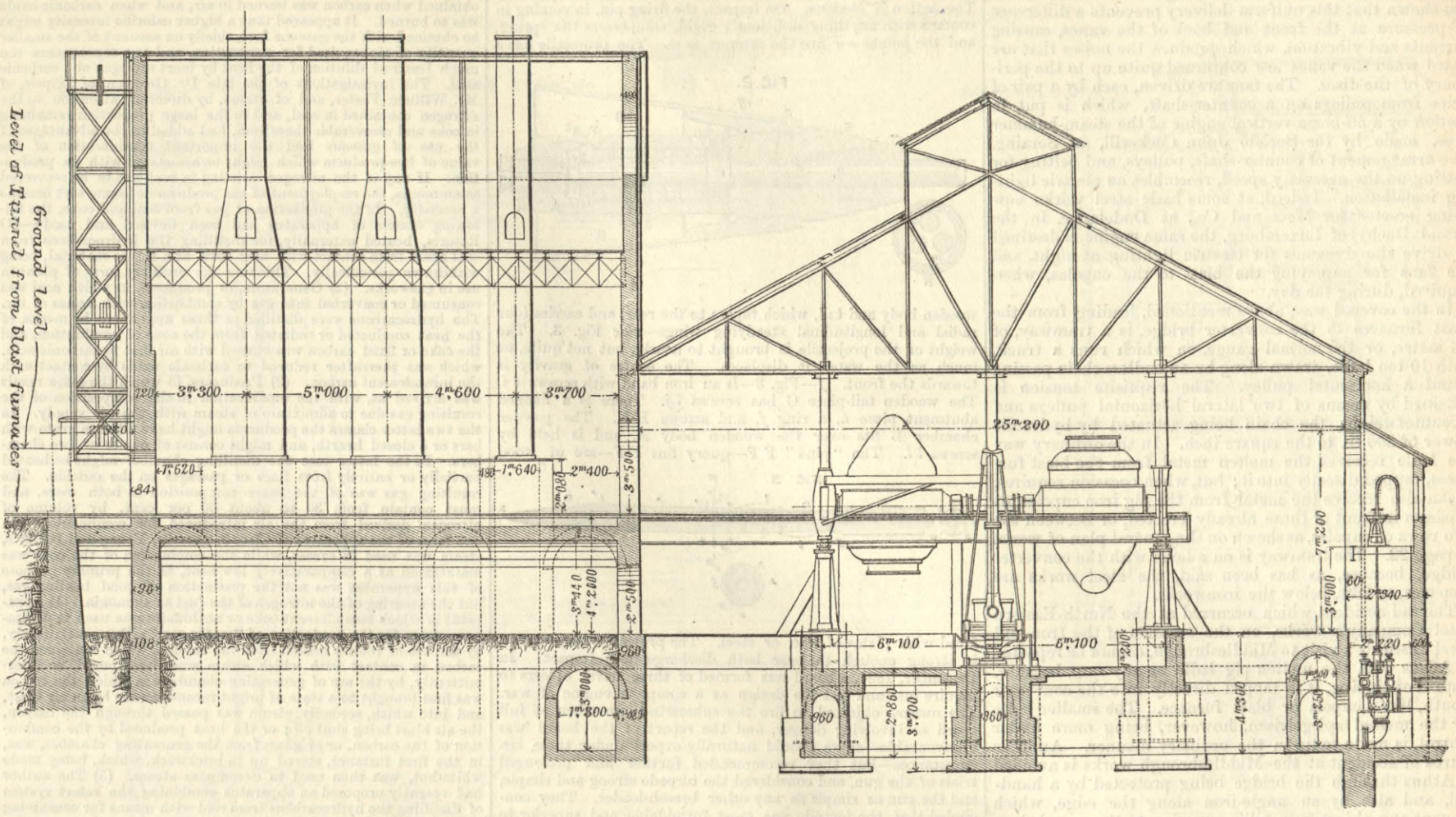
THE ATHUS STEEL WORKS.



VERTICAL SECTION, LONGITUDINAL THROUGH MELTING DEPARTMENT, AND TRANSVERSE THROUGH CASTING HOUSE.

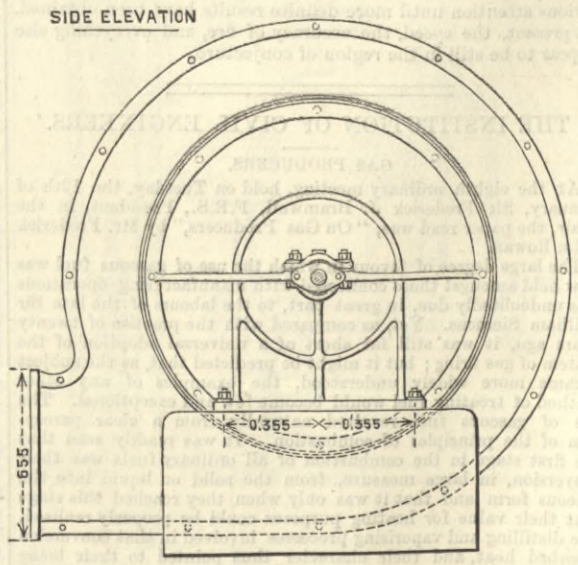
THE ATHUS IRON AND STEEL WORKS.

No. III.

Steel Works.—Excepting only the works of the Aachener Hütten Actien Verein, at Rothe-Erde, near Aachen, where probably the Thomas-Gilchrist process is best carried out, the Athus Steel Works yield to none at present erected on the Continent for completeness and convenience of arrangement. They were designed, in accordance with the Holley method, by M. A. Greiner, engineer in charge of the blast furnaces and steel works at Seraing, and carried out by the Cockerill Company. Referring to the general plan of iron and steel works—see page 22 *ante*—a large Bicheroux furnace,* a 15-ton steam hammer, eighteen Gjers' soaking pits, and an hydraulic crane, have now been erected on what is marked "space for ingots." But, on account of the low price of steel, the erection of the rolling mill has been delayed, and only six of the twelve boilers for the steel works have at present been laid down.

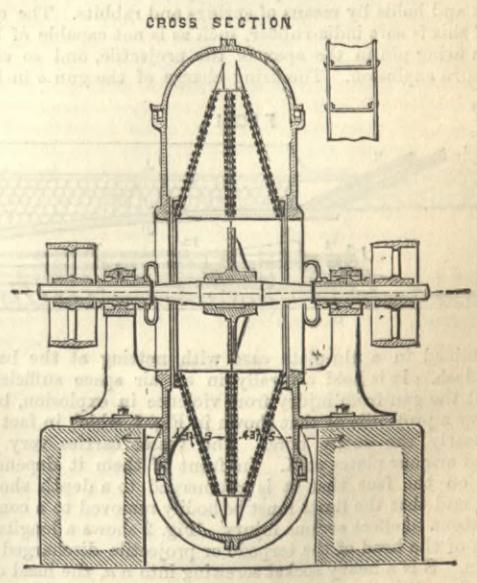
The above vertical section is longitudinal through the melting department, but transverse through the casting-house adjoining. A subterranean passage, shown on the general plan of works, and seen at the level of the converter bridge in the section, leads from the blast furnaces to the casting-house for conveying the molten metal directly to the converters, as will be explained below; but it was necessary to provide for melting the pig iron run on Sundays and at such times as the steel works might not be ready to receive it. Accordingly, two cupolas, seen in the section, have already been erected for this purpose, together with a smaller one adjoining, and another opposite, for melting the spiegeleisen. Space is also left on the other side of the building, not shown in the section, for two more iron and two more spiegel cupolas when required. At the end of the building is an Armstrong hydraulic lift, made by the Cockerill Company, for raising the charge to the level of the cupola mouths. The frame of the lift is constructed in iron, with guides like those of a mine shaft, having automatic catches which drop, after allowing the platform to pass them, so as to sustain the cage and charge. The rack and pinion are solid steel castings. The capacity of each of the spiegeleisen cupolas is 2 tons, and that of each of the pig iron cupolas 12 tons. At first only 8 tons were charged in at a time; but the quantity has been gradually increased until more than 10 tons are now melted at once in about half-an-hour. The cupolas are lined with refractory fire-bricks obtained from Morialme, near Charleroi, and from Forges near Chimay, in the province of Hainault. They are, as a rule, of fair quality, the lining generally lasting for seventy charges. The bottoms of the cupolas are made to let down, so that the interior may cool quickly when it becomes necessary to repair the lining. The sectional area of the tuyeres is 40 square centimetres, or 6 square inches, for the pig cupolas; and 30 square centimetres, or 4½ square inches, for the spiegel cupolas, as it is considered right that the blast should expand rather than be throttled, in which latter case the fan would not be performing its full duty.

For supplying the blast to the cupolas, there are a couple of Farcot fans—one in reserve—each yielding, at 900 revolutions a minute, 500 or 600 cubic metres, or 17,658 to 21,190 cubic feet, of air, at a pressure corresponding to that of 45 cm., or 17¾in., of water. This system of fan affords a blast of considerable pressure, or a high degree of vacuum, and also possesses the advantage of giving great elasticity of blast, as it is capable of yielding a very variable volume of air, while only absorbing motive power corresponding with the volume delivered. M. E. D. Farcot, of Paris, has during many years past turned his attention to the improvement of exhaust and pressure fans, and his investigations have also led him to devise a dynamometer for ascertaining the exact amount of power absorbed by belt-driven machines, such as ventilators. His first pressure fan, with annular reservoir round the periphery of the revolving portion, was put down at Creusot in 1881, pressures corresponding to only 15 cm. and 20 cm., or 6in. to 8in., of water being then required. These were afterwards increased to 25 cm. and 30 cm., or 10in. to 12in.; and ultimately a pressure of even 45 cm., or 17¾in., of water was attained without accident, while utilising 70 per cent. of the motive power expended. When, however, the number of Bessemer steel works increased on the Continent, and it was required to melt 7 and 10 tons of iron per hour in small cupolas, pressures of 50 cm. to 60 cm., or 20in. to 24in., were required. Having ascertained by experience that his fans yielded a pressure in direct ratio to the square of the speed, M. Farcot was able to attain a pressure of 1 metre, or nearly 40in., of water with a single fan of small diameter revolving at great velocity. In one instance, the centrifugal force developed by the high speed caused a fan, which had been designed for a much lower volocity, to break down; and it was some time before the exact cause of failure was ascertained. However, on increasing the strength of the vanes and tripling the number of rivets connecting them with the side discs, pressures of 50 cm. and 60 cm., or 20in. and 24in., of water were maintained regularly and without accident, by 2-metre and 2½-metre fans, at the works of De Wendel, at Hayange; Cockerill, at Seraing;



and many others on the Continent. The Athus fans are shown in the annexed side elevation, longitudinal section with half the outer casing removed, and cross section; and also by the accompanying enlarged sectional details of the vane arrangement. The fan proper, or revolving portion, which M. Farcot calls a "turbine," consists of two conical discs connected by curved vanes, which latter do not extend quite to the periphery of the discs, but fall short of them by 4½in., the diameter of the side discs being 1·774 metre, and that of the central disc and vanes 1·54 metre. In this way, there is formed an annular chamber or reservoir of half the area of the open-

ing at the periphery of the vanes, which serves to collect the air issuing from the channels formed by the vanes, while equalising the pressure, and distributing it over the whole outer surface of the revolving portion. The vanes,



inclined at an angle of about 45 deg., are arranged so as to take up the air without shock over the whole circumference of the central inlet. The air, thus drawn along between the vanes, circulates in the channels formed by them, following a curve of special form, so as to be delivered in a direction more inclined than the radius, making with it,

* An engraving of the Bicheroux furnace was given in connection with the visit of the Institution of Mechanical Engineers to the Cockerill Works. See THE ENGINEER of July 27th and August 3rd, 1883, Nos. 1439 and 1440, vol. lvi., pages 63 and 85.

in fact, an angle of about 35 deg., and thus considerably increasing the effect of the centrifugal force. Experience has shown that this uniform delivery prevents a difference of pressure at the front and back of the vanes, causing currents and vibration, which produce the noises that are heard when the vanes are continued quite up to the periphery of the discs. The fans are driven, each by a pair of belts from pulleys on a counter-shaft, which is put in motion by a 50-horse vertical engine of the steam-hammer type, made by the Société John Cockerill, at Seraing. The arrangement of counter-shaft, pulleys, and belting for getting up the necessary speed, resembles an electric lighting installation. Indeed, at some basic steel works now being erected for Metz and Co., at Dudelange, in the Grand Duchy of Luxemburg, the same engine is destined to drive the dynamos for electric lighting at night, and the fans for supplying the blast to the cupolas, when required, during the day.

In the covered way, above mentioned, leading from the blast furnaces to the converter bridge, is a tramway, of 1·4 metre, or the normal gauge, on which runs a truck, with 10-ton ladle, drawn along by an endless chain passing round a horizontal pulley. The requisite tension is obtained by means of two lateral horizontal pulleys and a counterweight, the chain being actuated by hydraulic power of 300 lb. to the square inch. In the ordinary way the ladle receives the molten metal from the blast furnaces, tapped directly into it; but, when occasion requires, it can also receive the metal from the pig iron cupolas, as it passes in front of those already erected, or between the two rows of cupolas, as shown on the general plan of works at page 22. The tramway is on a level with the converter bridge, because, as has been said, the steel works are 8 metres, or 26ft. below the ironworks.

The sad accident which occurred at the North-Eastern Steel Company's works, on the occasion of the Iron and Steel Institute's visit to Middlesbrough, cannot be repeated at Athus with the molten pig ladle at any rate, because, instead of tipping, it is tapped directly into the converter mouth, like a cupola or blast furnace. The smaller ladle for the melted spiegeleisen, however, being more under control, is made to tip in the ordinary manner. Another source of accident at the Middlesbrough works is avoided at Athus through the bridge being protected by a hand-rail, and also by an angle-iron along the edge, which prevent any object from falling over on to the men below.

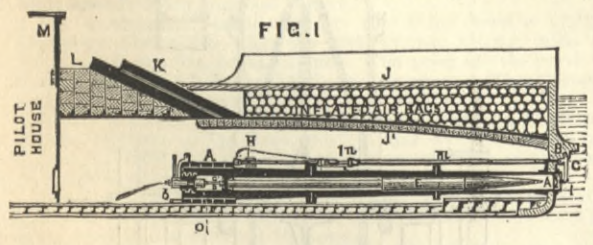
The steel works were put up under the superintendence of M. H. Schuler, engineer, from the Liége School of Mines, who afterwards took their management, under the general direction of Baron Fernand D'Huart, administrator délégué, or managing director of the Athus Company.

ERICSSON'S DESTROYER AND SUBMARINE GUN.*

THE Destroyer is a species of torpedo boat or, if Ericsson insists on it, a partially armoured gunboat made to attack bows on at a short range. Lieut. Jaques introduces the discussion of the subject by reference to the attempts made to destroy ships by firing at them beneath the water. This was attempted by means of Greek fire by Callinique in the year 668, and it is stated had been tried by Assyrians and Persians long before. Saint Cyr—a Frenchman—employed a carronade and powder towed below water in 1797, and Fulton, in New York harbour in 1814, designed and tried heavy submarine batteries. Phillips of Indiana in 1855, and Woodbury of Boston in 1861, revived the same idea, followed up by Forbes of Boston in 1862. In 1867 Duffy—an American—exhibited a submarine gun in the French Exposition. In England some trials with various guns, firing above water but at portions of vessels below water, showed that the Whitworth flat head was best suited for such an operation. In September, 1854, Ericsson submitted a design of an ironclad steam battery firing submarine projectiles to the Emperor Napoleon III., which was favourably acknowledged. In 1870 he addressed the U.S. Navy Department, proposing a torpedo propelled by compressed air. In 1866 Longridge submitted a design which he considers to have been the foundation of the Polyphemus, but superior to it in some respects. It had a submarine gun in the bow instead of the Whitehead torpedo tube. In Fig. 1 herewith we give a longitudinal section of the bows of Ericsson's Destroyer specially designed for attacking ships carrying 120-ton guns.

The vessel in its bows carries the gun, as shown, charged, in Fig. 1. There is a valve in the muzzle opened and closed by a hinged lever G. There is also a temporary valve entered in the bore from the breech and pushed up to the muzzle, where it catches and holds by means of springs and rabbits. The central part of this is soft india-rubber, such as is not capable of affecting the firing pin in the apex of the projectile, and so causing premature explosion. The firing charge of the gun *o* in Fig. 1,

FIG. 1

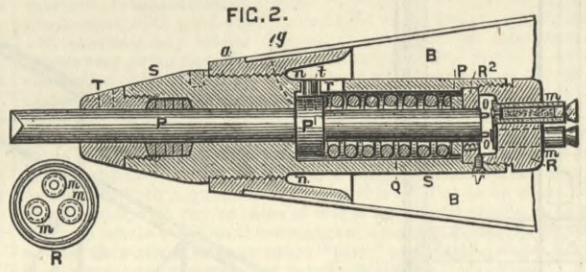


is contained in a tin-plate case with netting at the back to admit flash. It is held centrally in an air space sufficient to prevent the gun from injury from violence in explosion, behind so heavy a projectile as that shown in Fig. 1, which in fact occupies nearly the entire bore. The vessel carries very thick inclined armour plates at K. In front of them it depends for safety on the fact that it is submerged to a depth shown in Fig. 1, and that the floats must be bodily removed to a considerable extent to effect serious injury. Fig. 2 shows a longitudinal section of the head of the torpedo or projectile discharged from the gun. S is a heavy socket screwing into *n a*, the head of the projectile. B is the chamber containing the explosive or bursting charge. P is the projecting firing pin fixed in the axis of the socket S. Q is a very strong spiral spring. R is a screw plug with holes to receive fulminate primers or cartridges *m m*. It is held from turning by a screw *v*. The firing pin P, which is chisel pointed so as to bite well, carries on its rear end two or more points *o o*, to

* Question of the Day. No. xxi. G. P. Putnam's Sons, New York and London. By Lieut. W. H. Jaques, U.S. Navy.

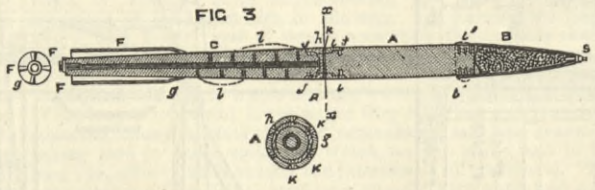
strike the primers *m m*. It works water-tight in the packing or stuffing-box T in S. The collar P is acted on by the spring Q. The action is obvious. On impact, the firing pin, in coming in contact with anything sufficiently rigid, compresses the spring, and the points *o o* fire the primers *m m*. The projectile has a

FIG. 2.



wooden body and tail, which tapers to the rear, and carries four radial and longitudinal steadying wings—*vide* Fig. 3. The weight of the projectile is brought to nearly, but not quite, as much as the water it displaces. The centre of gravity is towards the front. *f*—Fig. 3—is an iron band with screws *i i*. The wooden tail-piece C has screws *j j*. There is a flanged abutment piece *h*, a ring *f*, and screws K K. The powder chamber B fits over the wooden body A, and is held by screws *l l*. The "pins" F F—query fins F F—are of wood

FIG 3



faced with plates of iron or steel. The projectile thus made, is strong enough to bear both discharge and impact. In December, 1881, a board was formed of three naval officers to inquire into and test the design as a complete engine of war. The owners objected to fire the submarine gun when at full speed as involving danger, and the report of the board was unfavourable—as we should naturally expect under these circumstances—but they recommended further and prolonged trials of the gun, and considered the torpedo strong and simple, and the gun as simple as any other breech-loader. They concluded that the torpedo was most formidable, and superior to any known form of torpedo.

In January, 1883, the inventor took the entire matter into his own hands, and determined to prepare for a trial at sea; and in April, 1884, he sent in specifications and drawings for a steel Destroyer, to be delivered complete within twelve months. The vessel is practically a floating gun carriage; it attacks at a range of 300ft., which Ericsson considers sufficient to give it a good chance of escaping destruction. Lieut. Latour's experience in destroying the Chinese flagship shows the extreme danger that may be run by torpedo boats in approaching close to attack. For further details the reader is referred to Lieut. Jacques' volume, which gives a clear and good description.

We must be permitted to add for ourselves that we find the Destroyer in a more imperfect state than we had supposed it to be. We fail to get anything like a practical trial hinted at, and in such a design this is most important. Certain objections present themselves which could only be removed by the results of actual trial. First, in the system of discharge. The velocity being imparted by a firing charge in the gun must diminish very rapidly in passing through water; we cannot believe that a torpedo so propelled has the future that a self-propelling one has before it. The resistance of water is enormous, and increases rapidly with the velocity; hence a self-propelling torpedo with comparatively low velocity meets with much more less resistance and has its full velocity near the end of its run, instead of wasting it in useless violence at the starting point. Then the Destroyer, we are told, does not equal in speed the torpedo boats of accepted types. This sounds most serious, if not fatal to success. We presume Ericsson trusts to the armour to preserve the boat from destruction. The Destroyer, however, has to approach within 300ft. at least before it can act. It has, in fact, both to advance more slowly, and also to come closer, by the confession of its advocates, than an ordinary torpedo boat. We do not for a moment contemplate the armour being pierced, but unless there is a considerable wave raised, an insignificant common shell with a percussion fuse striking the inflated bags and thin steel deck in front might apparently work destruction and disable the gun and boat. Even the projectiles of a quick firing gun might do so. However, without insisting on such objections, we may repeat that the Destroyer is not at all in a stage to claim serious attention until more definite results have been obtained. At present, the speed, the accuracy of fire, and everything else appear to be still in the region of conjecture.

THE INSTITUTION OF CIVIL ENGINEERS.

GAS PRODUCERS.

AT the eighth ordinary meeting, held on Tuesday, the 12th of January, Sir Frederick J. Bramwell, F.R.S., President, in the chair, the paper read was, "On Gas Producers," by Mr. Frederick John Rowan.

The large degree of favour in which the use of gaseous fuel was now held amongst those connected with manufacturing operations was undoubtedly due, in great part, to the labours of the late Sir William Siemens. Yet, as compared with the practice of twenty years ago, it was still far short of a universal adoption of the system of gas firing; but it might be predicted that, as the subject became more widely understood, the examples of any other method of treating fuel would become few and exceptional. The use of gaseous fuel resulted naturally from a clear perception of the principles of combustion. It was readily seen that the first stage in the combustion of all ordinary fuels was their conversion, in large measure, from the solid or liquid into the gaseous form ,and that it was only when they reached this stage that their value for heating purposes could be properly realised. The distilling and vaporising processes involved in that conversion absorbed heat, and their character thus pointed to their being separated from subsequent heat-producing operations. When they were carried on in the same chamber in which the resulting gases were burned, the maximum temperature attained was, as might be expected, much lower than that attainable by other means. There were also sources of loss of heat inseparable from the direct use of solid fuel, such as imperfect combustion, the impossibility of minimising the quantity of air introduced for combustion on account of the complexity and constant variation in the operations involved, radiation from solid residue, &c., all of which intensified that result. The actual conditions of combustion and the extent of the various losses, in quantity of heat, occurring in coal-fired furnaces has been formulated by Rankine, Minary, Schwackhöfer, and others, while Robert Galloway had directed attention to the difference in temperature, or calorific intensity, obtained when carbon was burned in air, and when carbonic oxide was so burned. It appeared that a higher calorific intensity might be obtained with the gaseous fuel, chiefly on account of the smaller quantity of air required for combustion, and as a consequence the much lessened dilution of the heat by inert nitrogen and carbonic acid. The investigations of the late Dr. Grouven, of Leipsic, of Mr. William Foster, and of others, by directing attention to the nitrogen contained in coal, and to the large proportion remaining in coke and recoverable therefrom, had added to the advantages of the use of gaseous fuel the important consideration of the value of bye-products which might be associated with its production. If any of the nitrogen existing in coal was to be recovered as ammonia, the employment of gas producers of some sort became a necessity. In the production of gas from coal and coke, the following classes of apparatus had been devised and used:—(1) Retorts, heated externally, for distilling the hydrocarbons from coal apart from contact with air; coke, as a refuse material, being withdrawn periodically. This was the ordinary form of plant in use in gasworks. (2) Generators, or producers, in which coal was consumed or converted into gas by combustion with access of air. The hydrocarbons were distilled in these appliances by means of the heat conducted or radiated from the zone of combustion, and the coke or fixed carbon was burned with air first to carbonic acid, which was thereafter reduced to carbonic oxide by contact with the incandescent carbon. (3) Producers, in which the same result was arrived at, with the modification in the composition of the resulting gas due to admixture of steam with the air supply. In the two latter classes the producers might have either a grate with bars or a closed hearth, and might consist of one or of two chambers. In the latter case the distilling chamber might be heated partially or entirely from flues or passages on the outside. The resulting gas was of the same composition in both cases, and must contain from 30 to about 60 per cent. by volume of nitrogen derived from the air introduced for combustion. In one form of the apparatus of Class 3, namely, Young and Beilby's, steam was used in excess, while the combustion of the coke was maintained at a comparatively low heat, as the primary purpose of this apparatus was not the production of good heating gas, but the securing of the nitrogen of the fuel as ammonia. (4) Apparatus in which incandescent coke or anthracite was used to decompose steam for the production of "water gas," either continuously, by the use of retorts heated from the outside, which contained the carbon in contact with which steam was decomposed, or intermittently, by the use of generating chambers in which the carbon was first brought to a state of bright incandescence by an air blast, and into which, secondly, steam was passed through the carbon, the air blast being shut off; or the heat produced by the combustion of the carbon, or of gases from the generating chamber, was, in the first instance, stored up in brickwork, which, being made white-hot, was then used to decompose steam. (5) The author had recently proposed an apparatus combining the retort system of distilling the hydrocarbons from coal with means for consuming the resulting coke or fixed carbon in an atmosphere of steam only, excluding air and applying a sufficiently high temperature to prevent or minimise the formation of carbonic acid, the whole working together continuously and automatically. The practical value of any example of these various classes depended upon the quality of the gas produced and the cost of production, a rough practical test of the efficiency of a gas producer being afforded by the percentage of carbonic acid and nitrogen contained in the gas, and the volume of gas of a given temperature produced per ton of coal. An exception was made in such special apparatus as that of Young and Beilby, which must be tested by the yield of ammonia obtained per ton of coal. A table containing, it was believed, all the trustworthy analyses of producer gases available was given in an appendix. These analyses showed that the gas from producers worked by internal combustion did not contain more than 45 per cent.—but as low sometimes as 26 per cent.—of combustible ingredients, having, according to the various authorities, a theoretical calorific intensity of from 1575 deg. to about 2200 deg. Cent. Water-gas made either by means of retorts or of intermittent apparatus, and ordinary illuminating gas made by distilling coal, contained from 86 to 97 per cent. of combustible matter with corresponding possibilities of producing high temperatures. Illuminating-gas had, however, a higher calorific value than ordinary water-gas, but not higher than the gas made in the apparatus of Lowe and Strong. The investigation of thermo-chemical data, connected with the question of the economical working of producers, did not enter into the scope of the paper; but the advantage of using steam along with the air supply in internal-combustion producers might be referred to. Mr. R. Schöffel had calculated, on the supposition that producers were worked at a minimum temperature of 1200 deg., that 85 parts of carbon were gasified by air when 12 parts were gasified by steam, and that 18·5 parts of steam were required for 100 parts of carbon. Mr. A. Wilson had shown that the mixture to produce 100 parts by weight of gas was roughly:—Coal, 17·5; air, 79·9; and steam, 4·0; or that 100 parts of coal required 22 of steam. Allowing for the difference between coal and carbon, Schöffel's calculation was practically in accordance with Wilson's. It was however, probable that, in the future, efforts would be directed towards the perfection of means of producing gas free from the dilution of the large quantity of nitrogen derived from an air supply, as this system not only afforded the means of obtaining high temperatures of combustion, but also tended to simplify furnace arrangements, rendering it necessary to heat the air only prior to combustion in them and not, as at present both air and gas. The historical portion of the subject embraced the various steps in the introduction of gaseous fuel; the numerous attempts to manufacture it according to the information possessed at the time, and the experience thus gained; and the different designs of producers, with the influence of the introduction of suitable furnaces for the use of gas upon these designs. The employment of waste gases from iron furnaces and from various metallurgical operations was clearly the first movement in this direction. The author then proceeded to describe, in detail, the gas producers of Bischof, Ebelmen, Ekman, Beaufumé and Siemens—the latter being an outcome of the regenerative furnace. Lundin and Bérard added apparatus to producers for washing the gas; and descriptions were given of the Benson producer, and those of Minary, Wittenström, and Kidd. The processes of Lowe and Strong for illuminating and for heating gas were then referred to, followed by notices of the producers of Tessié du Motay, Wilson, Dowson, Gröbe and Lürmann, Sutherland, a modified Siemens' producer of the old type, Howson, and the apparatus of Young and Beilby, which was devised primarily to recover as ammonia the nitrogen in shale and coal. The paper concluded with an account of what had been done in the way of recovering ammonia and tar from producer gases.

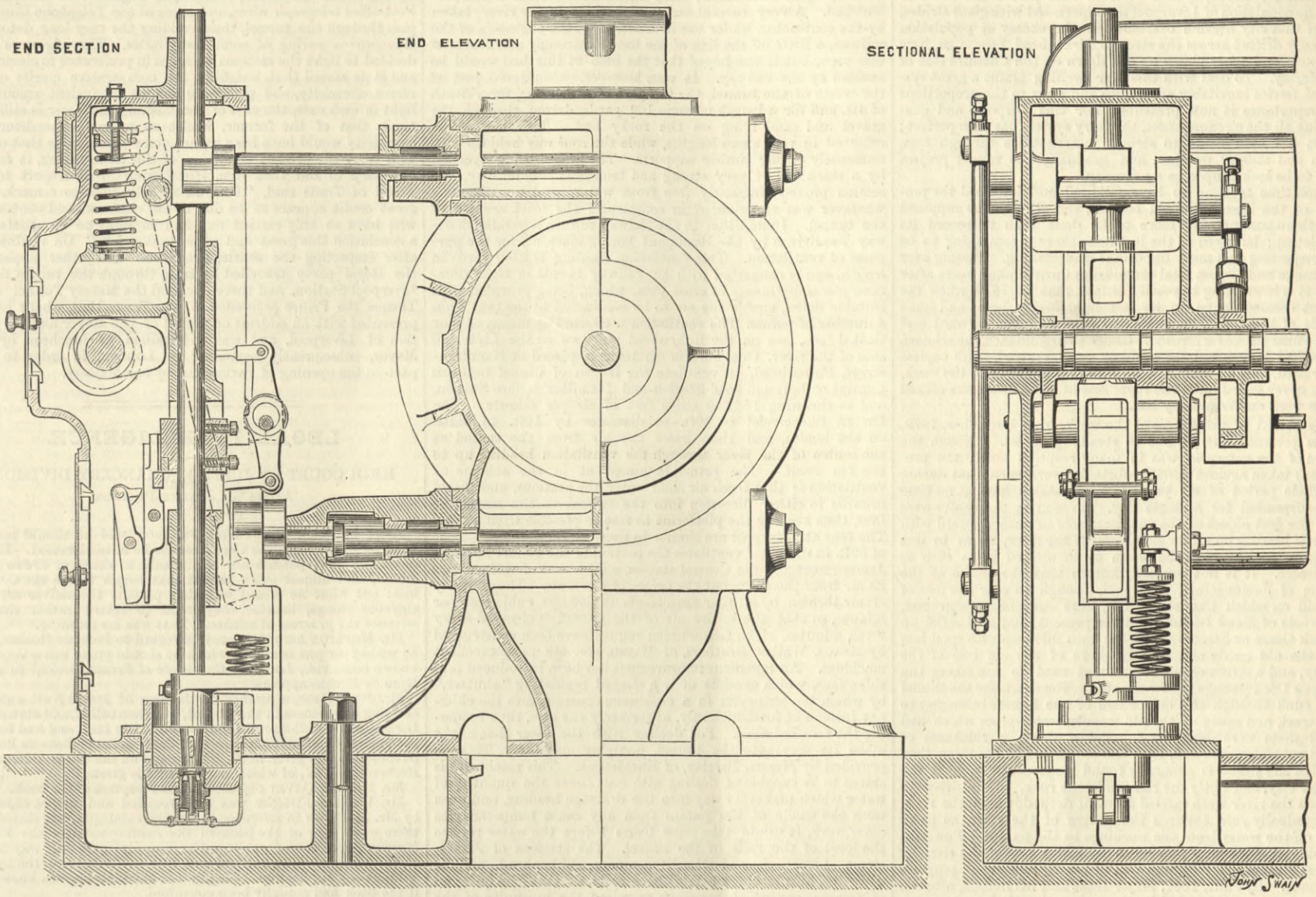
TENDERS.

TENDERS for providing and fixing wrought iron hurdle fencing in Lancaster-street and Regent-street, for the Corporation of Leicester. Quantities by Mr. J. Gordon, C.E., borough surveyor.

	£	s.	d.
Brookes and Co., Wolverhampton—accepted	288	0	0
Wright Brothers, Leicester	324	5	0
E. C. and J. Keay, Birmingham	327	5	0
W. Hayward and Co., Wolverhampton	338	15	0
Iron, Wire, and Wire Rope Fencing Company, London	343	1	3
W. W. Judd and Co., Leicester	346	11	3
W. T. Burbidge, Leicester	363	10	0
Hydes and Wigfull, Sheffield	368	18	9
Hill and Smith, Brierley Hill	389	11	8
J. O. and C. E. Brettell, Worcester	397	8	9
G. B. Smith, Glasgow	402	7	6
Baldwin and Amies, Ashbourne	472	15	0
C. Mason and Co., Leicester	621	17	6
Johnson Brothers and Co., London—incomplete	281	0	0

150-HORSE POWER HORIZONTAL ENGINE.

MESSRS. HICK, HARGREAVES AND CO., BOLTON, ENGINEERS.

