VISITS IN THE PROVINCES.

PATENT SHAFT AND AXLE-TREE COMPANY'S WORKS.

THE Patent Shaft and Axle-tree Company, whose full complement of men is 4000, though little more than half that number are now employed, has three separate works at Wednesbury, and derives its title from an improved form of cart axle-tree, for the manufacture of which the company was originally started. This, however, is a thing of the past, though large quantities of railway wheels and axles are produced. The wheels are made by placing, in a ring or hoop, bar iron spokes, bent as described in our last impression in connection with the Midland Carriage and Wagon Company's works, covering the heated centre with a washer made white-hot on both sides, the whole being subjected to pressure in a hydraulic press. This manufacture, however, carried on at the company's Brunswick works, was not in action during the meeting of the British Association. The company's machinery for producing cold-rolled shafting was also, unfortunately, not in operation during our visit.

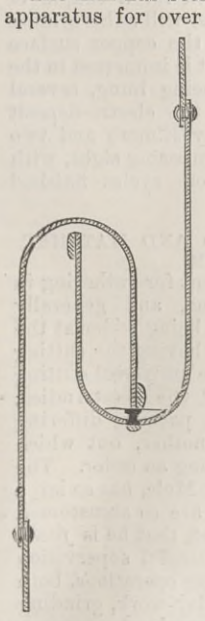
The company does not now make pig iron, some old blast furnaces which have long been disused being now in course of demolition. At the Mon Bay Works, steel is made chiefly by the Martin process; but there is one old pit which receives molten metal from an open-hearth furnace or from two Bessemer converters, as occasion may require. For the open-hearth process the Batho furnace is employed exclusively, in which—just the reverse of the arrangement in the Radcliffe furnace adopted at Woolwich Arsenal—the various portions are kept separate. The furnace proper, or reservoir, is cylindrical with a flat bottom and vaulted roof, lined with silica bricks; and the four regenerators, reversed about every half-hour, are in the form of tubes or pillars, making a quincunx with the central furnace. The regenerators are encased with boiler-plate, also lined with silica bricks; but, both in their case and in that of the reservoir, there is a layer of the red ashes from slag heaps outside the silica brick lining. Thanks to this excellent non-conductor, the outside of the regenerator remains comparatively cool, while there is intense heat within. The hot air and gas from the producers mingle in the crown of the furnace, and are reflected on to the bath of molten metal. A great advantage of this furnace—with which every satisfaction was expressed by the engineer, Mr. Wailes—is that the brick lining can be renewed in a great measure from the outside.

At the Old Park Works bridges are built and erected, to be afterwards taken to pieces for shipment. Here was made the Benares Bridge, with seven spans of 360ft., and here are now being built a bridge for Cairo and a lattice girder bridge with vertical struts for the Indian State Railways, having the diagonal tension-rods that run in one direction provided with screws and nuts for exactly adjusting their tension to that of the bars crossing them in the other direction. Holes in plates are marked off by means of a wooden template, into the holes of which are passed, first a centre punch and then a piece of pipe dipped in white paint, for showing the position of the centre mark. Hydraulic pressure of 400 lb. per square inch is obtained by short-stroke pumps, and Tweddell's hydraulic rivetters are used where possible.

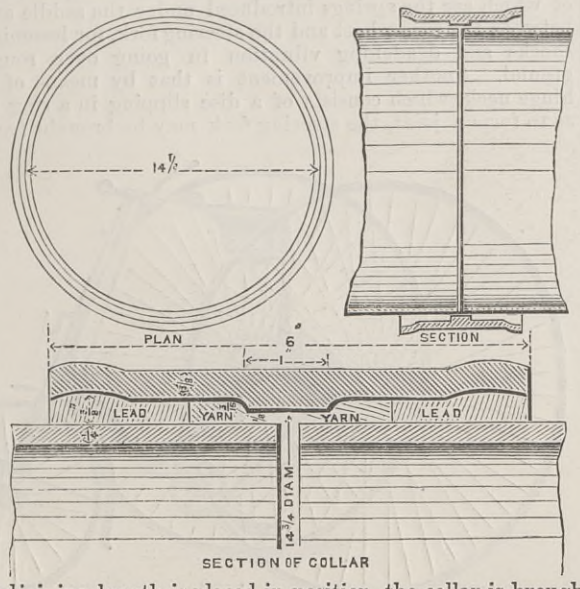
MESSRS. THOMAS PIGOTT AND SONS' ENGINEERING WORKS.

