of employment probably for two months. The hydraulic engine shed, in some way as yet unexplained, caught fire. The flames immediately extended to the "gantrey," or wooden staircase, by which the miners ascend to the pit bank to go down the shaft, and then spread to the woodwork surrounding the pit mouth. There were in the workings at the time eleven men and 120 ponies. The men were carpenters, sent down to make repairs during the Christmas holidays. Three fire engines from Doncaster, Mexborough, and Rotherham were promptly on the spot; but the flames were not subdued before the whole of the valuable machinery in the engine-house had been destroyed, with the result, of course, of cutting off communication with the bottom of the shaft. It was necessary, therefore, to devise some means of working the cages up and down the shaft, all the engines working them having been destroyed. A new departure in pit management was successfully tried. The rope was attached to the colliery locomotive, and by running it along the line the cage was drawn up and the men liberated, little the worse for their prolonged detention—some ten hours. The ponies had to be left below. The cause of the fire cannot be exactly stated. It is supposed to have originated through the friction of the wire rope on the iron drum. The damage is estimated at from £20,000 to £30,000, which is covered by insurance. To the mining community of Denaby and Mexborough the fire means a great affliction, as it will be impossible to resume work until new engines, screens, headgear, and other appliances of a great colliery are erected.

At the Cutlers' Hall, on Christmas-eve, the Master-Cutler—Mr. James Dixon—attended to distribute the Hudson Charity. It has been my custom for several years to "assist" at this "function," a clerk from the law office of the company and the Master-Cutler's official completing the number who took part in it. The charity was established in 1741 by Joseph Hudson, who gave by will to the Cutlers' Company £200, which yields £8 10s. to be divided annually on Christmas-eve among poor file strikers in sums not exceeding 10s. each. Of the seventeen who received the half-sovereign last year, three had died, and one had emigrated to America, to make a fresh start in life at the age of seventy-two. Those selected to take their places were aged from sixty-two to seventy-nine, their record as file strikers ranging from thirty-five to nearly fifty years. Their united ages averaged rather over seventy-one. Several file strikers attributed their loss of employment to the greatly increased use of file-cutting machines, it never occurring to any of them that they had reached an age at which file striking should cease. Many of them had been thirty-five years with one firm, and two stated they had been apprenticed to the employers whom they had served all their life, and so had their fathers before them. It was an interesting gathering which recalled the industrial Sheffield of other days. To nine unsuccessful applicants the Master-Cutler kindly gave a consolation half-crown each.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE attendance at the iron market held at Middlesbrough on Tuesday last was scanty, and scarcely any business was transacted. The tone was, however, exceedingly satisfactory, and there is every prospect of improved trade and higher prices as soon as the new year has fairly commenced. Throughout last week the price of No. 3 g.m.b. was 33s. per ton; but on Tuesday it could not be bought at less than 33s. 3d., and many sellers asked even more than that. Inquiries are now mostly for forward delivery. Buyers freely offer 34s. for their requirements during next quarter, but sellers are by no means eager, as they think they will do better by waiting. Makers for the most part are keeping out of the market, as they have enough on order to last for some time to come. Forge iron remains firm at 32s. 6d. per ton, or 2s. more than the price accepted at the beginning of the month.

Stevenson, Jaques, and Co.'s current quotations: "Acklam Hematite," Mixed Nos., 45s. per ton; "Acklam Yorkshire," Cleveland, No. 3, 35s.; "Acklam Basic," 35s.; "Refined Iron," hematite and Cleveland, 65s. to 55s; "Chilling Iron," 55s. to 60s., net cash at furnaces.

Warrants have risen in value $10\frac{1}{2}$d. per ton during the week. The price now asked is 33s. $10\frac{1}{2}$d.

Messrs. Connal and Co.'s Middlesbrough stock of pig iron increased last week 4136 tons.

The finished iron trade is somewhat quieter, owing to the holidays. Prices, however, are firm, and makers have sufficient orders on their books to keep them busy for some months to come.

The prices current on Tuesday were as follows, viz.:—Ship plates, £5 per ton; boiler plates, £6; ship angles, £4 12s. 6d.; common bars, £4 17s. 6d.; and best bars, £5 7s. 6d., all free on trucks at makers' works, less $2\frac{1}{2}$ per cent. discount.

The demand for steel rails has not yet improved, and the price for heavy sections remains at £4 2s. 6d. per ton. Steel ship plates are £7 5s. Orders cannot now be placed for anything like quick delivery, the books of most makers being full for two or three months at least.

Some three or four years since there was something like a rage for illuminating iron and steel works by the electric light. A company was started at Middlesbrough and immediately proceeded to establish works and plant in the district known as the Marshes, for the purpose of supplying the neighbourhood. After a brief existence this company ceased operations, and sold its appliances. Some works, however, purchased their own installations, and these are using them up to the present time. The advantage of better lighting was immediately felt, and manufacturers were no longer content with the old system of single gas-burners. Triple burners on the "Sugg" and the "Bray" systems found considerable favour; but the supply of gas at the more distant parts of the mains was often found to be deficient to an extent which prevented them from working efficiently. Just when a universal desire for better lighting for manufacturing purposes had been created, without very satisfactory means having been devised for satisfying it, came the illuminating appliance known as the Lucigen, to the relief of light users. This is now so well known that a descriptiou would be superfluous. Let it suffice to say that it is apparently superseding all other methods where there are large spaces, either under cover or in the open. In the former case, of course, there must be some means of ventilation, as the quantity of products of combustion is considerable, and they are diffused throughout the enclosed spaces. The Lucigen affords an excellent way of utilising refuse combustibles of a tarry nature for which it might be difficult otherwise to obtain a market. Those supplied with compressed air are much more easily lighted than those which are supplied by steam. In the latter case, and especially if the steam be much charged with water, there is often considerable difficulty in setting the apparatus going. But once fairly at work, it seems to do as well as that supplied with air. Certainly the light given is magnificent, and better adapted to industrial operations than the electric light. It is less concentrated and less intense; it is more diffused, and therefore does not throw such deep shadows. Nor has it the same effect on the sight in producing momentary blindness, which is the case with the electric light, and which may easily lead to accidents. In large shops in the North seven or eight of these Lucigens may sometimes be seen at work at the same time.

Encouraged by the indications which seem everywhere present of returning industrial prosperity, the colliers in the county of Northumberland have already taken their first step to enforce the resolutions adopted at the recent conference of the Miners' National Association held at Newcastle. They have gone so far as to send in to the colliery owners a request that they will meet a deputation to discuss the above resolutions. It will be remembered that these resolutions include a demand for a 10 per cent. advance in wages, a reduction of the day's work to seven hours below and eight hours above ground, an idle day per week, and a week's holiday at some time to be hereafter fixed, with the object of diminishing stocks and raising the price of coal. Inasmuch, however, as the coal trade has not as yet really benefitted by the better times, it is not likely that the operatives' demand will be acceded to in any respect whatever.

The returns of the amount of new shipping built on the banks of the Tees during the year 1887 have just been issued. At Middlesbrough six steel steamers have been built and four iron barges. These amount to 15,068 gross tons and 9225-horse power. They do not include a large steel steamer of 2400 tons burden, which will shortly be ready for launching. At Stockton eight steel and two iron steamers have been built, besides fourteen iron barges. The total capacity amounts to 20,278 tons and 1965-horse power. It will be observed that, although the district is one where iron is sold at minimum prices, and steel is no cheaper than elsewhere, the great bulk of the tonnage has been of the latter material. Of course, in all large steamers triple expansion engines have been fitted and steel boilers. The prospects of the shipbuilders as regards future work, although fair, are not so bright as many people suppose. There are four or five large steamers on the stocks at Middlesbrough, but at Stockton there are not many orders in hand, and builders complain that prices are still unremunerative.

At Hartlepool the shipbuilding industry seems to be flourishing, Messrs. W. Gray and Co. have during 1887 built more than double the tonnage which they turned out in 1886. Messrs. E. Withey and Co. have recently booked some orders for new vessels; Messrs. T. Richardson and Sons have made marine engines of 37,800-horse power in the aggregate. The Central Marine Engine Works have three engines in hand at present, and orders for more are daily expected.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Scotch ironmasters have issued full statistics of the trade of the past year, through their secretary, Dr. A. B. M'Grigor, and these show for the first time the exact official figures of the trade. Hitherto the Scotch iron statistics have always been partially incomplete, leaving certain items to be estimated, but on this occasion full returns were obtained, and it is hoped that they will be continued in future, and possibly issued at shorter intervals than a year. Alongside the figures for 1887 I have placed those of 1886 for the sake of comparison:—

	1887.	1886.
Make of pig iron (including hematite and basic) from Christmas, 1886, to Christmas, 1887	932,240	935,801
Average number of furnaces in blast during that period	79 96	83
Stock of pig iron (including hematite and basic) as at Christmas, 1887	285,332	342,718
Number of furnaces at present in blast	85	—
Shipments—		
1. Foreign	285,990	228,204
2. Coastwise	121,297	147,596
3. By rail to England	8170	9950
Deliveries of pig iron (including hematite and basic)—		
1. Foundries	128,912	123,186
2. To malleable iron and steel works	346,822	299,509

Note.—The shipments and deliveries include those from Messrs. Connal and Co.'s stores.