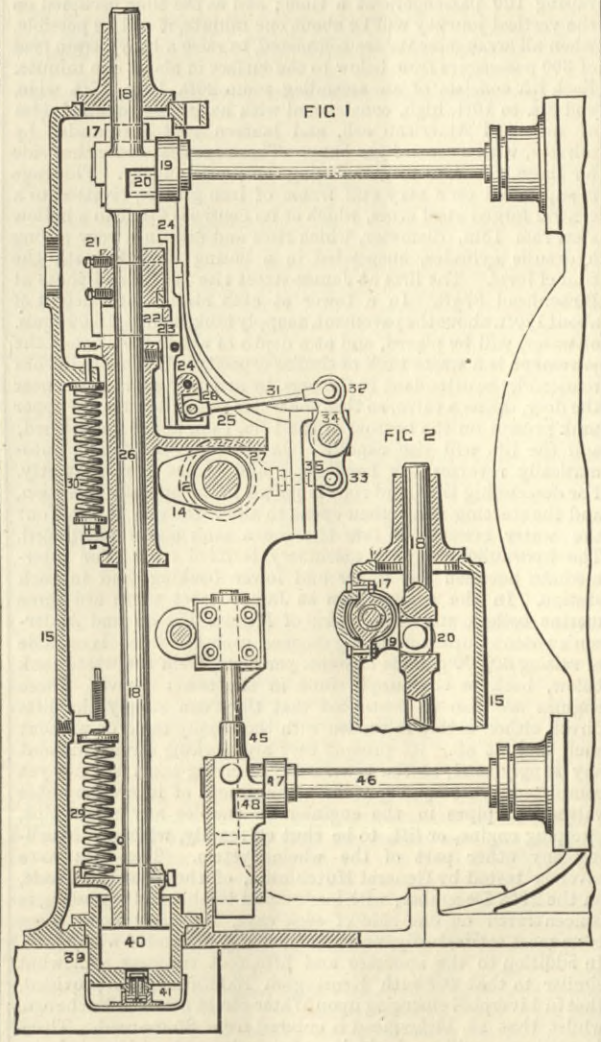


MESSRS. HICK, HARGREAVE'S, AND CO.'S HORIZONTAL ENGINE.

WE illustrate above and on page 68, an engine which deservedly attracted much attention at the Inventions Exhibition. The engine is fitted with Hargreaves and Inglis' trip gear. We give an elevation of the engine, and an enlarged view of the valve gear. We also give so much of the patent specification as will suffice to make the action of the valve gear intelligible. A horizontal valve motion shaft 12, Fig. 1, driven by means of bevel wheels from the crank shaft, is carried at the side of the cylinder at the level of and parallel to the cylinder's axis, and has cams 14 fixed on it for opening the admission valves. The part of the valve motion shaft 12 near the cylinder is carried in two hollow standards 15, in and on which are also carried various parts of the valve gear. One of these standards 15 is shown in vertical section in Fig. 1, whilst Fig. 2 is a section of the upper part as taken at right angles to Fig. 1. The admission valves, which are supposed to be of the Corliss type, but not shown in detail in the drawings, are placed, as usual with such valves, across the top of the cylinder, their spindles 16 being horizontal, and extending outwards to bearings 17 at the upper part of the standards 15. The admission valve spindles 16 are acted on each by a vertical rod 18 arranged to move vertically in guides in the top and bottom of the standard 15, each valve spindle having fixed on it a lever 19 formed or fitted with a pin, having on it a square block 20, which has a slight transverse movement in a slot or groove formed across an enlargement on the vertical rod 18. Below the slot each vertical rod 18 has adjustably fixed on it a block or boss 21 fitted with a horizontal steel engaging edge 22 across the bottom at one side, and a corresponding steel engaging piece 23 is fixed upon a lever piece 24, which is jointed to a casting 25 formed with a sleeve or tube 26 to slide on the vertical rod 18. This casting 25 is also formed with a horizontal arm 27, and it is on the underside of this arm that the cam 14 on the valve motion shaft 12 acts. As the cam 14 rotates it lifts the sleeve piece 25, 26, 27, and the lever piece 24 thereon, being then in a suitable position—insured by means of a helical spring in a socket formed in the sleeve 26, the spring pressing the lower part of the lever piece towards the cylinder; the engaging piece 23 engages under the engaging edge 22 of the block 21 fixed on the vertical road 18, and causes this rod to be lifted and the valve to be opened by it. The cam 14 is shaped to keep the valve open for a maximum period, and when the steam or motive fluid is to be cut off at an earlier period of the stroke, a trigger 28 acts on the lever piece 24 so as to move its engaging piece 23 from under that 22 of the vertical rod 18, whereupon the vertical rod drops by its own weight, aided, if necessary, by a spring 29, and quickly closes the valve.

One object had in view in devising the improved valve gear is the opening of the valve to its full extent or nearly so at a very early period of the stroke, so that it may be well open even when the cut-off is made very early, a result which is not satisfactorily obtainable with ordinary Corliss valve gear. The cam 14 is shaped to open the valve quickly and fully and then to keep it so open until the release takes place, and a spring 30 is applied to the sleeve piece 26 to keep it with its arm 27 always in contact with the cam. The trigger 28 is centred on the sleeve piece casting 25, and it is connected by a rod 31 to a lever piece 32, 33, on a shaft 34 carried in stationary bearings in the standards 15, and hereinafter termed the regulating shaft. The lever piece is a tubular boss having oppositely directly levers 32, 33, formed or fixed on its opposite ends, and receives a rocking motion by means of a rod 35 from an excentric on the valve motion shaft 12, and thereby causes the trigger 28 to effect the release. The parts of the regulating shaft 34 on which the lever pieces 32, 33 are carried are formed excentrically relatively to the parts of the shaft held in the stationary bearings, in consequence of which a small rocking or angular adjustment of this regulating shaft in its bearings alters the action on the triggers 28 so as to cause the cut-off to take place at an earlier or later period of the stroke. The regulating shaft 34 is connected to a governor.

The usual dash-pot or cylinder 39 for arresting the motion of



the parts when closing the admission valves is by preference placed at the bottom of the standard 15, a piston 40 being fixed at the bottom end of the vertical rod 18, and a check valve 41 being fitted to the bottom of the cylinder 39 to admit air when the rod and piston rise. An adjustable valve or cock may be fitted to the cylinder 39 to regulate the ingress and egress of the air. The exhaust valves of the engine may be worked from the valve motion shaft 12 in various ways. Excentrics 42 on the shaft act each on a lever piece 43, which is arranged to act in the manner of a Corliss wrist plate, and which is connected by a rod 44 to a short vertical rod or slide 45. Each rod or slide 45 which works in vertical guides is made to act on the exhaust valve spindle 46 by means of a cross slot, the spindle 46 having fixed on it a lever 47 formed or fitted with a pin, on which there is a square block 48 working in the cross slot. The excentrics 42 might be connected directly to the vertical slides 45, but with the interposed lever or wrist pieces 43 a pausing or lingering takes place in the movement, so that it operates with a diminished extent of motion of the valves.

Messrs. Hick, Hargreaves, and Co., state that they are applying this new valve gear to a good many engines. It was first applied to a large engine at the Eagley Mills, Bolton, with a single cylinder and Corliss valves, the cylinder 52in. diameter, 6ft. stroke, 60 revolutions per minute, 1800 indicated horse-power, belt driving; afterwards to a pair of compound mill engines, with cylinders 50in. and 84in. diameter, 8ft. stroke, 45 revolutions per minute, 100 lb. pressure, rope driving, as well as to many other large engines, it being specially adapted to cylinders of large size. The particulars of the Exhibition engine are as follows:—Cylinder 20in. diameter, 4ft. stroke, 60 revolutions per minute, 150 indicated horse-power, Corliss valves. The cylinder is steam jacketted on an improved plan, with separate liner and end valve chambers. The piston-rod is of steel, steel crosshead, wrought iron connecting-rod 11ft. centres, marine type, wrought iron crank, and forged steel shaft, rope pulley fly-wheel 20ft. diameter, built up on Mr. Hick's improved plan, with separate centre boss, separate arms, and segments in the rim. The joints are planed by special machinery, the arms are boarded up, and internal toothed segments on the rim are fitted for the automatic barring engine. This small turning engine is arranged with two cylinders, a worm and worm wheel; it is put into gear by a brake, and falls automatically out of gear when the main engine starts. The peculiarity of the new Corliss valve gear fitted to this engine is that it gives the steam valves a very quick opening. They are full open at one-tenth stroke; if the cut-off is later than one-tenth the valves remain full open without movement, a separate motion effecting the release or cut-off. The exhaust valves are worked separately by independent movements, and the gear allows of the separate or independent adjustment of each of the four valves. The point of expansion is controlled by a high speed governor combined with one of Knowles' patent supplementary governors, which are coming now into very extensive use in this country. The load on this Exhibition engine was very varying, but the record taken each day by the Moscrop recorder showed that the speed was maintained almost exactly, which is, of course, of great importance for spinning mills, where the Knowles governor is well appreciated.

OPENING OF THE MERSEY TUNNEL.

AFTER nearly twenty years' waiting, perseverance, and hard work, the subway between Liverpool and Birkenhead not only is an accomplished fact, but has been declared open by, and has received the stamp of royalty at the hands of, the Prince of Wales, who being the guest of the Duke of Westminster, at Eaton Hall, during the past week, was able to take part in the ceremony of inaugurating one of the greatest examples of engineering skill and commercial enterprise which the present generation—if not the present century—has witnessed. In the Severn Tunnel there is, perhaps, a greater illustration of what modern engineers can accomplish; but the Mersey Tunnel is the first of its order open to the public since the Thames Tunnel of very many years ago, and is entitled to the honours of a new work, which promises to be of greater commercial and general public advantage than can easily be estimated; affording the means of direct and rapid intercourse between the two banks of

a great river which has hitherto been a serious impediment to easy inter-communication. It appears from authentic documents that there has existed something in the nature of a ferry system between Liverpool and Birkenhead for the last eight hundred years, but for the present purpose it is enough to look back for twenty years. Within that period the business and the population of Liverpool have increased with giant strides, and as that city became overcrowded the excess of population naturally drifted across the river to Birkenhead, Seacombe, New Brighton, and other places up and down on the Cheshire side of the Mersey. To deal with this ever-swelling traffic a great system of ferries inevitably sprung up and grew to the proportions and importance it now presents. For this purpose, and considering all the circumstances, the ferry system has been perfect; but it has been liable to serious interruptions through fogs, rough and stormy weather, and gradually the tunnel project came to be looked upon as a necessity.

From time to time we have followed and described the progress of the Mersey Tunnel scheme, and it might be supposed that there was nothing more to be done than to record its completion; but even at the last hour there is something to be said respecting this most important undertaking. Passing over its strange and almost fatal vicissitudes during many years after 1866, it is interesting to recall the fact that in 1879, when the project seemed to be on its last legs, Major Isaac and some friends of kindred spirit and equal courage came forward and made a final stroke for fortune. Under their guidance, the scheme, which had languished for so many years, revived, fresh capital was raised, and at length a new start was made on the work, which never ended until the royal seal of completion was affixed to the work on Wednesday last.

The record of the stages of the work, from December, 1879, to the present time, is one of steady progress. Though the nature of the enterprise was in many respects novel, the precautions taken against possible obstacles were such that during the whole period of six years the operations have at no time been suspended for a single day. So soon as the shafts were sunk, the first object of the engineers was to push forward with the trial heading on either side towards the river, so as to test and prove the nature of the strata to be worked in as soon as practicable. It is not generally known that the shafts at the bottom of James-street, Liverpool, though so near the foot of the hill on which that street lies, were sunk in made ground. The whole of Mann Island, from the present quay wall right up to Back Goree or Strand-street, has been filled up with spoil laid upon the old sandy and muddy shore of the old bed of the Mersey, and a street called Bird-street used to run where the George's Dock passage is now situated. The shafts for the tunnel were sunk through the old cellars of the houses belonging to this street, and many of the old wooden water-pipes which had served them were disinterred. Below these, a thickness of tipped rubbish was found, then the old strand of the river, then the blue silt which is generally found underneath it, next the boulder clay, and lastly the red sandstone rock. The drift-ways towards the river were carried forward deep down in the rock, and gradually rose towards the centre of the river, so as to drain off the water from the workings to the pumps. Powerful pumping engines were put down on either side of the river by Messrs. Hathorn, Davey, and Co., of Leeds, and rapid progress was made. By June, 1881, Major Isaac and his friends, after an outlay of some £125,000, felt themselves justified by the progress made, and the knowledge and experience of the strata under the river which had by that time been gained, in appealing to the public for capital.

In September, 1881, it was found necessary to have a second shaft on either side the river, so that one might be exclusively devoted to pumping purposes, while the spoil from the workings, which was continually increasing in amount, should be brought to the surface by the new shafts. These facilities were at once accorded by the Mersey Docks and Harbour Board. The formation of these second shafts was followed by the laying down of an additional pumping set, and the occasion of their completion was seized for an interesting ceremony, on the 29th of October, 1881, when Mr. Wm. Laird, Mayor of Birkenhead, and Sir Wm. B. Forwood, Mayor of Liverpool, started the new pumps. Whilst the work was proceeding in the driftway, the excavation for the actual tunnel was accordingly pushed on; but, owing to the gradient falling towards the river, it was necessary to get rid of any water that accumulated at the faces. To this end bore holes were put down at stated intervals into the drainage headings, and, as each advance hole was bored, the preceding one was plugged up.

In the spring of 1883 a new feature in the works was added by the adoption of the now celebrated boring machine of Colonel Beaumont, R.E., which in the end greatly accelerated the driving of the headways and main tunnel. Mr. Waddell's operations in breaking up the rock at different places to the size of the main tunnel, and bricking in short lengths, followed close upon the tunnel driven by Colonel Beaumont. On the 17th January, 1884, the last few feet of rock which divided the Beaumont machine on the Birkenhead side from the driftway on the Liverpool side were broken away by the boring machine in presence of the chairman, the Right Honourable H. Cecil Raikes, M.P., Major Isaac, Colonel Beaumont, Mr. Brunlees, and Messrs. Fox, the engineers, Mr. Patterson, the Mayor of Birkenhead, Mr. D. Radcliffe, the present Mayor of Liverpool, and a large party. After mutual congratulations, the Liverpool party, headed by the chairman, struggled past the boring machine, and were thus the first to pass from side to side under the river by the route which so many thousands will, henceforth, by the enterprise and perseverance of these pioneers, be enabled to enjoy.

One of the most creditable features of this work is the almost absolute accuracy with which the two sections of the tunnel under the river—being bored, of course, separately, and dependent upon correctness of calculation—were eventually brought together. Engineers, at all events, will appreciate the merit of the work when they learn that the deviation where the two sections met in the middle of the river was only one inch. Neither of the shafts at Birkenhead nor Liverpool was in the centre line of the railway, and the greatest length of base line that could be secured for working from was 12ft. The distance across from shaft to shaft was 1770 yards, or rather more than a mile. As soon as the necessary length of excavation at each face of the "break ups" in the tunnel—some 9ft. to 12ft.—was taken out, the bricklayers came in and rapidly built up the permanent tunnel. This consists of from six to eight rings of very heavy brickwork in cement, the two inner courses being blue Staffordshire or Buckley bricks. The width of the tunnel is 26ft., the height above rails 19ft., giving a height of 23ft. from invert to crown of tunnel. At the two stations—James-street, Liverpool, and Hamilton-square, Birkenhead—the tunnel arch is enlarged to 50ft. 6in. span and 32ft. in height by a length of 400ft. In enlarging the adit to the full size of the tunnel, an interesting geological fact, which had been anticipated, was proved. The evidence from borings for wells and other purposes, at Widnes, and other points in the upper reaches of the Mersey basin, had led Mr. J. Mellard Reade, C.E., of Liverpool, to the opinion that, in the old times, the neighbouring land was at a higher level, and that the Mersey then found its way to the sea along a course which, now that the land has again subsided, was filled up again and buried deep below the bottom of its present bed. A very careful series of borings in the river, taken by the contractor, under the instructions of the engineers of the railway, a little off the line of the tunnel, strongly corroborated this view, but it was hoped that the base of this bed would be avoided by the railway. It was, however, encountered just at the crown of the tunnel, the top part of which was, for a depth of 4ft. and for a length of some 100 yards, driven through the gravel and sand lying on the rocky bed. This had to be removed in very short lengths, while the roof was held up with immensely strong timber supports. The gravel being overlaid by a thick bed of very strong and tenacious boulder clay, this section proved singularly free from water, and no difficulty whatever was experienced in completing the brick arching of the tunnel. In addition to the railway tunnel, a parallel driftway was driven by the Beaumont boring machine, for the purposes of ventilation. This ventilation heading is 2300 yards in length, and is connected with the railway tunnel in eight different places by means of cross cuts, which, being provided with suitable doors, enable the air to be conducted to the fans from a number of points. The ventilation is effected by means of four Guibal fans, two on the Birkenhead and two on the Liverpool side of the river. One, 30ft. in diameter, is placed in Hamilton-street, Birkenhead, to ventilate the length of tunnel between Central or Borough-road Station and Hamilton-square Station, and is throwing 186,000 cubic feet of air per minute. The fan at Shore-road is 40ft. in diameter by 12ft. in width on the blades, and this draws the air from the tunnel at the centre of the river through the ventilation heading up to the fan itself. The principle aimed at in the scheme of ventilation is that fresh air shall enter the stations, and travel inwards in either direction into the tunnel to the respective fans, thus keeping the platforms as free as possible from smoke. The fans at Liverpool are similar to those at Birkenhead. That of 30ft. in diameter ventilates the portion of the tunnel between James-street and the Central station, whilst that of 40ft. draws its air from the tunnel at the centre of the river. The quantity of air thrown by all four fans is about 600,000 cubic feet per minute, so that the entire air of the tunnel is changed every seven minutes. The fans and fan engines have been constructed by Messrs. Walker Brothers, of Wigan, and are most excellent machines. An ingenious improvement has been introduced into these fans, which consists of a $\wedge$ shaped regulating "shutter," by which the air passes in a continuous current into the chimney instead of intermittently, as formerly the case, thus rendering the fans noiseless. For dealing with the water that might make its way into the tunnel, pumping machinery, has been provided by Messrs. Barclay, of Kilmarnock. This machinery is stated to be capable of dealing with four times the quantity of water which makes its way into the drainage heading, and even were the whole of the pumps from any cause temporarily to cease work, it would take some hours before the water rose to the level of the rails in the tunnel. The stations of James-street, Liverpool, and Hamilton-square, Birkenhead, are, of necessity, at a level far below the streets, so that the question of access is one which has much exercised the ingenuity of the engineers. A staircase is provided, but will probably be but little used except for gaining access to the machinery and store-rooms. At each station are provided three large and powerful hydraulic lifts, constructed by Messrs. Easton and Anderson, and placed in position under the superintendence of Mr. W. E. Rich, M.I.C.E., assisted by Mr. Charles May. The following particulars respecting these lifts will be interesting:—In each of these stations there are three lifts, each capable of raising 100 passengers at a time; and as the time occupied on the vertical journey will be about one minute, it will be possible, when all arrangements are completed, to raise a heavy train load of 300 passengers from below to the surface in about one minute. Each lift consists of an ascending room 20ft. long, 17ft. wide, and 8ft. to 10ft. high, constructed with handsome panelled sides of teak and American ash, and lantern roof surrounded by mirrors, with a central gas lamp. There are seats on either side for those who care to rest during the short journey. This cage is supported on a very stiff frame of iron girders, rivetted to a central forged steel cross, which at its centre is fitted to a hollow steel ram 18in. diameter, which rises and falls in a very strong hydraulic cylinder, suspended in a boring sunk beneath the tunnel level. The lifts at James-street rise 76½ft., and those at Birkenhead 87½ft. In a tower at each station, at a height of about 120ft. above the pavement, a supply tank, holding 10,000 gals. of water, will be placed, and at a depth of about 60ft. below the pavement is a waste tank of similar capacity. When any lift has to ascend, the attendant in the cage, by means of a hand rope near the door, opens a valve, so that the water pressure from the upper tank presses on the bottom of the 18in. ram, above mentioned, and the lift will rise rapidly. On reaching the top it automatically reverses the hand rope, and comes to rest quietly. For descending the hand rope is pulled in the opposite direction, and the starting valve then opens to allow the ram to force out the water beneath it into the waste tank above mentioned. The hydraulic pumping machinery is fixed on a floor intermediate between the upper and lower booking hall in each station. In the engine-room at James-street there are three marine boilers, and three pairs of Messrs. Easton and Anderson's patent duplex pumping engines, each of which is capable of raising 30,000 gallons of water per hour, from the waste tank below, back to the supply tank in the tower above. These engines are also so connected that they can supply the lifts direct, either acting in unison with the supply tank, or without such tank at all. At present they are working direct without any supply tank, as the towers for receiving them are not yet completed. A very ingenious arrangement of interchangeable valves and pipes in the engine-room enables any main pipe, pumping engine, or lift, to be shut off readily, without disturbing any other part of the whole system. The lifts were severely tested by General Hutchinson, of the Board of Trade, on the 29th December, with loads equal to about 140 passengers concentrated on one side of each cage, and they stood these tests most satifactorily, and ascended and descended with them. In addition to the staircase and lifts, foot subways, somewhat similar to that at South Kensington Exhibition, are provided, that in Liverpool emerging upon Water-street near the Exchange, whilst that at Birkenhead is entered from Shore-road. These foot subways will no doubt be extensively used, and are admirable specimens of good workmanship. In the rolling stock, every modern improvement has been introduced. The carriages have been built by the Ashbury Company, and form close-coupled trains. They are fitted with the vacuum brake and with inside handles which fasten themselves without being touched. The carriages are lighted with gas by the Pintsch's Lighting Company, and are provided with wheels and axles of very special manufacture. The engines have been built by Messrs. Beyer, Peacock, and Co., and are capable of drawing very heavy loads. They are what are known as condensing engines, with the view of keeping the tunnel free from steam, and in this they have so far been highly successful. The signals have been provided by the Railway Signal Company, of Fazakerley, and the telegraph by Mr. John Lavender, telegraph engineer, of Manchester. Post-office telegraph wires, and those of the Telephone Company pass through the tunnel, thus avoiding the very long detour by Runcorn—a saving of some forty miles. The engineers have decided to light the stations with gas in preference to electricity, and it is stated that, weighing the comparative merits of gas *versus* electricity, and providing for an equivalent amount of light in each case, the cost of establishing the latter is still four times that of the former, whilst an annual expenditure on electricity would have been rather more than double that of gas. This being the present condition of the undertaking, it is only necessary to add that Gen. Hutchinson in his report to the Board of Trade said, "I think it only just to remark, that great credit appears to be due to the engineers and contractors who have so ably carried out and brought to so satisfactory a conclusion this great and important work." On Wednesday, after inspecting the shafts, lifts, fans and other apparatus, the Royal party travelled by train through the tunnel to the Liverpool Station, and there declared the Mersey Tunnel open. Thence the Prince proceeded to the Town Hall, where he was presented with an address on behalf of the Mayor and Corporation of Liverpool, and was entertained at luncheon by the Mayor, subsequently hastening to London, in order to take part in the opening of Parliament by her Majesty.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE, CHANCERY DIVISION.

Before Mr. Justice Pearson.

OTTO *v.* STEEL.

After luncheon Mr. Justice Pearson said he should not like what he stated when the Court rose to be misunderstood. He did not mean that patents are so difficult to draw, or are so badly drawn, that almost every patent that comes before the Court is bad: but what he meant was that patents themselves are mischievous things, because they tend to retard rather than to advance the progress of science. That was his meaning.

Mr. Moulton here intimated, in regard to Beau de Rochas, that he wished to put in a book which he should prove was a very well known book, viz., Lorenz' "Catalogue of French Books," in which Beau de Rochas appears.

Mr. Meno Haas, a partner of the firm of David Nutt and Co., carrying on business in the Strand, was then called, and stated that Lorenz' was a well-known book, published in 1867, and had been in the possession of his firm since that date. A list of Beau de Rochas' publications was given in it. The second on the list is "Nouvelles Recherchés," &c., of which the full title is given.

Mr. Horace Davey objected to the reception of the book.

Mr. William Fletcher was then recalled and further examined by Mr. Moulton in reference to Lorenz' catalogue. He stated that there was a copy of the book in the reading-room of the British Museum, open to the public without applying in any way to any of the officials. The readers can take it down from the shelves without any application. He did not know of his own knowledge if the book had actually been consulted.

Mr. Davey objected to the reception of the book, on the ground that it did not prove anything material.

Mr. Moulton than said he proposed to deal with the question later on, and continued his address, dealing further with the plaintiff's patent of 1876. Dr. Otto there puts it forward that his charge is opposed to the others in not being explosive, but that it is a gradual combustion instead of an explosion. Now, he had asked Sir Frederick Bramwell, and he had got from him two or three times this admission, that if you have certain gases to ignite, uniform mixture burns more gradually than if it is irregularly mixed, and it is quite clear why it does. Supposing it is very rich in one part, that burns up so very much more rapidly and produces the heat so very much more quickly that it makes up for the slower ignition of the latter part. Sir Frederick Bramwell two or three times admitted that the combustion was more gradual if it was uniformly mixed than if it was not, and, to his astonishment, in the re-examination of Mr. Imray it was put forward that the uniform dilution would be slower in its combustion, and that therefore Otto's invention was that it was not uniformly diluted, and it burnt more quickly. As Mr. Imray said, it gets the pressure on at an earlier part of the stroke. Now, was he not right in saying that there had been a complete change of front? Dr. Otto thought he had changed an explosion into a gradual combustion, and that is what the Court of Appeal thought. He says so here in his specification, and the witnesses called to support his case say that by his arrangement you can get the pressure on so much more quickly in the early part of the stroke. Which is true? It seemed to him it was almost immaterial to his case.

Mr. Justice Pearson: Supposing you substitute for the word "gradual" the word "longer," will not that be right then? You must have—and I am afraid I shall offend against science on this part of the case—to begin with, a certain amount of explosion in order that you may get your rise of pressure to start with. If you have the whole explosion instantaneous, the result, as I understand it, is this, that you get your maximum immediately, and having got to your maximum, then your power ends, and the rest of the power is gone and lost. If, on the contrary, you begin with, if I may so say, a moderate explosion, and get a rise at once, and then let the remainder of the combustion, I will not say be more gradual, but be longer, you get a sustained action instead of losing the benefit of the heat.

Mr. Moulton said he should be delighted that it should be put in that way. He should show his lordship that you get just as much with the uniform mixture as with the non-uniform mixture. The only thing is, if you could keep your mixture non-uniform, you would get a very much more uniform and more explosive action; but so far as the gradual development of heat is concerned, you get that more with the uniform mixture than with the non-uniform. Now, this is claiming the gradual development of heat. He had got Sir Frederick Bramwell's statement that it is more gradual when it is uniformly mixed; and he should prove that not out of Sir Frederick Bramwell's mouth alone.

Mr. Justice Pearson: Would not the effect of that be—I do not wish to interrupt you, but I am obliged to ask you questions so that I may understand you—that if you get any gradual combustion you get an energy so slowly generated that you practically do not get the energy that you want? Is not that so?

Mr. Moulton said it might be. As a practical matter, it was not so in any of those earlier engines, but he could quite understand you might, by using a thoroughly unpractical dilution, get so slow a combustion that you would not get the full benefit of what you burn; but that does not relate to anything like the Lenoir. The Lenoir was substantially about as rapid as the Otto, but what he wanted to call his lordship's attention to was this, that the very merit which carried this patent through the Court of Appeal was the gradualness of the combustion, which prevented the explosive action, whereas the very merit that is put forward now is the suddenness of the rise of pressure at the beginning, which gets the pressure on at the earlier part of the stroke.

Mr. Justice Pearson: I should have thought the merits of Otto's was this, that you get a very rich portion of the charge immediately against the touch-hole the moment you fire it. And you get, if I may so say, a considerable part of the combustible

RAILWAY MATTERS.

A SATISFACTORY gripper for heavy cable railway purposes has not yet been devised, but one is wanted.

RUSSIA is preparing to celebrate in March the semi-centenary of the commencement of her railways.

LAST week a train, conveying troops, was wrecked near Valdivia, Chili. Thirty persons are said to have been killed, including eleven officers.

ARRANGEMENTS have been made with the London and South-Western Railway Company by the Amalgamated Society of Railway Servants for carrying out a series of trials with safety couplings for railway carriages and wagons.

THE *Times* Brussels correspondent writes:—"It is stated that the King of the Belgians has transferred for 10,000,000f., to a syndicate of French bankers, the authorisation, given by the French Government as payment for the Kwilu-Nyady district, to hold a lottery to the amount of 20,000,000f. in France. This sum is to be employed in the construction of steamers for the Upper Congo, the making of roads, and other improvements in the new State."

THE Chicago *Railway Age*, describing the American railway wreckage for 1885, says that 22 railways, with 3156 miles of line, 141,000,000 dols. of debt, and 137,000,000 dols. of capital stock, were sold under foreclosure and re-organised; 44 railway companies, with 8386 miles of line, 198,000,000 dols. of debt, and 187,000,000 dols. of capital stock, failed to meet their obligations during the year, and possession was taken of the lines by the Courts for the benefit of the creditors.

ALTHOUGH not yet officially announced, it is understood that the four months' trials of various mechanically-moved tramway cars has resulted in the determination of the jury to award the first prize to the Compagnie Electrique, for the car propelled by electric motor and storage batteries, and the gold medal to Mr. W. R. Rowan, for his steam car. An interesting paper was read on Wednesday evening, at the Society of Arts, by Captain Douglas Galton, on the results of the experiments.

MR. R. BORE, for many years superintendent of the carriage works of the London and North-Western Railway at Wolverton and Crewe, has, the *Leeds Mercury* says, retired from that position, and Mr. Parker, the son of a chairman of one of the metropolitan lines, has received the appointment. Mr. Geo. Wadsworth, the chief accountant at Crewe, has also retired, and Mr. Macrae has been appointed to that position. It is reported that extensive alterations are in contemplation in connection with various departments of the railway works.

THE Belgian Minister of Railways, Posts, and Telegraphs and M. Belpaire, president of the Administrative Council of the Belgian State Railways, accompanied by the leading officials, have made a trial of two types of tramway trains, which it is proposed to organise for slight distances. They went from the Luxemburg Terminus to the Schaerbeek Junction in the composite Belpaire steam carriage that was exhibited at Antwerp. A tramway train was waiting, consisting of a small locomotive and three central passage carriages, of weight and dimensions considerably less than usual. The trip to Cortenberg was accomplished sadisfactorily; and orders for the Liliputian rolling stock are anxiously expected by manufacturers.

THE Americans are not all so well satisfied with their locomotive practice. Concerning a shocking accident which recently happened, the *Railroad Gazette* says:—"The very fatal accident near Atlanta is another instance added to the many which have preceded it of the danger arising from numerous openings into the locomotive boiler. In this case the locomotive of the rear train ran partly through the rear passenger car of the preceding train, and while some injury to persons would probably have been caused by the shock of the collision and the destruction of the car, as a matter of fact most of the casualties were caused by the escaping steam from the locomotive. It does not appear from the account that the locomotive was very badly injured, and in all probability the steam from the boiler made its way out chiefly by the openings left by the breaking off of the various boiler fittings. It is probable that in this case most of the death and suffering would have been spared had the locomotive been fitted with one of the simple appliances for reducing the number of holes in the boiler, and for closing the remaining ones in case of accident, to which reference has from time to time been made in our columns. That these appliances have not been more widely adopted is not altogether to the credit of our master mechanics; and it is to be hoped that the Austell accident, with its record of lives lost and terrible human suffering, may again recall the attention of those concerned to the expediency of making this improvement in locomotive construction."

MESSRS. BOLLING AND LOWE in their iron report say:—"The items which weigh so greatly on the iron industry are royalties and the railway carriage on coals, coke, ores, and the manufactured goods. Abroad, where the railways generally are in the hands of their respective Governments, the rates rule very much lower, say from 30 to 40 per cent. lower than here, and yet give better returns. Although much is said in England against State interference, nobody is now found to complain of the State taking over the telegraphs. Since railways were started fifty years ago things have greatly changed, and it is hardly too much to say that great waste of passenger train services now exists which, if altered, would allow the goods rates to be reduced and yet keep up the dividends. Frequently two or more companies run trains only partially filled between the same towns, and almost at the same hours. With telegraphic facilities for communication at hand everywhere, it cannot be said that it should be necessary for an ordinary traveller bent on business—and to the pleasure seeker still less—to claim a daily accommodation of twenty-six trains—as now—from London to Birmingham, twenty-eight to Liverpool, thirty-three to Manchester, nineteen to Hull, nineteen to Glasgow, and twenty-nine to Leeds. The third-class passengers are the railway company's best customers, forming 85 per cent. of the passengers carried, and 65 per cent. of the total receipts from passenger traffic, and they are not likely to object to any changes that would ease the existing burdens on the trade and industry upon which they depend."