These long-established works, situated at Spring Hill, alongside the Birmingham Canal, by which supplies are received, have of late years been increased by taking over the business of the Atlas Engine Company, whose type of engines are still made. Including a separate department for welded plate tubes, the works cover more than five acres of ground, and employ about 500 men, including erectors sent out to all parts of the world, even to the Antipodes. They are capable of turning out three boilers and one engine a week, in addition to bridge, gas, and water-tube work. For bridge and girder work when there is repetition, the holes are marked off with the aid of a template. Steel is being more and more used for boilers; and in such a case the rivet holes are drilled. For this purpose, an improved double drilling machine, suspended inside the cylindrical shell and worked by rope gear, drills two holes, diametrically opposite to one another, at the same time. Both steam and hydraulic rivetters are used; and rivet blanks are headed in a belt-driven press, the lower die of which is brought forward to receive them by a lever and links.

The firm has been engaged in the manufacture of gas apparatus for over sixty years, during which period the capacity of gas-holders has increased from 40,000 cubic feet to 8,000,000 cubic feet, and the diameter from 60ft. to 220ft. All the rivet holes in a gas-holder sheet are punched simultaneously by a hydraulic press; and in telescopic gas-holders the usual water-joint angle-iron and longitudinal rows of rivets for the hydraulic joint are superseded by curved plates, as shown in the annexed sketch. This joint, with three lifts of 36ft. each, has been adopted for the gas-holder, 184ft. in diameter, put up by the firm at Sydney.