The total production is less by 2561 tons than it was last year, although it was anticipated from the extra activity and the increased number of furnaces in operation in the last two months that the turn-out might be somewhat larger. The foreign shipments have increased by 57,786 tons in consequence of the improved demand for Italy and the United States; but the coastwise shipments have decreased by 25,299, and the quantity sent by rail to England 1780, so that the net increase in the coastwise shipments and exports is 30,707 tons. The United States have taken 78,000 tons against 51,000 in 1886, and Italy has taken 64,000 against 30,000 tons last year. Our trade with Russia has fallen to very small proportions. The decline in the coastwise shipments is due to the extended use in Scotland of Cleveland and Cumberland pigs. The following comparative statement of the destinations of the foreign shipments of Scotch pig iron will be of interest:—

	1887. Tons.	1886. Tons.
United States	78,000	51,000
Italy	64,000	30,000
Canada	23,000	28,000
Australia	16,500	20,000
Holland	11,000	13,000
Russia	9,000	10,000
France	8,900	10,000
Germany	7,000	11,000
India	5,700	5,200
China and Japan	3,600	4 500
Belgium	3,000	3,500
South America	2,900	1,260

With reference to the home consumption of Scotch pigs, there has been an increase this year of 5726 tons in foundries and of 47,313 in malleable iron and steel works—a total increase of 53,039 tons. The stocks in makers' possession show a decrease of 56,000 tons, but in the Glasgow warrant stores have increased during the year 102,387, so that the aggregate stocks in Scotland are larger by 56,387 tons than they were at the end of 1886. There has recently been a marked advance in prices, which are yet, however, comparatively moderate. As to the prospect for 1888, it is certain that there will be a large consumption of pigs in our malleable iron and steel works, but the outlook as regards exports is not quite assuring. The probability is that, owing to the increased import tariff at Italian ports and the heavy shipments sent there during the last two months, we shall experience a greatly curtailed trade with Italy. We cannot hope for very great things from America, more particularly as it is now reported that the tariff reduction in the States will only apply to iron ore, and not at present to pigs.

The Glasgow warrant market was closed from Friday till Tuesday, and on re-opening a good business was done. At first the prices were steady, but they have since evinced a tendency to fluctuate.

The current values of makers' pigs are as follows:—Coltness, No. 1, 54s. 1d.; Gartsherrie, No. 1, 48s. 6d.; No. 3, 45s. 6d.; Calder, No. 1, 50s.; No. 3, 43s.; Summerlee, No. 1, 52s.; Carnbroe, No. 1, 46s. 6d.; No. 3, 43s. 6d.; Clyde, No. 1, 46s. 6d.; No. 3, 42s. 6d.; Govan, No. 1, 45s. 6d.; No. 3, 42s.; Monkland, 46s. and 43s.; Shotts, at Leith, 49s. 6d. and 46s.; Carron, at Grangemouth, 48s. and 42s.; Glengarnock, at Ardrossan, 48s. 6d. and 43s. 6d.; Eglinton, 45s. 6d. and 42s. 6d.; Dalmellington, 46s. and 43s.

The steel trade is very fully employed, and the late advances in prices are maintained.

The week's shipments from Glasgow of iron and steel manufactured goods embrace, locomotive engines worth £5500 for Bombay; machinery, £5101; steel goods, £4200; and general iron manufactures, £26,500.

In the coal trade there has been a good business, the demand for public works and household purposes having been active, in view of the stoppage of the pits for the New Year holidays. The shipments of the past week were from Glasgow, 25,750 tons; Greenock, 153; Ayr, 7595; Irvine, 1925; Troon, 5290; Ardrossan, 3260; Burntisland, 10,109; Leith, 4591; Grangemouth, 13,019; Bo'ness, 5292; Methil, 7171; and Granton, 1901; total, 86,146, as compared with 75,531 in the same week of 1886.

The aggregate tonnage launched from the Clyde shipyards in the closing year has been 184,604 tons, consisting of 225 steam and twenty-six sailing vessels. In the last twelve years the output has been as follows:—

1887	184,604	1881	341,868
1886	172,287	1880	239,815
1885	195,033	1879	173,800
1884	297,784	1878	215,640
1883	418,482	1877	169,710
1882	395,270	1876	174,824

The proportion of tonnage built of steel in 1887 has been about 145,000 of the whole.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Preparations at the Treforest Iron and Steel Works are now on the eve of completion, and early next week the two large blast furnaces will be again in action. The next step is expected to be the connection of these works with the old one of Mr. Fothergill's, which will be done, it is likely, by a subway. The start at these works comes in fittingly with the transformation of the Treforest, Caerphilly, and Newport line into a passenger line, and forms a good beginning for the new year.

If the other promises are fulfilled the steel make of the district will soon be materially increased. I hear of promising signs at Hirwain; and at the Willow Wire Works, Merthyr, at Swansea, to say nothing of Dowlais Works, where costly changes are still going on, though the works are certain to be transferred to the seaboard. Already arrangements are being entered into for getting a large water supply from the local authorities at Cardiff. Preliminary movements are also being suggested with regard to buildings and to horses.

It is not known how the construction of the new works will be started, whether the Dowlais Company itself, with the aid of local contractors for excavating, and the usual experienced men from the leading engineering establishments of Leeds and Manchester, or some large contractor of Mr. Walker's stamp. That gentleman, after a successful encounter with two of the largest undertakings in the country—the Severn Tunnel and the Barry Dock—is, I see, entering upon a still greater—the Manchester Ship Canal.

There has been little or nothing doing this week, and one solitary parcel of railway iron, 1500 tons to Galveston and one of blooms for San Francisco, are all that have been reported. Semi-activity at the works and the collieries has been the rule, and it was not until Wednesday that the colliers returned to work in any numbers worth recording. This will tell upon the week's total, which will be a small one. Some little interest is centred in the appearance of the totals for the year, which are not expected to vary much from those of the preceding year. In some cases there have been steady additions to the output. I take, first, Treharris, which, under Mr. Price's management, is turning out much more coal. The Albion, which is a new colliery, is now figuring well in the market. At Llwynypia an addition will soon be made to the output of Mr. Hood's collieries, and at the New Ocean colliery, and at Crawshays pits, Pontypridd, there have been substantial additions. At the end of last week some good cargoes of coal were despatched from Cardiff to foreign destinations. Two fine consignments of 3200 and 2000 tons were for Port Said, another of 2400 for Colombo, and a second for 1800 tons for the same destination; and on the same day—the 24th—no less than twelve cargoes, closely bordering on 2000 tons each. The chief destinations were to the coaling ports—a significant fact, and shows, as I intimated last week, that coalowners are preparing for possibilities.

With the new year the latest of our Mines Acts comes into force, and its operations will be watched with interest. Some of the new features commend themselves warmly to the attention. For instance, the issue of certificates to the underviewer, in addition to the manager, can but secure another competent guardian against mishap. Then we have the regulations with regard to safety lamps, which will bring more efficient lamps into use, and there is also the increase of general rules by thirty-nine, many of them important. Legislating for the pit only dates back forty-five years. The early levels and workings at the "crop" needed no legislative guide, or any great amount of scientific skill. Since 1842 the scrutiny of Government has been direct, and well done. The first measures were in respect of morality, forbidding women to descend the collieries, and from that date to the present a good half-dozen Acts, with their supplementary adjuncts, have been passed and brought into wise operation. The Act of 1872, which the mining population owe in a great measure to Lord Aberdare, then Mr. Bruce, has been one of the best and most successful in its operation.

Frequenters of exchange and metal markets are to a large extent holiday making this week, hence my list is scanty. Coal retains its price, 9s. 3d. to 9s. 6d.; best house coal firm; Rhondda No. 3 particularly so, and demand good; common coal, 7s. 9d.; small steam, 4s. 3d.; small bituminous quoted as scarce 6s. 9d.; pitwood advancing 16s.; steel rail unchanged; prices for ordinary between £4 and £4 5s.; blooms, £4 5s.; bars, £4 13s.; Siemens' bars, £5 2s. 6d.

Tin-plate workers have had a lengthy holdiday, and the market on Saturday will show this. Quotations are firm, and as tin appears to be settled in its high groove, tin-plates cannot be expected to alter. Makers are well sold, and good business is secured for some time. Highest price of tin £167. Liverpool market reports state that tin-plates are easier, and prices likely to drop. This is not likely. Stocks are low and demand good. Newport, Mon., coasting total coal last week was under 20,000 tons.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The iron markets everywhere show great animation. Not only in crude iron is there a strong rising tendency, but manufactures in iron and steel of all sorts find a ready sale at enhanced prices. Buyers who have been long hanging back are now pressing forward to cover, by purchasing their requirements, for fear of still further advanced prices overtaking them. On the Berlin Exchange the favourable situation of the iron trade finds expression in speculative industrial values showing a more buoyant tone than other kinds of shares. President Cleveland's message has also favourably affected the iron trade here, not to mention the steady notations, with no relapses, on every foreign market.