ACCORDING to a statement in a recent *Revue Generale des Chemins de Fer*, the length of railways open for traffic in Europe on December 31st, 1884, as compared with the mileage open at the same date in 1883, Germany heads the list with 36,737 kilos. of railway, as against 35,908 kilos. in December, 1883; increase during the year, 829 kilos., or 2·31 per cent. Next follows France with 31,216 kilos., against 29,714 kilos.; increase, 1502 kilos., or 5·05 per cent. Great Britain and Ireland, 30,514 kilos., against 30,179 kilos.; increase, 335 kilos., or 1·11 per cent. Russia and Finland, 25,391 kilos. against 24,888 kilos.; increase, 503 kilos., or 2·02 per cent. Austria, 22,106 kilos., against 20,857 kilos.; increase, 1249 kilos., or 5·99 per cent. Italy, 9925 kilos., against 9455 kilos.; increase, 470 kilos., or 4·97 per cent. Spain, 8663 kilos., against 8251 kilos.; increase, 412 kilos., or 499 per cent. Sweden and Norway, 8162 kilos., against 7960 kilos.; increase 202 kilos., or 2·54 per cent. Belgium, 4319 kilos., against 4273 kilos.; increase, 46 kilos., or 1·08 per cent. Switzerland, 2761 kilos., against 2750 kilos.; increase, 11 kilos., or 0·40 per cent. Holland and Luxemburg, 2654 kilos., against 2521 kilos.; increase, 133 kilos., or 5·28 per cent. Denmark, 1944 kilos., against 1813 kilos.; increase, 131 kilos., or 7·23 per cent. Roumania, 1602 kilos., against 1520 kilos.; increase, 82 kilos., or 5·39 per cent. Portugal, 1527 kilos., against 1494 kilos.; increase, 33 kilos., or 2·21 per cent. Turkey, Bulgaria, and Roumelia do not show an increase in the mileage of their railways during 1884, which had a length of 1394 kilos. in December, 1883; nor do the railways of Servia, with 244 kilos. Greece, on the contrary, increased her railways from 22 kilos. in 1883 to 175 kilos. in 1884. The total length of European railways on December 31st, 1884, was 189,334 kilos., compared with 182,999 kilos. on December 31st, 1883. The aggregate increase was 6335 kilos., or 3·46 per cent.

NOTES AND MEMORANDA.

THE death-rate in Italy has, during the past few years, been rapidly decreasing, and the birth-rate increasing.

THE Lancashire and Cheshire Telephone Exchange have determined to lay a wire to Thirlmere Lake for use during the progress of the Manchester waterworks scheme.

THE entire population of Italy in December, 1881, last census, was 28,459,628, made up of very nearly equal numbers of male and female, 14,265,383 being male and 14,194,245 female—an excess of 71,138 males.

THE foundations of a vast Roman hippodrome have been unearthed in the immediate neighbourhood of Nantes. With these remains a Roman road and many fragments of villas have been found, as well as a theatre suited for the accommodation of about 4000 persons.

TELEPHONE must be wearing out very rapidly or extending in use. The Bell Telephone Company's statement of the output of instruments for the month ended December 20th shows: Gross output, 3069, against 2206 in the previous month; returned, 1472, against 1827; net output, 1597, against 379.

SOME method of filling up the spaces left by salt extraction is much needed. Last week another serious subsidence occurred in London-road, Northwich. Suddenly the road sank, leaving a deep breach, into which the water rose with great rapidity to within three yards of the surface of the road. Nice for horse-drivers, and for adjacent property.

THE total number of persons in Italy living by industrial occupations and handicrafts is estimated at 7,300,000, or a fourth of the whole population. The number of persons engaged in the sulphur mines of Sicily and elsewhere was 26,078; in peat cutting, &c., 1460; in other mining pursuits, 33,236. 382,131 persons were engaged in manufactories. Of these, 219,844 were spinners, 69,447 being children; 77,779 weavers, 13,628 children; in tanning, 18,515, 664 children; in printing, 15,499, 618 children; and 3624 in glass manufacture, 289 children. In 1876 there were 229,538 weavers who worked in their own houses, chiefly in Sicily, Sardinia, Calabria, Apulia, and the Marca of Ancona. In 1881 there were 37,291 sea fishermen, including coral fishers and those who gathered sponges, 9219 persons engaged in fishing rivers, lakes, and ponds, and 12,108 boatmen and men engaged on passenger vessels.

THE Pennsylvania Railroad Company has presented to the National Museum at Washington the old locomotive "John Bull," and it has been placed in the hall of the Museum. The "John Bull" was built by George Stephenson in England, and was the first locomotive used on the Camden and Amboy Railroad, having been put on the line between Bordentown and South Amboy about fifty years ago. The road had then been completed between these points for some time, but had previously been operated by horse-power. The *Railroad Gazette* says, "John Bull" remained in service for a number of years, and when finally superseded by more powerful machines it was placed in the Camden and Amboy shops at Bordertown and carefully preserved. When the New Jersey lines were leased to the Pennsylvania Railroad it still remained in the shops, and was exhibited by that company at the Centennial in Philadelphia.

HERR H. E. LOW has obtained and forwarded to the Imperial Museum in Vienna twelve large stone slabs bearing the footprints discovered last year in the solid rock in a quarry over Lake Managua, in the territory of Nicaragua. The interest was increased by the statement that those footprints had been overlaid by eleven different layers of stone, extending to a depth of four metres, and indicating an antiquity for our race quite transcending all conjectures hitherto hazarded. They are about three-quarters of a metre square. They can now be inspected by European geologists. The footprints are sunk into the stone to a depth of from eight to ten centimetres. The stone itself is a porous volcanic tufa, and the superincumbent layers, which had been removed for building purposes, were all of a more or less solid volcanic conglomerate. The footprints are very conspicuous, and seem to be those of three distinct persons, one of whom was a child.

AT a recent meeting of the Edinburgh Royal Society, Sir W. Thomson read a paper on certain cases of motion of a liquid filling an ellipsoidal hollow; and a paper on the communication of motion from a liquid to a rigid containing shell. He showed that the motion of a liquid when rotating about the long axis of a prolate spheroid is essentially unstable, so that no great speed of rotation can be got up in the liquid in this case by making the containing shell rotate about the long axis. Prof. Turner showed that the relative length and breadth of the sacrum may be taken as a test of development in different races of mankind. In the higher races the length exceeds the breadth. Prof. Crum Brown read a paper on a case of interlacing surfaces. In this paper he extended the problem of the locking of threads to surfaces, pointing out that only certain surfaces can be covered over by such an interlacing system. For example, the sphere cannot be so covered while the cylinder and anchor ring can. Prof. Tait communicated an elementary examination of the laws of collision of two systems of spheres, showing as clearly as possible what assumptions are necessary in obtaining average results, and how they are justified. The case in which one system of spheres gains energy from without, while the other loses to external objects, is investigated, and shows that the final average energy is not the same in the two systems, thus affording an escape from the difficulties raised by Botzmann's theorem. In a second paper Prof. Tait defined the mean free path as the average of the free paths at any moment being described by all the particles. The definition, as usually given, is the average speed of a particle divided by the average number of collisions per particle per second. When the former definition is employed, the factor by which the mean free path is reduced in consequence of the motion of the other particles is found to be 0·68 nearly, instead of 0·71 nearly, as found from the second definition.

EXPERIMENTS have lately been made to determine whether vapour does, or does not, rise from the ground on dewy nights. One method tried of testing this point was by placing over the grass, in an inverted position, shallow trays made of thin metal and painted. These trays were put over the ground to be tested after sunset and examined at night, and also next morning. It was expected that, if vapour was rising from the ground during dewy nights, it would be trapped inside the trays. The result in all the experiments was that the inside was dewed every night, and the grass inside was wetter than that outside. On some nights there was no dew outside the trays, and on all nights the inside deposit was heavier than the outside one. An analysis of the action of these trays is given, and it is concluded that they act very much the same as if the air was quite still. Under these conditions vapour will rise from the ground so long as the vapour-tension on the surface of the ground is higher than that at the top of the grass, and much of this rising vapour is, under ordinary conditions, carried away by the passing air, and mixed with a large amount of dryer air, whereas the vapour rising under the trays is not so diluted; and hence, though only cooled to the same amount as the air outside, it yields a heavier deposit of dew. For studying the formation of dew on roads, one slate was placed over a gravelly part of the road, and another over a hard dry part. Examined on dewy nights the under sides of these slates were always found to be dripping wet, while their upper surfaces, and the ground all round, were quite dry. The importance of the heat communicated from the ground is illustrated by a simple experiment with two slates or two iron weights, one of them being placed on the ground, either on grass or on bare soil, and the other elevated a few inches above the surface. The one resting on the ground, and in heat communication with it, is found always to keep dry on dewy nights, whereas, according to an article in *Nature*, the elevated one gets dewed all over.

MISCELLANEA.

A *Weekly Export Summary* of exports from the United Kingdom to the Australasian Colonies is being published by Messrs. Watson and Co.

EARLY next month the Wolverhampton Chamber of Commerce will hold a special meeting to consider the whole question of continental competition.

THE keel of the largest ship yet built in Victoria was recently laid by the Commissioner of Customs. The builders are Messrs. Campbell, Anderson, and Sloss. The vessel, which will cost £18,000, is for the Customs Department.

THE employers in the nut and bolt trade have favourably entertained a suggestion from the operatives for the formation of a Conciliation Board, and the first meeting of both sides to attempt the formation of such Board will be held shortly.

THE Staffordshire Railway and Canal Traders' Association have forwarded a memorial to the Severn Commissioners, asking that improvements may be made to that river which would result in placing the Black Country within thirty miles of sea-going craft.

IT is said that the Hornsey Local Board have referred to their solicitor evidence taken before a committee of the Board with respect to an offer of £1000 made to the surveyor of that Board on condition that he facilitated the passing of certain tramway plans.

AT a meeting on Wednesday of the promoters of the North African Inland Sea scheme M. de Lesseps stated that Captain Landas was about to survey the Tunisian oases, and that on his own return from Panama, by April at latest, the company would be formally constituted.

THE Whitecross Wire and Iron Company is introducing a new "Zebra" steel wire fencing, in which the wire is crimped so as to increase its apparent size and visibility, and materially to increase its elastic extensibility. The idea might be extended to some electrical purposes, such as cables and leads.

MESSRS. BOLLING AND LOWE say prices and wages in the iron trade have reached a point that seems to leave little room for a further fall. Whatever enterprises, involving a great use of iron and steel, that capitalists take in hand, now have for their basis the lowest cost figures known for twenty-five years; and, if carried by sea, the same holds good with regard to freight.

MUCH regret has been occasioned in mining circles in South Staffordshire by the announcement of the death, at the age of fifty-one, in the river Niger district, on the west coast of Africa, of Mr. Walter Ness, C.E., Glasgow, who a few months ago went out to Africa as the representative of the South African Trading Company, London, to explore certain mining properties. Mr. Ness had hoped to do twelve months' work in Africa, but he was struck down by fever. He was a man of much ability, and was chosen by the Government some years ago, at the suggestion of the Dudley Institute of Mining Engineers, to develope the coalfields of Central India.

THE *Mineral Water Trades' Review*, referring to the idea that water becomes purified by freezing, says upwards of 2000 tons of ice are gathered from a pond in New York each winter by the people living in the vicinity. On November 10th Dr. Edson reported to the Board of Health that the water of the pond was unfit for use, and that the ice taken from it ought not to be used by families. A row of stables which are drained into it, and one feeder of the pond has for ten years been made to flush the cesspool of a large house. The sanitary superintendent has been instructed to make an examination of the ice when the pond freezes.

IT is said that large and extremely rich deposits of silver ore have been found near Port Arthur, Ontario, in Lake Superior, the spot being included in the famous Silver Islet mine formation. A daily contemporary says:—"Five men are engaged in the workings, and the ore is now being shipped. Half a million dollars have already been invested in the undertaking, and one mine has been sold for 250,000 dols. Sixty miles of wagon road have been constructed, and a railway charter has been applied for." Whether these discoveries have been recently made, and the five men have made the sixty miles of road in a week, does not appear; but as this news is telegraphed, this is probably intended.

THE annual conference of miners of Great Britain was opened at Birmingham on Tuesday, and it will be continued until Friday. Amongst the questions put down for discussion are the appointment of a Minister of Mines; an extension of power to the common informer to prosecute; and the best means to be adopted to insure the better organisation of working miners. In his presidential address on Wednesday, Mr. Thos. Burt, M.P., said that now that the miners had six men drawn from their own ranks in Parliament, they might safely count on many measures affecting the mining interest occupying the attention of the new Parliament. He should lose no time in bringing in a Bill to make the Employers' Liability Act compulsory.

THE *Colonies and India* says:—"A large demand seems to have arisen in the Madras Presidency for what are known as the Swedish ploughs. A consignment of 250 of these was recently sent out by the Secretary of State for distribution throughout the Presidency, one for each taluk, and no less than 183 were thus delivered. The cost of each plough is about eighteen rupees, and the expenses of packing and delivery were undertaken by the Saidapett Farm. The fact of the distribution has caused a large demand for the ploughs in the Bellari, Kurnal, Salem, and other districts where the cattle are generally strong enough to work them, and a good black soil prevails. Many orders for the ploughs are being carried out at the workshops of the Agricultural Department.'

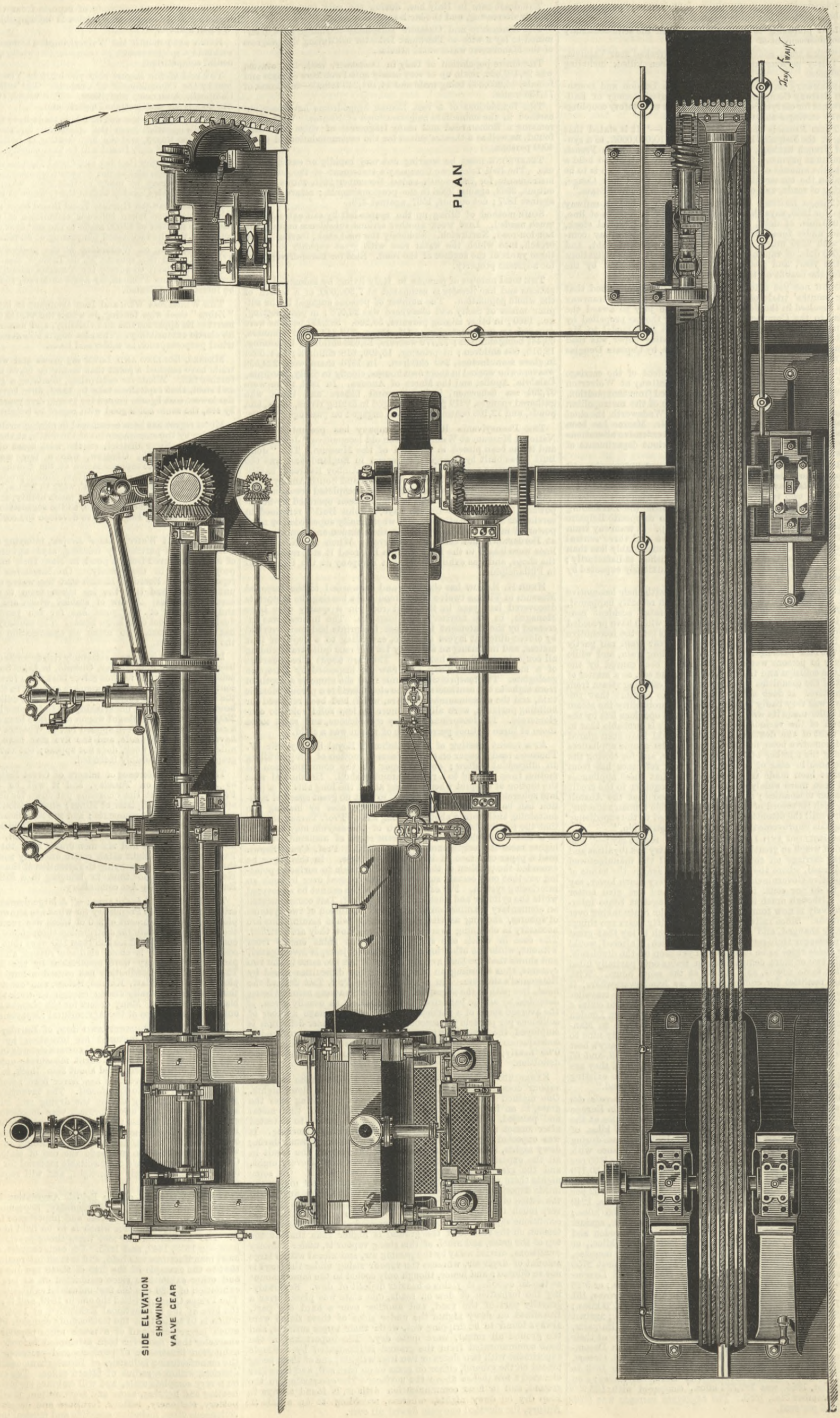
MESSRS. JAMES DUCKETT AND SON, of Burnley, inform us that they have recently matured an invention by which they are enabled to make very large earthenware cisterns in one piece. One just made and successfully burnt measures—outside 7ft. 8in. × 3ft. 7in. × 3ft. 6in. deep, and about 3½in. thick, to hold 415 gallons of water. We believe this has never been accomplished before, and the fact is of much interest. The invention relates to the prevention of cracking during the drying and burning processes, and has proved, we are informed, very successful. As securing greater soundness the process is variously useful, and Messrs. Duckett and Son are making small-sized cisterns by the same process from 1in. to 2in. in thickness, according to size of cistern, which are intended to supersede the use of slate, iron, and zinc. Glazed earthenware is a most suitable material for this purpose, as it can be made perfectly watertight, and will require no paint or repairs.

THE next meeting of the British Association is to be held at Birmingham, beginning on Wednesday, September 1st. It will derive more than usual interest and importance from the exhibition of local manufactures which is to be held in connection with it. The Association has met three times previously in Birmingham—in 1838, 1849, and 1865. On each occasion an exhibition of local manufactures was held, and it is an interesting fact to record that to the example of the first of these are due all international and other exhibitions since conducted on so large a scale. The exhibition of 1838 was the first industrial exhibition in the country. The Prince Consort visited the one in 1849, and it suggested to him the idea of the International Exhibition of 1851. The exhibition which is to be held on the forthcoming occasion will be on a very much larger scale and of a much more popular and attractive character than has ever been attempted before. It is to be an exhibition illustrative of products and processes connected with the manufacturing industries of Birmingham and the surrounding districts within a radius of fifteen miles. The exhibition will be on a very complete scale, and will embrace engineering, hardware, heating and lighting, arms and ammunition, jewellery, glass and pottery, stationery, leather, furniture and decoration, and a miscellaneous class, including scientific and musical instruments.

150-HORSE POWER HORIZONTAL ENGINE.

MESSRS. HICK, HARGREAVES, AND CO., BOLTON, ENGINEERS.

(For description see page 61.)



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NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

CONTENTS.

THE ENGINEER, January 22nd, 1886.

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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

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

R. T. C.—*The usual practice is to add* 40 *lb. per foot.*

J. H. W.—*There is no society of the kind that we can recommend.*

GAS ENGINES.—*A letter on this subject sent to the address given by "A. H. W.," has been returned by the Post-office.*

PATENTEE.—*You will have to file declarations in support of your application, to which the opponent will reply. You had certainly better consult an agent or solicitor.*

MARINE.—*It would be useless to publish your inquiry at present. The results obtained have not been satisfactory; if they had been, you would have had no occasion to ask your question.*

J. R.—*Put on the red centre line last. The light to which you refer is put on to make the shaft look round, which it will not do without it. See Binns' treatise on "Mechanical Drawing," Part II.*

A. RAMSAY.—*We do not know to what you refer. There was some reference to cutting stone by a wire and sand, and there have been descriptions of Tilghman's sand blast process of cutting glass and files.*

W. AND S. (Lancaster).—*If the results you have obtained up to the present are satisfactory do not make any alteration; let well alone. If they are not satisfactory, if you will state in what way the bearings give trouble, we shall be happy to advise you further.*

S. S.—*See Matheson's work "On Depreciation and Valuation." London: E. and F. N. Spon. Generally, in reply to your inquiry, it must be said that the books are so various and deal with the subject from so many points of view, that no one book can be named, as the choice must be made in accordance with the purpose of the valuation. Consult the library of the Surveyors' Institute, Westminster.*

EXTRACTING OIL.

(To the Editor of The Engineer.)

SIR,—Can any of your readers inform me of the chemical process for obtaining all the oil out of seeds—beyond what can be obtained by the presses—the apparatus necessary for such process, and the approximate cost of same?

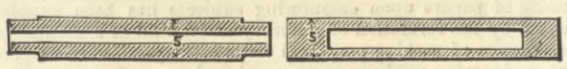
ENQUIRER.

Stevenage, January 14th.

HYDRAULIC PRESSES AND HOLLOW STEEL SPINDLES.

(To the Editor of The Engineer.)

SIR,—Will any reader please inform me through your columns who are the publishers of the best work on modern hydraulic presses, accumulators, &c.? Also if there is any published information re a process of rolling or pressing steel in hollow cylindrical or recessed cylindrical forms, as per sketch?



I hear a firm at Remscheid, Germany, is offering such goods as a new patented speciality, at prices about twice those of mild steel bars.

Zurich, Switzerland, January 10th.

NOSILLE.

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

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Tuesday, Jan. 26th, at 8 p.m.: Ordinary meeting. Paper to be read, with a view to discussion, "The Injurious Effect of a Blue Heat on Steel and Iron," by Mr. C. E. Stromeyer, Assoc. M. Inst. C.E. Friday, Jan. 29th, at 7.30 p.m.: Students' meeting. Paper to be read, "Electrical Measuring Instruments," by Mr. Llewelyn B. Atkinson, Stud. Inst. C.E. Dr. John Hopkinson, F.R.S., M. Inst. C.E., in the chair.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS, 25, Great George-street, S.W.—Thursday, Jan. 28th, at 8 p.m.: The President, Professor D. E. Hughes, F.R.S., will deliver his inaugural address "On Self-induction of an Electric Current in Relation to the Nature and Form of its Conductor."

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, Jan. 25th, at 8 p.m.: Cantor Lectures. "Friction," by Professor H. S. Hele Shaw. Lecture II. The friction of fluids. Tuesday, Jan. 26th, at 8 p.m.: Foreign and Colonial Section. "The Importance of a National Scheme of Emigration for the Best Interests of British Commerce," by Mr. Arnold White. The Most Hon. the Marquis of Lorne, K.T., will preside. Wednesday, Jan. 27th, at 8 p.m.: Eighth ordinary meeting. "Machinery in Mines," by Mr. Henry Davey, M. Inst. C.E., Sir Frederick Bramwell, F.R.S., Pres. Inst. C.E., will preside. Thursday, Jan. 28th, at 8 p.m.: Applied Chemistry and Physics Section. "The Magnetism of Ships and the Mariner's Compass," by Mr. William Bottomley, jun.

DEATHS.

On the 13th inst., at Melbourne, JOSEPH LEECE, C.E., of Urmston, and of Sir Joseph Whitworth and Co., Manchester, aged 52 years.

On the 17th inst., at Bournemouth, EDWARD NEWCOMBE, Civil Engineer, in charge of the Midland Railway Company's South Wales District (late of Swansea), second son of W. L. Newcombe, Green Bank, near Derby, aged 43.

THE ENGINEER.

JANUARY 22, 1886.

TORPEDO BOATS.

AMONG theorists there is—and will be, until there is a war—considerable difference of opinion concerning the part which torpedo boats can be made to play in naval warfare. But there is no difference of opinion concerning the mechanical perfection which has been attained in their construction. Only those who have had to design such craft—and their number is extremely limited—can form any conception of the complexity and difficulty of the problem presented for solution. So much has to be done, and the space and weight available are so small, that the torpedo boat may really be regarded as one of the highest triumphs of engineering skill ever produced. In the first place a hull has to be produced, which, while not much thicker than the pasteboard cover of a book, must be competent to withstand without in any way losing its form, violent strains, not only from the sea without, but from the machinery within. In this light craft we have concentrated in one place a boiler weighing several tons, in another a quantity of coal, and further aft engines capable of exerting from 500 to 1000 indicated horse-power. It seems absurd to suppose that a boiler can be carried in so flimsy a structure without going through the bottom of it; or that it can be possible to fasten down machinery to so light a hull. The hull is, however, much stronger than it looks. To *thin* steel plates no exception need be taken. These, at all events, are honest, and do not play pranks with the reputation of the metal; and they are so skilfully and carefully put together and stiffened here there and everywhere by ribs and angle-bars, that a torpedo boat is, for its weight, probably one of the strongest structures made. Leaving the hull, we come to the boiler. The points of difference between this boiler and that of a locomotive are numerous and important. The power developed weight for weight is much greater. A first-class torpedo boat boiler has a heating surface of about 650 square feet, 18 or 19 square feet of grate, over 200 tubes 6ft. long and 1½in. diameter inside. The working pressure is about 120 lb. The tube surface is not more than half that allowed in a locomotive boiler of the same power. The grate area is about the same. Experiments made at Portsmouth have shown a consumption of fuel at the rate of 96 lb. per square foot of grate per hour with 6in. of water air pressure; but this rate has been considerably exceeded. As much as 10,840 lb. of water were evaporated per hour, or at the rate of 6 lb. of water per pound of coal, omitting fractions. This is a wonderful economic performance, considering the conditions; but it is nothing compared with the absolute efficiency. Taking the total heating surface at 650 square feet, we have an evaporation at the enormous rate of 17 lb. per square foot of surface per hour. If we suppose that the tubes did one-half the work and the fire-box the other half, we find that as the fire-box surface was about 60 square feet, about 93 lb. of water were evaporated by each square foot, while each square foot of tube surface evaporated about 9·3 lb. No other steam generator in the world has such an efficiency as this. It is not remarkable that special skill and ingenuity has had to be displayed in order to get a boiler to stand such a strain and to supply fairly dry steam without priming, and this, be it remembered, in a boat tossed on a rough sea. The engines are miracles of lightness and perfection of material and workmanship. Nothing but the best workmanship in the fullest sense of the term can be made to answer. The very screw propeller used has been evolved by Mr. Yarrow from almost countless experiments, particulars of some of which of the most interesting character have already been published in THE ENGINEER. We shall say nothing of the armament of these craft; that is a subject which for the moment we do not discuss.

Perfect as the torpedo boat has been and is, it does not seem that finality has been reached. Messrs. Yarrow and Co. appear to be able to meet every demand made on them for faster and faster boats. To Mr. Thornycroft, of Chiswick, belongs the distinction of being the first man who ever drove any craft at the rate of 19 knots, or 22 miles, an hour through the water. Mr. Yarrow, however, was the first to run a boat at 22 knots, or 25·36 miles; and even this performance he has recently beaten—for he is now building boats capable of running at 24 knots, or 27·66 miles, an hour. It is a noteworthy circumstance, however, that our own Government is perfectly contented with 19 knots, although no other Government is. It is admitted on all sides that high speed is essential to the success of torpedo boats; yet, in the face of this, England is acquiring a fleet of the slowest torpedo boats in the world, and this while every endeavour is being made to accelerate the speed of every other class of fighting ship. We have no doubt that the facts have been overlooked by the Admiralty, for which there has been every excuse. As soon as administrative matters have settled down a little into shape, torpedo boats will again receive the attention they deserve, and orders will be given that the highest possible speeds shall be attained. If foreign Governments attach importance to having boats which can steam 22 knots an hour, that importance is either well founded or it is not, and steps should be taken, if necessary, to ascertain the reasons on which the preference for high speeds is based. It may be shown that there are some counteracting disadvantages—though we much doubt this—which have weighed with our own Admiralty. If so, they should be explained, in order that they may be removed. Our own conviction is that speed ought to be had at any price, and we have little doubt that the moment attention is drawn, as we have drawn it, to the subject, precautions will be taken to give Great Britain, boats as speedy as anything that European or American Governments can show.

CATALOGUES.

IT would be difficult to trace any connection between the excellence of design, workmanship, and efficiency of any make of machinery and the character of the catalogue sent out by its manufacturers, unless it be that, conscious of real as well as comparative excellence in design and make of their machines, they not only feel that good things should be properly illustrated and described, but, following up their drawing-office and workshop policy, they act upon the well-worn truth that what is worth doing at all is worth doing well. It may, on the other hand, be said with some confidence that there is immediate connection between the business capacity of a firm and the character of its catalogue. There is no doubt that the manufacturers of different classes of machinery have to address very different classes of purchasers. A catalogue of agricultural implements, which goes direct into the hands of the farmer in most places, will perhaps be sufficient if it contains mere perspective views of most things, accompanied by that sort of superficial description which consists mainly of a boasting reference to best iron, bright work, finish, paint, quantity sold, and the stock phrases of the commercial traveller; but even this is questionable, for farmers are, like all other classes, not so indifferent to the proper presentation to them of a thing upon which they may intend spending money, nor are they ignorant of the constructive merits of implements and machines. The catalogues of a considerable number of makers go into the hands of agents who are not solely guided by the commission they obtain, and who, looking to their own reputation, endeavour to find the best machines and implements. The catalogues should afford them information on the construction and forms of details, aided by sufficient drawings. Many American catalogues commenced giving these long ago, but some of our agricultural machine makers give mere outside and imperfect views, which in many cases are as much use as an engraving of a watch-case would be to an horologist; and their customers are treated like children who want to buy toys, and need but a badly-engraved picture, a little claptrap, and the price, to make them buy at once.

This sort of thing does not do at all for the purchasers of machine tools, or for most of those who want to buy steam engines and boilers. It does not do now to say—"These engines are fitted with cylinders of the best iron, the widest and strongest brasses in the trade, the best wrought iron cranks, the heaviest fly-wheels, and the most economical and efficient governors, while the boilers are of best iron, with large fire-boxes." People want to know actual sizes, shapes, and weights; real figures as to economy; and drawings that show really, not with artistic liberty, the design of the thing they want to buy. Some of our English manufacturers are becoming alive to the necessity of placing their manufactures as far as catalogues will do it, properly before the purchasing world; but much as they have improved, they are almost all behind some of the American makers of such things as steam engines, pumps, bridges, roofs, and machine tools. The engravings given, for instance, in the catalogues of the Porter-Allen engines, of the Trenton engines, the Straight Line engine, the Baldwin locomotive, the Dominion Company's bridges, and many others, are elaborately complete and excellent; the letterpress is a straightforward description, with, of course, an allowable amount of egotism in the reference to what are considered the points of excellence in the general and detail design and results attained. The whole is well printed and got up like a sober book, though the covers may be of paper. In contrast to these, some of the catalogues of English makers are got up as though with a view to attract illiterate savages by the covers coated with all the colours under the sun, and with text and engravings to match. Why respectable firms spend so much on gaudy covers seems wholly inexplicable, when the money so wasted might with so much advantage be expended in improving that which is between them. This is especially true of many agricultural engineering catalogues, the jargon in some of which is enough to condemn the firm in many minds. There is a style of language which will pass muster in a showyard, but it does no one credit in a cata-

logue. To properly compile a catalogue requires some literary capacity and taste, combined with practical technical knowledge; but some manufacturers seem to think it is the work of a booking clerk aided by their commercial traveller. The repellent character of many catalogues is, however, the result. A catalogue, even of agricultural implements, should not consist of a number of pages each of which has the general character of a country play or circus bill both in tone and variety of type. Out of about forty lines, thirty-nine seem to strike the compilers as being each more important than the other; and to carry out this conviction every fount in a considerable establishment is requisitioned, the result being that every page is a jumble of large type, small type, large capitals, small capitals, italics, Roman, Egyptian, fine-faced, and heavy-faced letters, all struggling for supremacy, like the equality-loving members of a communistic republic.

The catalogues of machine tool makers, including cranes, pumps, and steam engines, are not characterised by this style, but the proportion of catalogues which do justice and credit to the engineering manufacturers by whom they are published is comparatively small. They are too brief, too general, insufficiently illustrated, or illustrated by engravings which do not give sufficient detail, and many have in them too much of that "gas" which in a more pronounced degree characterises the "Sludge-cum-Poker Daily Fire Brand," or the puffy comments made by a shopkeeper selling cheap ironmongery.

Even the size of a catalogue is not an unimportant matter. There is much too great a diversity in practice in this respect. There is no necessity for this. Almost all catalogues might conveniently be octavo, royal octavo, or small quarto size. Some makers go out of their way to find an awkward size, and some arrange them so that the back is one of the least dimensions, like an ordinary cheque book, a form which is awkward to read and awkward to shelve—result, waste paper basket. Whether makers of machines think their catalogues interesting enough to serve as occasional books for drawing-room amusement does not appear, but they all act as though they expected them to lie flat upon a table partly for ornament, for the front cover is invariably ornate, according to the taste of publisher or printer, while the name or title is rarely printed on the backs of even the bulky catalogues. Thus, when they are stowed away on office shelves they are lost, or one has to get down a dozen to find one.

Catalogues are really very important books from a technical, historical, as well as trade point of view, and they may be a credit to those who publish them or the reverse; but English manufacturers ought to pay a little more attention to them than they usually do, for they may serve to a considerable extent as letters of introduction.

GOOD AND BAD CHAINS.

WHILE the honest English manufacturer is carrying on an unequal strife with his foreign competitors, the unscrupulous middle man, with a reckless disregard for everything but immediate gain, is doing his best to ruin trade. It is not a pleasant task to pry into foul places, and the work of the sanitary engineer is not always agreeable. Duty must be performed, however, no matter how disagreeable, and we feel compelled to call attention to practices which cannot be too strongly condemned. There are in Great Britain certain firms whose productions have a world-wide reputation for excellence. The brand or trade mark of these firms is an "open sesame" to the markets of the world. Men not pre-eminent for honesty of purpose avail themselves of this fact, and palm off on the purchaser that which is often worthless rubbish as being really the excellent productions of men whose personal reputation is as unblemished as that of the wares which they sell. It would be unfair to single out any individual and hold him up to condemnation as a special sinner. We do not wish to attack men but a system, and that system, we assert, cannot be maintained without the most serious consequences to British trade. An advertisement which will be found in one of our outer pages this week supplies an apt illustration of the practices which we condemn. The story connected with this advertisement is at once interesting and instructive. We have said that we do not attack individuals but a system. Therefore we shall give no names.