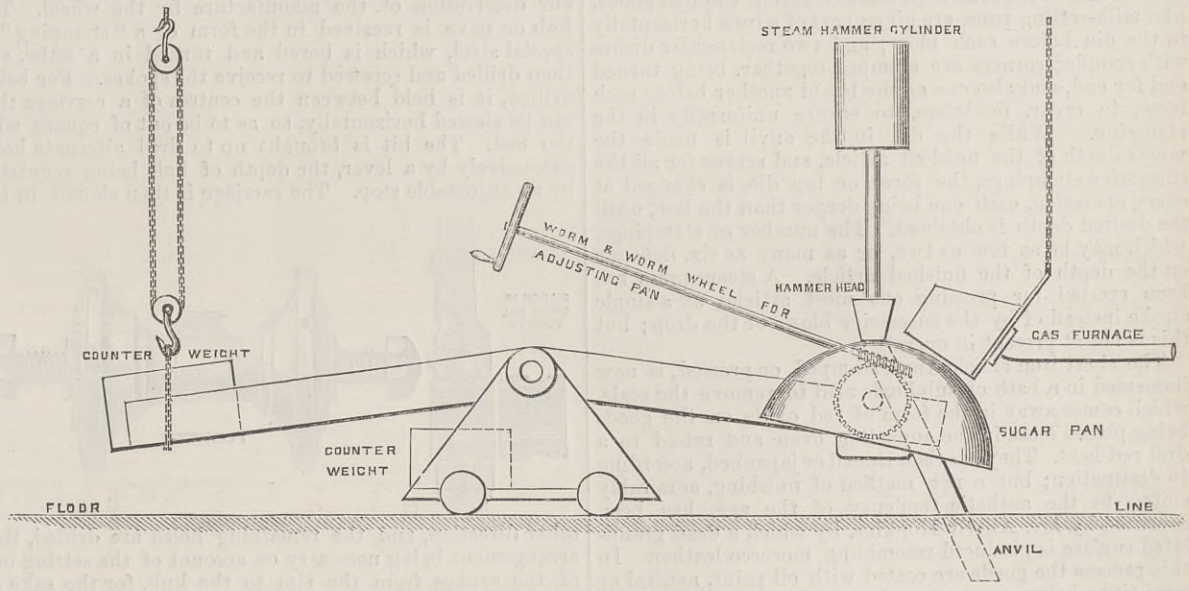


Messrs. Pigott and Co. have lately turned their attention to superseding cast iron water mains by those of wrought iron, so as to save weight in transport over difficult ground. They have lately taken an order for eight miles of 14in. piping for South Africa, in which the reduced weight over a distance of 700 miles will effect a saving of £20,000 in the transport. An experience of twenty years proves that ordinary dipping and painting secures perfect immunity from oxidation. In the case of cast iron water mains it is necessary to break at least one length in order to take up any portion; but the firm has devised an improved joint shown by the accompanying sections, for their plate iron mains, by the use of which any length may readily be taken up and laid down again. In this arrangement, which has been adopted for the Kimberley Waterworks, a length is laid with the joint collar passed over one end. When the



adjoining length is placed in position, the collar is brought over the joint, as shown in the sections; and the joint is caulked with yarn from both ends, over which lead is run in the ordinary way. If it be required to take up a length, the lead and yarn are picked out; and the collars of two joints are run back over the ends of the pipes, when the length may be taken out.

In making these tubes, powerful rolls for bending plates 15ft. long and of any diameter have been put down at the works, and they are believed to be the largest in the country. Tubes up to 18in. diameter are rolled with a single plate in the circumference, so as to require only one longitudinal joint. To remove the tube from the rolls, the top roll of the three is withdrawn through one standard in a few seconds by means of a quick-speed screw, worked by patent chain gearing from a separate engine. From about 9in. upwards in diameter, the tube seams are welded by a drop hammer on an arm terminating in a curved anvil, with a gas furnace close behind the hammer. Fire-box flues for vertical and donkey boilers, and also the Adamson and Arnold barrel-shaped flues, are made in the same way. Indeed, the largest Lancashire boilers might thus be welded up in one piece, as well as all vessels where absolute tightness under a high pressure is required, such as torpedo-launching tubes and Westinghouse air cylinders.



MESSRS. PIGOTT'S GAS WELDING PLANT.

The British Association members were shown a new method of welding up sugar and saltpetre pans, especially for South America. The four seams were originally rivetted, but it was found that they leaked, while the rivet heads offered an obstruction to cleaning out. The pan is now, as before, made up of four segmental plates, bent hot in dies under the hydraulic press. They are fitted together in position, the outer contiguous edges having been chamfered off by being sheared at an angle, so that the cross seam is a V-shaped furrow. The pan is mounted on temporary trunnions in the end of the beam, consisting of two flat bars on edge, shown in the annexed sketch. The beam is carried on a counter-weighted truck running on rails, so that it may be taken up to and withdrawn from the hammer and gas furnace, while the pan may make a complete revolution on its temporary axis between the bars of the beam by means of the hand wheel, shaft, worm, and worm wheel. The pan is run up to the gas furnace, which has already raised to an intense heat some refractory material underneath it. When a portion of the seam is brought to a welding heat, a rod, with the end also at welding point, is laid in the furrow, and that portion, brought under the hammer, is welded. This operation is repeated until all the seams are made good, with the result that they can scarcely be detected, and the welds will stand any test applied to the remainder of the plate. The arrangement illustrated is capable of dealing with a pan weighing between one and two tons.

The chief peculiarity of this gas-welding apparatus, which is only worked by Messrs. Pigott, Messrs. Lloyd and Lloyd, and a few selected licensees—and probably the secret of its success, lie in the fact that the gas—whether ordinary retort or water gas—is thoroughly mixed with the air necessary for its combustion at a point far distant from the tuyere by which the welding heat is developed. This requires that the gas mains contain an explosive mixture for several hundred feet of their length; and the explosion is only kept back from the pipes by the velocity of the blast forwards being greater than that of the explosion backwards. The air and gas are drawn together through a blower several hundred feet from the tuyere; but, if the blast should cease from any cause, a loud explosion would take place. This, however, is rendered harmless by cleverly arranged explosion valves, consisting of thin discs of india-rubber, which, though shattered themselves, allow an explosion free access to the atmosphere without doing any damage. By proportioning the admission of gas and air an excess of gas can always be maintained, so that there is no probability of burning the iron; while, owing to the gaseous fuel, no dirt or cinder can get into the weld. The consequence is that the thinnest sheets of iron or steel may be welded with the greatest ease and certainty.