From Breslau it is reported that the raw iron syndicate has contracted with the Silesian wrought iron convention to take the whole of the output of the furnaces so long as the convention continues in force, which is till the end of 1890, at a base price of M. 53 p.t., or M. 3 above the late current base. This certainly shows confidence in the future. The business doing in manufactured iron and steel is also brisker than is usual at this time of year. Sheets cannot be delivered as fast as required, wire rods, wire and wire nails are in the best request, the former costing now M. 115 p.t., and bar and sectional iron and steel find ready buyers at the convention figures. Over the border in Austria, too, the iron business has revived, now that the general wrought iron combination has been definitely constituted for three years. The Belgian iron market still continues very firm; bar iron has been raised to 110f. p.t., and more furnaces are to be put into blast at the beginning of next year; whilst in France, though it has not been found possible to establish a common sales bureau for the combined groups of works, still the situation has so far improved throughout the land that there is every prospect of a satisfactory business being done on the turn of the year. Meanwhile, bar iron has got up to 135f., and girders to 125 p.t.

In the Rhenish-Westphalian districts the Siegerland ores are now coming more and more into request by the works in Westphalia as foreign ones become dearer to procure, and a further small rise has taken place, so that raw steel stone fetches M. 9 to 9·50, and roasted ditto up to M. 13, and brown hematite up to 10 p.t. at mines. The Swedish-Norwegian Railway Company is already advertising to deliver its Gellevara iron ores, so soon as the line from Lulea to the mines is quite finished, which it would appear is shortly to be the case. There is no change to note in Luxemburg ores. A fresh large blast furnace works will be started there in the spring.

The pig iron trade keeps uncommonly brisk. In spiegel there is little new to note; the highest grade of 20 p.c. Mn. now costs M. 70, and the lowest of 8 to 10 p.c., 53 at works in the Siegerland. American inquiries seem rather better, but for export generally there is still only a small call. Forge pig goes off well, so well, indeed, that at the meeting on the 19th inst. the convention raised all the prices of pig iron as follows:—Forge pig, M. 50—a rise of M. 2; Bessemer, 53—rise $3\frac{1}{2}$; basic pig, 45—rise 1; foundry, 51 to 57 for the 3 Nos.—rise on each 1 p.t. The last sort has been very brisk of sale of late. In the steel sorts there is no change otherwise to note. The total production for November, including Luxemburg, has been 343,081 t.; forge pig and spiegel, 161,678 t.; Bessemer, 31,905; basic, 101,507; and foundry, 47,991 t. From January 1st to November 30th, 3,547,497, against 3,054,436 t. last year. The manufactured iron trade is called satisfactory, but complaints are heard about the want of specifications and export orders. Domestic demand is reported good, nevertheless it scarcely keeps pace with the output, which must tell in the end. In the end the hoop iron rolling mills have joined the grand convention, at which there is rejoicing, as it gives a strengthening tendency to it. Hoops continue in very brisk demand, and the price is rising in order to bring it up to a level with bars, which it had not yet attained. It is now noted M. 132·50 to 135 p.t. There is no change in sectional irons and girders to record. Boiler plate sales have become more active, and after months of stagnation the base price was fixed on the 19th inst. at M. 160, rise 10, and that of tank plate quality to 140 p.t. at works. Plenty of orders for sheets come in to keep the mills constantly going, though the list price has been moved up M. 6, so that it is now M. 148 p.t. at works. Three fresh mills have joined the convention, including the celebrated Dollingen works. As regards wire rods, there is little to note beyond what was said last week. The deliveries abroad have slightly increased, and the convention could maintain its quotations. The wire nail makers are still elaborating their scheme for a convention, and its conclusion is daily expected. This is a great trade here, counting by thousands of tons yearly. There has occurred nothing worth noting in railway steel material. The Saxon Railway Administration is about to give out twenty coaches; Breslau, eighteen coaches and 445 goods trucks; and Frankfurt, ninenteen coaches and luggage vans, and 100 trucks; so that the wagon factories, with the former orders already received, will get through the winter in a tolerably satisfactory manner. The machine and constructive iron shops are well employed momentarily, particularly those engaged on roofing with galvanised corrugated sheets. Prices are not altogether satisfactory, but twenty-two works met on the 20th inst. and raised the price of castings and cast iron wares M. 20 p.t.

The Bukarest Chamber has just voted 10,000,000f., on account, for the purchase of 100,000 repeating rifles, of which fact English gun factories might, with advantage, take notice.

A pretty little trial is now going on here. It is the trial of an action recently commenced by the State Railway Direction of Hanover against two engineers, and also the foreman and two workmen at the works of a North German company, which must not be named, for fraudulent practises in obliterating and restamping rejected rails, already marked by the railway inspector as rejected, with the intent of passing these with the accepted rails. The action has been instituted, strange to say, through the denunciation of the two practical delinquents, the workmen, who will now have to appear as witnesses against themselves. But into the details of a very unsavoury trial it is not necessary to go. That the accused have been punished by imprisonment for so many months is enough for the public to know, nor would I have mentioned it, perhaps, if it had not transpired during the trial that, all the boasting in the technical journals about the superiority of German iron manufactures, and that they were better than those of other countries—meaning, of course, England—and forgetting that such qualities existed as Staffordshire marked bars or those of South Yorkshire, is a myth and nothing else, as I have always maintained. For it appears the inspector rejected 50 to 60 per cent. of the rails offered for acceptance; not only that, but it is clear that many were rejected for flaws evidently arising from indifferent rolling. This is the point, for I have always said the finish of all kinds of German iron and steel is not to be compared to that of English, always taking say a year's output, for example, and not a few selected pieces. The same may also be said of the quality, sort against sort; in fact, I have never seen perfect puddling, rolling, or fitters' work in this country, and until nature has kindly planted another race of workpeople with other characteristics than at present in the country to replace them, I probably never shall. An English puddler, roller, or fitter, who ever worked two or three months' beside his rival in a works here would bear these statements out. Those who write and puff up the excellence of German workmanship no doubt believe honestly enough what they say, and it is probably ignorance of the minutiæ of the practices in both countries at once which leads them astray, but no one well acquainted with these matters can doubt the intrinsic worth of the work put into iron, steel and machinery by the English workman over that of his rival, and so long as this continues, with honest dealing and fair play, I for one have no doubt whatever that England, if she will, can hold her supremacy in every market abroad, no matter where. It should be mentioned that 51 to 60 per cent. of rejections is undoubtedly more than should have been put on one side in reason, and that an unfriendly feeling between the parties concerned may have exaggerated the shortcomings of the rails.

An invaluable discovery for a great city, indeed for any inland town, has lately been made at Berlin, in the shape of a spring of saline water, containing 3 per cent. of salt, which it appears is just about the proper grade for bath purposes. The water is now undergoing a thorough analysis.

A report of the geologist Berendt was obtained last winter on the probability of finding a spring, which he predicted would be found at a depth of 230 to 300 m., but whether salt or not was an open question. In July this year, on the Admiralty premises, all the necessary preparations were made for a deep boring, which was carried on till December, when, at a depth of 223 m., a 93 m. bed of septarian clay, which appeared at 130 m. below the surface, was bored through and a sandstone bed—whether new red is not explained—was struck, and at the depth of 230 m. in all, the column of salt water rose to the surface.

The Railway Diary and Officials' Directory, 1888. — This diary, published by Messrs. M'Corquodale and Co., is so well arranged to meet the wants of railway men, and the stock of information contained is so varied and useful, that it has steadily won its way in the railway world, and the smallness of its cost adds to its popularity. It gives a calendar, official list of the chairmen and executive officers of the independent lines of railway in the United Kingdom, dividends paid for the four previous half-years, and information relating to postal, stock, and stamp matters, railway requirements, and directories.

NEW COMPANIES.

THE following companies have just been registered:—

Bramham and Peech, Limited.

Registered on the 19th inst., with a capital of £20,000, in £5 shares, to carry on business as mechanical and civil engineers. The subscribers are:—

	Shares.
John Charters, 74, Amhurst-road, Hackney, engineer	1
James Bramham, 112, Malmesbury-road, Bow	1
James Maby, 9, Ashley-road, Essex-road, N., provision merchant	1
J. Philpot, 17, Kirkstall-road, Streatham, auctioneer	1
F. J. Hunt, 43, Highbury New Park, soap manufacturer	1
J. Goodwin, 53, Malmesbury-road, Bow, commercial traveller	1
J. Baker, North London Railway Coal Depôt, Old Ford	1

Most of the regulations of Table A apply.

Harby's Rope Works, Limited.