There are three classes of chains in the market, commonly rated as good, better, and best. We should call them bad, middling, and excellent. The peculiarity of these chains is that they will all stand a proof test; but while it is just as much as the bad chain can do to stagger through under its burthen, the best chains have a large margin to spare. The common chains are much cheaper than the other qualities, and are freely used. After the Employers' Liability Act was passed, employers formed a Mutual Assurance Corporation to provide for claims made under the Act. Chains are extensively used for cranes, and in working coal trams, under circumstances where a failure of the chain might cause loss of life or serious injury to workmen. So many bad chains have been used that the corporation at last found itself compelled to issue a circular, of which the following is a copy, dated September 20th, 1885:—"In consequence of the serious claims which the corporation have had to meet accruing from accidents caused by defective chains, it has been resolved, where chains are used, to require a certificate of testing or examination, by a competent neutral party, to be produced by the assured on each renewal. We may state that the claims due to defective chains have been so serious that the board have been compelled to advance the rates in some cases, and unless the testing and examination required is done, it will be necessary still further to advance them or to decline such risks altogether. It is, as you are aware, a condition of the policy that the assured undertakes to exercise reasonable diligence to insure that the plant and ways are in a good state and sufficient for the use they are put to. The corporation desire to call the attention of the assured to this condition, as in many cases with which they have had to deal the accidents would not have occurred had it been observed."

This circular is conclusive evidence that there are good chains in the market. A certain firm required 500 yards of chain made of $\frac{3}{8}$in. iron. for hauling pit wagons. They applied to a commission agent for his estimates. He quoted prices for three qualities. The would-be purchasers chose the best, and did not haggle about price. The agent gave the order to a Staffordshire firm of repute. This firm sublet the contract to another firm, who made the chain. The New British Iron Company makes a special cable iron branded with a lion, and known as "Lion iron." The company has made this iron since 1825, and it enjoys a wide-spread reputation. The works of the company are situated at Corngreaves. The contract for the 500 yards of chain stipulated that it should be made of Lion iron. The chain was not made of Lion iron, but the purchaser was told that it was. The iron of which it was really made was much cheaper than that specified. It will have been seen from the circular which we quoted above that the chain must be tested by a "neutral" party. A certificate was supplied with chain running as follows:—"Cradley Heath Chain Testing Works. This is to certify that a $\frac{3}{8}$in. best chain, 500 yards in length, and weighing 1 ton 5 cwt. 0 qr. 25 lb., has been proved and found capable of sustaining a degree of tension equal to 1 ton 12 cwt. 2 qr., being the Admiralty test, proof mark, J.W. No. 338, stamped on the end link. ——, superintendent." There is a Lloyd's Testing Company, with testing machine, near Cradley Heath, duly certified under the Chain Cables Act, but, as will be seen, some makers eschew this place, and test at their own works or their neighbours', and term themselves "the Cradley Heath Testing Company." The certificate in this case was issued by the maker of the chain, and, consequently, did not comply with the conditions laid down by the insurance company. It is quite evident that, under these circumstances, the purchaser of the chain did not get what he paid for, but an inferior article. It is quite unnecessary that we should call a policy with such a result by any particular name. Our readers will find no difficulty in selecting proper adjectives.

To some persons it may seem that the transaction is too small to call for much notice, but the melancholy fact is that it is but one case out of numbers, and it is to be feared that the practice is extending under the pressure of hard times. It is more difficult to sell anything than it has been, and prices are cut so low that there is no margin left for the middle-man, who then resorts to doubtful practices to make a living. A purchaser wants a particular brand of iron. It is worth, say, £7 a ton to the consumer. The middle-man cannot buy it for less than £6 15s., so that he clears only 5s. a ton; but he can buy an unbranded iron for £5 10s. or £6 a ton. He has only to sell this to the consumer as what he has ordered, and to make a profit of £1 a ton instead of 5s. He may lay to his conscience the soothing unction that the unbranded iron is just as good as the branded. We may even admit that it is, but the transaction is none the less dishonest. A watch was once sold, professing to be made by a very eminent firm of watch makers. It cost £20. When the watch was dirty the owner very naturally took it to the so-called makers to be cleaned. They saw at once that the watch was not their make, and kept it, offering the owner what he had paid for it. He refused, and sued the holders. They defended the case. In the course of the trial it came out that the watch was actually constructed by a man who worked for the firm, and that the watch was a very good one. The head of the firm stated, however, that they would charge £35 or £40 for the same watch. Asked on what grounds, he replied that their name on a watch was a guarantee of excellence for which the public found it worth while to pay a considerable sum. In the same way there are makes of iron in the market which have no reputation, and yet are just as good as those whose excellence is guaranteed by the special marks of celebrated firms. The public are willing to pay for this guarantee, and it is a distinct fraud to pretend that such a guarantee exists when it does not.

The evil wrought by such practices is very serious—much more serious than can be imagined. Billets of very indifferent iron are made up specially to resemble Swedish, branded with famous brands, and sent abroad. Frauds of this kind are practised so unblushingly that middle-men of position and reputation do not hesitate to ask makers to brand second-class iron as first-class, and cannot quite understand why any expression of indignation should accompany the refusal. Turn where we will, we are told that it is useless to put good things in the market, that they cannot be sold. The truth is, that the middle-man cannot make as much profit out of the good thing as he can by selling a bad article as the best. Some of the middle-men now live on the reputation of a few first-class houses, and this reputation they are doing all that lies in their power to destroy. The effect of this will be that manufacturers will combine the merchant's business with their own. We hold that the taking of such a step would be matter for regret. The merchant or middle-man must be useful, but unless he is not only honest, but honourable, he cannot complain if he is dispensed with.

One word in conclusion. Mr. Trail has done excellent service in the matter of chain cables and anchors. Is he unable to suggest some satisfactory way of preventing the issue of untrustworthy certificates of tests? Juries, at all events, when called on to assess damages under the Employers' Liability Act, ought to bear heavily on employers who use chains that do not bear a Government test, or that of some recognised authority of assured honesty.

A TRAIN THROWN OVER A SEA WALL INTO THE SEA.

A REPORT by Major Marindin has been published which renews attention to a subject on which a wide difference of opinion exists. It refers to an accident which occurred on the 26th November last, near Mound station, on the Sutherland section of the Highland Railway. In this case, as a mixed train from Wick—consisting of engine and tender, one loaded wagon, six empty wagons, four loaded wagons, post-office sorting van, brake-van, third-class carriage, luggage-van, first-class carriage, composite carriage, and rear brake van, or in all eleven goods wagons, and seven vehicles fitted for running in passenger trains—was approaching the up distant signal at Mound station at 4.42 a.m., one of the goods wagons near the front of the train left the rails. The engine, tender, and leading wagon which remained on the rails, and the second wagon which had all four wheels off the rails, broke loose from the train, and, before being brought to a stand ran ahead for about 500 yards beyond the spot where the first mark of any wheel being off the rails was found; the third, fourth, and fifth wagons ran over a bank about 10ft. high into the sea, on the left-hand side of the line, and, the permanent way being broken up, the whole of the remaining vehicles in the train then left the rails, being found after the accident in the following positions:—The whole of the wagons were in the water outside the passenger vehicles, the third on its wheels, the fourth bottom upwards, and the fifth with one end mounted on the other two, being the group farthest east; then going westward, in which direction the train was running, the sixth separate from the others, standing on its wheels about 30ft. out in the water, then the seventh, also separate, on its side and rather farther out; than the eleventh on its side nearer the bank; then, nearer in shore, the tenth, the ninth, and the eighth on its side, grouped round the leading end of the post-office van, which was on its wheels, with the leading end in about 6ft. of water, and with the side smashed in. Behind the post-office van was the front brake van and the third class carriage on their sides in the water, and behind these the luggage van on its side upon the slope of the bank, nearly opposite to the most easterly group of wagons in the sea, the first class carriage off the rails with the leading end over the edge of the bank, and the two rear vehicles on the line although off the rails. There were seven passengers in the third-class carriage, and all of these, the post-office servant who was in the sorting van, and the front guard, were in the water, but only three passengers are returned as having been bruised and shaken. An axle of the leading goods wagon was broken, and probably was the cause of the derailment; Major Marindin says, there can be no doubt whatever that this accident, in which the passengers in the leading carriage were in imminent danger of losing their lives by drowning, was due to the practice, so often condemned by the Board of Trade, of running mixed trains with the goods wagons in front of the passenger carriages, and unless the convenient working of the traffic is to be considered of greater importance than the safety of the travelling public, the customary mode of making up mixed trains should therefore be abandoned.

ATLANTIC TELEGRAPH COMPETITION.

THE competition in the Atlantic telegraph service has very considerably affected the receipts of the different companies engaged in the service. It is not only that the rate per word is less now than it was, but also that there are more companies to divide the lessened earnings amongst. Thus in the last half of 1885 the Direct United States Cable Company received £38,115 as its earnings, or share of the joint earnings rather; whilst in the corresponding half of the preceding year its receipts were not less than £68,824. This company is one of those which pool the earnings and divide the proceeds amongst the concerned companies in defined proportions, and thus it may be fairly assumed that there will have been a falling-off as marked in the receipts of the other members of the combination, which includes nearly all the companies. It is clear, then, that the receipts from Transatlantic telegraphy have very considerably fallen, and we have as yet no facts to lead to a conclusion that the lower tariff or the better trade indications in the United States have led to more work for the cables, though this must be looked upon as prospective. Even in the low word-rate now current the companies pay dividends which, if not large, are certainly very good returns on the market prices of the companies' shares. They have accumulated, also, very large reserve funds—that of the company we have named being now £320,000, whilst that of the old Anglo-American Company must now approach a million sterling, though not quite up to that substantial figure. The low prices and the better trading condition of the United States should now give soon a fuller volume of work for the larger number of cables under the Atlantic, and it is to this larger revenue and better employment for the plant and staff that the companies will have to look in the end for better dividends, though these should be materially aided by the reduced sums which will have to be credited to the reserve funds. The substantial accumulations of the past few years will now grow with some rapidity, from the interest on their own capital, and the revenue of the company may now be devoted more to the recoupment of the shareholders for the risk they run in placing their capital under the sea. It is there doing a good work, indeed, and those who enable that work to be done deserve full remuneration for the capital which they risk, and which now receives small dividend.

THE ENGINEERING ASSOCIATION OF NEW SOUTH WALES.

THE *Sydney Morning Herald* of the 25th of November devotes an interesting article to the future work of the engineer in the construction of railways, harbours, and river works in the great country which the Australian colonists possess, the occasion of the article being the annual general meeting of the Association named above. The Association was established fourteen years ago, and had some struggles for existence, but it seems now to be well established. Perseverance on the part of the founders of the Association has led to such an extension of effort that the reading of papers upon engineering subjects has been supplemented by the formation of a library and a kind of museum; to the practice of making periodical visits of inspection to important engineering works in and around Sydney, and even to the holding of public exhibitions. The Association claims also to have been the main instrument in bringing about the establishment of the Technical College in connection with the School of Arts. There is no wider field than that before the engineer in Australia, although some years may elapse before the developments of trade open up the possibilities of still greater trade by the aid of the works of able engineers. The Association will no doubt be the parent of an institution of high importance in the country, and steps should be taken to make it in every way worthy of future influence and authority. It might be well to adopt a much shorter name for the society.

THE TRANSMISSION OF DRAWINGS BY SIGNAL.

MR. ALEXANDER GLEN, of the 14th Middlesex (Inns of Court) R.V., read a paper on the "Transmission of Maps and other Drawings," at the theatre of the United Service Institution, on Friday afternoon last. An observation made by Lieut.-Colonel Bonham on the undeveloped state of army telegraphy in 1883 was the means of directing Mr. Glen's attention to this subject, with the result that he has devised a very simple, complete, and efficient system of telegraphing not only the outlines of maps and drawings, but also shades of any depth, numbers without employing words, and the like. Colours might be sent, we presume, similarly. The whole key to the system lies in each of the stations having corresponding papers, such as sheets

divided up into small squares, which are lettered, or in which points may be fixed by telegraphing co-ordinate measurements. In the case of shading, squares are supplied of different depths of shadow lettered for identification. Numbers are sent by using letters as single words, beginning at O for 0, P for 1, and so on—omitting T—up to Y. If Z be put before the letters, the figures refer to miles; thus, Z Q U would be twenty-five miles. It is hardly worth while to go into details here. They will be easily imagined in general character, and anyone wishing to study the subject should obtain the paper in full. They appear, however, to be well worked out. For example, a transparent sheet of horn marked in squares laid over any drawing at once enables that drawing to be read and telegraphed in proper signals. In practice success has been striking. For example, one-sixth part of a plan of a village out of "Brackenbury's Minor Tactics" was telegraphed by flag signal in twenty minutes last summer before Colonel Moncrieff. At Uxbridge a field sketch was made and telegraphed, being reproduced as the message was read, so that it was finished a few minutes after the signalling ceased. It is suggested that a general might sit with a map in front of him and have the movements of his columns depicted as they go on, so as to have them crawling in front of him like a sort of live chessboard. Finally, an absurd illustration of what might be done was given by telegraphing Colonel Bulwer's likeness, which gradually displayed itself with a fidelity defying mistake to the eyes of the surprised recorder. This, we think, has a great future before it.

RESERVOIRS ABOVE GROUND.

WE but lately directed attention to the approaching completion of the works destined to supply Colombo, the chief seaport of Ceylon, with water. We regret to hear that the anticipations we then expressed as to their early utilisation have been to some extent falsified by a singular accident occurring at the Maligahakanda reservoir, in which the supply for the city is to be stored in close proximity to it for distribution. The occurrence has raised anew the question as to the advisability of under any circumstances constructing a reservoir wholly above ground level. The immediate neighbourhood of Colombo is, it appears, of so very flat a character that it was impossible to secure the head of water necessary for high service to it upon any natural elevation. As the consequence, it was determined to build the work entirely above surface level. For this determination there appears to have been no alternative, and works of a similar kind have been too often successfully completed to leave much room for the argument put forward by some of their total inadmissibility. But the occurrence to which we now refer proves that at least such a plan of construction is liable to mischances such as could rarely attend any system of reservoirs below the ground line. The material on which the work was in this special case founded is known locally as "cabook," a kind of indurated clay, which, although soft and easy to work in its natural bed, hardens rapidly on exposure to the atmosphere, and is largely used in blocks for building purposes. When referring before to the subject of these works, we said that the water had been run in to this reservoir. The latter had scarcely filled, however, before cracks appeared in the solid masonry of the impounding wall. This possessed a large margin of strength beyond the limit of absolute theoretic requirement, and it could not therefore be that its failure was due to any want of massiveness, while the fact that the walling remained in perfectly true alignment is sufficient to disprove any imputation of defective workmanship. It is therefore evident that the defect showing itself has arisen from some failure of the material built upon, and in the case of all overground reservoirs there is, it appears to us, always the chance of some such failure from which works of this nature as usually constructed are almost entirely free. We understand that as yet it has been impossible to determine the cause to which the accident is due. The water in the Maligahakanda reservoir was at once run off, and it does not seem that any large expenditure is necessary for its restoration. But the incident—should it ultimately be found to be due to the cause we have suggested—certainly furnishes an argument against the advisability of trusting the impounding of great masses of water to artificial work. To do so in the vicinity of a populous city is always to be deprecated, although we by no means say that such a course is in every case to be avoided. Still, the fact that it is open to the objections taken to it by many engineers is emphasised by the accident we have described.

THE ELECTRIC LIGHT AT THE BRITISH MUSEUM.

ON a previous occasion we touched briefly upon the defective manner in which electricity is applied to the lighting of the grand reading-room at the British Museum. We were not without the hope that ere this some endeavour would have been made to remove the cause of the many complaints made by those who use the library; but we regret to learn that the trustees have taken no step towards that end, and that study is still attended by all the annoyances and difficulties which we before stated. There is a complete absence of diffusion of light; the crossing shadows are such as to completely prevent reading with any comfort, while the spluttering of the carbons is exceedingly disagreeable and disturbing. There is no difficulty whatever in substituting for the lamps now in use others which will burn in absolute silence and without a hiss or a flicker. The illumination of the reading-room is a great public boon even with all present disadvantages; but the fact can afford no reason why, with every possibility for improvement, the trustees should rest content with the existing lamps and carbons.

LITERATURE.

Harbours and Docks, their Physical Features, History, Construction, Equipment, and Maintenance, with statistics as to their Commercial Development. By LEVESON FRANCIS VERNON HARCOURT, M.A., M.I.C.E. Oxford, at the Clarendon Press, 1885. 2 vols., text and plates. London: Henry Frowde.

THOSE acquainted with the author's book on rivers and canals will have been glad to note the publication of this promised work on harbours and docks, for although these subjects have been very often and at great length dealt with in the pages of the "Proceedings" of the Institute of Civil Engineers, all engineers will nevertheless be ready to acknowledge the high value of a work written by an acknowledged authority on the subject, and one who fully understands that he enhances the usefulness of his book by giving not only credit for, but full references to all writings which he has consulted or quoted. This has been done so fully by Mr. Harcourt, that although he treats some parts of his subjects somewhat briefly, his references make it easy for anyone to find at once fuller treatment of any point. The work is divided into two volumes, the first being text, treating separately harbours and docks, and the second consisting of sixteen well-executed plates of works executed at home and abroad by English and by foreign engineers.

The first chapter is entitled "preliminary consideration," but deals chiefly with wind pressures and velocities, the influence and prevalent direction of winds. The character and use of Robinson's and Osler's instruments are described, and the main results of the experiments made by the Committee on Wind Pressure on Railway Structures, 1881, are given. An interesting and useful graphic method of representing the comparative prevalence of winds as frequently adopted on French charts is given, and this might have been supplemented by some reference to the records obtained by the recording instruments of Lord Crawford at Dunecht, where the changes of direction and intensity of the wind and barometric pressure are registered continuously and simultaneously, the air pressure by a large and powerful barograph, which gives a very large range of direct movement of the recording pencil. For harbour engineering purposes the compass curves of wind prevalence referred to are most useful, for although an extraordinary wind of a day's duration will do more in changing the condition of a foreshore than twelve months' ordinary winds, the prevalent wind direction is a matter of the highest importance, and these curves show this at a glance.

The second chapter, on waves, is necessarily of much greater length, but this and the third chapter, on tides, currents, and changes in coasts, must be taken together, as tidal influences are great on waves as affecting harbour engineering. The earlier work of Scott Russell finds an important place in the author's digest of the theory of wave motion, velocities, and depth of wave influence, and it is noticeable that the theory of M. A. R. Emy, intended to explain some surface effects by ground waves set up by structures in the sea or notable irregularities in the sea bed, is now wholly discarded, although at one time this theory of *flot de fond* was warmly taken up. The comparatively quiescent state of the water at moderate depths, even under a very rough sea, is, however, now generally accepted as amply proved, while greater importance is attached to long waves and the translating effect of wind, especially where the shore is of a character to encourage the inshore breaking of waves not large enough to be broken on shoals and yet large enough to belong to the worst seas. In the expression of the force of the waves reference is made to Mr. Stevenson's marine dynamometer measurements, but the author gives some of these without any opinion as to the dependence which is to be placed on an instrument of the kind which is intended to represent dynamic forces by comparison with static pressures. The instrument, no doubt, gives valuable comparative figures, and these in the book are supplemented by facts, such as the breaking off of the iron tower of the Calf Rock Lighthouse, at a height of 86ft. above high water, in December, 1881. Thus, whatever the pressures recorded by Mr. Stevenson's instrument, the facts show that they are sufficient, occasionally, to do great damage, even at great heights.

In his third chapter the author has performed a difficult task in compressing into about thirty pages a useful summary of tidal theory, tidal observations, and tidal effects, as they bear upon the questions of harbour construction and maintenance. The chapter is necessarily devoted to statements of leading facts connected by sufficient explanatory observations. In remarking upon peculiar tides and unequal tides, the author notices the great inequality along some parts of the Australian south coast, where one tide per day is sometimes practically eliminated, but he does not mention the peculiar tide in Poole Harbour, which seems to be the result of interference partly caused by the configuration of the coast, including the Isle of Wight and Durlstone Head, the effect of the passage of the tidal wave round the Isle of Wight on the tide of Southampton waters being here increased by the contour and shallow depth of the bed off Poole Harbour. Changes in coasts form the subject of a considerable part of this chapter, and a most interesting one. That which may be called the dynamics of these changes is a very fascinating branch of study for any engineer who has any love of pursuing a scientific subject further than his practical requirements may urge him; and these changes provide the theme of a very large number of observations and co-related facts in the latter part of this and the succeeding chapter, all tending to show that while the engineer engaged in harbour engineering must possess a good theoretical knowledge of the conditions affecting the generation and modification of waves, tidal and wind currents, he must depend very much for his success on the goodness of the judgment which guides him in determining position, character, and form of works to be constructed, with a view not only to the object, but to the attainment of that object with the least possible maintenance cost—a result which can only be attained by a thorough knowledge of all the already mentioned conditions as existing not only before, but as likely to be after the completion of the works. Changes in coast have often been said to occur mysteriously, but generally these changes have been the results of neighbouring or distant natural or artificial alterations, as illustrated by the change in the deposit of silt in one harbour caused by extensions—or even of land reclamation works—in or off a near harbour. In this way a consideration of the progress of deltas in tideless seas may be a subject of importance in connection with river mouths and harbours in tidal seas. Rivers discharging large quantities of detrital matter into a tidal sea may not themselves silt up or form bars; but they discharge material which may form silt for a harbour near by, especially if contending tidal streams provide slack water depositing conditions. Some river mouths on our coasts have thus been choked by material which the rivers themselves have not provided. In the fourth chapter the author deals with harbours with regard to their form, and under the several heads—estuary harbours, harbours with backwaters, harbours partly sheltered by nature, harbours protected solely by breakwaters, and peculiar types of harbour with detached breakwaters—he describes their general characteristics and the marine conditions which determine the choice of their design. A remark concerning the parallel jetties at Dunkirk, built at their outer end of open timber work, so that they should interfere as little as possible with the drift along the coast, reminds us that the author does not refer to the use of open-work groynes or grids instead of the ordinary closed or solid groynes. Trials of these by Mr. Dowson have proved them to be capable of withstanding the heaviest seas and at the same time to prevent the removal of shingle, and actually to cause its accretion. The open-work form of breakwater for harbours has not been used, but it would appear that it might advantageously, as to cost, be employed, and the distance within the entrance at which the same height of wave would carry would probably be little extended. Floating breakwaters are referred to only to be condemned on the ground that the accumulated power of the wind lodged in the waves cannot be evaded but must be met, and theory and experience both point to the failure of floating structures in their power of doing this.

Mr. T. Stevenson has prepared what he terms "criteria" of exposed coasts, and various formulæ for the heights of waves within a harbour entrance and on coasts as affected by fetch of open sea, but, although these formulæ may guide a thoroughly practised engineer, they cannot be used by themselves, and Mr. Harcourt's book tends to increase at the same time the tendency to use such formulæ and to look upon the results as only of the nature of a possible check upon observational conclusions. In his lecture "On Tides and Coast Work" to the Institution last year, Mr. Stevenson referred to several of the formulæ which he has constructed from numerical values he has arrived at from extended experience and observation.

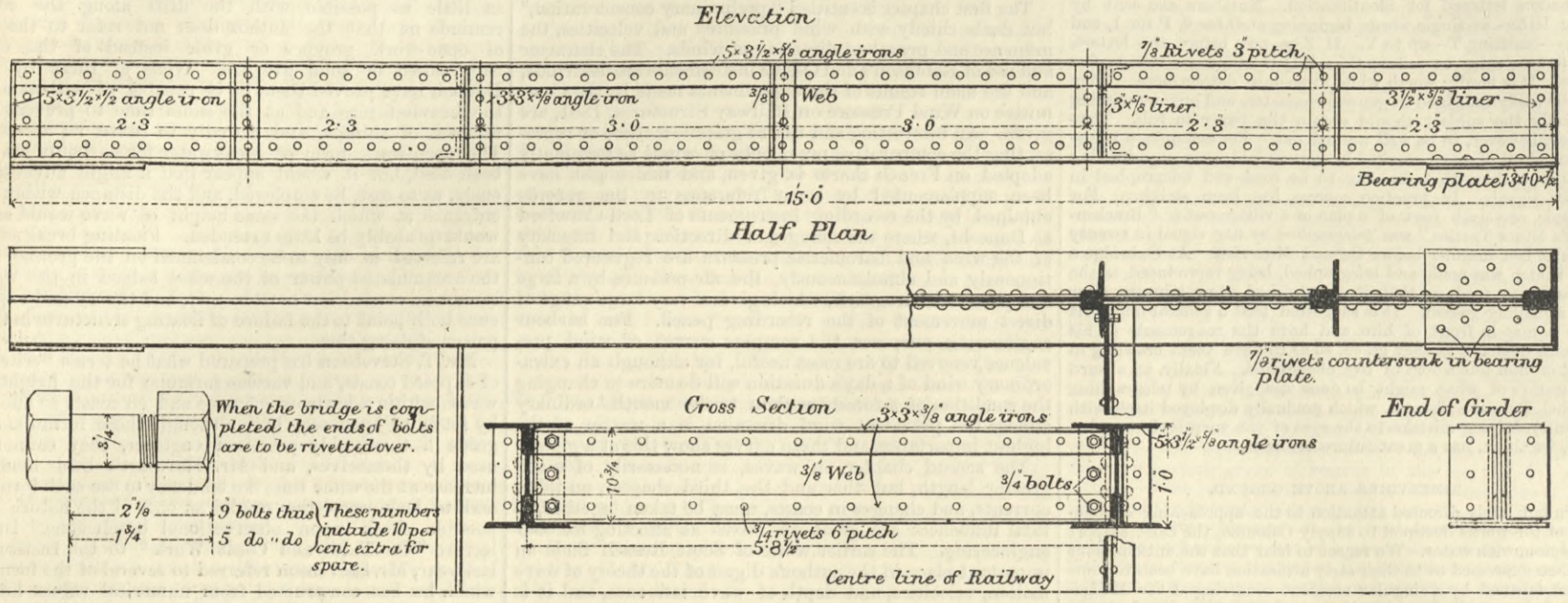
In chapters ten to sixteen he deals with harbours in relation to the type of breakwater which shelters them. In these chapters he describes about seventy harbours at more or less length, and in a large number of cases describes at length the physical peculiarities from a geographical and engineering point of view. The methods of construction are given, and running comments and suggestions are made in each description. Here, as in the chapters on Docks, the author makes most of his descriptive notices the vehicles for observations and theoretic deductions. Over forty home and foreign docks are described, many of them with much detail and all the chief dimensions. In appendices are given dimensions and statistical information, and tidal ranges. The machinery of docks is not dealt with, and is not a part of the author's subject, though allied to it; but apart from the machinery, this is the most complete modern book dealing with harbour and dock engineering from a theoretical and practical point of view now published in the English language. It is a book written by the author, and not a mere compilation and reduction of papers read at good or second-rate technical meetings. It is original, and is a most instructive book. It is remarkably well printed, and the lithographic plates, containing about two hundred and thirty figures of harbours, docks, retaining walls, breakwaters, jetties, quays, lighthouses, beacons and buoys, and concrete block placing machinery, all to scale, are, as well as the few wood engravings distributed in the text, a credit to the publishers. It is a book which must be consulted by those interested in harbours, breakwaters and docks, and will, like Mr. Harcourt's book on "Rivers and Canals," probably form a text book in all civil engineering colleges.

Official Report on New Ordnance Material to U.S. War Department. By CAPTAIN BIXBY, U.S. Engineer. 1885.

THE American *Engineering News* has been giving in some detail the substance of the report named above. A valuable summary of various systems of checking recoil will be found in the number for Nov. 14th last. The Krupp ball-and-socket non-recoil gun, and no-recoil trunnion pivotted gun, as well as his slight-recoil pivotted gun, are briefly noticed. No opinion is given in this number. so we have little to say here. Illustrated descriptions of the two first were given in THE ENGINEER of Aug. 15th, 1879, and of the last, which is a more recent design, in THE ENGINEER of Oct. 13th, 1882, p. 270. The Albini Armstrong carriage is also noticed, with a cut showing action, and another Armstrong no-recoil design is mentioned which is applicable to guns of the largest calibre not yet made public—General Inglis' idea of a yoke or frame made in the gun port, on a circle concentric to the pivot on which the gun traverses. The gun carriage is attached to the yolk frame by means of its water buffer pistons, and its recoil is thus efficiently checked. The same cut in the report will be found on a larger scale with description in THE ENGINEER of July 29th, 1881, p. 77, 73, and 74, to which Capt. Bixby gives a reference with regard to front parapet anchorage, which he notices next. The work must be valuable, judging from the summary. He has collected together a number of designs of the same character, in fact, a larger number than we had realised the existence of, as they have come out in very different times and places. Capt. Bixby contrasts well with many writers in the full acknowledgment he makes of any sources of information. This is the more to be noticed, as we remember Capt. Bixby's visit to this country, and the fact of his being present at experiments at Shoeburyness. Many writers, under the circumstances, would have employed any reports made at such experiments without thinking it necessary to name them, though giving references certainly does not in any way weaken the weight of a writer's opinions, but rather the reverse, for it generally bespeaks a man of weight. A man who refers to all sources of information that he knows, takes the position of reviewing and giving his judgment on all that he can lay before his readers. A man who appears anxious to put everything as the result of his own observation, seems on the face of things to be likely to be more curtailed in his range of view, or else to be quoting more than he admits; moreover, he appears rather to claim to be a reporter than a judge.

NAVAL ENGINEER APPOINTSMENTS.—The following appointments have been made at the Admiralty:—G. W. Barry, engineer, to the Watchful; A. E. L. Westaway, engineer, to the Scourge.

CONTRACTS OPEN—BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY.



CONTRACTS OPEN.

BOMBAY, BARODA, AND CENTRAL INDIA RAILWAY COMPANY.

THE work required under this specification comprises the construction, supply, and delivery at one or more ports named in the tender, or in Bombay, of the whole of the ironwork for sixteen plate girder spans of 15ft. in total length, together with all nuts and bolts required to complete the erection of the work in India, with an addition of 10 per cent. for waste. Drawings can be seen at the company's offices, 45, Finsbury-circus. Quality of the iron is to be such as will stand the following tests:—

	Tons.	Contraction per cent.
Round and square bars, and flat bars under 5in. wide	24	20
Angle bars, and T-bars, and flat bars 5in. wide and upwards	22	15
Plates	21	10
Plates across the grain	18	5

The rivet iron must be of such a quality that any rivet made from it will stand the following tests, without showing signs of failure: Bend double upon itself whilst cold; bend double upon itself whilst red hot; the shank being nicked whilst cold and bent double, showing the fibre of the iron to be of good quality; flattening down the head whilst red-hot until its diameter is equal to 2½ times that of the shank without showing any signs of cracking at the edges; punching through the shank when at a red heat, with a taper punch, a round hole the diameter of the rivet, without showing signs of cracking or splitting. The expense of testing to be borne by the contractor. Three sets of hand-made tracings on cloth 25in. in width to be supplied with the work. Contractors to fix their own time for delivery. Mr. A. M. Rendell, of 8, Great George-street, Westminster, is the engineer. Tenders to be in by 27th inst.

A BATCH OF TRADE CATALOGUES.

DURING the past few months we have received a number of catalogues, some of which we may acknowledge by giving their titles and names and a few passing comments on their contents.

First we may mention a very nice book, "Machine Tools," by Ludwig Loewe and Co., Berlin and London, sent by Mr. S. J. Wilford, the London representative of the firm. This is a well got up catalogue, with illustrated descriptions of lathes, boring machines, drilling and shaping machines, milling machines, slotting, planing, and punching machines, presses, chucks, and other tools; and a list of the specialities, such as rifle, pistol, and ammunition-making machines. This book is a credit to the managers of the fine works at Berlin, wherein milling machine employment is carried out to perfection in making rifles, pistols, and other military requirements.

The next is a quarto "Illustrated and Descriptive Price Book of Machinery and Ironwork," compiled for Messrs. Stothert and Pitt, of Bath, by Mr. C. Cornes, A.M.I.C.E., and Mr. T. Calvert, and published by Messrs. E. and F. N. Spon, as well as by the makers of the machinery described. Messrs. Stothert and Pitt are well known makers of cranes and other lifting machinery, including Mammoth cranes for block setting in harbour operations and those specially required by contractors on heavy work. These, as well as a great variety of cranes of all kinds, concrete, and mortar mixers, floating cranes and dredgers, hoisting and hauling engines, crabs and winches, winding engines, lifts, vertical and horizontal; Collman, and other engines; boilers; chain and other pumps; sewer ironwork; hydrants, engineers' fittings, and contractors' tools generally. It is a well got up book of 316 pages and with a good index. Like the book above-mentioned, it should have the name at the back, but it has not, and this, which would have cost an extra penny or two per copy, reduces the possible value of the catalogue to the publishers by a good deal.

The next on our list is entitled "Catalogue of Oil Mill Machinery, Oil Refineries, and Grain Warehousing Machinery, manufactured by Rose, Downs, and Thompson, Old Foundry, Hull." It is a quarto book, neatly got up, and descriptive of that machinery and ironwork only, which is made by the firm, and, like the two already mentioned, the descriptive matter is of the kind which a machine and mill builder would address to those acquainted with the subject. Messrs. Thwaites Brothers, of Bradford, send us a nicely bound catalogue of their steam and power hammers, Root's blowers, rapid cupolas, trunk air compressors, portable forges, and saws for iron. This catalogue does not do justice to the high reputation gained by the steam hammers and other products of the Vulcan Ironworks. Pages of various sized type are disagreeable to the eye. The descriptive matter given shows the high value and numerous applications of the Roots' blowers and the economy resulting from the Stewart's cupola; but it is not pleasant to read. The illustrated catalogue of the "London and Colonial Engineering Company" is of another kind. It is oblong in form, has a costly gaudy front cover of paper, and it gives external views of the vertical, horizontal, and marine engines, and of the boilers and travelling cranes made by the company. A redeeming feature is the very full dimensional particulars which accompany the descriptions. This is the first catalogue published by the company; future editions will no doubt give more illustrations, and, perhaps, be bound with the back along one of the long sides. The "Phœnix Iron Company," of Trenton, New Jersey, sends a catalogue of the Trenton engines. It is oblong, but not large, and throughout is neat and quiet in style, and the descriptive matter is very complete, and aided by exceedingly good engravings, of the engines and their details. The "Ferracute Machine Company," of New Jersey, sends a copy of its catalogue of presses for stamping out all kinds of large and small iron, brass, tin, and copper articles such as small boxes, spoons, forks, washers, cog wheels, ladles, cups, and pans. It is well illustrated by excellent engravings and of a handy octavo size, but needs better cover and binding.