A. KENRICK AND SONS' HOLLOW-WARE WORKS.

These works at West Bromwich, the frontage to which is in the Gothic style of architecture, little suggestive of the ware produced therein, cover five acres, of which more than three-fourths are built upon. Having until lately employed 1200 hands, the company has, during the period of depression, only reduced the number to 1100, but they are working only about five and a-half days in the week. The company has, with thorough confidence in a revival of trade sooner or later, taken advantage of the low price of materials and labour to erect new works covering six acres on the other side of the street, and buildings are rapidly approaching completion. Fuel and raw materials, chiefly pig iron, are brought quite up to the works by the South Staffordshire Canal, which also removes the finished products. From 60 to 70 tons of hollow-ware—that is to say, pots, kettles, &c.—are turned out weekly, together with from 40 to 50 tons of small cast iron goods, such as door knockers, umbrella stands, and the like. A 1ft. 9in. tramway is laid throughout the works, which are remarkable for their order, neatness, and cleanliness. As accumulations of greasy dirt and cotton waste are greatly conducive to, if, indeed, not the actual cause of fire from spontaneous combustion, the rule is strictly enforced that the shops be thoroughly cleared and cleaned every night.

All the hollow-ware is cast in green sand moulds, in boxes made specially for the various articles and sizes thereof required. Pots are cast a full ⅛in. thick at the bottom and less than ⅛in. elsewhere. After being turned out of the moulds they are placed, one within another, in pans, made of boiler plate, closed by a cover luted with clay. The pans are placed in a furnace for annealing, and allowed to cool gradually, thus diminishing the brittleness and hardness of the metal, so that the outside may be dressed and the inside turned. The dressing is effected by holding the goods against rapidly revolving emery wheels; and the inside is turned—even in the case of oval pots—entirely by hand, a very smooth surface being given. After cleaning with sal-ammoniac, to remove grease, the pot is placed on a fire like a smith's hearth. Pure molten tin is poured in and rubbed on the inside with a cork held by a rod. The excess of tin is then poured out, at two or three pours, in such a way that it shall give a final wash all over the inside, to insure smoothness and uniformity in the lining—an operation which requires great practice and dexterity. The outside is coated with japan, after which the goods are placed in a steam-heater oven raised to a sufficient temperature to dry the varnish without melting the tin.

The spouts of kettles are cast on, the core having been made separately; but the handles are made of wrought iron, and attached by rivetting. Frying-pan handles are bent out of sheet iron, so as to be hollow, and therefore, to a certain extent, non-conducting of heat. Saucepan handles are also bent out of sheet iron, as formerly; but an improvement has been introduced in casting, on to their larger or outside end, a ring of metal which prevents any gaping at the seam liable to pinch the hand in use. In some cases the handle is fitted to the saucepan by a socket, being securely locked without a rivet. Lids or covers are sometimes cast; but, for the most part, they are made of tin-plate. The blank is dished and flanged, sometimes to the depth of 1½in., between dies at one stroke of a steam press, this firm having been the first to make covers stamped out of a single piece of metal at one stroke, without seam or rivet. The rough edge of the flange is then cut off to gauge by a pair of revolving disc cutters, the cover being chucked in a special lathe. It is then again placed in a

steam press, when a single stroke produces a rim which rests upon the saucepan edge, to prevent the cover from slipping in. Formerly this rim was soldered on; but the present arrangement makes a more durable job. The edge of the flange, left raw and sharp from the press, is now cut off square by revolving disc cutters, when the cover is again chucked in a lathe—an instantaneous operation—and held by a forked lever or clamp, when the tool box is fed up by a quick screw. The box carries an upright fork, on one branch of which are a pair of rollers for thinning out the edge, and on the other a grooved roller for twisting it completely over. This is a very ingeniously designed tool, as the two rollers are made to close and separate; and the grooved roller swivels for turning the edge over.