This is the conversion to a company of the business of Messrs. James Harby and Co., of 96, Leadenhall-street, and Chrisp-street, Poplar, rope and twine manufacturers and hemp spinners. It was registered on the 17th inst., with a capital of £100,000, in £5 shares. The subscribers are:—

	Shares.
H. Wills, 26, Heathland-road, clerk	1
S. W. Haliday, Sidcup, Kent, accountant	1
D. H. North, 108, Graham-road, E., engineer	1
J. Farrington, 78, Daleview-road, Stamford Hill, shipbroker	1
J. A. Last, Fife Lodge, Gunnersbury, clerk	1
F. Harvey Urry, 19, Dayton-grove, Peckham, clerk	1
G. E. Mew, Kingston-on-Thames, solicitor	1

The number of directors is not to be less than three, nor more than five; qualification, 100 shares. The first directors are Messrs. George Brockelbank, Anerley; William M'Culloch, 147, Leadenhall-street; Albert Watkins, 4, Great St. Helen's; E. A. White, 1, Fenchurch-avenue; and Jonathan Bell, managing director. The remuneration of the board will be £1000 per annum, with £50 additional for the chairman—if any—and £100 for every 1 per cent. dividend in excess of 10 per cent., but £2000 per annum is to be the maximum amount.

Jensen's Electric Bell and Signal Company, Limited.

This company was registered on the 17th inst., with a capital of £100,000, in £1 shares, to take over and develope the business and to acquire all the patent rights of Jensen's patent electric bell and signal system for Great Britain and all other countries, the United States and Canada excepted. The subscribers are:—

	Shares.
A. R. Cole, Whitton	1
A. C. Dockerill, 160, Albion-road, N., clerk	1
C. Isaacs, 105, Warwick-road, Maida Hill, secretary of a company	1
J. Spencer, 9, Fenchurch-street, stationer	1
R. H. Gould, 11, Great Coram-street clerk	1
F. Burr, 43, Porson-street, Lewisham, clerk	1
E. B. Howard, 9, Lebanon-street, Walworth, clerk	1

The number of directors is not to be less than two, nor more than seven; the subscribers appoint the first; qualification, £100 in capital. The directors will be entitled to £750 per annum remuneration when 10 per cent. dividend is paid, with an additional £100 for every 1 per cent. dividend in excess of 10 per cent.

Loweswater Lead Company, Limited.

On the 17th instant this company was registered, with a capital of £10,000, in £1 shares, to carry on the business of a mining and smelting company, and to acquire certain property referred to in an unregistered agreement of the 2nd instant between Henry Burrow Vercoe and William Fred Howard, but of which no particulars are given in the registered objects of the company. The subscribers are:—

	Shares.
*L. Soliagu, 79, Tulse-hill	1
*E. B. Haselden, Woodberry Down, N.	1
*J. S. Sawrey, 53, Carleton-road, N.	1
C. J. Walker, Sidcup, clerk	1
G. Mason, Lower-road, Deptford	1
G. E. Bentley, 18, Spencer-road, Herne-hill, cashier	1
F. Sanderson, 21, Celia-road, Tufnell Park, N., clerk	1

The number of directors is not to be less than three, nor more than five; qualification, 100 shares each. The first are the subscribers denoted by an asterisk. The remuneration of the board will be £400 per annum, with an additional £100 for each 1 per cent. dividend in excess of 10 per cent. per annum.

Namaqua United Copper Company, Limited.

This company was registered on the 16th inst., with a capital of £210,000, in £7 shares, to acquire the business, goodwill, and property of the Namaqua Copper Company, Limited. The subscribers are:—

	Shares.
F. J. Merrilees, 31, Hereford-street, Mayfair, shipowner	1
D. M. Currie, 3, Fenchurch-street	1
Bernard Parker, St. Michael's-alley, solicitor	1
P. C. Mercer, 7, Wilberforce-road, N., accountant	1
E. F. Abbott, 36, New Compton-street, W.C.	1
T. M. Gill, 4, Napier-terrace, St. Ann's-road, N., accountant	1
J. Sinclair, 40, Woodsome-road, Highgate-road, N.W.	1

The number of directors is not to be less than three, nor more than seven; qualification, £350 in shares. The remuneration of the board is to be £1000 per annum, and an additional sum of 3 per cent. on the profits accruing in each year after paying 10 per cent. on the shares, but £2000 is to be the maximum amount of such remuneration.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

19th December, 1887.

17,463. Drums, G. F. Redfern.—(*F. Quillet, France.*)
17,464. Lamps, G. Porter, London.
17,465. Holders for Umbrellas, G. Porter, London.
17,466. Dyes, R. Worms, London.
17,467. Vulcanised Metal Sheets, J. Bosch and W. Kumpfmiller, London.

20th December, 1887.

17,468 Buffers for Railways, &c., W. Parker, Sheffield.
17,469. Printing Apparatus or Type Writer, J. Jackson and P. A. Martin, Birmingham.
17,470. Preparation for Paints, W. S. Somers, Liverpool.
17,471. Loading, &c., Ships of Palm and Cocoa-nut Oil, G. A. Moore, Liverpool.
17,472. Telescopic Bedstead for Military, &c., Purposes, S. Green, Nottingham.
17,473. Engine Counters, T. S. McInnes, Glasgow.
17,474. Commercial, &c., Books, J. T. Bradbeer, Cheltenham.
17,475. Machine to Cut Rivets from Wire, J. Jardine, Nottingham.
17,476. Air-tight Bottle, H. G. Boston, York.
17,477. Magic-lantern Reflectorscope, W. H. Day and G. Dimmer, West Cowes.
17,478. Oil-can Spouts, J. Wright, Stockport.
17,479. Heating Workshops, &c., J. H. Roberts, Bradford.
17,480. Application to Wheels of Tramcars, &c., to Prevent Accidents, L. Porri, Great Grimsby.
17,481. Horseshoe, J. D. Billings, London.
17,482. Automatic Engaging, &c., Rotative Clutches, R. J. Hodges and A. Bridgman, London.
17,483. Concrete Pavements, A. J. Boult.—(*A. L. Barber, United States.*)
17,484. Filling Bags or Sacks, I. Bradburn and R. Stubbs, Liverpool.
17,485. Sieves, H. Luther, Liverpool.
17,486. Gossamer Waterproof Fabrics, A. J. Boult. (*L. W. Sinsabaugh, United States.*)
17,487. Chemical Fire-extinguishing Apparatus, J. Haslam, London.
17,488. Slide Bolt for Water-closets, &c, J. R. Mott and Co., Birmingham.
17,489. Finishing Pile Fabrics, T. Salt, Sons, and Co., and W. Hanson, London.
17,490. Invisible Window Alarm, C. C. Wright, London.
17,491. Breech-loading Small-arms, T. Woodward, Birmingham.
17,492. Tap Unions, Valve, &c., W. Fraser, Birmingham.
17,493. Clocks, E. Kohn.—(*J. Pallweber, Germany.*)
17,494. Wet Method of Extracting Gold from Crushed Ores, J. H. Pollok, Glasgow.
17,495. Wet Method of Extracting Gold from Crushed Ores, J. H. Pollok, Glasgow.
17,496. Governor for Prime Movers, S. Dawson, Manchester.
17,497. Slippers, J., F., and H. Parsons, London.
17,498. Wax Matches, C. G. Harris, Glasgow.
17,499. Apparatus to Aid Cyclists to Impel their Machines, A. Slim, Birmingham.
17,500. Air Equalising Furnace, &c., T. A. Meggeson, Middlesbrough.
17,501. Scissors, J. Boulay, Salisbury.
17,502. Electricity Meters, G. Hookham, Birmingham.
17,503. Spirit Levels, G. Cook, London.
17,504. Automatic Fire-alarm, J. Rayner, Halifax.
17,505. Dustproof Ball-bearings for Velocipedes, &c., T. C. Pullinger, Greenwich.
17,506. Cartridges for Ordnance, G. Quick. London.
17,507. Equilibrium Slide Valves and Gear, W. Musgrave and G. Dixon, Bolton.
17,508. Switches, F. L. Rawson and W. White, London.
17,509. Execution, &c., of Embroidery, S. Redhouse, London.
17,510. Manufacture of Fire-lighters, J. F. Wiles, London.
17,511. Dyes, J. Y. Johnson.—(*Farbenfabriken vorm. F. Bayer and Co., Germany.*)
17,512. Station Gas Governors, &c., J. K. Bartlett, London.
17,513. Built Crank Shafts, H. and G. E. Fownes, London.
17,514. Grates, R. Brown, London.
17,515. Gas-burner, H. J. Haddan.—(*W. M. Jackson, United States.*)
17,516. Receptacles, &c., for Bread, F. F. Terks, London.
17,517. Carriage, J. Estner, London.
17,518. Cases for Flexible Goods, C. L. Eberhardt, London.
17,519. Feeding Water into Boilers, J. Murrie, Glasgow.
17,520. Generators, J. Neil, Glasgow.
17,521. Raking and Collecting Hay, J. and E. Gifford, London.
17,522. Explosive Substance, &c., M. Vogelsang, London.
17,523. Automatic Apparatus, H. Abbott and J. Douglas, London.
17,524. Belts, &c., S. Pitt.—(*J. F. and B. F. Mellor, South Australia.*)
17,525. Gratings, E. P. Hooley and J. Ellis, London.
17,526. Separating Cream from Milk, W. Snaydon, London.
17,527. Cartridges, J. P. Gillmore and F. J. G. Hill, London.
17,528. Phonic Reception of Telegraphed Communications, C. Ader, London.
17,529. Automatic Apparatus, B. Burkin, London.
17,530. Blowing, &c., Glass, J. Armstrong, Birmingham.
17,531. Button-making Machines, J. C. Schott, London.
17,532. Manufacture of Aluminium, H. H. Lake.—(*C. Netto, Germany.*)
17,533. Sewing Machines, H. H. Lake.—(*H. B. Metcalf, United States.*)
17,534. Beds, &c., H. Dobell, London.
17,535. Drawer Equalisers, J. H. Knaus, London.