Mr. W. Guenther, of the Central Engineering Works, Nottingham, sends a satisfactory catalogue of the well-known Guenther turbines; and the "Ashcroft Manufacturing Company," of New York, sends a catalogue of the gauges, indicators, valves, safety valves, tools, and feed pumps, made by it. It is very nicely illustrated and printed, but it is double the size—quarto—it need be.

Messrs. W. H. Bailey and Co., of Salford, have just sent us a catalogue of their steam and water fittings. This is a price list of 166 quarto pages, illustrated by an enormous number of engravings, many of which are sectional and so contrived as to give a general and a detail view. The variety of fittings is so great and comprehensive that we could not pretend to mention any by name, and "Bailey's fittings" are so well known as to make it sufficient to say a new catalogue has been published. From a utilitarian point of view, this catalogue is generally satisfactory, but at slightly greater expense the general appearance and attractiveness of the articles on almost every page might be much improved. There is too much on most pages. On page 43 are two engravings which have the appearance of not being "blocked down," and though they may attract attention, they are ugly.

Messrs. Rowson, Drew, and Co., London, send an "Illustrated Catalogue of Constructional Ironwork." It is oblong—might as well have been bound the other way—and contains numerous illustrations of girders, roofs, corrugated ironwork, and a large number of sections of rolled joists, and of girders made up from these.

Messrs. Frederick Braby and Co., London, send an illustrated catalogue of ornamental and other zinc roofing work. It is illustrated by coloured lithographs of zinc roofing and details, and a photograph of the very fine zinc-work, the Mansard roof, dormers, finials, &c., of the Grand Hotel. It is neatly got up, but is oblong in form.

Messrs. Charles Churchill and Co., of London, send a quarto catalogue of 248 pages of American machinery and tools. It is difficult to tell why so much of the cheap machinery, lathe tools, cutlers' drills, and thousand-and-one sundries here shown should still be imported from the States.

Messrs. John Birch and Co., Liverpool, send a quarto "Representative Catalogue of Machinery, Machine Tools, and Engineering Materials" sold by them as merchants. It contains over 200 pages, illustrated by about 800 engravings, and its contents range over the whole category of mechanical requirements of every class of engineering contractor and works' owner. It is printed on paper of too dark a tone, and the name and trade mark of the firm are too prominently and obtrusively printed in light colour on every page, but it is a useful catalogue.

Messrs. Jackson and Co., Manchester, send a list of their steel and iron tooth wheels for all purposes. This list is useful, but might be made to look as though it were thought worth doing.

The Leeds Forge Company has issued a catalogue which is noteworthy as illustrating the great growth of a business in the well developed applications of its chief speciality, Fox's corrugated flues, but its form is objectionable.

A very small catalogue of welded and rivetted boilers for hot water heating apparatus and other purposes is sent by Messrs. Hartley and Sugden, of Halifax. It is a neat litt'e price list, and is noticeable as having the name in clear gilt letters on the back.

Another style of catalogue is that issued by the Hydraulic Engineering Company, Chester, relating to hydraulic motor machinery, hydraulic cranes, punching, rivetting, shearing, bending machines, and lifts. This is a meritorious attempt to produce a creditable exposition of the manufactures of the company, and although it serves to call to the mind the fact that the company makes this and that kind of crane or machine, the credit of the production is chiefly due to the printer and photographer, the illustrations being all photographs direct on the paper forming the pages. The descriptive letterpress is very meagre, there are no drawings except of the exteriors, and no prices, and only a few general dimensions. It serves only as a type book of the class of machinery made by the company, and affords the names of the Governments and other bodies who have been purchasers.

Messrs. Henry Greene and Co., of Upper Thames-street, send an illustrated price-list, of handy octavo size, containing a miscellaneous collection of tools, utensils, steam and water fittings, pumps, boilers, and machines, which they as merchants, established, it is said, before the fire of 1666, and, therefore, of long personal experience in selection, supply.

STEEL-MAKING LADLES.

THE practice of carrying melted cast iron direct from the blast furnace to the Siemens hearth or the Bessemer converter, saves both money and time. It has rendered necessary the construction of special plant in the form of ladles, of dimensions hitherto quite unknown. Messrs. Stevenson and Co., of Preston, make the construction of these ladles a speciality, and by their courtesy we are enabled to illustrate four different types, each steel works manager, as is natural, preferring his own design. Ladles are also required in steel foundry work, and one of these for the Siemens-Martin process is illustrated by Fig. 1, page 64. These ladles are made in sizes to take from five to 15 ton charges, or larger if required, and are mounted on a very strong carriage with a backward and forward traversing motion, and tipping gear for the ladle. The ladles are butt jointed, with internal cover strips, and have a very strong band shrunk on hot about half way in the depth of the ladle. This forms an abutment for supporting the ladle in the gudgeon band, being secured to this last by latch bolts and cotters. The gearing is made of cast steel, and there is a platform at one end for the person operating the carriage or tipping the ladle. Stopper gear and a handle are fitted to the ladles to regulate the flow of the molten steel from the nozzle at the bottom.

Fig. 2 shows a spiegel ladle, of the pattern used at Cyfarthfa. It requires no description. Fig. 3 shows a tremendous ladle constructed for the North-Eastern Steel Company, for carrying molten metal from the blast furnace to the converter. It holds 10 tons with ease. It is an exceptionally strong structure. The carriage frame is constructed throughout of 1in. wrought iron plates, and is made to suit the ordinary 4ft. 8½in. railway gauge. The axle boxes are cast iron, fitted with gun-metal steps. The wheels are made of forged iron, with steel tires and axles. The carriage is provided with strong oak buffers planks, and spring buffers; the draw bars also have helical compression springs of the usual type. The ladle is built up of ½in. wrought iron plates, butt jointed, and doubled rivetted butt straps. The trunnions and flange couplings are of cast steel. The tipping gear, clearly shown in the engraving, consists of a worm and wheel, both of steel, which can be fixed on either side of the ladle as may be desired. From this it will be seen that Messrs. Stevenson and Co. have made a thoroughly strong structure in every respect, and one, therefore, that will commend itself to most steel makers. We understand that these carriages are made in various designs and sizes to meet special requirements. Thus Fig. 4 shows one of different design made for a steel works in the North. This is also a large ladle. The carriage is supported on helical springs, and solid steel wheels. It will readily be understood that very great care and honesty of purpose is required in making these structures. A breakdown might any moment pour 10 tons of molten metal on the ground with the most horrible results. Messrs. Stevenson possess a well-earned reputation for this class of work.

THE INSTITUTION OF MECHANICAL ENGINEERS.—The thirty-ninth annual general meeting of this Institution will be held on Thursday, February 4th, and Friday, February 5th, at 25, Great George-street, Westminster. The chair will be taken by the President, Mr. Jeremiah Head, at half-past seven p.m. on each evening. The annual report of the Council will be presented to the meeting. The annual election of the President, Vice-Presidents, and Members of Council, and the ordinary election of new members, associates, and graduates, will take place at the meeting. The appointment of a professional accountant, to audit the accounts of the present year, will be made by the members, and his remuneration fixed. The present auditors, Messrs. Robert A. McLean and Co., chartered accountants, offer themselves for re-election at the same remuneration as heretofore, namely, ten guineas. The following notice of a motion for an alteration in the bye-laws was given by Mr. M. Powis Bale at the last general meeting. This motion will be made at the meeting on the 4th February. That Bye-law No. 22 be amended to read as follows:—"All papers shall be submitted to the Council for their approval, and after their approval *shall be printed and circulated among the members at least one week before the general meetings; and an Abstract only of each Paper* shall be read by the Secretary at the general meetings, or by the author with the consent of the Council." Bye-law No. 22 is as follows:—"All Papers shall be submitted to the Council for approval, and after their approval shall be read by the Secretary at the general meetings, or by the Author with the consent of the Council." The following Papers will be read and discussed, as far as time permits:—Description of an "Autographic Test-recording Apparatus," by Mr. J. Hartley Wicksteed, of Leeds. Description of "Tensile Tests of Iron and Steel Bars," by the late Mr. Peter D. Bennett, of Tipton. Description of a "Hydraulic Buffer-Stop for Railways," by Mr. Alfred A. Langley, of Derby. On the "Distribution of the Wheel Load in Cycles," by Mr. J. Alfred Griffiths, of Coventry.

LETTERS TO THE EDITOR.

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

REACTION WHEELS AND TURBINES.

SIR,—"Pynx Gryph" must not be offended with me for bluntly stating that in questions capable of being decided by mathematical demonstration, mere authority of opinion has no weight—at least, not with me. In quoting, therefore, Weisbach and Rankine, he ought to have given a summary of the analytical investigations of those gentlemen, in order that I might have an opportunity of trying to pull them to pieces.

"Pynx Gryph" affirms that the arms can be curved in such a way that no angular velocity will be imparted to the water after it has once entered the arms. It is clear that the curvature of the arm designed to effect this object must vary with the ratio of flow in the arm itself to the area of the orifice and the ratio of the relative velocity of outflow through the orifice to the absolute velocity of the orifice. I myself cannot conceive how such a result can be attainable, and it is clearly incumbent on "Pynx Gryph" to prove that it can by working out a general formula for determining the curve of the arm. I cannot understand the drum arrangement suggested by "Pynx Gryph," and shall feel very much obliged to him if he will send a section through the proposed drum and the orifices of discharge with his reply. I shall also feel obliged to "Pynx Gryph" if he will show in what way the determining of the shape of the blades of centrifugal pumps and Guibal fans is connected with the theory of reaction wheels.

"W. H. T." speaks in the plural. I conclude, therefore, that the three letters represent a firm. They state that the formula for reaction wheels can be easily deduced from that for turbines. "W. H. T." must not, any more than "Pynx Gryph," be offended with me for pointing out to them that it is not only necessary to give this formula, but to show how it was obtained, and how the formula for reaction wheels can be deduced from it. "W. H. T." are bound also to give full particulars of the experiments with reaction wheels which showed that the coefficient of efficiency of a reaction wheel can exceed ·6, including among the particulars the shape of the arms, and the diameters of the orifices of discharge ascertained by actual calliper measurement. I will reply to Mr. Norman after the discussion between "Pynx Gryph" and myself has been concluded. I wish to avail myself of this opportunity of correcting two errors in my paper, one relating to the statical pressure, the other to the resistance of the atmosphere.

The pressures between the points $b\,b_1$ on the back and front of the vane are not, as stated, equal. The pressure on the back of the vane starting from the point b is always greater than the pressure on the front of the vane up to the point where a tangent to the vane passes through the axis of the turbine. At this point the pressure on both sides of the vane is the same. Beyond this point the pressure on the back of the vane is less than that on the front of the vane. It is impossible, without knowing the exact shape of the vanes, to ascertain whether the excess of the pressure on the back of the vane from the point b up to the point where the tangent to the vane passes through the axis of the wheel is greater than, equal to, or less than the excess of the pressure on the front of the vane from the same point to the point b_1, but the difference between the two differences cannot have any appreciable value. Statical pressures, with the exception of those due to tailwater, can only exist in inward flow turbines. Since the arm of the moment of the excess of the pressures on the back of the vane at the receiving side of the wheel is much greater than the arm of the moment of the excess of the pressure on the front side of the vane at the discharging side of the wheel, statical pressures in inward flow turbines must necessarily tend to retard the wheel.

I avail myself also of this opportunity to again point out that centrifugal force can have no tendency either to retard velocity of flow in inward flow turbines, or to accelerate velocity of flow in outward flow turbines. The centrifugal force is simply square to the effort made by the flowing water to move in a straight line, and always acts normally to the curvilinear path in which the water is moving. This curvilinear path in the case of water flowing through turbines is simply the absolute path of the water, and as the centrifugal force can only act normally to this absolute path, it can have no effect in either retarding or accelerating velocity of flow.

The other mistake is the statement that the work done in overcoming the resistance of the air, when the velocity of the orifice is equal to $2\sqrt{2\,g\,H}$, is $(3{\cdot}2)^2$ times the work done when the velocity of the orifice is equal to $\cdot62\sqrt{2\,g\,H}$. This is the ratio of the resistances only. The ratio of the work done in the two cases per second will be as $(3{\cdot}2)^3 : 1$.

WILLIAM DONALDSON.

2, Westminster-chambers, January 19th.

MOMENTUM AND INERTIA.

SIR,—Mr. Donaldson writes funny letters, which I read with great surprise. I think we may, for the moment at least, drop all reference to Dr. Lodge.

Mr. Donaldson seems to have heard about definitions of momentum and inertia for the first time very recently. He does not appear to have ever read any standard author on dynamics, or he has forgotten what he read; and he consequently attributes definitions to me for which I am not responsible. Take, for example, the statement that momentum means "quantity of motion." He evidently thinks this is mine; but the definition was given to the world before either I or Mr. Donaldson was born. If he will turn to Gregory's "Mathematics," he will find it there. As for more recent authorities, if he will take down almost any text-book he can find on his library shelves, he will also find this definition. Thus in Kerr's "Elementary Treatise on Rational Mechanics," on page 144, we have—"The product of the mass and velocity of a particle is called the momentum or quantity of motion of the particle." One of the most recent text-books is that by Williamson and Tarleton. At page 52 I find—"The product of its mass and the velocity which a body has at any instant is called its *quantity of motion* or *momentum* at that instant." I do not think I need say more to convince Mr. Donaldson that the definition he calls in question did not originate with me.

I have much difficulty in understanding what Mr. Donaldson wants me to tell him about masses and motion. I suppose he does not think clearly about these things, and therefore he does not write clearly. I am compelled, therefore, to make a general statement in the hope that I may cover all the ground over which his questions range. "Does 'Φ. Π.,'" says Mr. Donaldson, "still maintain that the acceleration produced in different bodies by a given force acting during a given time varies as the masses of those bodies?" Of course I do. So did Newton. (1) Equal forces applied to equal masses produce equal velocities in equal times. (2) If we halve the forces, the masses and times remaining constant, the velocities acquired will also be halved. (3) If we double the forces, the times and masses remaining constant, we shall double the velocities, and so on. In other words, the force required to generate a given velocity in a given time varies as the mass, or as it is commonly written in text books, $F = m\,f$. Newton's second law runs: "Change of motion is proportional to the impressed motive force, and takes place in the right line in which that force is impressed." So far as I can see, this answers Mr. Donaldson's questions; but I hasten to explain that the enunciation of those laws did not originate with me, nor am I responsible for them.

Mr. Donaldson's explanation of the course of reasoning by which he thinks I arrived at my definition of inertia is very funny. It reminds me of the celebrated logical proof that every cat has three tails, which proof runs thus:—"No cat has two tails. A cat must have one tail more than no cat, *ergo*, a cat must have three tails."

The facts are as follows:—When we are told that a body possesses momentum—in other words, quantity of motion—and that one body may possess n times more or n times less motion than another body, I find it impossible to resist the conclusion that matter has a capacity for motion—a power, that is to say, of receiving it and holding it. We can as completely empty all the motion out of two masses into one mass, for example, as we can empty the contents of two small jugs into one large one. That matter can hold motion is the legitimate deduction from the words "quantity of motion in a body." I think Mr. Donaldson will concede this. We have next to consider whether this capacity for motion is, or is not, equivalent to inertia.

To the uninstructed mind always, and sometimes to the instructed mind, inertia is associated with resistance; but it is a fundamental truth that matter has no power whatever of resisting an effort tending to put it in motion. I think it is not unlikely that Mr. Donaldson will dispute this, but perhaps, for the sake of argument, he will concede that it is true. Now, when we find that a mass slowly acquires a given velocity, and that all the motion put into it in giving it that velocity can be made to reappear again, and that the apparent reluctance—always associated in the mind with inertia—to move is directly proportional to the mass of the body, is it not a legitimate conclusion to say that inertia means capacity for motion? The double mass must have twice as much motion poured into it as the single mass to produce a given velocity. My definition gets rid altogether of the idea of resistance, which is fatal to accuracy, and is in every respect, I maintain, a better definition than that usually supplied.

I have no desire to go over old ground, nor shall I open up an old discussion by saying anything here concerning the reaction which accompanies transfer of motion, and which is really a time factor. I must refer Mr. Donaldson to my letter of April 3rd, 1885, for my views on this point.

I have done my best to make myself clear this time at the risk of encroaching on your space too much. I hope that Mr. Donaldson will now understand me, and that he will take in good part—as it is meant and with all courtesy to a man of his reputation and attainments—the advice to turn to any good text-book of dynamics when he is in doubt as to what I say or mean. I cannot refer him to a better book than Dr. Lodge's. To the numerical statements in it I certainly take no exception. My further assertion, that of all the many works on statics, dynamics, &c., on my shelves, I value that, as far as it goes, the most, will suffice to prove that the points on which I and Dr. Lodge are at issue—principally matters of definition—are hardly numerous enough to be worth naming. Mr. Donaldson may take Dr. Lodge's book, broadly speaking, as my confession of faith.

Φ. Π.

London, January 18th.

A PROBLEM IN INDICATOR DIAGRAMS.

SIR,—The set of diagrams you illustrate on page 503 of last week's issue are very interesting, and I have pleasure in complying with your request to attempt solution of the problem they present. The engine seems to be a non-condensing compound one. The high-pressure cylinder I take to be fitted with main and expansion slide valves or other method by means of which an early cut-off is attainable without too early a closing of the exhaust. The expansion slide-valve, or its equivalent, giving facility for varying the point of cut-off, has been shifted to too early a grade for the pressure of steam with which the engine was working, the consequence being that there is insufficient steam, when expanded, to fill the high-pressure cylinder even, let alone the low-pressure one, as is shown by the expansion curve falling below atmospheric line towards end of stroke.

An ordinary single-cylinder engine working under these conditions, exhausting to atmosphere, would show a negative loop at the end of the card, and the return stroke of pencil would travel along the atmospheric line, or perhaps slightly above it, should there be any back pressure in exhaust pipe. In the present case there is a considerable vacuum varying in amount throughout the stroke, which represents the state of matters in the receiver until the valve begins to close exhaust and compression begins. The low-pressure card is more puzzling, and the first question that arises is—Why should the initial pressure in low-pressure cylinder be greater than terminal pressure in high-pressure cylinder?

To answer this question it is necessary to follow the card throughout its course, and it will be seen that after the expansion is completed in this cylinder, when the exhaust opens, the pencil immediately jumps, not only to the atmospheric line, as might be expected, but over it, showing that there must be back pressure in the exhaust, possibly from other engines exhausting into the same pipe, and this slight pressure is augmented in the cylinder when the exhaust port closes. If this explanation be correct, one would, however, expect a sudden drop to the receiver pressure when the valve opens again, but the absence of this is possibly due to large clearance and very small receiver capacity; besides which, the low-pressure card looks as if the piston or valve were leaky, though where the leak is from it is impossible to say, unless the one end of cylinder is worked high-pressure and the other end low-pressure.

Regarding the setting of the valves, the main valves have seemingly no lead; but if the expansion valve of high-pressure cylinder were altered to carry the steam further, or if the boiler pressure were increased, the cards would not be such as to puzzle anyone. It is not usual in actual practice to have to interpret cards without having some information as to the type of engine from which they were taken. In dealing with the diagrams illustrated, one has to make certain assumptions as to arrangement of cylinders, kind of valves, &c., which would not have been necessary if an outline of the engine had been given.

Glasgow, December 28th, 1885. BETA.

SIR,—I venture to make a few remarks upon these; they are of a paradoxical character, and difficult to solve. Assuming them to be real cards, and taken directly from the engine, my answers to your queries will be—(1) No; (2) valve faces and pistons in bad repair; (3) condensing; (4) no. Two types of engine would produce similar cards under same conditions. First, compound condensing engine, with high-pressure cylinder in communication with condenser—direct—by means of an exhaust valve worked either by cam or trip gear. The high-pressure cylinder diagram is substantially good, but is distorted by presenting an unreal cut-off—fault, leaky piston; the line below the atmospheric line is again distorted—fault, leaky piston. The low-pressure cylinder diagram is distorted nearly out of recognition. The steam line is evidently caused by leakage in some quantity past either an auxiliary steam valve, or from steam jacket; such leakage is evidently in connection with the exhaust side of high-pressure piston and the steam side of low-pressure cylinder; evidence, the loop on low-pressure diagram and the cushioning corner of high-pressure diagram. Secondly, the other type is annular, low-pressure cylinder enveloping the high-pressure cylinder, and both worked by one valve, which valve is in bad condition, the air pump out of order, and an imperfect joint between condenser and bottom end of high-pressure cylinder. I think that a general repair is needed; the problem diagrams would then assume a form which the makers would expect.

34, Heytesbury-street, Dublin, January 20th. J. BATEY.

[We have received a very large number of letters on this subject, from which we have selected fair examples. The engine in question was that exhibited by Messrs. Galloway and Sons at the Inventions Exhibition. It was designed to supply 180 indicated horse-power, but was never loaded to more than about 30-horse power. An illustration of the engine will be found in our impression for Dec. 4th, 1885. The problem has been solved correctly by the greater number of our readers. The low-pressure cylinder really acts the part of a species of air pump, and when the exhaust opens, air rushes into the low-pressure cylinder instead of steam coming out. It is a non-condensing engine. The power shown by the low-pressure card must be deducted from that shown by the high-pressure card. The valves are properly set. We have here an admirable example of what takes place when an engine is used which is too large for its work. No doubt there are many compound engines at work at present in which the low-pressure cylinder is little more than a drag on the high-pressure cylinder. We are pleased that so many of our readers have solved the problem. Some of the answers we have received demonstrate, however, that what the indicator has to tell is not as widely understood as it ought to be.—ED. E.]

THE ANTWERP EXHIBITION.

MONSIEUR,—Je vous remercie pour l'article que vous avez bien voulu publier sur la machine que j'ai exposée à Anvers. Je n'ai pu en prendre connaissance qu'aujourd'hui, et je me permets de vous signaler une erreur.

Vous dites que mon brevet date de 1867 et que depuis lors j'ai construit des machines ayant ensemble une force d'environ 27,000 chevaux. Vous avez trouvé ce chiffre dans un article publié dans le No. 241 du Panthéon de l'Industrie, et je vous prie de remarquer que ce No. 241 est date du 16th Novembre, 1879. Depuis cette époque le succés de mes machines a été croissant, et en Décembre, 1885 le total des machines du système Nolet construites dans mes ateliers, ainsi que par divers constructeurs à qui j'ai accordé des licences de construction, représente une force d'environ 45,000 chevaux.

Vous m'obligeriez beaucoup, si à l'occasion vous vouliez rectifier ce chiffre.

Vous remerciant d'avance, je vous prie, Monsieur, d'agréer l'assurance de ma parfaite consideration. CH. NOLET.

Gand, Janvier 15th.

AN ELECTRICAL PROBLEM.

SIR,—Perhaps some of your readers will answer a question to which I can obtain no reply from text books?

I have a solenoid which works a small hammer. It is a model. The little hammer weighs about 2 lb., and is raised about 3in., the core being sucked into a solenoid with the usual make-and-break. I work this with a battery. The hammer will make nearly three hundred blows a minute. The work done is then about 150 foot-pounds per minute.

By putting the make-and-break out of contact, or fixing it in contact, I can either send the current through the solenoid continuously, so keeping the hammer always suspended, or I can send the current continuously through the coil, the hammer being removed.

Now according to the text books the battery will be affected by working the hammer—that is to say, it will run down slower when the hammer is at work than when it is not. I want to know how the doing of work affects the battery. Does it affect the resistance in the solenoid coil?

Secondly, I want to know whether the work of keeping the core—hammer—suspended against the action of gravity will affect the battery or not?

Lastly, I may say that I find no difference whatever in my batteries. They run down just the same whether the hammer is or is not at work.

Any rational explanation of the theory involved would not only be a boon to me, but to many of my fellow-students.

Cromer, January 19th. STUDENT.

TRADE DEPRESSION AND FOREIGN COMPETITION.

SIR,—The very interesting review of Mr. Jeans' able work on the "Supremacy of England," which appeared in THE ENGINEER for December 25th, 1885, is calculated to make your readers ponder over those doctrines of Free Trade which have become part of the faith of every Englishman, and on the very imperfect and one-sided application which they have received at the hands of the world. Most of us can remember the commencement of the Free Trade movement. When that movement was started England was indeed supreme. The power of Prussia was as yet an unknown quantity, and counted for little in diplomatic calculations, and we were then not only industrially and materially the first country in the world, but might well have claimed to rank as a first-class military Power. Since then a quarter of a century has elapsed—perhaps the most eventful twenty-five years the world has seen—and our position is strangely altered.

We can scarcely even be considered as a second-rate military Power, and our industrial supremacy looks very shaky. Those countries who once joyfully received and adopted the gospel of Free Trade have acted too much like him who received seed among thorns and allowed the care of this world and the deceitfulness of riches to choke the word, and so became unfruitful. Indeed, the doctrine of Free Trade has not been a fruitful one on the Continent, and what is most annoying about it is that the stupid and bigotted people who have adopted a policy of protection of home industries will not see that they are ruining themselves to the advantage of the English consumer. So foolish and obstinate are they, that they are actually competing with us in our own country in manufactured goods of which we once had the monopoly, underselling us, and absoutely shutting their eyes to their deplorably benighted condition. As a matter of fact, before we started our Free Trade propaganda we were the workshop of the world. Since then, by dint of judicious nursing and fostering, foreign countries have become able to compete with us not only in foreign markets but at home.

Whilst considering this very disagreeable and mortifying fact, we should bear two important points in view. In the first place, the tendency of mechanical inventions is to supersede and entirely dispense with skilled labour wherever possible; and the second point, which is still less reassuring, is that the standard of living amongst the working classes abroad is much lower than with us, and consequently their wages are below those of their English colleagues. These two points are exceedingly obstinate, and it is difficult to calculate the amount of optimism necessary to disregard them. The columns of the *Times* have for the last few months been enlivened by the appearance from time to time of some rather vague and inconclusive, but exceedingly witty, letters from the pen of Mr. Howorth, on Free Trade. So far as it is possible to get any definite insight into the writer's views from these letters, he is a protectionist. But I for one, Sir, would be slow to enlist myself in the ranks of protectionists, not from any weak-kneed or blindly superstitious reverence for the religion of Free Trade, but simply because I very much fear that protection would be a bad thing for our carrying trade. At present we are practically the carriers of the world, and I understand carrying is a very profitable business, for which our insular configuration and exceptional position particularly fit us. By adopting protection America has ruined her carrying trade, and we, in following in her footsteps, would simply drive the trade of Liverpool and London to such formidable rivals as Antwerp and Havre, and possibly Flushing. It is well known that a very large percentage of our imports and exports are simply goods on their way through England from one country to another, and would be materially reduced in volume were prohibitive tariffs to be placed on them. Neither wholesale protection nor yet unfair and one-sided Free Trade will benefit this country, or revive its dying industries. But we must alter our attitude towards these questions. In other departments of politics the *laissez faire* school is coming more and more into discredit, and people are everywhere awakening to the idea that if we are to maintain an expensive and ornamental Government we should at least turn it to some use. Raising the income-tax and getting us into difficulties abroad—out of which we have to help them with our purse and blood—are scarcely functions of great utility. It is also time we should recognise the fact that the producer is of more importance to his country than the consumer. We are supposed to govern ourselves, our laws and institutions are popularly supposed by the vulgar to be the reflex of our opinions. If that be really the case, why should we not try to bring our Government more closely into sympathy with the interests of the people? Of course, we know that party Government is a great obstacle to this; and in this connection I may be permitted, Sir, I hope, to express my regret that the eminent members of the Liberal party, supporters of Free Trade doctrines, should have declined to sit on the Royal Commission on the Depression of Trade, which has become abortive through such

action. What we want, Sir, is less party spirit and more patriotism, less of abstract philosophising in a branch of science which is peculiarly unamenable to experiment, and a more earnest desire to improve the national well-being.

The true secret of the success of foreign countries in their industrial policy is not to be found so much in any particular legislation as in a strong, a sincere and patriotic spirit of emulation. They are determined, people and Government, to rival us, and their consuls, their officials, their capitalists, and workmen are putting all their strength into united, well-directed, and generally successful efforts. PESSIMIST.

January 19th.

FREE TRADE AND NO TRADE.

SIR,—Near the end of the letter which you did me the honour to publish in your last impression, I said that, with your permission, I would endeavour to show that Protection may be made a means of distributing internal wealth. This I shall now proceed to do. The best way to do it within reasonable limits is to first give an illustration of my meaning.

Let us suppose that in some country there are two classes, one living on capital, the other by labour. Suppose that all the capitalists with one consent determine that they will buy nothing of native manufacturers, but that they will import everything that they want, because by doing so they will save a little money. This they will be in a position to do, because they can take or send their money, being portable, where they please. The direct result of this policy will be that those who have only labour to live by must starve, or else carry their labour to other countries—that is to say, if they have means of emigration. Let us further suppose that the Government of the country, being impartial, resolves that the labouring classes shall have the means of living, and accordingly prohibits the importation of any article of foreign manufacture. Then the tables would be turned, and the capitalist would be compelled to employ his fellow-countrymen. In this latter case the internal wealth of the country would be distributed unless, indeed the capitalists all emigrated. The capitalist would, perhaps, be a little worse off, but not much, for labour would compete with labour to supply cheaply. The main result would be that sought for, namely, both classes of the community would be enabled to live in their own country, whereas under the previous *régime*, the moneyed man lived in one country and the producer in another. So far as the conditions of climate, &c., will allow, it is always best that the producer and consumer should live in the same country.

I have here drawn, as a matter of course, a picture of an extreme case. In England, at all events, the distinction between the capitalist and the labourer is not sharply defined. The entire population is not divided by a hard-and-fast line between those who have no capital and those who have, between those who work and those who do not. But it is beyond question that there are very large sums of money lying idle because no investment can be had for them in this country; and that a great deal of money comes into this country from abroad in the shape of interest on money lent and profits made on work done in other countries—that is to say, there are a good many people who are practically independent of the assistance of the men in this country who live by labour. Furthermore, we have large classes, such as manufacturers, who are wholly dependent on their fellow-countrymen for labour. I state these things in order to avoid being misconstrued. They are trite facts enough. I name them to make it quite clear that I do not suppose that the population of Great Britain consists of a few capitalists on the one hand and some millions of workers on the other.

Now, it is an axiom of political economy that the source of all wealth is labour. The natural products of the earth, such as coal, virgin forests, &c., are called capital, and are supposed, like all other capital, be it gold or land, to be valueless without the aid of labour. This being so, it is obvious that the country which does most work must be also the richest, and that when we see hundreds of men walking about idle—as can be seen any day in the North of England—we may take the lamentable spectacle as an evidence of national poverty. It follows that, to carry out the sound principles of political economy, every effort should be made to keep the greatest possible number of the population of Great Britain at work. If it can be shown that under Protection more hands would be employed than under Free Trade, then I maintain that Protection is the best policy. It devolves on those who advocate Free Trade to prove that under it more hands are employed and more capital is invested in manufactures than would be the case under Protection.

If the working men of this country were told that it was the intention of certain capitalists to import 30,000 German artisans, who were coming here to work at the rate of 18s. a week, what would they say? Yet at the present moment many more than 30,000 Germans are working for this country at 18s. a week. The only difference is that they work in their own country; they are paid by the English consumer all the same, and they spend their wages abroad, so that we here have not even the advantage to be gained from the outlay of wages among ourselves. Put into plain English, foreigners are at work for us while our own men are idle.

I am quite aware that I shall be told if we did not buy from Germans they would not buy from us. I might urge that if we produce and consume at home we shall not want them to buy. But I will accept the argument as sound, yet maintain that the fact does not make matters any better for the working man. Mr. Metropolitan A. Stock buys German sugar; this is practically paid for by money obtained from the London rates. If Mr. Metropolitan A. Stock bought sugar made by Englishmen that would be so much the better for the English sugar refiners, and so far as I can see the balance of trade would still be in our favour. It is quite possible that he would have to pay a little more for his sugar than he does now. It does not follow that he would therefore be the worse off in the long run. Besides, the argument quoted above falls to the ground, because the Germans will not buy from us. They do all that a protective tariff can do at all events to keep our wares out of their country.

The argument I urge then may be put thus:—That country will be best off in which there is most employment. Under a protective tariff there are more men employed than would be employed under Free Trade, therefore Protection is better than Free Trade. It remains to be seen whether any of your readers either can or will attempt to dispute this syllogism. I assume that it will be disputed, and one of the first arguments held will be, no doubt, that if an industry cannot stand without Protection it had better be suffered to fall. This is a very old argument—a standing dish, in fact. It is worth while to consider it in the light of facts. If any of your readers can turn to "Webber's History of the Cotton Manufactures of the United States," they will find information which will leave no doubt on the minds of the most incredulous that Protection has built up an enormous and most valuable industry in that country. The manufacture has had many vicissitudes—dying when Protection was taken off, coming to life again the moment it was restored. I believe I am not far wrong when I say that about one million of men, women, and children now live on wages earned in manufacturing cotton goods in the United States. It requires some power of argument to maintain that it is not worth while to protect an industry which supports so many individuals. We need not confine our attention to the United States. We have only to turn our regards to Belgium, Germany, or France, to see the enormous development that manufactures have undergone under Protection. Indeed, I do not think that any one disputes that Protection does develope manufactures. Only we are told that manufactures are bad for these people. In reply, I ask, What would Germany be without her manufactures? She would have nothing left to support her but agriculture, and it is well known that a country in that condition must be poor, nearly, indeed, savage; for the fine arts and the sciences do not flourish in purely agricultural countries. We are often told to look at the condition in which Germany now is, notwithstanding the tariff. I ask, In what condition would she be if she had not a tariff? I will answer my own question. Those who possessed any money would invest it out of Germany. They would buy what they wanted in England or elsewhere. They would, in a word, employ English workmen. Their unhappy countrymen, lacking money, would lack everything, because their labour would be worthless, just as the labour of our own ship-platers is at this moment. Under Prince Bismarck's fostering care, although Germany is borne down and well-nigh crushed under the burthen of an enormous standing army, she has become a great manufacturing nation, and she can sell in England goods that England cannot produce herself at the price.