Small castings are finished by being chucked in lathes, a rod in the poppet of which is made to advance quickly by a lever to bore and if necessary screw the hole, while the outside is turned by hand, or by means of a slide rest. The company has brought out a well-finished dumb-bell, with blind cord wound round the handle and secured at the ends by wooden pegs driven tight into holes. Cast iron hinges are made by casting one portion—that with two sockets—separately, inserting the pin, and then dipping the joint in oil and afterwards in finely ground sand. The remaining portion is then cast on to the former, the sand taken up by the oil preventing adhesion of the metal in those portions.

MESSRS. J. H. HOPKINS AND SONS' TIN AND IRON PLATE WORKS, BIRMINGHAM.

At these works, which, unfortunately, are far from running at their full capacity, are produced such articles as milk-setting pans, dish-covers, and wash-basins. Where the shape will permit, the goods are stamped from sheet iron under drops, of weight varying with the size of article to be produced. Those for small goods are worked by belt and drum, which winds up a chain and so raises the "hammer" enclosing the "force," or top die, a trigger releasing it at the desired moment. What is called the "die" is fixed in the anvil, which, in the larger sizes, is laid upon an extensive foundation of fir balks and concrete. The larger sizes of drops are worked directly by a steam piston in a single-acting cylinder, pulling the chain over a pulley, and thus raising the hammer with its "force." Generally two, but sometimes three, articles are stamped together, being subjected to two or three blows during one operation, that is to say, while being drawn out to a certain extent towards their finished form. Circular goods, like milk-setting pans, are given part of a turn horizontally in the die before each blow; and two rectangular dishes with rounded corners are stamped together, being turned end for end, and also one on the top of another before each blow, in order, doubtless, to ensure uniformity in the stamping. While the die in the anvil is made the whole depth of the finished article, and serves for all the successive stampings, the force, or top die, is changed at every operation, each one being deeper than the last, until the desired depth is obtained. The number of stampings, which may be as few as two, or as many as six, depends on the depth of the finished article. A steam press has been erected for pressing out most articles at a single stroke instead of by the successive blows of the drop; but this is not at present in operation.

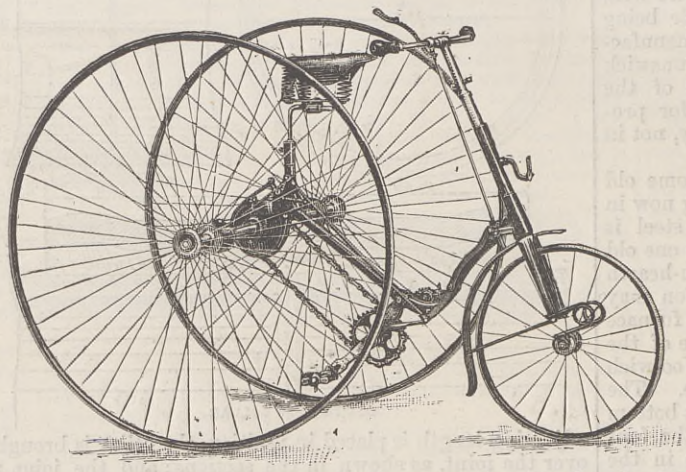
The sheet iron article, thus stamped or pressed, is now immersed in a bath of sulphuric acid to remove the scale, which comes away in the form of red oxide on the goods being placed loose in the annealing oven and raised to a dull red heat. They are then tinned or japanned, according to destination; but a new method of finishing, admirably suited to the æsthetic tendency of the age, has been invented by Mr. Alfred Hopkins, by which a dead granulated surface is produced resembling morocco leather. In this process the goods are coated with oil paint, neutral or semi-tints being generally selected, and, while still wet, are subjected to the action of a roller coated with some flexible composition, or are simply dabbed with a piece of rag in places where the roller cannot act. This draws up the paint in a regular manner all over the surface, producing a very pleasing effect when relieved by transfer or stencil decoration. Baking in an oven at a low heat, as in japanning, suffices to harden and fix the coat.