21st December, 1887.

17,536. Holding Acids, W. Atkinson and G. A. J. Schott, Bradford.
17,537. Angle Iron Shafts for Engines, &c., J. M. Storr, Lea.
17,538. Wringing Machinery, D. Stewart and R. Walker, Glasgow.
17,539. Joints for Pipes, D. Marshall, Glasgow.
17,540. Self-clamp Guillotine Cutting Machines, A. Morfitt, Nottingham.
17,541. Cylinder Ends, H. B. Barlow, Manchester.
17,542. Manufacture of Basins, &c., H. Sutcliffe, Halifax.
17,543. Glass Bottles, D. Rylands and B. Stoner, Barnsley.
17,544. Traps for Catching Rabbits, W. Campbell, London.
17,545. Adjustment Spanners, E. A. Budding, London.
17,546. White Lead, J. M. Bennett and J. Telfer, Glasgow.
17,547. Instrument, J. P. Browne, Glasgow.
17,548. Magneto-electric Machines, M. Settle, Manchester.
17,549. Rotary Fans, J., R. Crighton, and G. C. Peel, Manchester.
17,550. Incubator, D. Whitehead and J. W. Wilde, Manchester.
17,551. Dyeing Fabrics, J. Frost and G. E. Sutcliffe, Yorkshire.
17,552. Railway Key, A. Ashley and E. Marriott, London.
17,553. Comb, M. Evans, Chester.
17,554. Irrigation in Hot-houses, W. Gumbley, Guernsey.
17,555. Meat-chopping Machines, W. Scheffel, Barmen.
17,556. Ventilators, H. Stockman, North Sunderland.
17,557. Velocipedes, J. Starley, London.
17,558. Enriching Coal Gas, W. H. Bennet.—(*J. Lamy, Paris.*)
17 559. Blowers, H. Spooner, Plaistow.
17,560. Quenching Fire on Sailing Ships, T. Pease, Tranmere.
17,561. Crank Motion, F. T. J. Schneider and C. R. Werth, Liverpool.
17,562. Metallic Mattresses, G. A. Billington, Liverpool.
17,563. Transmitting Rotary Motion, J. C. Sellars, Liverpool.
17,564. Fuel Economisers for Grates, J. A. Schofield, London.
17,565. Loom for Weaving Cloth, A. Storrer, London.
17,566. Compressing Salt Rolls, W. R. Comings.—(*The United States Salt Roller Company, United States.*)
17,567. Centrifugal Governors, A. Budenberg.—(*Schaffer and Budenberg, Germany.*)
17,568. Goods Delivery Vans, I. Young, London.
17,569. Milk Barrows, R. Pitt, London.
17,570. Cakes for Feeding Cattle, A. J. Boult.—(*P. F. Pallas, Germany.*)
17,571. Bicycle Saddles, H. F. Tyler, London.
17,572. Belt Fastener, A. Belcher and J. F. M. Clarke, London.
17,573. Transporting Loads from one Place to another, F. J. Arnodin and M. A. de Palacio, London.
17,574 Coating Plates with Tin, &c., T. Freeman, London.
17,575. Transmitting and Indicating the Direction of Revolution of Engine Shafts, J. S. Gisborne, London.
71,576. Filter, W. Varrall, London.
71,577. Duplicate Safety Shoe, J. Hoare and A. Butler, London.
17,578. Checking Money, J. White, London.
17,579. Meters for Water, &c., P. M. Justice.—(*J. Thomson, United States.*)
17,580. Sighting Apparatus foi Guns, H. Andrews and J. A. Norton, London.
17,581. Lasting the Uppers of Boots and Shoes, A. E. Lewis and A. E. Stirckler, London.
17 582. Apparatus for Indicating Time, E. F. H. H. Lauckert, London.
17,583. Colouring Matters, O. Imray.—(*R. Nietzki, Switzerland.*)
17,584. Syphon Tanks, R. Morris, London.
17,585. Electric Regulators, N. Benardos, London.
17,586. Chromium Compounds for Dyeing, C. D. Abel.—*Messrs. Rudolph Kroepp and Co., Germany.*)
17,587. Pressing Hay, &c., J. E. S. Perkins, Peterborough.
17,588. Opening and Closing Fanlights, &c., H. A. Ball, London.
17,589. Coating Metal Plates with Tin, &c., R. M. Lloyd, London.
17,590. Garment Stay, S. Pitt.—(*E. C. Bowling and H. P. Glover, United States.*)

22nd December, 1887.

17,591. Raising the Healds in Looms, C. Bedford, Halifax.
17,592. Laying Wires for the Transmission of Electricity, R. B. Lee, Manchester.
17,593. Extracting Oil from Fish J. Taylor, Leith.
17,594. Grinding Grain, &c, W. Adair, Liverpool.
17,595. Pistons, &c., M. Douglas and J. Colling, Sunderland.
17,596. Snares for Rabbits, W. Burgess, Malvern Hill.
17,597. Holding Keys in Railway Chairs, J. Drage and J. P. Annett, Eastleigh, near Southampton.
17,598. Governor for Steam Engines, W. Taylor, Coupar-Angus.
17,599. Dynamo-electric Machines, R. E. B. Crompton and J. Swinburne, Chelmsford.
17,600. Spring Brackets for Bicycle Lamps, J. Harrison, Birmingham.
17,601. Plates of Door and other Handles, G. Moore, sen., A. L. Stamps, and G. Moore, jun., Birmingham.
17,602. Buckles for Straps, &c., J. B. Brooks, Birmingham.
17,603. Separating Postage Stamps, J. J. Allen, Halifax.
17,604. Fire-escape, C. P. Rogers, Plymouth.
17,605. Fire-place Clothes Pole, J. Buchanan, Glasgow.
17,606. Hoes, J. Perks, London.
17,607. Propulsion of Vessels, M. Immisch, London.
17,608. Linoleum, W. F. Clerk, Esher.
17,609. Folding-chairs, G. A. Farini, London.
17,610. Combined Desk and Type-writer, J. Harrison, London.
17,611. Carding Machines, W. H. Beck.—(*A. Rivret and H. Honoré-Colson, France.*)
17,612. Purification of Sulphuric Acid, F. L. Teed, London.
17,613. Round Hollow Articles, T. R. Voce, Birmingham.
17,614. Economising Fuel, &c, A. L. Chance, Birmingham.
17,615. Washing Dishes, H. Howard, Brentwood.
17,616. Horseshoes, H. Martin, London.
17,617. Shaping Envelopes, &c., W. C. Nangle, Whitchurch.
17,618. Breaking or Forcing Down Coal, J. Cunliffe and J. Whitehead, London.
17,619. Water Tap and Stop Cock, W. H. Wallis, London.
17,620. Lace, H. S. Cropper and T. H. Dexter, London.
17,621. Fire Extinguisher, H. N. Morgan, London.
17,622. Money Pad, F. Slazenger, London.
17,623. Lubricators for Machinery, &c., R. J. Hodges, London.
17,624. Apparatus for Testing Automatically the Weight and Strength of Persons, E. Edwards.—(*C. Bach, Switzerland.*)
17,625. Gold Saving, &c., Machines, C. Mitchell, London.
17,626. Horseshoes, F. Dominik and M. M. Rotten, London.
17,627. Tobacco Pipes, &c., B. Bradford, Liverpool.
17,628. Fire-lighter, W. H. and A. Smith, J. A. Dark, London.
17,629. Producing Light from Hydrocarbon, &c., W. King and G. K. Jones, jun., London.
17,630. Disposal of Refuse of Towns by Burning, J. B. Alliott, London.
17,631. Electric Batteries, J. C. Lemmens London.
17,632. Roller Shutters and Blinds, H. Müller, London.
17.633. Compounds of Chocolate, &c., for Beverages, O. Krueger, London.
17,634. Producing Engravings in Relief, C. Chédiac, London.
17,635. Lamps, J. T. Paul, London.
17,636. Internal Stoppers for Bottles, W. B. Fitch, London.
17,637. Cutting Leather, &c., in Strips, E. Clarke and J. B. Rootham, London.
17,638. Engines Worked by Vapour of Paraffin Oils, J. H. Knight, London.
17,639. Applying Pedals to Pianofortes, G. J. Webb, London.
17,640. Frames for Holding Pieces of Plush, &c., S. C. Lister and J. Reixach, London.
17,641. Printing Telegraphs, J. E. Wright and J. Moore, London.
17,642. Colour Printing, J. M. Allen, London.
17,643. Tins for Gunpowder, A. Luck, London.
17,644. Tack Driver, O. E. Lewis and A. E. Stirckler, London.
17,645. Ball Castors, H. R. A. Mallock, London.
17,646. Axle-boxes, D. Macnee, London.
17,647. Drive Chains, O. Imray.—(*J. A. Jeffrey, United States.*)
17,648. Preventing Incrustation in Boilers, A. Pople, London.
17,649. Type-founding Machines, L. and A. Foucher, London.
17,650. Purifying Water, A. H. Hobson and C. H. Rosher, London.
17,651. Horseshoes, J. P. Ottaway, London.
17,652. Preparing Fibres for Spinning, J. R. Garratt and W. Scott, Down.
14,203A. Swings, W. Wilson, London.—[This application having been originally included in No. 14,203, dated 19th October, 1887, takes, under Patents Rule 23, that date.]