I do not for one moment hold that excessive protective duties ought to be levied in Great Britain; but I do maintain that conditions now exist which render it desirable that money now spent in paying wages to foreign workmen should be spent in paying wages to our own fellow countrymen. A moderate tax on imported silk goods, for example, would leave no one in this country one penny the worse, and would at once restore a valuable industry to our shores. The list might readily be extended were it necessary, which it is not.

The present position in many of our centres of industry is simply deplorable, only because we import what we ought to make at home, and we pay for what we import, not in goods made at home, but in money. Germany can buy English pigs from us, convert them into steel, and undersell our own steel-makers in Great Britain, in spite of duties, and get paid for this steel in English gold. I am far from advocating heavy or indiscriminate duties. I am, as I have said, neither a Protectionist nor a Free Trader. I hold that conditions may arise which dictate for any country which of the two policies is the better. When I read about hundreds, nay, thousands, of my fellow-countrymen walking about in idleness, I cannot resist the conclusion that steps should be taken to find them work, and that this can only be done by inducing consumers to employ own countrymen to work for them instead of employing foreigners. I may be told that the foreigner can do it cheaper. This may be so, but it is not a statesmanlike policy, or one that will pay in the end, to sacrifice any class in a country for the sake of cheapness. If, as I have said, labour is the foundation of all wealth, then that policy which gives most employment must be the best, and it will be difficult to defend a policy which, while opposed to that of the rest of the civilised world, takes no thought of those who are willing to work and cannot.

I have no doubt that a host of general propositions may be urged against the position which I have taken. These propositions have unfortunately been for the most part elaborated from the internal consciousness of the propounders. They do not apply in practice. I have never yet heard their truth demonstrated by illustrations drawn from facts. Possibly the time has come at last for this. Will any of your readers demonstrate for my benefit and that of many others the truth of the proposition that under all circumstances the consumer should, for the national good, buy at the lowest price; and will he in doing this draw his arguments not from books, but from the facts of modern everyday English life?

January 18th. TRADER.

WATCH TRIALS AT KEW.

SIR,—In your issue of the 1st inst. you published an article, written by Mr. D. Glasgow, jun., on watch trials which have recently taken place at Kew; and this gentleman comes to the conclusion that these trials, as compared with trials of Swiss watches, show a higher result for the English watch. Now I almost fail to see a proper justification which could lead to such an opinion, and I take thus the liberty to make the following remarks:—

(1) Mr. Glasgow gives us a table of only 5 extraordinary good watches of English make, but gives the results of 117 Geneva and 30 Neuchâtel watches. The limit for the term "extraordinary good" being for the mean daily variation fixed to 0·75 sec., it is certainly more probable that the 117 Geneva watches and the 30 Neuchâtel watches show a greater mean result than only 5 English watches. Yet the English first-class watches show only a superiority in this condition, but not so for the other two, which are very important.

(2) A real superiority is only shown in the ordinary Class A, while for the other classes the results are decidedly favourable for the Swiss watch.

(3) For Class A in general there is a much greater percentage of "extraordinary good" Swiss watches, viz.:—

	Extraordinary good.	Class A.	Total.
English	5 ..	81 ..	86
Swiss	117 ..	78 ..	195

(4) To make a proper comparison between the two kinds of watches, it wants to be known what percentage of used and new watches were tried.

(5) The date of the Swiss trials seems to me a rather early one. I think, to make a proper statement, the trials ought to take place about the same time, considering the never-resting tendency for improvements. Again, there are the prices, which should be considered, and also the durability.

I and my countrymen would certainly be thankful to Mr. D. Glasgow for correcting his statements, because I am sure he is aware that our reputation in watch-making is a vital point of this great and old industry of Switzerland. I enclose my card, but not for publication. PROGRESS.

Manchester, January 13th.

THE TALLEST CHIMNEY IN THE WORLD.

SIR,—As THE ENGINEER is referred to as an authority, I trust you will allow me to correct a statement made in your column of "Notes and Memoranda" last week, to the effect that the chimney lately erected at the lead works, Mechernich, near Cologne, Germany, is the tallest in the world.

In my book on "Tall Chimney Construction," I give descriptions of both Mr. J. Townsend's Port Dundas and Messrs. Tennant and Co.'s St. Rollox chimneys, and as the respective owners of these immense structures very kindly corrected my MSS. before printing, there cannot be much doubt as to the correctness of the dimensions, which are as follows:—

	Port Dundas. ft. in.	St. Rollox. ft. in.	Mechernich Lead Works. ft. in.
Total height from bottom of foundation to top	468 0	455 6	441 8
Height from ground line to top ..	454 0	435 6	430 2

From this statement it will be seen the German shaft is shorter than either of these justly celebrated Scotch chimneys. The above dimensions relating to the St. Rollox shaft agree with those given by the late Professor Rankine, but Mr. Robert Hodge, engineer to the Plymouth Corporation, says the total height from foundation to top is 447ft. 6in., and from ground line to top 432ft. 6in. Taking these lesser figures, it is still higher than the Mechernich chimney shaft. I enclose proofs of those portions of my book which relate to the Port Dundas and the St. Rollox chimneys, which may interest your readers. R. M. BANCROFT.

9, Ashmount-road, Upper Holloway, London, N., Jan. 12th.

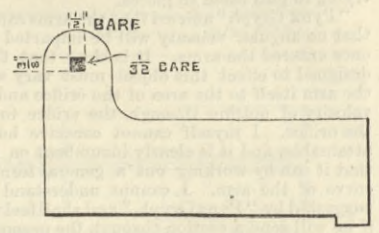
[We do not print Mr. Bancroft's enclosure, as, although interesting, it consists of copious extracts from his book. We have previously spoken in favourable terms of this book, and must now refer our readers to it for the particulars of a large number of examples of tall chimneys.—ED. E.]

THE PECULIARITIES OF STEEL.

SIR, In your issue of 1st inst. you published a letter signed "Basic," in which a statement was made, that of the Bessemer steel plates sent to Messrs. Jack and Co., to build the boilers of the British Queen and British King, 40 per cent. were returned to the makers as unfit for use. Thinking nobody would credit such an assertion, I did not at the time answer the letter; but as I find there are people who pay attention to anonymous writers, will you allow me to state that out of the 146 tons of plates sent to Messrs. Jack and Co., thirteen were returned to the works, weighing in all 3 tons 11 cwt. Five of these were either defective or spoiled in the working, and the remaining eight having been sent by mistake in excess of the order, were returned as being of no use to the engineers. F. B. DU PRE.

Tudhoe Ironworks, Spennymoor,
January 18th.

SIR,—A few days ago a remarkable occurrence took place in our works. I beg to make a report of it with the anticipation of knowing the cause. It may also interest some of your readers. A solid engine wheel, 2ft. 6in. diameter, had a steel tire shrunk on. The tire had been on for about fifteen hours when it burst with a loud report. A segment weighing 120lb. was thrown violently against the fitting shop main shaft 14ft. high. Upon inspection the fractured parts represented a good quality steel. The flange of the tire had a flaw in one part about $\frac{3}{4}$in. square by $\frac{1}{32}$in. deep. I enclose a chip of the tire to show the steel was not very brittle. W. W. REES, M.I.M.E.



Swansea, January 19th.

DEEP BORINGS—WATER SUPPLY.

SIR,—I read the paragraph in your last week's paper about water supply from deep borings in Kent with great interest. In 1881, when I first assumed the office of managing director of this company, I found that the cost of cleaning out the boilers alone was over £200 per annum, and that on the drying floors, after about six months' use, there was 4½in. of salt and other matter deposited. I consulted Mr. Thomas Tilley, of 15, Walbrook, the eminent well sinker, and, acting on his advice, I persuaded the directors to bore for water on our own freehold here. The result justified my recommendation, and on May 1st, 1882, we struck water at 809ft. 6in. deep, on a spot about 500 yards, as the crow flies, from the Chatham Dockyard boring. The strata bored through was:—

	ft.	in.
Chalk	570	0
Chalk marl	48	0
Gault clay	189	6
Hard rock (ironstone)	2	0
	809	6

The water—60 gallons per minute—rises 61ft. above high-water mark, and is then distributed to all parts of the works and cottages. The saving in cleaning boilers is £200 per annum, each boiler now being cleaned at a cost of 4d. to 5d. once in six months. The saving in wear and tear must be very large, but of this I can give no statistics at present.

I enclose copy of analysis made for me by the late Dr. Voelcker.

Artesian Well Water.

An imperial gallon contains—	Grains.
Oxidisable organic matter	·67
Oxide of iron and alumina	·56
Carbonate of lime	·34
Sulphate of lime	3·33
Carbonate of magnesia	1·68
Chloride of sodium (common salt)	49 23
Alkaline carbonates	20·91
Soluble silica	·56
Total solid constituents (dried at 130 deg. Cent.)..	77·28
Actual (saline) ammonia	·070
Organic (albumenoid) ammonia	·021

J. HOLMES WOOD, Managing Director.

Whitewall Cement Works, Rochester,
January 12th.

ANALYSING OILS.

SIR,—I note the letter of "E. D." in THE ENGINEER of the 1st inst. I have found in my own practice here that the following is a good test for Gallipoli oil:—Place 20 c.c. of the oil to be tested in a test tube, suspend a thermometer in the oil, and heat up to 250 deg. C. If the oil be reasonably pure it becomes slightly lighter in colour, and evolves an odour not unlike strawberries. If the oil be adulterated with cotton seed or similar oil, the mixture grows darker in colour and gives off a penetrating and disagreeable odour. For my own part, I do not believe that pure olive oil exists as a marketable commodity. Dr. Nichols, who is a great authority, says that it is impossible to detect slight admixtures of other oils except by a very elaborate process, of which he is the discoverer, I believe. If you want to get absolutely pure oil, I do not think you could do better than apply to him. I do not know his address, but it is somewhere in the City.

23, Queen Anne's Gate, W. HARRY STANGER.
Westminster, S.W., London, January 6th, 1886.

BOILER FLUES.

SIR,—Having just noticed "J. S.'s" letter in THE ENGINEER of the 1st instant, I beg to offer a little of my experience in chimney shaft building. In the first place, I advise him to use no cement whatever, except the concrete, for the foundation, but to build it as light as possible; neither use any grout whatever in the chimney proper, and to have five stretching courses and one header. The best bricks for the flues are fire-bricks, of course; but soft bricks will do very well made of loam, and not over hard burnt. If he will furnish me with the height and unit of boiler power he requires, I will send him a drawing of same at a trifling cost. No chimney is ever too large. HY. HARRISON.

44, North-road, Longsight, Manchester,
January 14th.

FORCED COMBUSTION.

SIR,—I have to thank you for your insertion of my letter of last week in your issue of the 15th inst. Referring to your remarks on the subject of my letter in your leading article, and the invitation given me to supply further information on certain features connected with the use of forced draught and the pecuniary results of the working of my system in the New York City, I would take the opportunity of mentioning that, as in all probability I will read a paper on the subject shortly, in which the points you mention will be dealt with, I would prefer not to anticipate at present what I propose then to say. JAMES HOWDEN.

Glasgow, January 19th.

COMPOUND LOCOMOTIVES.

SIR,—I have read with much interest the articles and correspondence in THE ENGINEER upon the comparative merits of the compound *versus* the simple locomotive. On perusing the reports—published in several papers—of coal consumption for the past half year, I notice that one railway—viz., the London, Tilbury, and Southend Railway—has attained an average of 26 lb. per mile. These engines were designed by Mr. Adams for the company, I am given to understand, and are used for both classes of traffic. The performance of these engines is due in no small measure to efficient maintenance and thorough supervision.

Here we see a simple engine with an exceedingly low coal consumption; the question may well be asked—What scope is there

for a compound? and can one be designed to surpass the result mentioned? BOGIE.

January 18th.

INCLINED SHAFT ROTARY ENGINES.

SIR,—In the diagram of relative positions, Fig. 1, inserted in connection with this subject in the last issue of THE ENGINEER, there occurs an error which should be corrected. The two positions of the piston in the two upper quadrants, when they are inclined at angles of 45 deg. to the vertical, are shown much too far into the cylinder from the centre of the cylinder frame. Their distance from the corresponding position of the crank pin of A should be the same as that of the opposite piston from the same point. This distance must evidently be the same in every position considered, as the pistons are rigidly connected together by a common piston-rod, the piston-rod pairing with the crank pin midway between the two pistons, as shown in Fig. 3. R.

January 18th.

RAILWAY COUPLINGS.

SIR,—In your issue of November 6th attention was directed to the resolution passed at the Annual Congress of the Amalgamated Society of Railway Servants, with reference to a proposed trial of the various appliances which enable wagons to be coupled and uncoupled without the danger of a man having to pass between them. I am now glad to be able to inform your readers that at an interview at Waterloo Bridge station last week between Mr. Scotter, general manager, and Mr. Haddow, goods manager, of the London and South-Western Railway, and myself and Mr. E. Harford, general secretary, on behalf of the Amalgamated Society, the arrangements were made for the proposed trial. The railway company offers every facility, including the use of wagons and sidings, and the trials will take place at Nine Elms as soon as the inventors have fitted their various appliances to the vehicles.

CLEMENT E. STRETTON, Vice-President,
Amalgamated Society of Railway Servants.
Head Offices, 306, City-road, London, E.C.,
January 19th.

THE SNOWSTORM AND THE VESTRIES.

SIR,—With reference to the above, both the vestries and their surveyors have recently experienced a fair amount of obloquy at the hands of a generally unthinking public. I do not for a moment wish to exonerate from blame those to whom it is due, but a consideration of the figures below will prove the unreasonableness of the complaints of many persons whose object in life is attained when they see their names in the local papers in connection with a complaint. Indeed, Sir, many persons obtain a great deal of cheap popularity by this simple means, and who otherwise would be unheard of and unknown. With regard to the recent snowstorm, the figures relating to the amounts to be dealt with, and the attendant expense, are simply appalling.

According to the figures given by Sir Joseph Bazalgette when addressing the Institution of Civil Engineers as president, in 1878, the mileage of the metropolis exceeded 1700, the width between the channels being 30ft. If we add 18ft. for the footways, and allow for the increase since that date, the superficial area will certainly be not less that 54,000,000 square yards. My observations proved that the recent fall was equal to a depth of 3in. when compressed as carted; therefore the quantity to be dealt with amounted to no less than 4,500,000 cubic yards. Allowing for the distance to the available tips, it would be difficult for a cart to deal with more than 20 cubic yards per diem; thus 225,000 horses and carts and drivers would be required, costing, at 10s. per diem, £112,500; 450,000 fillers and sweepers, costing, at 3s. 4d. a day, £75,000—if the snow were cleared in one day.

That it is impossible to do so must be at once conceded. Indeed, it is exceedingly doubtful if all the snow could be cleared in twenty days, and it follows that carting can only be practiced to a very limited extent, and that should be in the direction of freeing the principal thoroughfares, crossings, &c., from snow. In my district —Wimbledon—the quantities to be dealt with were only one-hundredth of the above, and although every man that offered his services was engaged at 4s. per diem, twenty was the maximum number available. What is really required is the cordial and hearty co-operation of all the occupiers. If the rather lax regulations were so framed that the obligation to free from snow the footways adjoining all premises within a reasonable time were compulsory as regards the occupier, and a penalty for non-compliance were not only provided, but means for its enforcement also —since the police-courts are wholly inadequate to deal with the enormous number of cases that would at first assuredly arise—much good would result. The footways being clear, one gang should clear the snow from the channels to insure the flow of all water resulting from a possible thaw, while another should clear the middle of the streets, the snow being thus heaped in parallel rows along the sides of the roadway. Extemporised snow ploughs may with advantage be utilised for the street clearing. By these means the foot and roadways may be rapidly put in good condition for both vehicular and pedestrian traffic. Of course the surveyor's efforts will be in the direction of the principal thoroughfares, and the amount of work he will perform will depend on the number of men and carts available; but as regards the footways, there is no reason why all should not be quite free from snow within a few hours after the cessation of any fall.

W. SANTO CRIMP, Assoc. M. Inst. C.E., F.G.S.
Wimbledon, January 18th.

LAUNCHES AND TRIAL TRIPS.

ON January 15th the ss. Prometheus, built by Messrs. R. and W. Hawthorn, Leslie, and Co., to the order of the Ocean Steamship Company of Liverpool, left the Tyne. The dimensions of the vessel are as follows:—Length, 320ft.; breadth, 36ft.; and depth, 27ft. 9in. Her engines, constructed by Messrs. Robert Stephenson and Co., are of the Holt's tandem design, having cylinders 27in. and 58in. diameter, with a stroke of 5ft., and indicating 1500-horse power. Steam of 80 lb. pressure is supplied from one large double-ended steel boiler of a total weight of 75 tons, and this is fitted with Fox's patent corrugated furnaces. After the compasses were adjusted the engines were put under full steam, and a speed of 12½ knots was attained. This is the second of four similar vessels now being built and engined by the same firms.

On Monday, the 18th January, Earle's Shipbuilding and Engineering Company launched from their yard at Hull two iron screw fishing trawlers, built by them for the Boston Deep Sea Fishing and Ice Company. Their dimensions are 85ft. by 19ft. 9in. by 10ft., with flush deck aft and small raised forecastle forward. They are built to Lloyd's 90 A 1 class. The accommodation for captain and officers is aft, and that of the crew in the forecastle; the whole of the remaining space clear of engines is fitted for the storage of ice and fish. The vessels are ketch rigged with pole masts, and are fitted with a powerful steam winch of Earle's special design and make for working the trawl gear. They will be fitted by the builders with direct-acting inverted compound engines, having cylinders 12in. and 22in. diameter by 20in. stroke, which will be supplied with steam of 90 lb. pressure from a steel boiler with one of Fox's corrugated furnaces.

On the 14th inst. the official trial took place of the torpedo boat Adler, which Messrs. Yarrow and Co. have completed for the Austrian Government, and the speed obtained was 22·4 knots loaded with 16·9 tons, representing the fully equipped condition. The Adler is the fastest torpedo boat at present afloat, and will shortly leave this country for Pola. Her dimensions are 135ft. in length by 14ft. beam. The officers' accommodation in this case is forward of the machinery, and the crew are placed aft, which is the usual practice in the Austrian service. There will be two torpedo guns fitted forward for direct ahead fire. The coal capacity is equivalent to a run, at a speed of 11 knots, of from 2000 to 2500 miles.

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

(*From our own Correspondent.*)

THE accession of orders which has resulted from the quarterly meetings has not been conspicuous, and makers upon 'Change here this—Thursday—afternoon, and at Wolverhampton yesterday, spoke of the business as unsatisfactory. There is not much disposition to place orders of magnitude, and the prices which consumers offer are disappointing. Some of the sheet-makers in particular, rather than accept the rates offered, are preferring to run their works half-time.

The market is discussing with some interest the proposal of the galvanised sheet-makers to restrict production, with the view of keeping up prices. A further meeting is to be held, but the market does not anticipate that the proposal will be found workable. £10 15s. to £10 17s. 6d. is mostly quoted for average qualities of 24 w.g., packed in bundles, delivered at Liverpool, and the other sizes advance £1 per ton per gauge. Packed in cases, average qualities of 24 g. are quoted £11 5s. to £11 7s. 6d. Liverpool. Makers report that some good lines are coming through for corrugated sheets for South America, and for flat sheets for India and Canada. Large consignments continue to be made to the Australian markets, and at date of last mail advices prices of 26 g. at Melbourne ruled at £15 10s. to £17—prices which left no profit to importers. Galvanised sheet makers note with much satisfaction that the first signs of a revival in trade are appearing in Australia.

Wool has risen upon the Melbourne market, and should the present advance of ½d. per lb. keep up for only twelve months the Australian colonies would be £10,000,000 richer. Such an increase of spending power would tend materially to the advantage of South Staffordshire.

Merchant sheets in the block vary from £6 2s. 6d. per ton for singles upwards; galvanising doubles are £6 10s. upwards, and trebles £7 10s. to £7 12s. 6d.

Best—thin—sheet-makers are nominally as firm as the few leading marked bar makers in declining to alter their quotations. The demand which they are experiencing is fairly good, and their works are running with greater regularity than many others. Messrs. John Knight and Co. quote: Working-up sheets, £10 10s.; soft steel sheets, £12 10s.; and charcoal sheets, £19 10s. Doubles are 30s. extra, and lattens 60s. extra. The firm hope to start their new works at Brierley Hill in about three weeks from now, and they have laid in new and improved machinery so as to meet all requirements of the trade. Messrs. Crowther Bros. and Co., of the Stour Vale Works, quote their "Vale" sheets £10 10s.; S. B. brand, £11; best best, £12; and treble best, £13; semi-charcoal, £14; charcoal, £15; and best ditto, £16 6s. Their steel sheets vary from £11 to £12 10s. and on to £13 10s., according to quality.

The bar trade keeps quiet at £7 10s. to £8 2s. 6d. for some marked sorts, £7 down to £6 10s. for the makes of certain of the other "list" houses, £6 for ordinary, and £5 10s. down to £5 as the minimum for common bars.

The East Worcestershire tin-plate trade is not strengthened by the abandonment of the makers' combination in Wales, yet nominal quotations keep up. Messrs. Knight quote Cookley K charcoals 24s.; I. C. and Cookley coke-plates, 20s.

Steel prices are easy, and local makers continue to meet with sharp competition from other districts. From Scotland, for example, excellent steel sheets—singles—are this week quoted, delivered here, at £8 10s., and steel nail sheets at £7 10s. Bessemer blooms made by West Coast and Welsh firms are quoted £4 15s. to £5 5s. delivered here; and billets, at £4 10s. upwards. Staffordshire steel masters quote for basic steel—£6 for common plates; £7 for boiler plates; £5 10s. to £6 for steel bars; and £7 10s. to £8 10s. for singles, according to quality, with £1 additional for doubles.

The Staffordshire Steel and Ingot Iron Company is just now making a speciality of large sized bars for engineering work. The present output of the company is pretty equally divided between plates and bars, which are being used for a great variety of purposes from best boiler-making down to bridge, girder, and tank-making, and also for general engineering uses. The prospects of the basic steel manufacturers should be improved by the wider diffusion of the information and the action of Lloyd's Committee of Register last year in reducing the tensile strain needed for steam boilers built of the dephosphorised metal.

Much interest has been excited this week by its having transpired that the tender of Messrs. Briscoe and Sons, merchants, Wolverhampton, for the Victorian contract of 40,020 tons of rails and fish-plates was £5 11s. 10½d. per ton. This was more than 6s. per ton below the tender next in order. It may be news that the deposit which had to be lodged by each tenderer was £12,000. It does not yet appear whether Messrs. Briscoe have succeeded in placing the order on terms satisfactory to themselves.

The reduction of 5 per cent. in ironworkers' wages, which has this week come into operation in Staffordshire, applies also to the finished ironworks of Shropshire, Derbyshire, South Yorkshire, Cheshire, Lancashire, and some of the localities of South Wales. Even at the reduced wages steel rollers in Staffordshire are able to make, if they are clever hands, £1 per day, while the puddlers are not making more than 8s. per day.

Native pigs are quiet. All-mines remain at 55s. to 60s. for hot blast, 75s. to 80s. for cold blast. The Spring Vale Iron Company, who are the largest makers in Staffordshire, quote this week:—Hydrates, 50s.; mine iron, 42s. 6d.; and common forge, 32s. 6d. Bradley's Capponfield pigs are quoted: Best, 45s.; common, 32s. 6d.; Darlaston—made from Northampton ores—38s. per ton. The Spring Vale Company is blowing four furnaces, and states that its stock is not increasing. Northampton pigs keep at 38s. delivered, Derbyshires, 39s. and 40s.; and Lincolnshires, 41s. In consequence of the continuance of the low prices an additional number of Derbyshire makers are just now blowing out their furnaces.

Hematites keep firm, and they were sustained to-day—Thursday —by reports which were in circulation that United States orders are still coming forward for hematites and for steel rails, though not, it is assumed, in heavy lots. Barrow forge hematites were quoted at 55s., and No. 1 at 60s. Ulverstone hematites were quoted 54s., and offers to buy at 53s. 6d. were reported to have been refused. For the make of the Distington Company, Whitehaven, as much as 57s. 6d. net was asked, the sellers justifying the price by the statement that the iron was exclusively made from native ores.

For the first time in the history of the trade, Spanish hematite pigs are just now being introduced to consumers in our market. A brand is being offered which is imported from Somorrostro, and for which a richness is claimed alleged to be unpossessed by native hematite pigs. The analysis is given as: Silica, 2 per cent.; manganese, ·85; sulphur, ·029; phosphorus, ·038; pure iron, 97·083 per cent. The agents here who are introducing it are prepared to accept easy prices. Native makers question the advantage which buyers would obtain by using the pig over native metals, since the Welsh hematites, for example, are known to be almost exclusively made from Spanish ores, and should, they urge, be therefore equal in quality to the imported Spanish pigs. Analysis is, however, the only true test.

Staffordshire ironstone is quoted 12s. to 14s. per ton, and Northampton ironstone, 5s. 3d. to 5s. 6d. per ton delivered hereabouts.

Welsh, Derbyshire, and Wigan furnace cokes vary from 12s. 6d. to 15s. delivered to consumers' furnaces here.

Forge coal is 5s. to 6s. long weight, with a tame demand. Furnace coal is 8s. to 9s. boat gauge, and mill coal 7s. per ton.

Orders for cultivating, mining, roadmaking, and edge tools are reaching manufacturers in considerable bulk, on account of the east and west coasts of South America, Brazil, the Indian Empire, Australia, and South Africa. Makers in this district are expressing dubiousness concerning the reports of merchants of the growth of German competition in South American and other foreign markets. They declare that in all the leading tools they can beat the Germans without difficulty.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of trade continues without improvement; the quarterly meetings have brought forward no increased demand, but, if anything, have left behind them a still more depressed tone, and the tendency of prices is downwards. Except that hematite makers still hold out for some portion of the advance which was put on after the considerable sales made for shipment a month or so back, the real selling prices both for pig and manufactured iron, or the prices which makers are willing to entertain where there is actual business in prospect, have got back to quite as low, if not a lower point than was touched during the most depressed period of last year, and a despondent tone prevails all through the market. The year so far has failed to bring forward anything upon which any hopeful prospects for the future can be based, and trade generally has probably never presented a more discouraging outlook than it does at present.

There was but a very dull iron market at Manchester on Tuesday, with less than an average attendance. In most cases pig iron sellers reported an almost complete absence of inquiry, and where there was any business doing it was at extremely low figures. For Lancashire pig iron, delivered equal to Manchester, makers' quoted prices remained at about 39s. to 39s. 6d., less 2½, and for some of the better class district brands as much as 39s. 6d. to 40s. was being asked for foundry qualities. Quotations based upon present list rates were, however, simply nominal, and it is only on small special sales that anything above 37s. 6d. to 38s., less 2½, is being got for either local or district brands delivered into this district. In outside brands the current market prices show no very material change from those quoted last week, but there is practically little or nothing doing, and where business is to be got there are sellers at extremely low figures. For hematites makers still quote about 53s. 6d. to 54s., less 2½, for good foundry qualities delivered into the Manchester district, and at these figures they are tolerably firm, but buyers are not disposed to pay them, and there is no business of any weight being done, so that quoted prices at present are scarcely more than nominal.

In the manufactured iron trade business continues extremely dull, with very low prices ruling for all descriptions of finished iron. There are very few makers who are getting more than £5 2s. 6d. for good ordinary qualities of bars delivered into the Manchester district; hoops average about £5 12s. 6d., and local-made sheets £6 10s. to £6 12s. 6d. per ton.

Throughout all branches of engineering, trade continues very slack, and the reports issued by the trades' union societies show that the number of men out of employment is still on the increase. The question which is attracting most attention is, of course, the reduction in wages, and the opinion is expressed by representatives of the men that the recently increased number of men coming out of employment is not altogether due to actual decrease in trade, but in great measure to the attempt now being made to reduce wages. In support of this view an instance is pointed out where the men have been on short time for months past, but are now told that if they will accept the reduction they can resume full work at once. Of course this is the men's view of the case, and is put forward with the object of minimising the actual depression in trade which has rendered the present action of the employers absolutely imperative. The real state of affairs is also being further misrepresented by the men by statements which have been put forward to the effect that the principal firms in the district are holding aloof from the movement. It is quite true, as I pointed out last week, that several of the large firms, for special reasons, have not yet actually posted the notices for a reduction, but the notices which have already been put up in Manchester and the district affect no less than 14,000 men, and there is no wavering whatever in the determination of the Employers' Association to enforce a reduction in wages, which, under the present condition of trade, has become a necessity. Special meetings of the Trades' Union societies have been held to consider the question of a reduction in wages, which, according to the reports sent in, is regarded as uncalled for, and a strong feeling appears to be shown to resist if it is insisted upon. At a representative meeting of the Amalgamated Society of Engineers it was resolved that the members affected by the proposed reduction should seek an extension of time, and failing in that, they should, along with other societies affected, take into consideration the desirability of firmly resisting the present notice of reduction. At a special meeting of the members of the Steam Engine Makers' Society a resolution was passed to leave the question with the Executive Council to confer with other societies affected, and if no extension of notice or consideration is given they were prepared to carry out their instructions even if it resulted in a cessation of work. The members of the above society in the Oldham district have also passed a resolution to the effect that the present demand for a reduction of wages is inopportune and unnecessary, because the wages now paid were below those of other districts, and that their wages ought rather to be brought up to the level of other districts before any action was taken to reduce them. The general belief is, however, that there will be no serious strike in connection with the present reduction; in fact, the impoverished condition of the Trades Union Societies' funds, as I have pointed out in previous reports, almost precludes the possibility of any protracted struggle being entered upon, and it is more than probable that some means of arriving at an amicable understanding between the employers and the men will be sought after.

The announcement of the death of Mr. Joseph Leece, the managing director of Sir Joseph Whitworth and Co., has been received with general regret throughout the district. Thirty-seven years ago Mr. Leece entered, as a boy, the then comparatively small works carried on in the centre of Manchester by Mr. Joseph Whitworth, and giving employment to about 200 or 300 men, and he has ever since been closely associated with the development of the works, rising from one position to another until he controlled one of the largest concerns of the kind in the kingdom, the present works at Openshaw, in the outskirts of Manchester, covering upwards of thirty-five acres, and employing some 2000 hands. For many years Mr. Leece was prominently identified with the improvements worked out by Sir Joseph Whitworth in the construction of small arms, and which practically have been the basis out of which have sprung the numerous developments of the modern rifle. During the earlier years of the Wimbledon meetings Mr. Leece was also a regular attendant, and not only there, but elsewhere, was the winner of several valuable prizes. In 1874, on the formation of Sir Joseph Whitworth's business into a limited company, Mr. Leece was appointed to the post of managing director, and this position he continued to hold until his death. For the last couple of years, however, Mr. Leece has been failing in health, and early in November last, under medical advice, he sailed for Australia, but only lived to complete the passage; his death, at the comparatively early age of fifty-two, taking place soon after his arrival in the colony. Always of a kindly and genial disposition, Mr. Leece won the esteem and confidence not only of those with whom he was closely associated in the management of the works, but of the workmen in every department, and by none will his death be more deeply regretted than by the officials and employés of Sir Joseph Whitworth and Co.

The annual report presented to the Manchester Society of Engineers, at their meeting held on Saturday, shows the Association to be making very satisfactory progress. Notwithstanding decreased interest, and in one case an actual loss of £70 on building society investments, the ordinary income of the Society had

been so much in excess of expenditure that with the close of the year there was a balance of £76, the Society's funds having increased from £2455 to £2531. During the year 46 new members have been elected, and the total number is now 285.

In the coal trade a generally dull tone prevails; even with the present severe weather there is no pressure for house fire coals, and other sorts, for iron making and steam purposes, still meet with only a very slow sale. Pits are kept on about full time, but supplies are plentiful, and prices, if anything, weak, best coals averaging 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common, 5s. 3d. to 5s. 9d.; burgy, 4s. to 4s. 6d.; and slack, 2s. 6d. to 3s. 6d., according to quality.

Shipping has been very quiet, with steam coal delivered at the high level, Liverpool, or the Garston docks, to be got at about 7s. per ton.

Barrow.—I have better news to report this week in one department, and worse to chronicle in another. Steel makers have secured some good contracts, and are likely to be busier during the early months of this year than they were at any time during the past year. The foreign orders which have come to hand have very materially improved the position of steel makers, and although at the moment this is only shown in the rail department, it is confidently expected it will soon show itself in the minor branches of the steel trade. Tin bars, for instance, are expected to be in fair demand; indeed, large contracts for this class of steel have been held for some time, and have led to a fair activity. There is, however, not much doing in merchant steel generally, and there is but little trade in special bars, wire, billets, bands, &c. A new trade in steel nails is being prosecuted, with good chance of success. The other department, in which a worse trade has to be noticed, is that of ironfounding, one of the largest works in the district having practically suspended operations owing to the want of orders. This position also affects iron shipbuilders and marine engineers, who have but few orders in hand, and the inquiry which is being made as to new contracts is very poor and unspirited. The pig iron trade is very quiet, but there is, nevertheless, a maintenance of the improved inquiry which set in at the close of last year. One or two furnaces have been relighted, and others are to follow shortly. Stocks have also been somewhat reduced, but they are still very large. Prices are unchanged, but are firm at 45s. per ton for mixed parcels of Bessemer iron net at makers' works. It is believed that prices will soon be further increased.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

In spite of the unusually prolonged spell of cold weather, there has been no appreciable change either in the demand for coal or the prices quoted by the various companies in the Yorkshire and Derbyshire districts. While household coal thus remains in what may be called a stationary state, steam coal is so plentiful in these two counties that the coalowners speak of it as "quite a drug in the market," and the prices are extremely low at some of the pits. Gas coal is being freely ordered by the different gas companies, whose requirements cause those specially engaged in this trade to be fairly well employed. It is satisfactory to know, although both parties are anxious to refrain from publishing particulars at present, that the negotiations for the establishment of a sliding scale in the Yorkshire district are proceeding satisfactorily, and unless some unexpected hitch should take place, an amicable arrangement may probably be completed in the spring. A satisfactory solution of the wages difficulty in the coal trade would not only steady that great industry, but have a material and beneficial effect upon the iron and steel and kindred industries.