The fixing of tin bottoms to ordinary earthenware plates, for forming hot-water plates, is a process in which great ingenuity is exercised. The tin blank is flanged in a press; and the edge, trimmed square by a pair of revolving disc cutters, is then drawn out by hand hammer on an edge stake, though it might be done in a machine, as described in connection with Messrs. Kenrick's works. After the edge is thus drawn out to receive the earthenware plate, the casing is chucked in a lathe, when the plate is inserted, being kept in position by a wood block brought up to the smooth face, and over which it slides while the plate and casing revolve together. The thinned edge of the casing is then gradually turned over the edge of the plate by a blunt hand-tool. The rings are made by twisting wire, by means of a crank handle, on to a bar of the required triangular section, thus producing a continuous spiral. Each separate turn is then cut off by cutting pliers, and the larger side inserted in the tin socket, which is soldered on to the casing.

COVENTRY MACHINIST COMPANY'S CYCLE WORKS.

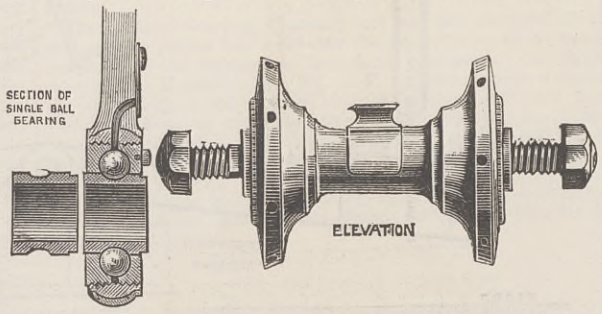
The most interesting portion, from an engineer's standpoint, of yesterday's—Thursday, 9th—British Association excursion to Coventry, was the visit to the Cheylesmore Works of the Coventry Machinists Company, which employs from 400 to 500 hands. This company originated in the European Sewing Machine Company, founded in 1860, to start a fresh manufacture which should, if possible, relieve the distress which prevailed among the ribbon weavers. The starting point of the cycle manufacture was the asking a price for 500 bicycles by Mr. R. B. Turner, of Brussels, from his uncle, Mr. Jos. Turner, who was then manager of the company. At first, the directors were indisposed to incur the expense of making the necessary tools, believing that the craze, as they deemed it, would soon die out. However, they were at length persuaded to accept the order, and thus Coventry became the seat of the cycle trades. The modern bicycle, made almost entirely of steel, is composed of about 500 different parts, which require as careful manufacture and fitting as a first-class rifle.

The annexed illustration shows the latest machine brought out by the company for the present season, in the Marlborough Club tricycle, the distinguishing features of which are the springs introduced under the saddle and between the fore-wheel and the steering fork, for lessening shocks and deadening vibration in going over rough ground. Another improvement is that by means of a hinge neck, which consists of a disc slipping in a ring so as to form a joint, the steering fork may be brought from



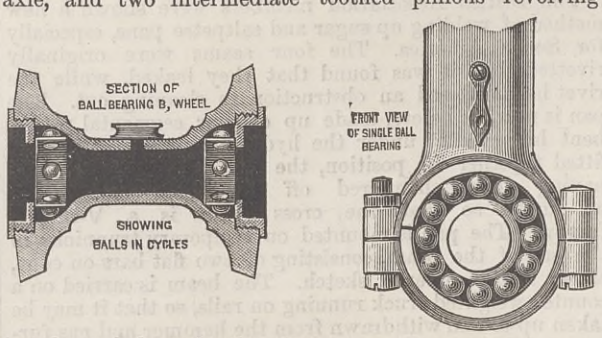
its normal position, as shown in the engraving, to the vertical, for permitting a lady to mount without soiling her dress against the wheels, the fork being afterwards securely locked in position by a bolt, rod, and handle. For lady's use also the chain is enclosed in a light guard of wire gauze. The brake is controlled by hand or foot at option, and all working parts except the pedals are fitted with the adjustable ball bearings described and illustrated below.