23rd December, 1887.

17,653. Supplying Oil, J. W. Vine, W. Fox, and B. Smith, London.
17,654. Safety Letter-box, F. J. Ryan and F. Perks, London.
17,655. Electric Incandescent Lamp, R. H. D. Mills, London.
17,656. Tiles, G. A. Marsden, Liverpool.
17,657. Alkaline Carbonates, W. W. Staveley, Liverpool.
17,658 Lamps, J. Radcliffe, Manchester.
17,659. Economising Fuel, &c., J. Cooke, Stockton-on-Tees.
17,660. Horseshoes, H. Wilkins, Erdington.
17,661. Winding Frames, W. T. Glover and E. Whalley, Manchester.
17,662. Automatic Supply of Liquids, J. Holroyd, Manchester.
17,663. Lever Governor, T. F. Matthews and J. Johnston, Liverpool.
17,664. Economising Fuel, J. Nelson, Newcastle-upon-Tyne.
17,665. Fractured Patella Fixture, H. Fisher, London.
17.666. Fire-bars with Projections, H. Hartung, Berlin.
17,667. Hats, J. Bevan, Denton.
17,668. Camp Stools, A. Stewart, Glasgow.
17,669. Telephonic Apparatus, D. J. Smith and D. Sinclair, Glasgow.
17,670. Ironing Curls of Hat Brims, T. Rowbotham, Manchester.
17,671. Cabinets with Sliding Drawers, A. Watson, London.
17,672. Sheet-metal Lattice-work, A. E. Barthel, London.
17,673. Machines for Shaping Metals, W. H. Allen, London.
17,674. Non-smelling Closet, F. P. and R. H. Pyne, Heavitree.
17,675. Closing Gates Automatically, T. G. Townsend, London.
17,676. Apparatus for Producing Gas, R. S. Lawrence, London.
17,677. Guiding Twist-drills, &c., W. J. Griffiths, London.
17,678. Universal Boot, &c., Cleaner, G. H. Cable, London.
17,679. Railway Crossings, J. Stabler, London.
17,680. Luggage Carriers for Velocipedes, G. Townsend, London.
17,681. Automatic Sale of Sweetmeats, F. F. Giles, Kidderminster.
17,682. Telephones, T. Cheesman, Hull.
17,683. Needles, T. Harper, Birmingham.
17,684. Roller Blind Furniture, T. Caldwell, London.
17,685. Oscillating Horses or Chairs, E. Davies, London.
17,686. Starting Gas Engines, H. N. Bickerton, London.
17,687. Files for Letters, S. Maier.—(*F. S. Verlag, Germany.*)
17,688. Locks or Latches, T. Burns and J. S. Dumbell, London.
17,689. Steam Engines, &c., F. and F. W. Clark, London.
17,690. Stoves, J. Beard, London.
17,691. Reversible Toasting Apparatus, W. E. G. Forbes, London.
17,692. Anchors, H. E. Newton.—(*E. T. Starr, United States.*)
17,693. Fixing, &c, Photographic Pictures, H. B. Berkeley, London.
17,694. Extinguisher for Lamps, G. E. Dehany, London.
17,695. See-saws, E. G. Colton, Hendon, and G. Jeffery, London.
17,696. Saccharum, J. W. Bailey and J. A. R. Greaves, London.
17,697. Steam Boilers, P. Hanrez, London.
17,698. Lighting Domestic Fires, J. T. Parlour, London.
17,699. Pencil Sharpener, &c., R. W. Gardner, London.
17,700. Display of Copy Slips for Schools, F. V. Brooks, London.
17,701. Felt Hats, C. Vero, London.
17,702. Turret Mountings for Guns, T. Nordenfelt, London.
17,703. Corsets, J. Chapman, London.
17,704. Telephones, A. C. Herts, London.
17,705. Weighing and Marking, W. Snelgrove, London.

24th December, 1887.

17,706. Flower Scissors, H. W. Sparke, West Brighton.
17,707. Gas Stoves, W. H. Pike, Newcastle-upon-Tyne
17,708. Traction and other Engines, I. W. Boulton, Manchester.
17,709. Water-closet Bowls, S. Worsencroft, Manchester.
17,710. Self-locking Sight for Guns, H. S. Maxim, London.
17,711. Match-box, F. Durand, London.
17,712 Separating Liquids from Solids, J. S. Sawrey and H. Coleet, London.
17,713. Multiplying Copies of Writing, &c., D. Doyle, Cork.
17,714. Card Shooting Machines, W. Deakin, Birmingham.
17,715. Funnels, F. G. Atkins, Birmingham.
17,716. Application of Heat in Furnaces, W. Roberts, London.
17,717. Steam Boilers, H. B. Buckland, Newcastle-upon-Tyne.
17,718. Wool-combing Machines, W. H. Bailey, Keighley.
17,719. Spring Clasp Balance Mount, A. Martin, Hanley.
17,720. Valve Gear, J. H. Holmes, Newcastle-on-Tyne.
17,721. Hydraulic Rivetting Machines, R. B. Smith, Glasgow.
17,722. Electric Telegraphic Apparatus, J. S. Gisborne, London.
17,723. Type-writers, S. J. Sewell, London.
17,724. Velocipedes, V. P. Fevez, London.
17,725. Shot and Shell, J. Nicholas and H. H. Fanshawe, London.
17,726. Electro-motors, J. G. Statter, London.
17,727. Bookbinding, W. W. Neel, London.
17,728. Bracelet Fastening, J. Wood, Birmingham.
17,729. Delivering, &c., Matches, C. Groombridge and G. Delgado, London.
17,730. Brackets, C. Groombridge and J. P. Rickman, London.

17,731. Laundry Trucks, T. and G. Perry, London.
17,732. Novel Elastic Substance, H. M. Steinthal, London.
17,733. Flushing Water-closets, &c., J. Breeden, London.
17,734. Fire-lighters, W. R. Wells, London.
17,735. Fire-lighters, E. Greenfield, Hastings
17,736. Jointing Building Blocks, &c., T. S. Horn and J. J. Robson, London.
17,737. Car Coupling, J. A. Bosch, London.
17,738. Petroleum, &c., Engines, G. W. Weatherhogg, Swinderby.
17,739. Double Ash-pit for Furnaces, L. Mondini, London.
17,740. Sweeping Floors, A. J. Boult.—(*H. Rothenburg and R. Schedlich, Germany.*)
17,741. Wire Netting Machine, F. A. Wilmott, London.
17,742. Treatment of Diphtheria, &c., J. D. Newton.—(*V. Meyenburg, Germany.*)
17,743. Feeding Bottle, G. Hughes.—(*Messrs. Gire and Co., France.*)
17,744. Petroleum and other Engines, T. C. Hogg, London.
17,745. Brakes for Velocipedes, P. D. Hedderwick, London.
17,746. Preserving Milk, J. B. Guérin, London.
17,747. Tubular Boilers, S. Saunders, London.
17,748. School Desks and Seats, J. Haynes and W. B. Osborne, Birmingham.
17,749. Trousers Stretchers, H. Scott, Liverpool.
17,750. Substitute for Coffee, B. Rigwert, London
17,751. Glass Tablets, Show Cards, &c., E. Swift, London.
17,752. Compound Engines, E. Davies, London.
17,753. Convertible Tricycles, J. Johnson and A. R. Wickens, London.
17,754. Coating Metals, J. Westgarth and W. Charnock, London.
17,755. Trucks, S. Barber and C. S. Peach, London.
17,756. Mechanical Refrigeration, W. L. Williams and S. Puplett, London.
17,757. Portable Electrical Batteries, M. McMullin, London.
17,758. Ordnance, J. A. Longridge, London.
17,759. Turning the Leaves of Music, W. R. Leeson, London.
17,760. Restoring Pressure of Exhaust Steam, A. M. Clark.—(*M. Honigmann, Germany*)
17,761. Brakes, J. Jaeggli, London.
17,762. Electric Signalling Apparatus, L. Sellner, London.
17,763. Supporting Pottery Ware in Kilns, E. Leak, London.
17,764. Packing Rings, W. Lockwood, London.
17,765. Gas Heating Apparatus, H. P. Miller, London.
17,766. Coupling Railway Rolling Stock, G. E. Ribault, London.
17.767. Material for Roofing, &c., J. A. Archer, London.
17,768. Covering Wire, W. S. Smith, jun. London.
17,769. Extending Side Table, F. Trollope, London.
17,770. Coating Metal Plates, J. Lysaght, London.