Manufacturers of ordnance, propeller blades, crank shafts, and certain descriptions of railway material are pretty full of work. Some very good orders have recently come in from our own Government, as well as from France, Spain, and Italy, in big guns. Italy still believes in mammoth war ships and heavy guns, and in the next naval conflict will speak with a potent voice. Railway material is being freely made for certain colonial markets, particularly British East Indies, which has been a most important customer of late for goods of this description.

Messrs. Charles Cammell and Co., Cyclops Steel and Ironworks, have completed the rearrangement necessitated by the death of Mr. George Wilson, chairman and managing director. Mr. Thomas Vickers, of Manchester, the vice-chairman, becomes chairman; Mr. Alexander Wilson (brother of the deceased, and inventor of the "Wilson" armour-plate) becomes managing director. The staff officers continue as before.

Mr. Benjamin Nicholson, of the Shoreham Steelworks, who has carried on business for many years in these premises at Bramall-lane, has retired in favour of his sons, who will carry on the trade under the style of Benjamin Nicholson and Sons. Leading specialities of their manufacture are stonemasons' tools, steel for spindles and other purposes, files, &c.

The Sheffield Chamber of Commerce are deeply interested in the new markets to be opened up by the annexation of Upper Burmah, which will lead to business with Siam and Southern China as well. They had arranged with Mr. Colquhoun, the explorer in Burmah and China, for a lecture, but that gentleman having been ordered back to Burmah, his companion in exploration, Mr. Holt S. Hallett, is to address the Chamber at its annual meeting on the 28th inst., and to give a popular lecture in Firth College in the evening.

Further witnesses are to be examined from Sheffield before the Royal Commission on the Depression of Trade, including Mr. J. D. Ellis, chairman of Messrs. John Brown and Co., Atlas Steel and Ironworks, and inventor of the Ellis system of compound armour; Mr. T. E. Vickers, chairman and managing director of Messrs. Vickers, Son, and Co., River Don Works; Mr. Samuel Osborn, of Messrs. Samuel Osborn and Co., steel manufacturers, Clyde Steelworks; Mr. Charles Bell, Master Cutler, of Messrs. Roberts and Bell, silversmiths and electro-platers; Mr. William Chesterman, manufacturer of tapes, measures, &c, Bow Works; and Mr. Herbert Hughes, the secretary, who will give evidence on the subject of false markings of goods.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The prospects of the Cleveland pig iron trade have not improved during the past week. The market held at Middlesbrough on Tuesday last was entirely devoid of animation, but prices were not further reduced. Some buyers seemed to expect concessions owing to the continued fall of prices at Glasgow, but sellers would not entertain less than 31s. 1½d. per ton for No. 3 g.m.b. That price was also taken by merchants for delivery to the end of February. There is very little inquiry for forward delivery, even though some merchants are willing to sell No. 3 at 31s. 9d. for delivery to the end of June. Makers, as a rule, will not commit themselves for large quantities either for prompt or forward delivery at present prices. Forge iron is apparently somewhat stronger than No. 3, as the price still remains at 30s. 6d. per ton.

No transactions have recently taken place in warrants. They are still offered at 31s. 9d. to 32s. 3d. per ton.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s store at Middlesbrough amounted on Monday last to 149,898 tons, being an increase of 2747 tons during the week.

Shipments of pig iron from Tees-side wharves are far below what might have been anticipated even for the month of January. Up to Monday last only 26,717 tons had been sent away, or 6000 tons less than in the corresponding portion of December.

There is no improvement to report in respect of the manufactured iron trade. The few firms who still keep their works going have great difficulty in getting specifications, and are unable to work full time. Prices are as follows:—Ship plates, £4 10s. to £4 15s. per ton, according to quantity and nature of specification; angles, £4 5s. to £4 7s. 6d.; and common bars, £4 12s. 6d. to £4 17s. 6d.; all free on trucks at makers' works, less 2½ per cent. discount.

It is reported that Messrs. Wigham, Richardson, and Co., of Low Walker, near Newcastle, have received orders for five iron vessels, which they will commence to build as soon as the Tyneside wages dispute is settled.

Messrs. B. Samuelson and Co., of Newport Ironworks, Middlesbrough, have reopened their ironstone mines at Slapewath, near Guisbrough. About 100 men and boys will find employment. The mines have been closed for eighteen months.

So far, the operatives connected with the iron shipbuilding trade at the East Coast ports do not seem inclined to accept the reduction of wages which their employers are seeking to enforce. They hold frequent meetings among themselves, but reporters are not allowed to be present, and their decisions can only be guessed at. The Mayor of Newcastle—Mr. B. C. Browne, of Hawthorn, Leslie, and Co.—has offered to act as mediator. The men, however, after considering his letter, came to the conclusion that it could not be entertained, and that no communication ought to be held with him, he being an employer.

On Tees-side the shipbuilding firms offered to allow their men to remain at work a fortnight longer at the previous rate of wages. The latter, however, prefer to strike with their northern comrades at once, unless they are allowed to continue unconditionally at previous rates until the dispute is settled. They think the fortnight's grace offered is no real concession, but simply an interval desired by the employers to finish certain important repair work before the strike begins. Messrs. Irvine and Co., of West Hartlepool, and R. Dixon and Co., of Middlesbrough, will continue to work as usual, as they act independently of the other employers, and will pay the old rates of wages for the present.

Mr. Maginnis read a paper before the Liverpool Engineering Society, on Wednesday, the 13th inst., on the peculiarities of steel. The meeting was largely attended, many persons hoping that new revelations would be made as regards this important subject. They were, however, doomed to disappointment. Mr. Maginnis' paper was almost precisely the same as that which he contributed to The Engineer a few weeks since, and no new light was thrown by him on the mysteries involved. A discussion ensued, but instead of being free and open, as all discussions should be, where those who take part in them really desire to arrive at the truth, there was a spirit of reticence observable among the speakers which interfered with the interest and usefulness of the proceedings.

A meeting of the Cleveland Institution of Engineers was held at Middlesbrough on the 18th inst. Mr. Perry F. Nursey, of London, read an interesting paper on "Pile-driving Machinery," which was illustrated by diagrams and a model. An animated discussion followed, in the course of which various members related their experience of pile-driving and the machinery used therein. It appears that the first known instance of pile-driving by steam was in 1837, when the contractor, for constructing a wharf at Redheugh, near Gateshead, employed a locomotive for hauling up the monkey by means of a rope and snatch-block. Nasmyth's steam pile-driver was brought out about ten years later, and was used in the construction of the high-level bridge at Newcastle.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The prospects of the Scotch pig iron trade do not improve as those connected with it could desire. A lower level than before was touched by prices this week, and although there have since been one or two slight upward movements, caused, it is said, by the covering operations of brokers, the condition of the market is far from satisfactory. The opinion is gaining ground that merchants and ironmasters will have to make up their minds to a lower range of prices than has been experienced for a long time, and that on such account relief must be sought in a reduction of railway rates and of the royalties exacted by the owners of mineral properties. As it is, the position of the pig iron trade is one of great embarrassment, such as has not been felt for many years. The foreign demand for Scotch pigs is very poor, and the home consumption is apparently more restricted than ever.

Although the additions to Messrs. Connal and Co.'s stocks are smaller than in the closing months of the year, the private holdings of makers are understood to be increasing more rapidly, and an early curtailment of production would not be a surprise to anyone. The quantity of pig added to the warrant stores in the past week has been 2075 tons. The shipments of pigs from Scotch ports were 4725 tons, as compared with 5598 tons in the preceding week, and 6391 tons in the corresponding week of last year.

Business was done in the warrant market on Friday at 39s. 10d. cash. Monday's market was very depressed, 39s. 7½d. cash being quoted on that day. On Tuesday previous transactions occurred at 39s. 8d. to 39s. 10d. cash, while 40s. cash was quoted in the afternoon. Business was done on Wednesday at 39s. 11d. to 40s. 1½d. cash. To-day—Thursday—the market was stronger, with business up to 40s. 2½d. cash.

The values of makers' pigs are depressed as follow:—Gartsherrie, No. 1, 45s.; No. 3, 42s. 6d; Coltness, 48s. and 44s. 6d.; Langloan, 46s. and 43s. 6d.; Summerlee, 50s. and 43s. 6d.; Calder, 48s. and 42s. 6d.; Carnbroe, 44s. and 42s.; Clyde, 45s. and 41s. 6d.; Monkland, 40s. 6d. and 38s.; Quarter, 40s. and 37s. 6d.; Govan, at Broomielaw, 40s. 6d. and 38s.; Shotts, at Leith, 46s. and 45s. 6d.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. 6d. and 43s.; Glengarnock, at Ardrossan, 44s. 6d. and 41s. 6d.; Eglinton, 40s. 6d. and 37s. 6d.; Dalmellington, 43s. and 39s. 6d.

Messrs. D. Y. Stewart and Co., Ironfounders, Glasgow, are reported to have obtained 12,000 tons of the 30,000 tons contract of cast iron pipes now being placed for the province of Baroda.

In consequence of the slackness of the pig iron trade, Messrs. William Baird and Co. have stopped one of their ironstone collieries in the Kilsyth district, and it is understood that some others are to be laid off in Ayrshire.

Messrs. P. and W. M'Lellan, of the Clutha Ironworks, Glasgow, have secured a contract to supply a railway bridge for the river Jumna, in India, and about 4000 tons of steel will be employed in the structure.

The workmen at a number of the Scotch steel works have agreed to a reduction of wages.

The iron and steel manufactured goods shipped from Glasgow in the past week embraced £6000 worth of machinery, £1396 sewing machines, £24,600 steel goods, including sleepers to the value of £21,340 for Port Darwin, Australia, £18,500 general iron manufactures, of which a large proportion went to the Australian Colonies.

The very severe weather now being experienced has improved the demand for household coals, but the shipping department of the trade is comparatively quiet. The principal shipments of the past week have been 26,696 tons from Glasgow, 90 tons from Greenock, 7699 from Ayr, 1742 from Irvine, 5060 from Troon, 1387 from Grangemouth, and 812 tons from Leith. Merchants are of opinion that the coming season will be an active one in the continental shipping department, but they may likely have to wait a couple of months before the demand sets in. Owing to the dulness in the shipping trade, the trade in bunker coals continues slack.

The Slamannan miners, after being on strike since the beginning of December for an advance of 6d. a day in their wages, are now returning to their work. Seeing no prospect of any increase in the price of coals, and as the demand began seriously to fall off just as the strike commenced, the masters were compelled to resist the demand, and most of them had their pits altogether closed. In the adjoining district of Airdrie, the colliers have been working at the old rates.

There has also been a strike of miners at Denny, in Stirlingshire, the men in this case claiming an advance on account of the price of coals having been raised 1s. a ton.

It is reported that the West Lothian Oil Company has reached the Broxburn shale in a new pit it has been sinking at Deans' works. It expects that it will soon have an output of 200 tons of shale per day.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

There has been such a steady continuance of severe weather, storms and snow, that work generally has been impeded, and shipments fallen again to a minimum state of things. I am glad, however, to hear that the belief in an improved iron and steel trade, and coal as well as tin-plate, is retained.

With regard to iron and steel shipments, 500 tons to Pernambuco from Newport, and an insignificant cargo of 130 tons from Cardiff, formed the whole of the iron exports of last week; but I am assured that the weather was the offender. Cyfarthfa and Dowlais, Tredegar, Ebbw Vale, Blaenavon, and Rhymney may be regarded as doing as well as most of the works this season, and are certainly not doing less than usual.

The Cardiff waterworks contract has been given to Mr. Jones, of Neath, favourably known in connection with Mr. Jepson. Contractors, as a rule, look suspiciously at waterworks, for few of them pay anything like a railway. The work will be an immense one. The greatest depth of reservoir will be 54ft. The idea enunciated in these columns, that a short railway for transit of materials would pay, has not yet been adopted. An objection was that it would cost £20,000; but if the cost of conveyance is less than this, there are other items for consideration—the expediting of labour, quicker completion, &c. Besides, the railway could be sold at the completion to the farmers of the district or rented.

Now that the Great Western tunnel is an accomplished fact, I hope that the Rhondda tunnel will come on for consideration. Mr. Grierson has, I believe, in conjunction with local officials, given his approval to this method of "tapping the Rhondda."

The Rhondda and Swansea Bay Railway will touch coal this year; but it can only be at the back door, so to state, of the Rhondda.

The Great Western Railway scheme should be a tunnel from Cwmamman te Ferndale. They would have the benefit of a falling gradient with the load, Aberdare Valley being lower than Ferndale.

The Rhymney Railway Company is going in for powers to construct a certain portion of the Monmouthshire and Cardiff railway scheme. This will tap the new Rhondda of the future, be good for the Rhymney, and for Cardiff.

The coal trade is not very brisk. Cardiff shows a slight increase in shipments, but Newport and Swansea are falling off. The wonder is with such inclement weather that so much has been done. Small steam is in moderate demand at 4s.; best samples realise 4s. 6d. House coal is tolerably brisk, but prices are not moving. Present rates are 8s. 3d. for No. 2 and 8s. 9d. for No. 3. Best steam coal can be bought at collieries for 9s. 6d., and I hear of some f.o.b. for the same price. In fact, prices are not good, and a lessened shipment of 20,000 to 30,000 tons a week, and a low price, forms a combination which the Welsh coalowners strongly object to.

The Mardy inquest has finished, and the result is, as many anticipated, unsatisfactory. The witnesses were competent and thoroughly practical men, and the coroner has had a long experience in colliery accidents; but the question, of course, is left unsolved. Mr. Wales, the inspector, was of opinion that it was firing the shot in the hard heading, others that it was the comet light at the arching, and some few the coal dust. However, the arrival of the verdict as given by the jury is good. They recommended means for laying and taking out coal dust, and for the instruction of boys in colliery rules.

Tin-plate is quiet. An effort is being made to revive the Monmouthshire and Gloucestershire Association. At Swansea a few tolerable shipments for Italy, France, and Hamburg were made last week, but nearly 50,000 boxes went into stock. Stocks now amount to 141,385 boxes. Larger shipments for the States next week will clear a quantity of these. Prices are about the same as last week. Coke tins realise 13s. 6d. to 14s.

The Shipping Trades.—In their annual review of the shipping market Messrs. John Hughes and Co., Liverpool, say:—"The past year can be best described as one of steady endurance for all concerned with shipping, for it set in with a continuance of the previous depression, and has closed without any change for the better. The reason of this deplorable state of things can be traced almost entirely to the operation of the Limited Liability Company Acts, which have been used by many impecunious, reckless, and inexperienced persons to introduce into this most important branch of business a large amount of outside capital, far in excess of legitimate requirements, and which has been invested in the building of new steamers, many of which have been laid up in port the greater part of the time since they were launched, for want of remunerative employment. The system of holding in shares undoubtedly has its advantages, but investors are apt to overlook the fact that even handsome earnings do not always permit of the distribution of large dividends, for provision should be made not only for depreciation and boiler renewals, but in these days of rapid changes, a machinery substitution fund is very desirable, as the newest type of motive power may very soon become obsolete—for no sooner has the old-fashioned engine been superseded by the compound than the triple expansion comes upon the scene, giving extra speed with an enormous saving of fuel, placing boats of the former type at a considerable discount, and making some of the most ancient ones totally unmarketable. The use of steel in shipbuilding grows very rapidly in favour, and there can be little doubt that steamers with steel hulls and triple expansion engines will be the favourite type of boat to build when business revives. The style of sailing ship most popular is about 2000 tons register, but it is to be hoped that they will not in turn be over produced, as the trades for which they are suitable are limited, but in any event they will only be capable of doing one-third the work of steamers of the same registered tonnage." Möller's "Steamship Circular" says:—"The most disastrous year ever known in the steam shipping business has come to a close. Although the new year does not open up under bright prospects, yet it appears that the downward tendency, both as regards prices of ships as also rates of freight, has now been arrested. The enormous increase in the mercantile steam fleet during the four previous years, estimated at about 1,914,000 tons, has told its own tale, and it must be hoped that the dearly-bought experience may serve as a warning for the future. The total tonnage of steam and sailing ships combined launched in 1885 is not likely to be much over 400,000 tons, which shows a considerable falling-off compared with the previous year, when the total tonnage launched was 549,896 tons. The losses during the past year have been heavy. Of steamers for the general trade very few are now being built, but on the Clyde the principal yards are fairly employed, with work for the Government and some of the large companies. On the East Coast, however, work is very slack, and builders are prepared to take orders at very low figures. As steel is now very little dearer than iron, this material is being mostly used, and in the large steamers the triple expansion engines have to some extent been adopted, the results hitherto obtained having been very satisfactory. After various attempts to substitute petroleum for coal as a fuel, a steamer has been built for the Brazilian trade, called Himalaya, fitted for that purpose, and given very favourable results; in fact, it is stated that on a trip which lasted fifty-four hours the consumption amounted to little over eight gallons per hour, at a cost of about £1 per day, while the cost of coal for that period would have been about £7. In addition to the economy in fuel, a great saving is also obtained in space and labour. Some experiments have also been made in propelling ships by electricity, but as yet only on a small scale, although not without good result." On this subject we may refer our readers to the article in our last impression.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, January 9th.

DURING the year twenty-two railways of the United States, with 3156 miles of main line, and a bonded debt and capital stock amounting to 278,500,000 dols., have been sold in foreclosure and transferred to new ownership. The result of this is that the capital stock is generally wiped out, and the bonded debt changed into new forms of securities, sometimes of less and sometimes of greater amounts. During 1885 forty-four companies passed into the hands of receivers representing a total mileage of 18,386, with a capital stock and indebtedness of 385,500,000 dols. This is a rather unfavourable showing for American railroads, but fortunately the prospects for improving traffic are decidedly better. However, a great deal of improvement must be made before the American railway system can be regarded as creditable. The iron trade is very active in all parts of the country. During the past week a large number of orders have been secured for all kinds of material, from pig iron to steel rails, and a general improvement in values seems to be near at hand, because of the urgency with which orders are placed. Steel rail mills are sold up six to seven months ahead. Merchant steel makers met at Pittsburgh this week and agreed to advance prices and establish a better classification for steel than has hitherto prevailed. The crude iron makers throughout the country intend to advance prices still further, and it is predicted that within thirty or sixty days at furthest forge iron will command 17·50 dols. at tide water and number one foundry 20·50 dols. The production of the furnaces at the 1st of January according to figures just to hand are 91,814 tons per week of all kinds of iron. The anthracite production is 30,000 tons, bituminous production, 55,000 tons per week in round numbers. The rolling mill owners of the New England and Middle States will meet in Philadelphia on Wednesday of next week and probably advance prices. In addition to the question of prices they will discuss tariff matters, and make such a defensive or aggressive movement as circumstances may seem to justify from present indications. But very little effort will be made to unsettle the tariff, and it is already discounted that the silver question will remain as it is. Stocks of material in hand at New York on January 1st were 739 tons of pig iron, 3010 tons of old rails, 3261 tons of steel wire rods, 4126 tons of Swedish iron, 967 tons of tin, 855 tons of Russian sheet iron, 54,100 boxes of tin-plate, 430,671 lb. of pig lead, 26,813 lb. of sheet zinc. Old rails are extremely scarce, and 21 dols. is offered for American. A Boston syndicate is buying all the American rails they can possibly secure, and prices are likely to go higher. Arrivals from Europe are reported, and negotiations are in progress for large lots from foreign markets.

NEW COMPANIES.

THE following companies have just been registered:—

Dry Docks Corporation of London, Limited.

This company is formed to carry on business as dock or slipway owners, shipbuilders and repairers, boatbuilders, ship and insurance brokers and agents, engineers, ironfounders, iron and steel workers, and engine and boiler-makers. It was registered on the 9th inst. with a capital of £550,000, divided into 35,000 preference and 20,000 ordinary shares of £10 each. The subscribers are:—

	Shares.
*The Hon. J. B. Roche, 71, Pont-street, S.W.	1
*J. Lloyd Pierce, 27, Clement's-lane, merchant	1
A. McAlister, 21, West India Dock-road, shipowner	1
T. Wilkinson, 17, Gracechurch-street, insurance broker	1
*J. Lawrence, 1, Fenchurch-avenue, managing director of docks	1
J. Anderson, 45, Effingham-road, Lee	1
W. H. Saffery, 8, Old Jewry	1

The directorate is to consist of not less than five nor more than nine members, each holding at least fifty shares, or a corresponding amount of stock. The first are Messrs. Richard Revett, J. E. Platt, J. D. Pender, T. K. Fletcher, and the subscribers denoted by an asterisk. Minimum remuneration, £2000 per annum, with an additional £500 for each 1 per cent. dividend or bonus above 10 per cent. per annum. Mr. J. Lawrence is appointed managing director at a salary of £1000 per annum.

Fronboeth and Pantmawr Slate and Slab Quarry Company, Limited.

This company was constituted by deed of settlement on the 9th ult., and registered as a limited company on the 8th inst., with a capital of £35,000, in 350 shares of £100 each, of which 252 are taken up and are fully paid. Its objects are to carry on the business of slate, slab, and stone quarry owners, brick, tile, and pottery manufacturers, moulders in brick-earth or other material. The members are:—

	Shares.
*Wm. Davis, Bridge-end, Glamorgan	50
*H. C. L. Matthews, Henbury, near Bristol	50
*G. L. Matthews, Westbury-on-Trym, Gloucester	50
*D. J. Davis, Waldeck, West Hampstead	50
*R. P. Davis, Westbury-on-Trym	50
W. G. Matthews, Henbury	1
L. W. Matthews, 21st Hussars	1

The number of directors is not to be less than three nor more than five; qualification, £1000 in shares. Remuneration, £250 per annum. The members denoted by an asterisk are the first directors.

Rhea Manufacturing Company, Limited.

Upon terms of an agreement of the 5th inst. this company proposes to acquire the rights and interests of La Société d'Études Scientifiques Appliques à la Industrie au Commerce, in several letters patent for Great Britain and the Colonies, relating to the decortication and ungumming of rhea and other fibre, and for converting the same into filasse and other products. It was registered on the 11th inst. with a capital of £110,000, divided into 22,000 shares of £5 each, of which 20,000 are A shares, entitled to a preferential dividend of £6 per cent. per annum. The purchase consideration is £10,000 cash and 2000 fully-paid B shares. The subscribers are:—

	Shares.
*W. J. Thompson, jun., 38, Mincing-lane, colonial broker	100
*S. Lloyd Howard, Crawley Mansions, Gloucester-road	100
A. J. Bromham, 42, Abingdon-road, Kensington	1
W. Young, 81, Lorrimore-road, Kennington	1
F. H. Fletcher, 9, Wellesley-road, Croydon	1
*Alexander Mackenzie, 112, Elm Park-gardens, S.W., merchant	100
W. H. Burrell, 165, Fenchurch-street, clerk	1

The number of directors is not to be less than three nor more than ten; qualification, 100 shares; the first are the subscribers denoted by an asterisk, and Messrs. G. H. M. Ricketts and Henry Minchin; remuneration, £1000 per annum, and also 5 per cent. of the profits available for dividend.

Langworthy Brothers and Co., Limited.

This company was registered on the 11th inst. with a capital of £200,000, in £10 shares, to take over the businesses of cotton spinners and manufacturers, dyers and printers of cotton and linen goods, bleachers, and merchants, carried on by Messrs. John Lowcock, W. Wright, R. Lowcock, and J. W. Wright, under the style of Langworthy Brothers, at Salford and Manchester. The subscribers are:—

	Shares.
*J. Lowcock, Broughton Park, Manchester, cotton manufacturer	1
*W. Wright, Prestwich Park, Manchester, cotton manufacturer	1
*R. Lowcock, Timperley, Manchester, cotton manufacturer	1
*J. W. Wright, Prestwich Park, Manchester, cotton manufacturer	1
*F. W. Lowcock, Broughton Park, Manchester, spinning manager	1
*P. E. Wright, Eccles, near Manchester, salesman	1
*F. W. Roberts, Prestwich, near Manchester, bookkeeper	1
*J. Blears, Swinton, near Manchester, manager of dye works	1
*F. Tate, Ashton-upon-Mersey, salesman	1

The number of directors is not to be less than four nor more than nine; qualification, £500 of paid-up capital; the subscribers are the first.

Lyon Brothers, Limited.

This is a proposed conversion to a company of the business of glass bottle manufacturers carried on by Messrs. Lyon Brothers at the Peasley Glassworks, St. Helen's, Lancaster. It was registered on the 9th inst. with a capital of £60,000, in £5 shares, with the following who are responsible for £5 each as first subscribers:—

	Shares.
W. J. Smith, 47, Mark-lane, agent	1
Henry William White, 7, Church-road, Brixton-rise	1
S. J. Elder, 6, Bessborough-gardens, S.W., accountant	1
H. Greey, 33, Holbeck-road, Kennington, manufacturers' agent	1
A. W. Flowers, 11, Osborne-grove, Finsbury Park, clerk	1
J. F. Hunt, 25, Queen Anne's-gate	1
A. White, 10, Throgmorton-avenue, clerk	1

The number of directors is not to be less than five nor more than seven; qualification, £100 in shares or stock. The first are Messrs. John Lyon, William Lyon, J. H. Lyon, W. Curwen, and Henry Wyatt. Mr. J. Lyon is appointed chairman, and Messrs. W. H. Lyon and J. H. Lyon are appointed joint managing directors, the former at a salary of £400 per annum, and the two latter at £200 per annum each. The chairman and managing directors will be further entitled to £5 per cent. of the net profits after payment of £10 per cent. per annum dividend. Each other director will receive £100 per annum, and they will be further entitled to 2½ per cent. of the annual net profits after payment of £10 per cent. per annum dividend.

Noiseless Tire Company, Limited.

This company proposes to acquire and work certain inventions and patents relating to the manufacture and improvement of wheels and tires for vehicles, the invention of Messrs. George Davies, Wm. Hassalwood Carmont, and John McQueen, of Manchester. It was registered on the 8th inst. with a capital of £2100, in £10 shares. The subscribers are:—

	Shares.
T. H Birch, 23, John Dalton-street, Manchester, merchant	1
W. H. Wilson, Pendleton, Manchester, calico printer	1
W. E. Carmont, Longsight, Manchester, engineer	1
J. McQueen, Ardwick, Manchester, engineer	1
H. G. Nicholson, 100, King-street, Manchester, chartered accountant	1
J. S. Heywood, Pendleton, Manchester, salesman	1
J. Taylor, 3, Cooper-street, Manchester, auctioneer	1
W. H. Tiplady, Crumpsall, agent	1

Registered without special articles.

James Joicey and Co., Limited.

This is the conversion to a company of the business of colliery proprietors, quarry owners, shipowners, lime burners, brickmakers, &c., carried on by the firm of James Joicey and Co. It was registered on the 8th inst. with a capital of £500,000, in 1000 shares of £500 each. The subscribers are:—

	Shares.
*James Joicey, M.P., Dissington Hall, Northumberland, coalowner	1
Mrs. M. S. Joicey, Dissington Hall, Northumberland	1
*W. J. Joicey, J.P., Urpeth Lodge, Durham, coalowner	1
Mrs. M. Joicey, Urpeth Lodge, Durham	1
James Joicey, Eastcourt House, Wilts	1
J. G. Joicey, Eastcourt House, Wilts	1
*J. Thompson, Gateshead, coal fitter	1

The number of directors is not to be less than three nor more than five; the first are the subscribers denoted by an asterisk. The minimum remuneration to be paid to the board is £3000, and the maximum £5000 per annum.

PRODUCTION OF CHROMIUM IN THE UNITED STATES.—The production of chrome iron ore in 1884, all from California, was about 2000 long tons, or about two-thirds as much as in 1883. At an average value of 17 dols. 50c. per ton at San Francisco, the total value was 35,000 dols.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

12th January, 1886.

451. CHRONOMETERS, C. Becker, jun., London.
452. ATTACHING COVERS to JUGS, &c., E. Taylor, Alsager.
453. SQUARE or ANGLE-ENDED KERBS, &c., for FIREPLACES, S. Robinson, Dudley.
454. ENRICHING ILLUMINATING GAS, J. Parkes, Birmingham.
455. INSERTING TAPS in BARRELS, R. Bostock and T. Hirst, Halifax.
456. STEAM and WATER VALVES or STOP COCKS, G. M. Marchant, Halifax.
457. PREPARING SKINS, KIPS, and HIDES, A. J. Hailes, London.
458. TWINERS for DOUBLING YARN, W. Bottomley, Manchester.
459. SHIPS' DAVITS, L. C. Niebour, Kingston-on-Thames.
460. CUTTING CRICKET BATS, &c., W. H. Cook, London.
461. CARTRIDGE MACHINES, L. Jeffries, Birmingham.
462. SAFES, W. Eglin, Glasgow.
463. SPEED REGULATORS for WATER POWER, E. Buckley, Newtown.
464. IRON LASTS for BOOTS and SHOES, E. Newberry and J. W. Sharp, Kettering.
465. TAP SOCKETS for CASKS, &c., J. Everard, Sparkbrook.
466. BOTTLE RACKS, &c., J. P. Jackson, Liverpool.
467. JOINING PIPES, W. H. Withington, Manchester.
468. MACHINES for FILLING BOTTLES, J. P. Jackson, Liverpool.
469. ELECTRIC LIGHTS, A. C. Ferguson, London.
470. PORTABLE FIRE-ESCAPES, H. Cardwell, London.
471. STAY BUSKS, J. Jackson, Sheffield.
472. RAZORS, &c., J. Mayland, Sheffield.
473. VENTILATING HATS, &c., C. Potter, London.
474. SELF-ACTING CARD DISTRIBUTOR, T. Schneider, London.
475. ALARM CLOCKS, E. Davies, Birmingham.
476. THORN'S VEHICLE SCOTCH, J. P. Thorn, London.
477. AIR or GAS ENGINES, W. Fairweather.—(*G. H. Babcock, United States.*)
478. AIR or GAS ENGINES, W. Fairweather.—(*G. H. Babcock, United States.*)
479. SPANNERS or WRENCHES, F. Smith, London.
480. PURIFYING ACETATE of LIME, W. Wilson, London.
481. BASSINETTES, T. H. Rowe, London.
482. SEPARATING and PURIFYING METALS, W. W. Popplewell.—(*A. F. Wendt, United States.*)
483. ELEMENTS for PRIMARY BATTERIES, H. Woodward and E. M. Gregory, London.
484. PENTAGRAPHIC ENGRAVING MACHINES, G. R. Hugon, London.
485. BACKS for CHAIR BEDSTEADS, H. Myer, London.
486. VALVES, W. Marrable, Stratford.
487. TRAPS for WASTE PIPES, &c., E. S. McClellan, London.
488. BUTTS of HINGES, W. Youlten, London.
489. RAIL JOINTS, J. Shipley, New York.
490. BICYCLE SEATS, C. M. Clarke, London.
491. STOPPERING or CLOSING BOTTLES, &c., L. Dove, London.
492. LOCKS, A. J. Boult.—(*M. de Urriolaveitia, Spain.*)
493. GAS ENGINES, L. H. Nash, London.
494. POLISHING PLATEGLASS, &c., A. de Boischevalier, Liverpool.
495. BURNING OILS, S. Banner, Liverpool.
496. MAGAZINE FIRE-ARMS, A. Burgess, London.
497. AIR BRAKES for RAILWAY CARS, H. Hollerith, London.
498. CASH BOXES, A. J. Boult.—(*D. McArthur, Canada.*)
499. FOLDING PAN and STOOL, J. C. Porrett, London.
500. HORSE GEARS, F. K. Woodroffe, London.
501. CASTING of BRAKE SHOES for WHEELS of RAILWAY CARS, J. J. Lappin, Ontario.
502. OPEN FIRE GRATES, J. Jex-Long, Glasgow.
503. PAPER-MAKING MACHINES, W. R. Lake.—(*W. F. Edwards, U.S.*)
504. GAS BURNERS or LAMPS, W. R. Lake.—(*J. W. Baker, U.S.*)
505. AUTOMATIC ALARM SIGNALLING, &c., E. E. Ries, London.
506. GOVERNING, &c., VALVES, &c., W. R. Lake.—(*The Mason Regulator Company, U.S.*)
507. BINDING of BOOKS, W. R. Lake.—(*T. C. Love, jun., U.S.*)
508. STARCH, W. R. Lake.—(*W. T. Jebb, U.S.*)
509. GOVERNORS for MOTORS, O. Imray.—(*J. Dow, U.S.*)
510. OBTAINING ALIZARIN OIL from OLEAGINOUS SEEDS, A. Brunstein, London.
511. MACHINE-GUNS, T. Nordenfelt, London.
512. LIGHTING CIGARS and PIPES, W. Walton, Bishopwearmouth.
513. BOTTLING AERATED LIQUIDS, E. Rowlands and T. Ferguson, London.
514. FEEDING RACKS and TROUGHS, T. Preece, G. Preece, and H. Preece, London.
515. DRIVING, &c., of REFRIGERATING MACHINES, R. R. Gubbins, London.
516. SPOONS, A. Hamon, London.

13th January, 1886.