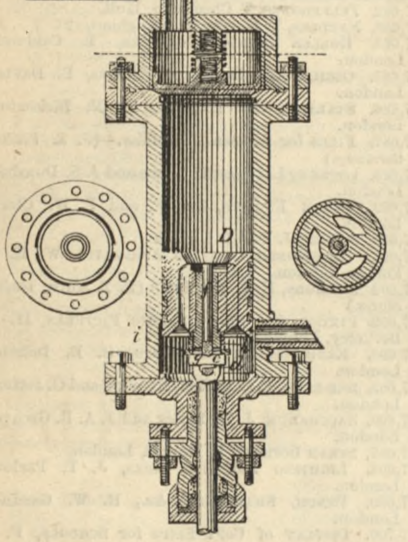
SELECTED AMERICAN PATENTS.

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

370,896. Compressor for Ice Machines, *J. Schuehle, San Antonia, Tex.—Filed May 27th,* 1887.

Claim.—In an ammonia compressor, the piston-rod B, having transverse opening e, in combination with

370,896.

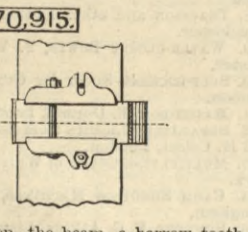


the valve D, stem f, having slot and shoulder g, key c, held therein by wedge d, and the spring h and washer i, substantially as and for the purpose set forth.

370,915. Harrow Tooth Holder, *P. H. Wilms, Holland, Mich.—Filed March 14th,* 1887.

Claim.—(1) In combination, the harrow beam, the blocks, having the grooves cutting through the side of the blocks at the centre of their curve, a bolt coupling the blocks together, the bolts attaching the blocks to the beam, and a curved tooth clamped between the upper walls of the grooves and the face of the beam at the opening in the grooves, substantially as set forth.

370,915.



(2) In combination, the beam, a harrow tooth the blocks having the open side recesses, their coupling bolt, and bolts passing through said open recesses and the beam, whereby the holder can be attached, and adjusted without removing any bolts or nuts, substantially as set forth.

370,937. Vice, *J. Ernst, Bay City, Mich.—Filed July 28th,* 1887.

Claim.—The combination, in a vice, of the front and

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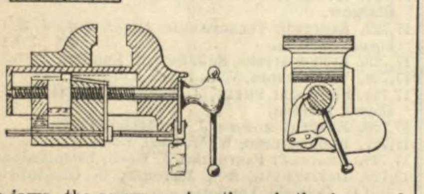
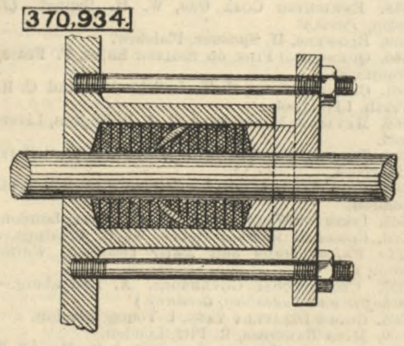


rear jaws, the screw passing through the jaws and having a collar provided with notches or teeth, a nut capable of engagement or disengagement with a screw, and an oscillating rod passed through the rear jaw and secured to and moving with the front jaw and provided with nut operating devices, with a lever rigidly secured to the rod and a pawl pivotted to the free end of the lever by one end and with its opposite free end engaging with the notches in the screw collar, substantially as and for the purpose set forth.

370,934. Piston or Valve Rod Packing, *J. B. Deeds and E. Dawson, Terre Haute, Ind.—Filed May 3rd,* 1887.

Claim.—The combination, with the stuffing-box, the rod, and adjustable gland or follower, of one or more

370,934.

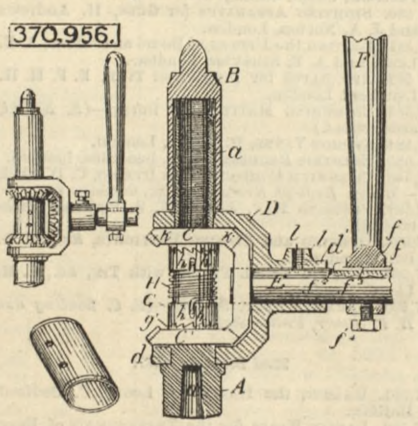


metallic packing rings snugly fitting the rod and interior of the box, and coils of rope surrounding the rod on opposite sides of said ring or rings, such rings being formed with an annular flange on the edge adjacent to the box, substantially as described.

370,956. Ratchet Drill, *A. W. Linton, Fargo, Dak.—Filed July 5th,* 1887.

Claim.—In the double-geared ratchet drill above described, the combination, with the spindle A, bearing in its upper end the screw B, the forked frame D, having the perforated handle d^1 and the threaded opening l^1, adapted to receive the set screw f^4, the shaft E, bearing the handle F and working in the perforated handle d^1, bevel cog wheel C^2 rigidly secured on the inner end of said shaft, bevel cog wheels C C^1 working around the spindle A, having flanges k^1 and hubs terminating in rings which fit around said

370,956.



spindle and bear ratchet teeth g^1, ratchet ring G, working around the spindle A, having slots h^1 and teeth g, meshing with teeth g^1, spiral spring H, coiled around said spindle and between said ratchet rings, having their ends h turned into the slots h^1, screws h^2, fitting in said slots and screwed into said spindle, shield K, fitting over said ratchet rings, said screws, and said coil spring, its bevel ends fitting in the bevel flanges k^1, substantially as shown and described, and for the purposes set forth.

370,961. Tongs, *W. H. Mannes, Colorado Springs, Colo.—Filed June 15th,* 1887.

Claim.—(1) The combination, with two tong parts, of which one carries the pivot pin and the other is provided with a number of parallel slots leading into a cross slot, of a guard plate held on the slotted tong part and serving to hold the pivot pin in one of the parallel slots, substantially as shown and described. (2) The combination, with two tong parts, of which one is provided with a number of parallel slots leading into a cross slot, of the pivot pin having a square head, and passing with its shank through an aperture in one tong part and through one of the parallel slots in the other tong part, and a guard plate adjustably fastened to the slotted tong part, and engaging with its upper

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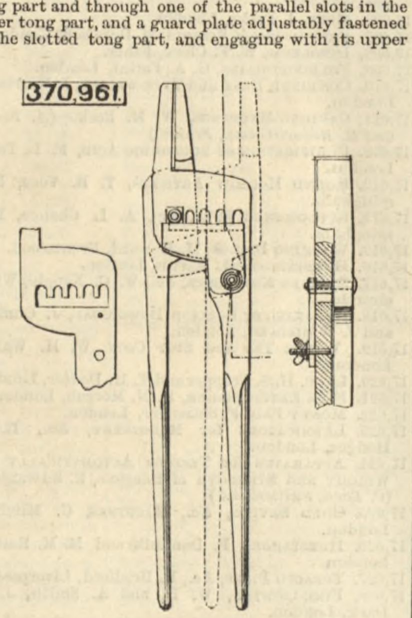

edge the square head of the pivot pin, so as to hold the latter in its respective parallel slot, substantially as shown and described. (3) The combination, with two tong parts, of which one is provided with a number of parallel slots leading into a cross slot, of the pivot pin provided with a square head and passing with its shank through an aperture in one tong part and through one of the parallel slots in the other tong part, a guard plate held on the slotted tong part and engaging with its upper edge the square head of the pivot pin, a bolt held on the slotted tong part on which said guard plate is pivotted, and a nut screwing on said bolt and against said guard plate for holding the latter in position on the slotted tong part, substantially as shown and described.

370,965. Nail-cutting Machine, *P. McDermott, New York.—Filed November 3rd,* 1886.

Claim.—(1) In a machine for cutting wedge-shaped pieces from a bar or sheet of metal, in combination, a stationary frame, a frame carrying knives or dies and toggle levers pivotted in the fixed frames, a crank and connecting-rod for actuating the toggle levers, a rocking lever, a connecting-rod joining the rocking lever to the pivotted frame, and a cam on the end of the crank-shaft for actuating the rocking lever, substantially as set forth. (2) In a metal-cutting machine, a frame, a knife or die holder fitted therein, toggle levers arranged to reciprocate the knife or die holder when moved to

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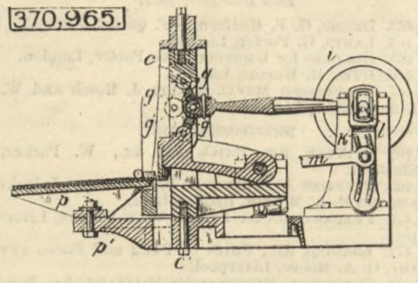
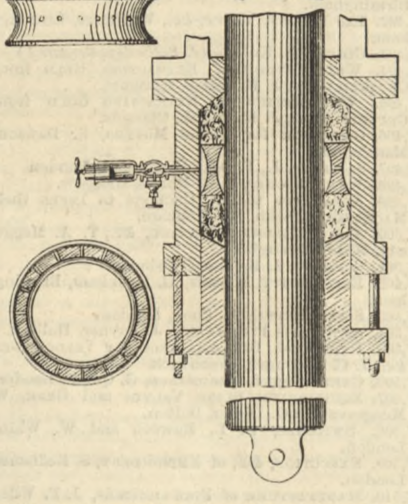


and from a vertical position, and a rotating crank and connecting-rod joining it to the central joint of the toggle levers, the throw of said crank being such as to move the central joint of the toggle levers on each side of their vertical position, whereby the knife or die holder is reciprocated twice each time the crank makes a full revolution, substantially as set forth. (3) In a metal-cutting machine, in combination, the pivotted frame c, knives or dies carried thereby, and mechanism for operating the same, the connecting-rod m, the lever k, and the cam l, substantially as set forth. (4) In a metal-cutting machine, in combination, the pivotted frame c, knives or dies carried thereby, and mechanism for operating the same, the connecting-rod m, the lever k, the cam l, and the fixed guide p, provided with stripper s, substantially as and for the purpose set forth. In a metal-cutting machine, in combination, the fixed frame b, the pivotted frame c, the knife or die holder e, the toggle levers g g, the connecting-rod h, the crank i, the cam l, secured to the shaft of the crank, the lever k, and the rod m, substantially as and for the purpose set forth.

370,979. Lubricator, *E. R. Simpson, S. B. Mott, and M. Speicher, Archbald, Pa.—Filed June 6th,* 1887.

Claim.—In a device adapted to lubricate a plunger or piston-rod, the combination of a packing box provided with a passage way, and a ring provided with

370,979.

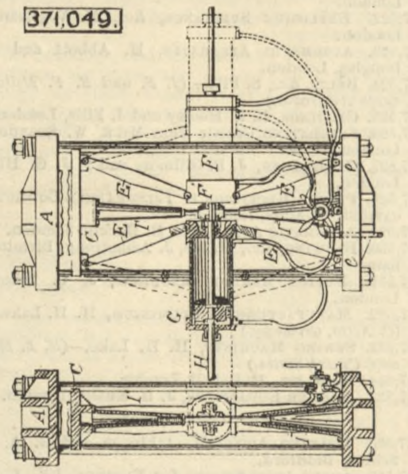


annular grooves on its outer end and inner faces, having perforations therein, a reservoir and a pressure plug therein, and a valve or stop cock between the ring and reservoir, substantially as set forth.

371,049. Combined Hydraulic and Knuckle Joint Press, *A. Fitts, Worcester, Mass.—Filed March 29th,* 1887.

Claim.—(1) The herein-described combined hydraulic and knuckle joint press, having two oppositely disposed pairs of knuckle joint arms respectively arranged to operate outward and inward in both right and left directions past their centres or vertical planes passing through the axes of the upper and lower end joints of the respective pairs of arms, substantially as and for the purpose set forth. (2) The combination, substantially as described, with the foot A^1 and follower C, of the double-acting cylinders F,

371,049.

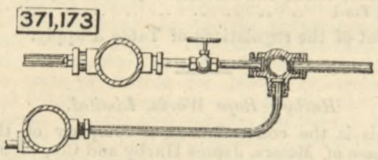


carrying knuckles F^1, and the arms E, jointed to said head and followers at e in a plane intermediate between the limits of movement of the cylinders or knuckle joints F^1. (3) The combination, substantially as described, of the followers C and head A, provided with standards I^1 and I^2, the double-acting hydraulic cylinders carrying the knuckle joints F^1, the arms E E^1, the piston-rods H, having pistons G, the central connecting hub H^1, and the guide rod I, all constructed and arranged in relation to each other for operation as and for the purpose set forth.

371,173. Water-separating Attachment for Ice Machines, *T. H. Butler, Harrisburg, Pa.—Filed June 13th,* 1887.

Claim.—(1) The combination, with the coil of an ice machine brine tank and the anhydrous-ammonia supply pipe connected thereto, of a pipe for automatically separating the water from the gas, connected to lower side of the said supply pipe at the point where the liquid ammonia commences to expand into gas. (2) The combination of the coil of an ice machine brine tank and the anhydrous-ammonia supply pipe connected thereto, of a junction provided with an enlarged cavity into which the liquid ammonia may commence to expand into gas, and a pipe connected to the lower side of the said junction for automatically removing the water therefrom. (3) The combination of an ice machine brine tank coil, a supply pipe for liquid anhydrous ammonia provided with a regulating valve, a junction having an enlarged cavity into which the liquid may commence to expand into gas, a pipe connecting the junction with the coil, a water drum placed at a lower level than the junction, a drain-pipe connecting the lower side of the junction with the drum, and an escape pipe provided with a stop-valve, also connected to the said drum. (4) The combination of an ice machine brine tank coil, a supply pipe for liquid anhydrous ammonia provided with a regulating valve, a junction having an enlarged cavity into which the liquid may commence to expand into gas, a pipe connecting the junction with the coil, a water drum placed at a lower level than the junction, a drain pipe connecting the lower side of the junction with the drum, an escape pipe provided with a stop-valve,

371,173

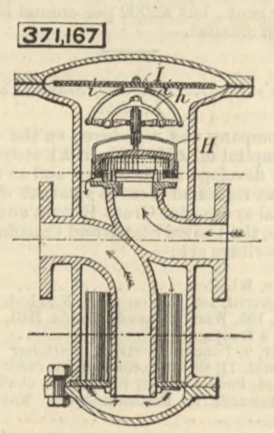


also connected to the said drum, and a junction piece connecting the said escape pipe with the suction pipe of the pump. (5) The combination of a series of ice machine brine tank coils, a supply pipe for liquid anhydrous ammonia, a manifold connected to the supply pipe, small distributing pipes provided with regulating valves secured to the manifold, junctions having enlarged cavities into which the liquid may commence to expand into gas, secured to the distributing pipes, large pipes connecting the said junctions with their respective coils, a water drum placed below the level of the manifold, drain pipes connecting the lower sides of each junction with the said water drum, and an escape pipe provided with a stop-valve, also secured to the drum, substantially as and for the purpose set forth.

371,167. Apparatus for Maintaining a Proportional Flow of Liquids, *C. C. Barton, New York.—Filed February 8th,* 1887.

Claim.—(1) In an apparatus for maintaining a proportional flow of fluid through pipes of the same or different diameters, the combination, with diaphragm I and valve H, of the two rigid arms i i, a guide which directs the movement of the valve, and levers connected with the valve on opposite sides of its centre, whereby it is balanced and also connected with the

371,167

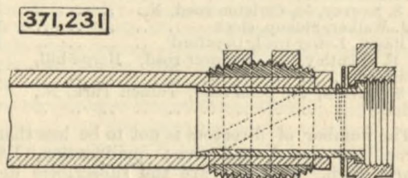


arms i i, substantially as described. (2) In an apparatus for maintaining a proportional flow of fluids through pipes of the same or different diameters, the combination, with the dead end G of the main pipe, of a stem j, carrying arms h h, which form the fulcrums for valve which are actuated by the motion of a diaphragm, substantially as set forth.

371,231. Hose-clamping Device, *Thomas G. Turner, New York, N. Y.—Filed January 15th,* 1887.

Claim.—(1) In a hose-coupling device, the combination of a coupling tube extending within the elastic hose, a clamp for compressing the elastic hose upon the coupling tube, and a connection or anchor connecting the coupling tube and clamp, substantially in the manner and for the purpose specified. (2) In a hose coupling device, the combination of the elastic hose, a coupling tube which enters the end of the said hose, a clamp for compressing the said hose upon the coupling tube, and a flexible connection or anchor embracing the coupling tube and engaging with the clamp at a single point, whereby, in the event of the tube starting out of the hose, an angular movement is given to the coupling tube and the clamp and an increased amount of resistance is offered to the separa-

371,231



tion of the parts, substantially as set forth. (3) In a hose coupling device, a hose coupling tube extending into the hose and having an attachment or extension whereby it is connected to the clamp device used for compressing the hose about the coupling tube, said attachment or extension being in contact with the clamp at a single point only, so that in the event of any outward movement of the coupling tube from the hose an angular movement is given to the clamp and coupling tube by reason of the single connection, as shown and described. (4) In a hose coupling device, the anchor or stop A^6, connecting the coupling tube A^2 and the clamping device A^3, A^4, and A^5 at a single point, for the purpose and in the manner set forth.