517. CEMENT, J. Bidwell and A. Bidwell, London.
518. BOOT CLEANING and POLISHING, W. Benner, Tralee.
519. SPOKE GRIPS, C. Freeman and J. Lucas, Birmingham.
520. ROLLER-BLIND FURNITURE, C. G. Morgan, London.
521. AUTOMATIC DOOR OPENER, J. Hicken, Portsmouth.
522. KITCHEN or other RANGES, J. Green, W. R. Green, and R. Green, Ecclesfield.
523. AUTOMATIC ELECTRIC FIRE-ALARMS, J. W. Smith, Leeds.
524. NOISELESS CLUTCH, C. Warren, Ipswich.
525. COOKING RANGES, W. Morrison, Glasgow.
526. BELTING, F. Reddaway, Manchester.
527. STEAM WORKING of STOP VALVES, R. W. Grace, Cheshire.
528. MAKING BATS, S. M. Wainwright, Leeds.
529. SHIPS' PORTS, R. Richards and W. Rockliffe, Sunderland.
530. EXTRACTING SEWAGE SLUDGE from TANKS, J. C. Bothams, Wiltshire.
531. MULTIPLYING COPIES of WRITING, &c., W. Cordeaux, Rotherham.
532. INCREASING the UTILITY of the TELEPHONE, G. J. Rhodes, Wolverhampton.
533. MACHINE for the SALE of GOODS, G. J. Rhodes, Wolverhampton.
534. MACHINE for ADVERTISING, &c., G. J. Rhodes, Wolverhampton.
535. FILLING GAS METERS, &c., W. Ambler, London.
536. PROPELLING VESSELS, J. Hopper, jun., near Gateshead.
537. MUSIC HOLDERS, H. D. G. Gillespie, Glasgow.
538. FIREPLACES, R. M. Somers, Leeds.
539. FIRE-BLOWERS, S. F. Hadfield, Weston-super-Mare.
540. SCREW PROPELLERS, L. P. Fairbanks, London.
541. PROPELLERS, A. F. Yarrow, London.
542. BASTING MEAT during ROASTING, E. Barber, London.
543. DRUMS, G. Potter, London.
544. ASH-BOX and SIFTER, S. Limebeer, London.
545. BRAZIER for containing FUEL, E. J. Houstoun, Glasgow.
546 SADDLES for VELOCIPEDES, G. P. Coleman.—(*F. Sillibridge, U.S.*)
547. DOOR BOLTS, H. H. Green, London.
548. FASTENINGS for TRAVELLING, &c., TRUNKS, J. Marston, London.
549. TOOL for REMOVING WHEELS, &c., from their SHAFTS, G. Owen, Glasgow.
550. PANTILE ROOFING, K. Weise, London.
551. TIRE FASTENERS, C. H. Farrow, London.
552. STOCKINETTE CLOTH, G. Attenbrough and M. A. Herbert, London.
553. BOOTS, &c., J. and A. Green and J. C. Swain, London.
554. COWL or VENTILATOR, G. Bolton, London.
555. CRANKS for TRICYCLES, G. J. Stevens, London.
556. SYPHON APPARATUS, C, Reiss and F. Hecht, London.—*21st November*, 1885.
557. TRAVELLER CRABS, A. Grafton, London.
558. DELIVERING CIGARETTES or CIGARS, J. Breeden London.
559. SHOULDER PIECES for WORKING GUNS, T. Nordenfelt, London.
560. FASTENER for SECURING WINDOWS, &c., J. Wragg, London.
561. SMOKE-CONSUMING FIREPLACE, J. M. Stanley, London.
562. SUCTION and DELIVERY PUMPS, S. P. Wilding.—(*L. Nasi, Italy.*)
563. BOX for THROWING DICE, W. Edwards and A. J. Dimmack, London.
564. TREATMENT of ANIMAL FIBRES, &c., O. Chemin, London.
565. RELEASING MECHANISM for the CAGES of MINES, T. R. Shillito.—(*F. Westmeyer, Germany.*)
566. PRODUCTION and TREATMENT of STEEL, R. Hadfield, London.
567. HAND FIRE-EXTINGUISHERS, W. R. Lake.—(*E. G. Rideout, United States.*)
568. COUPLINGS for RAILWAY VEHICLES, G. Turton, London.
569. HEMSTITCHING, J. Moore, London.
570. CAUSING FIRES to BURN UP BRISKLY, J. E. Brown Lincolnshire.
571. TWO-WHEELED CABS, J. T. Parlour, London.
572. METHOD of TREATING SOLID SEWAGE MATTER, E. R. Hordley, London.
573. ATTACHING TIPS to BILLIARD CUES, L. B. Bertram London.
574. METALLIC COMPOUND for the PRESERVATION of SHIPS, W. Hamilton, London.
575. APPARATUS for APPLYING POSTAGE STAMPS to ENVELOPES, E. F. Ede and P. de Bondini, London.
576. MANUFACTURE of METALLIC SLEEPERS, J. Colquhoun, London.
577. ARMOURED SHIPS, J. I. Thornycroft, London.
578. PROPELLING APPARATUS for SHIPS, J. I. Thornycroft, London.
579. SURFACE CONDENSER for TRAMWAY ENGINES, H. P. Fenby, London.

14th January, 1886.

580. TENTERING and DRYING MACHINES, J. T. and E. Kershaw, London.
581. WATER HEATING UTENSILS, J. Fagan, Skipton-in-Craven.
582. FASTENER for BOOTS, H. W. Robinson and C. J. Smith, Northampton.
583. SADDLES for BICYCLES, J. A. Lamplugh, Birmingham.
584. TELEPHONE APPARATUS, S. A. Edwards, Birmingham.
585. REEFING SAILS, J. Duncan, Glasgow.
586. RAILWAY COUPLINGS, H J. Lever, Tisbury.
587. HANGER ATTACHMENTS for SLIDING DOORS, T. H. Brattan, Liverpool.
588. SELF-REVOLVING DAVITS, J. Linkleter, Tynemouth.
589. DESK RULERS, T. D'A. Davis, Llanelly.
590. FLOATING BREAKWATERS, W. R. B. Chamberlin, Eastbourne.
591. DISINFECTING, T. Bradford, Manchester.
592. SLEEPERS, T. Child, Leeds.
593. MATCH-BOXES, J. S. Walley, Whitchurch.
594. APPARATUS for the PROTECTION of the RESPIRATORY ORGANS, J. C. Broadbent, Rochdale.
595. FASTENINGS for HINGED FOLDING DOORS, J. Lewtas, Manchester.
596. COMPOUNDS of ORGANIC ALKALOIDS and SACCHARINE, C. Fahlberg and A. List, London.
597. MACHINERY for BLEACHING QUILTS, R. H. Ainsworth and E. B. Manby, London.
598. BICYCLE WHEELS, S. Green, London.
599. APPARATUS for SUPPLYING AIR to FURNACES, N. Evans, Liverpool.
600. BEDSTEADS, A. J. Boult.—(*A. and L. Meyer, Germany.*)
601. APPARATUS for SEPARATING GREEN PEAS, R. Karges, Liverpool.
602. AUTOMATIC MECHANISM for USE on DOORS, W. Zimmerman, Liverpool.
603. MANUFACTURE of MINERAL HYDROCARBONS, S. Banner, Liverpool.
604. CONTROLLING or REGULATING VALVES, J. E. Miller, Liverpool.
605. STEAM BOILER FURNACES, E. Boutcher, London.
606. VARNISH, C. F. Rousset, London.
607. CURRY, B. Friedrichs, London.
608. ORE CONCENTRATORS, H. F. Dale.—(*The Tabor Concentrator Company, United States.*)
609. FABRICS, J. Newton, London.
610. MUFFS, M. Kosminski, London.
611. SECONDARY VOLTAIC BATTERY, O. Imray.—(*A. Khotinsky, Holland.*)
612. VALVE APPARATUS, E. S. Hough, London.
613. OVERHEAD BAR RAILS, T. Murdoch, Glasgow.
614. TOILET GLASSES, C. H. Fox and E. Norwood, London.
615. DYNAMO-ELECTRIC MACHINES, W. Grierson, Glasgow.
616. DRYING CHAMBERS, J. Howie, Glasgow.
617. CALICO PRINTING MACHINES, W. Stewart, Glasgow.
618. LOOMS for MAKING FABRICS with TWISTED FRINGES, C. E. H. Müller and C. Speiser, London.
619. LOOMS for WEAVING VELVET, &c., W. H. Bairstow, London.
620. LOOMS for WEAVING LOOPED, &c., FABRICS, W. H. Bairstow, London.
621. GALVANIC BATTERIES, F. H. Varley and the Varley Electric Patents Proprietary, London.
622. INSTRUMENT for SOLVING SPHERICAL TRIANGLES, &c., B. L. Smith, London.
623. COILING SPIRAL SPRINGS, H. J. Haddan.—(*E. Deutgen, Germany.*)
624. PROPELLING SHIPS, &c., C. Groombridge and J. P. Rickman, London.
625. METALLIC CARDS, TEASELS, or COMBS, B. G. E. Pierrot, London.
626. WATCHES, I. Aubry, London.
627. LAWN TENNIS BALLS, J. E. Ransome, London.
628. CLASPS for GARTERS, &c., J. C. W. Jefferys and W. H. Palmer, London.
629. TARTARIC ACID, T. Gladysz, London.

15th January, 1886.

630. RELEASING HORSES from VEHICLES, J. Griffin, Birmingham.
631. HEELS of BOOTS and SHOES, A. J. Aspinall, Liverpool.
632. SHADE CARRIAGE for CANDLES, R. S. Moss, London.
633. ENGINES for STEAM STEERING GEAR, J. Brown, Manchester.
634. TOASTING BREAD, &c., S. Heys, King's Norton.
635. SPOKES for WHEELS, W. Cowley, Liverpool.
636. ELASTIC BELT, J. Tucker, Old Lenton.
637. BLADE SHARPENERS, D. L. Brain, Southsea.
638. TONGS, H. C. Harrison, Birmingham.
639. ERECTING TELEGRAPH and other WIRES, J. Poole and K. McIver, Manchester.
640. SIGHT FEED LUBRICATORS, J. L. Grandison, Manchester.
641. PREPARED FABRICS, P. W. Seymour, London.
642. BLASTING COAL, A. R. Sawyer, Stoke-on-Trent.
643. PACKING TOBACCO, J. M. Baines and S. Washington, Manchester.
644. TABLE FORK, J. M. Baines and S. Washington, Manchester.
645. MOUSTACHE SHIELD for CUPS, &c., C. J. A. Bald, London.
646. CALCULATING APPARATUS, J. W. Stanley, Crewe.
647. SUSPENDER for PICTURES, &c., C. Davis and S. Gaunt, Birmingham.
648. HEWING COAL, T. Archer, jun., London.

649. TRAM-CAR WHEELS, T. Archer, jun., London.
650. TURN WREST PLOUGHS, R. Bawden, South Molton.
651. CLIP and CARRIAGE for PERAMBULATORS, J. Aylward, Coventry.
652. TOBACCO PIPES, H. A. H. Daniel, Bristol.
653. CASTING GAS FITTINGS, P. Barry, London.
654. LAMPS, H. Defty, London.
655. WATER HEATERS, J. B. Goggin, London.
656. DISTANCE INDICATOR, G. B. Smith, Birmingham.
657. REGULATING the DRAUGHT of CHIMNEYS, W. Wade, Halifax.
658. HORSESHOE NAILS, J. A. Huggett, near Chesterfield.
659. BREECH-LOADING SPORTING GUNS, W. O'C. G. Birkin, London.
660. SPRING FASTENER for GLOVES, F. A. Sommer, London.
661. SECURING RAILS in RAILWAY CHAIRS, W. Dickinson and J. Hibbert, London.
662. FRAMEWORK of VELOCIPEDES, G. Singer, London.
663. CARTRIDGES, H. J. Allison.—(*T. A. Middleditch, United States.*)
664. FINGER STALLS, &c., J. M. Sloan, London.
665. GAS-MOTOR ENGINES, J. Magee, Glasgow.
666. PRESSURE ROLLER for WARP BEAMS, H. E. Newton. —(*MM. Berger and André, Germany.*)
667. CONDENSING GAS-MOTOR ENGINES, H. Williams, Manchester.
668. ELECTRIC TELEGRAPH PRINTING RECEIVING INSTRUMENTS, F. H. W. Higgins, London.
669. PUMPS, E. L. Pontifex, London.
670. LUBRICATING POWDER, A. M. Clark.—(*B. Lenglet, France.*)
671. NEWSPAPER FILES, W. Schulz, United States.
672. REFRIGERATING MACHINERY, A. Neubecker, London.
673. FRAMES of SEA-GOING VESSELS, H. Withy and G. W. Sivewright, London.
674. COCKS, J. Dewrance and G. H. Wall, London.
675. WATER SPRAY APPARATUS, M. Lutzner and H. Gumtow, London.
676. CRUDE PHOSPHATE of LIME, A. Deckers and R. Tamine, Liverpool.

16th January, 1886.

677. SCANDINAVIAN PADLOCKS, J., D., and A. Minors, London.
678. APPARATUS for TREATMENT of FELT HATS, G. Atherton.—(*G. Yule, United States.*)
679. DRYING FELT HATS, G. Atherton.—(*G. Yule, United States.*)
680. FULLING STOCKS, G. Atherton, Manchester.
681. AIR CHAMBERS for USE in CONNECTION with FUR HATS, G. Atherton, Manchester.
682. STEAM REGENERATOR FURNACES, J. C. Brentnall, Manchester.
683. PREVENTING WASTE from the BREAKAGE of YARNS in THROSTLE SPINNING FRAMES, A. H. Dixon and W. J. Gradwell, Manchester.
684. AUTOMATIC STEERING for SAFETY BICYCLES, J. and G. N. Howes, Cambridge.
685. CABS, S. Adams and W. H. Bodin, Birmingham.
686. GENERATING STEAM, I. Engelson, Jersey.
687. KEYS for FASTENING RAILS to CHAIRS for RAILROAD, &c., LINES, J. Rebbla, Morley.
688. WATERPROOF CAPES for LADIES, H. Markus, Manchester.
689. EXPANSION STEAM ENGINES, J. Chapman, Leith.
690. PAPER-MAKING MACHINES, W. Tod, Glasgow.
691. MOTIVE POWER ENGINES, J. Black, Glasgow.
692. FILLING VESSELS with LIQUIDS, J. Sturrock, Dundee.
693. STOPPERING BOTTLES, H. Agar and J. Soper, Worcester Park.
694. WASHING and PEELING POTATOES, W. Corbet, Glasgow.
695. SHUTTLECOCKS, A. Whittle, Swinton.
696. STEERING MECHANISM of VELOCIPEDES, F. H. Parkyn and W. Simmons, Wolverhampton.
697. CARRIAGE COMMUNICATOR, W. W. Griffin, Liverpool.
698. REMOVING SNOW, F. Lyon, London.
699. TAPS for VISCOUS FLUIDS, C. M. Farrow, Swansea.
700. CONCENTRIC SCALE INDICATOR, &c., F. O. Ferguson, East Dulwich.
701. EXPANSION, &c., in STEAM or other PIPES, W. Crickmay, Caterham.
702. DRESS-CUTTERS, S. Waters, London.
703. POT-LIFTERS, L. T. Karras, London.
704. PROTECTING WOUNDS, &c., J. H. Haywood, London.
705. KNITTED WOOLLEN CLOTHING, A. Alexander, London.
706. ANTI-FRICTIONAL BEARINGS, H. Loud, London.
707. PULVERISING, &c., MANURE, H. J. Haddan.—(*W. Schmidt, Germany, and I. Frank, Austria.*)
708. VEHICLE, I. Wilderspin, London.
709. STROP, J. Pullman, London.
710. BOTTLE STOPPERS and NECKS, H. Linley, London.
711. SHAFTING AXES and other TOOLS, J. Evans, London.
712. CLOSING BOTTLES, &c., H. Lintott and H. T. Tallack, South Norwood.
713. CONDENSING SMOKE, B. Spencer and J. Driver, Halifax.
714. FISH-PLATE JOINTS of RAILS, A. G. C. Harvey, London.
715. PHOSPHORIC ACID, W. B. Giles and A. Sheaker, London.
716. ROTARY ENGINES, J. Hick and J. F. Phillips, London.
717. TORPEDOES, C. Wells, London.
718. TORPEDOES, C. Wells, London.
719. ANHYDROUS AMMONIA, A. Osenbrück, London.
720. MECHANICAL REGISTRATION of STATISTICS, C. D. Abel.—(*L. Bonazzi, Italy.*)
721. PETROLEUM LAMPS, J. C. Mewburn.—(*V. Delloue, France.*)
722. APPLIANCES for AFFIXING STAMPS, F. P. Griffith, London.
723. ELECTRO FIELD MAGNETS for DYNAMO ELECTRIC MACHINES, R. Kennedy, Glasgow.
724. AGRICULTURAL DRILLS, T. Clarke.—(*J. C. Carmichael, United States.*)
725. RINGS for BAGS, &c., E. de Pass.—(*E. Posen and Co., Germany.*)
726. INSTANTANEOUS FIRE HOSE COUPLING, A. Devonshire, Paisley.
727. GOVERNORS for MOTIVE-POWER ENGINES, T. Heather, London.
728. THUMB LATCH for DOORS, P. L. Le Duc, London.
729. FASTENERS for SECURING STAIR RODS, J. D. Prior, London.
730. CORSETS, W. R. Lake.—(*J. S. Crotty, United States.*)
731. HORSESHOES, G. H. Gregory, B. B. Anthony, and W. B. Carron, London.
732. KEYBOARDS for MUSICAL INSTRUMENTS, A. Luznik, London.
733. STOCKINGS and STOCKS, J. H. Cooper and W. J. Ford, London.

18th January, 1886.

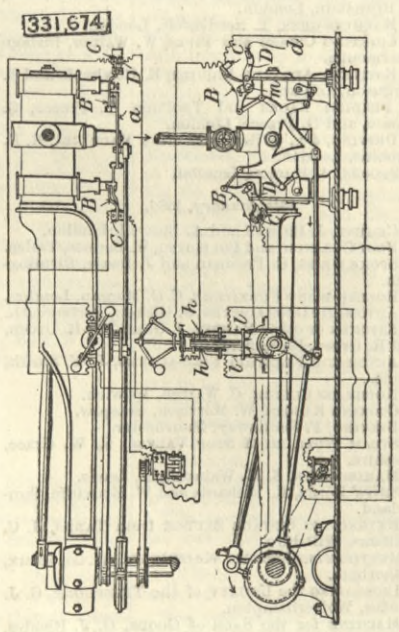
734. MANUFACTURE of WATER FILTERS, J. R. Shearer, London.
735. SELF-ACTING SWINGS, T. W. Newey, Birmingham.
736. STEAM ENGINES, T. Hunt, Manchester.
737. INDICATING HEAT in ENCLOSED CHAMBERS, W. Leggott, Bradford.
738. WORKING the VALVES of ORGANS by TUBULAR PNEUMATIC EXHAUST ACTION, M. Hetherington, Newcastle-on-Tyne.
739. SIGHT-FEED LUBRICATORS, T. Sandiford, Rochdale.
740. CHECKING FARES in OMNIBUSES, &c., J. McKenny, Dublin.
741. ARC ELECTRIC LAMPS, T. Stanley and C. Richardson, Hyde, and A. H. Davies, Newport.
742. SHACKLES, J. Lapthorn and J. F. Ritson, Greenock.
743. MEDICINAL INHALERS, J. Sturrock and G. D. McDougald, Dundee.
744. LID PROTECTOR, M. Dean, London.
745. TOOTH BRUSHES, C. Wall, Dublin.
746. PREVENTING DRAUGHTS from DOORS, &c., J. Warhurst and W. Carter, London.
747. THIMBLES, J. Barter, London.
748. PLOUGH SOCKS, J. Lindsay, sen., and J. Lindsay, jun., Glasgow.
749. SECURING MATTRESSES to BEDSTEADS, E. R. Billington, Liverpool.
750. KEYS for HOLDING RAILS, W. E. Partridge, Birmingham.
751. MAKING INFUSIONS of TEA, &c., F. E. V. Beanes, London.
752. APPLYING PRESSURE to STACKS of SILAGE, &c., T. Nuttall, Beeby.
753. APPARATUS for LOCKING UP BOTTLES, J. P. Bayly, London.
754. PUMPS, F. and S. Pearn and T. Addyman, London.
755. CALCULATING INSTRUMENT, P. Claudel, Liverpool.
756. SEWING MACHINES, J. Kayser, London.
757. ASTRONOMICAL TELESCOPES, W. Donahay, London.
758. EXPLOSIVE SUBSTANCES, &c., W. D. Borland, London.
759. HOSE and SOCKS, W., E., and F. Brown, London.
760. GENERATING MOTIVE POWER, A. Feiss, London.
761. DETECTING CAVITIES in MINES, &c., W. H. Tylor, London.
762. WORKING RAILWAY FACING POINTS, &c., C. A. and H. Kirby, London.
763. FACILITATING INSTRUCTION in GEOGRAPHY, H. J. Haddan.—(*J. Bertschi, France.*)
764. TUBULAR STEAM GENERATORS, H. Rittner, London.
765. PRODUCING PARA and ORTHO-NITROBENZYLALCOHOL, &c., J. Y. Johnson.—(*A. Faust, Germany.*)
766. GASSING YARNS, &c., T. Rivett. Manchester.
767. CLEANING the TEETH, J. Willis, Henley-on-Thames.
768. BOOK RESTS, J. G. Hayman, London.
769. ARC LAMPS, J. H. Holmes, London.
770. FLOORING TILES, &c., W. Benson and L. Gunning, London.
771. GENERATING ELECTRICITY, H. Edmunds and W. T. Goolden, London.
772. DRAWING CORKS, &c., M. Heslop and J. C. Cottam, London.
773. PURIFYING the FEED-WATER of STEAM ENGINES, G. F. Redfern.—(*J. Parent, France.*)
774. SURGICAL BANDAGES, &c., C. F. Rideal, London.
775. VESSELS for CARRYING SEWAGE, &c., C. Blagburn, London.
776. BOTTLE STOPPERS, J. W. Hall, London.
777. DUST CATCHERS, W. and J. Comerford, London.
778. PADDLE-WHEELS, A. T. Elford, London.
779. HIGH-SPEED FLUID-PRESSURE MOTOR, G. M. Capell, London.
780. COMBING FEED MECHANISM for CARDS &c., V. de Nydprück, London.
781. FIXING on SHAFTS DIVIDED PULLEY &c., R. Macer, London.
782. PUNCHING and DRILLING MACHINES, C. F. Findlay, London.
783. PURIFYING ALCOHOL, I. A. F. Bang and M. C. A. Ruffin, Paris.
784. SPEED INDICATORS, O. Imray.—(*A. Kapteyn, France.*)
785. FACILITATING the MINING of COAL, R. C. de Walcher-Uysdal, London.
786. PRODUCING CAKES of BRAN, &c., J. Finke and R. Lesshafft, London.
787. CASK CORKER, J. B. Carter, London.

SELECTED AMERICAN PATENTS.

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

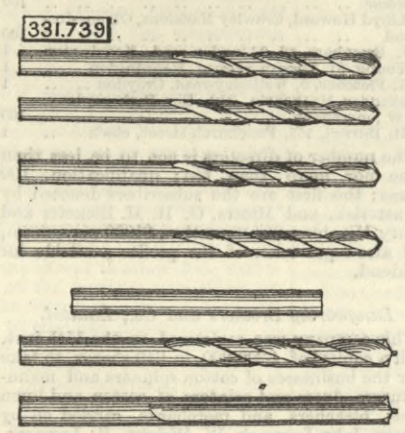
331,674. ELECTRO-MAGNETIC CUT-OFF FOR ENGINES, *Richard A. Bailey, Providence, R.I.—Filed April 17th*, 1885.

Claim.—The combination, in an engine or other analogous motor having mechanically operated inlet and exhaust valves, of one or more vibrating loosely-mounted levers having one or more electro-magnets secured thereto, a generator and regulator for the electric current, with an armature lever secured to the valve stem, and an inlet valve mounted thereon, substantially as and for the purpose herein set forth. In a detachable or drop cut-off engine, the loosely-mounted lever B, connected with the wrist lever *a*, electro-magnets C, secured to said lever B, an electric circuit embodying a generator and a regulator electrically connected, in combination with the arm D, secured to the valve stem *m*, said arm being provided with a vacuum pot or weight and the soft iron armature *d*, whereby the said lever B and arm D are magnetically connected, substantially as and for the purpose set forth. In a cut-off engine having its inlet valves electro-magnetically controlled, the combination, with the non-conducting rods *h*, having electrically connected conducting surfaces h^1 secured thereto, and means, substantially as shown, for connecting said rods with the regulator, of suitably mounted and guided electrically connected brushes *l*, and means, substantially as shown, for imparting reciprocating motion to the brushes, the whole combined and arranged whereby the conducting portions h^1 of the rods are adapted to move wholly above and partially below the contact surface of the brushes *l*, and corresponding with the extreme up and down positions of the regulator balls and sleeve, substantially as shown, and for the purpose hereinbefore set forth.



331,739. METHOD OF MANUFACTURING TWIST DRILLS, *Geo. R. Stetson, New Bedford, Mass.—Filed May 16th*, 1885.

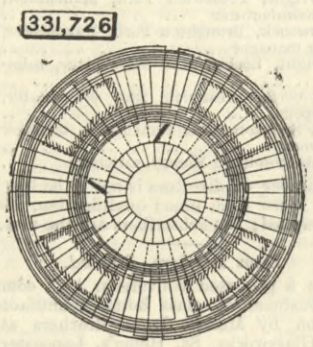
Claim.—(1) The improved art, method, or process of making twist drills herein described, the same consisting of the following steps, viz.: First, rolling a pair of grooves into the hot blank; secondly, twisting the hot grooved blank so produced to form, approximately, the twist of the drill; thirdly, rolling the hot grooved and twisted blank, substantially as described. (2) The improved art, method, or process of making twist drills herein described, the same consisting of the following steps, viz.: First, rolling a pair of grooves into the hot blank; secondly, twisting the hot grooved blank so produced to form, approximately, the twist of the drill; thirdly, rolling the hot grooved and twisted



blank, substantially as described; fourthly, annealing the blank so produced, and vitrioling it if required; fifthly, re-rolling this blank while cold, all substantially as herein described.

331,726. DYNAMO-ELECTRIC MACHINE, *Hermann Müller, Zurich.—Filed July 3rd*, 1885.

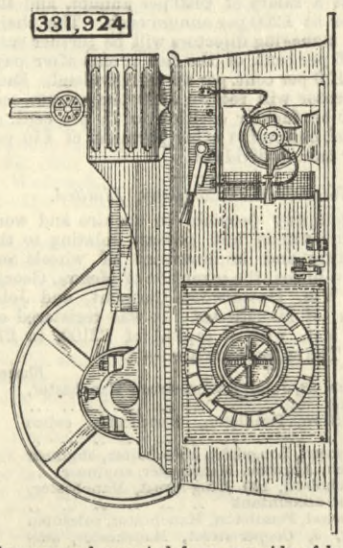
Claim.—In a multipolar dynamo machine, an armature having the conductors wound upon it in one continuous course, so that the distance between each two successive induced portions of the conductors is



greater or less than that between the poles of the field magnets according to the formula $D = d - \frac{n}{p}$ or $D = \frac{n}{p} - d$, substantially as set forth.

331,924. COMBINED ENGINE AND DYNAMO-ELECTRIC MACHINE, *Jonathan H. Vail, New York, N.Y.—Filed July 11th*, 1885.

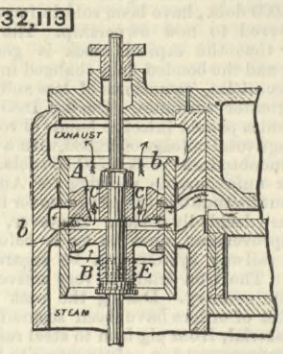
Claim.—(1) The combination, with an engine and a hollow base, of a dynamo-electric machine mounted upon an extension of the base, at the cylinder end thereof, the shaft of the dynamo being arranged transversely with relation to such hollow base, and projecting clear from the opposite sides of such base, a commutator at one end of such dynamo shaft open to access, and a pulley at the other end of such dynamo shaft connected by a belt with the driving wheel of engine, substantially as set forth. (2) The combination, with an engine and a hollow base upon which it is mounted, of a dynamo-electric machine within the base, driven by a belt from the engine and mounted on runners, screws adjusting the dynamo-electric machine to tighten the belt, and a mechanism turning



said screws and operated from one side of base, substantially as set forth. (3) The combination, with an engine having the operating wheel of its throttle valve located upon the side opposite the driving wheel, and a hollow base upon which said engine is mounted, of a dynamo-electric machine mounted upon runners on an extension of said base, at the cylinder end thereof, the shaft of the dynamo being arranged transversely with relation to said base, and projecting clear from the opposite sides of such base, a belt connecting the driving wheel of engine and pulley of dynamo on one side of base, the dynamo-commutator open to access on other side of base, adjusting screws for moving dynamo to tighten belt, and mechanical connections for adjusting said screws from the side of base opposite driving belt, substantially as set forth.

332,113. PISTON VALVE, *John W. Sargent, Scranton, Pa.—Filed August 10th*, 1885.

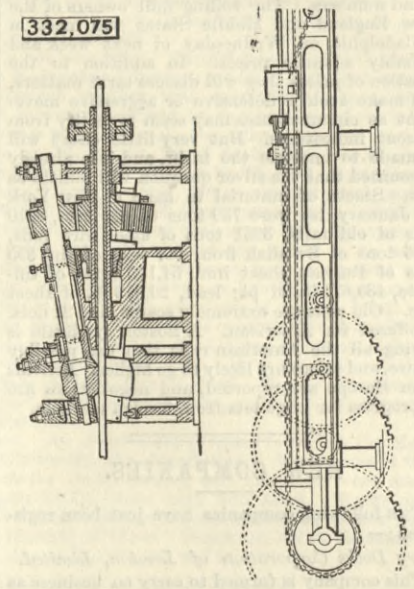
Claim.—(1) In combination with the cylinder and steam chest of an engine, a valve composed of two parts normally in contact and operating as one valve, but capable of being separated by pressure, substantially as described, and for the purpose set forth. (2) In combination with the cylinder and steam chest of an engine, a valve composed of two parts mounted upon a single valve stem, and normally in contact and operating as one valve, but capable of being separated by pressure, substantially as described, and for the purpose set forth. (3) In combination with the cylinder and steam chest of an engine, a valve composed of two parts mounted upon a single valve stem, one part being fixed upon said stem and the other part loose thereon, such parts being held normally in contact to operate as one valve, but capable of being separated by pressure, substantially as described, and for the purpose set forth. (4) In combination with the cylinder and steam chest of an engine, a valve composed of two parts, one fixed and one loose upon a single stem, a pressure spring for holding such parts in contact, and an annular space between the two parts communicating with the cylinder, whereby an excess of pressure in the cylinder will cause a separation of the two parts of the valve against the steam and spring pressure, substantially as described, and for the purpose set forth. (5) In combination with the cylinder and steam chest of an engine, a piston valve composed of two parts, one fixed and one loose upon a single stem, a spring for holding such parts in



contact, an annular space between the two parts, and passages in one of said parts to permit the escape of water after their separation, as hereinbefore described. (6) The combination of the cylinder and steam chest, the fixed valve section A, having passages *c*, the loose section B, the spring E, and the annular space or chamber *b*, in the valve section A, all substantially as and for the purpose set forth.

332,075. ART OF MANUFACTURING ROLLED AND POLISHED SHAFTING, *Philip M. Haas, Youngstown, Ohio.—Filed January 15th*, 1884.

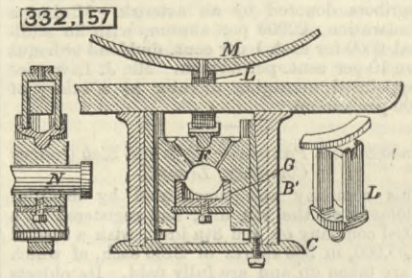
Claim.—(1) The improvement in the manufacture of shafting, substantially as hereinbefore described, which consists, first, in spirally rolling a round bar of suitable metal at substantially a cherry-red heat; and secondly, in die-drawing said bar when substantially



free from heat, whereby said rod or bar is converted into shafting uniform in diameter, and having a highly finished and well condensed surface. (2) The improvement in the art of surface finishing shafting, substantially as hereinbefore described, which consists, first, in cleansing and partially condensing the surface of a rod or bar of metal by rolling pressure applied thereto in peripheral lines, and secondly, die-drawing said metal.

332,157. LOCOMOTIVE JOURNAL-BOX, *George H. Kinzer, Grant's Pass, Oreg.—Filed June 2nd*, 1885.

Claim.—(1) A journal-box for locomotives, having convex concentric bearings, corresponding concave shoes, one of which is tapering and vertically adjustable, in combination with the pedestal, substantially as described. (2) The bearing-block having convex vertical sides and a socket in its top surface, the shoes having concave vertical bearings to receive said convex sides, the stirrup having ball to engage the socket, and the spring surmounting the stirrup, all combined as set forth. (3) A journal-box having convex bearings and concave shoes, adapted to work in a pedestal block, said box being also provided with a socket bearing and oil wells in its top and oil channels, for the



purpose described, in combination with the spring stirrup having a saddle to work in said socket in the manner shown. (4) A combined journal-box and spring bearing having convex bearings, in combination with concave shoes, one of which is rigid, the other tapering and adjustable, the tie plate, and set screw, substantially as set forth. (5) A journal-box for locomotives, having convex bearings, concave shoes, one of which is tapering and adjustable, in combination with a pedestal having one tapering jaw, a tie plate, and set screw, said box having a socketted bearing for the spring, the whole being arranged to yield to the irregular movement of the engine and to preserve the axles in line, substantially as set forth.