A French satirist has described the wheel-man as "*un fou à deux roues*," and the wheel is decidedly the principal feature in the machine, whether "bi" or "tri," as they are distinguished in shop parlance. We will therefore begin our description of the manufacture by the wheel. The hub or nave is received in the form of a "stamping" of special steel, which is bored and turned in a lathe, and then drilled and screwed to receive the spokes. For being drilled, it is held between the centres of a carriage that can be slewed horizontally, so as to be out of square with the bed. The bit is brought up to drill alternate holes successively by a lever, the depth of hole being regulated by an adjustable stop. The carriage is then slewed in the



other direction, and the remaining holes are drilled, this arrangement being necessary on account of the setting out of the spokes from the rim to the hub, for the sake of strength. The rim is similarly drilled by being held in a revolving frame, the axis of which is a little out of vertical, the holes in the hub being subsequently tapped rapidly by a revolving tap, the hub being held either in the hand or in a machine reversed by a pedal.

The above section and elevation show a finished "dust-proof" hub for a back wheel, provided with adjustable ball bearings, which reduce friction to a minimum. In modern tricycles a stamped and turned "bell," or gear box, is added to the left-hand wheel, for permitting play in going round curves. The bell encloses double driving gear, consisting of two toothed wheels fast on the axle, and two intermediate toothed pinions revolving



loosely or independently. Below are shown the "single ball"—or rather single row of balls—bearing for the small wheel suspended from the "fork."

Steel for the rims or felloes is received in straight bars of a crescent section; and in the modern machine this is also made hollow for the sake of lightness. The bars are bent to a circular form in a hand machine of the tire-bender class, solid rims requiring only one pass, but hollow rims five, the bending being started by a guide roller, and the top roll of the three being set down a quarter turn of a screw after each pass. The ends of the rims now probably overlap one another, so they are cut off to length, thinned out by emery wheels, or scarfed in the case of hollow rims, and brazed. The finished rim is then tried on a cone for circular truth, and on a face-plate for straightness, and made perfectly true in every respect.

Spokes are received in the form of coils of wire or bundles of steel wires, which are cut to dead length, headed, upset at one end, and screwed, generally by girls. There are several methods for attaching spokes to the hub and rim. The tangential arrangement, which would appear to possess great advantages as regards strength, does not appear to be adopted in the newest machines; in that case the headed wire was passed through the rim, screwed tangentially through the hub, and then screwed again into the rim on the opposite side, so that, if one spoke became broken, it was necessary to renew two. The most usual method now seems to be to head the spokes where they join the rim, and screw them radially into the hub. The heading is done in a belt-driven horizontally working machine like that for making wire nails, but not revolving so quickly. The end of the wire is inserted between two jaws brought together by a lever and an excentric. The operator seizes the right moment of the stroke, pushes the end up to a gauge, and quickly brings the clamps together. The advancing punch, with trun-conical head, pushes aside the bevelled gauge, which works vertically on a pivot, and then makes a head on the softened end of the wire. The other end is either upset in a similar manner, or receives a separate ferrule to give greater substance to the screwed portion. Sometimes, again, when the end itself is screwed, a separate tapped "nipple" is screwed down against the hub over the spoke already screwed in the holes. In any case the spokes are all in uniform tension, so that the wheel, though light, is very rigid. It is run round on a frame so as to make sure that it is true and perfectly balanced, and then it receives the tire. This is an endless band of india-rubber, of circular section, put on with as little tension as possible, so as not to favour cutting and gaping on its encountering sharp stones. The inside is provided with longitudinal corrugations, so as to present a larger surface to the cement with which it is attached; and tires have now lately been made with longitudinal corrugations on the outside, so as to counteract side slip in wet weather. The inside of the tire is further roughened on a revolving disc covered with wire cord for affording an additional hold to the cement. The latter is applied by a small wheel with semicircular rim fitting the groove of the cycle wheel and revolving on an axis in the pot containing the cement kept hot by a gas fire.

The cement dries, on cooling, almost instantaneously, when the rubber tire is slipped on, and the wheel hung for a second or two in an oven, which again melts the cement, thus completing the joint.

Steel tubes for the frame are received in straight lengths; they are cut to length, and bent in dies and on wood, being filled with sand, and the ends being plugged up with wood. The front fork sides are tapered and flattened in olivers and sometimes longitudinally corrugated in a press, and finished by grinding and emery glazing. They are brazed on to the head and on to the bearing cases that take the axle of the front wheel. The head of the back fork for a newly-patented safety bicycle that carries the crank shaft and chain wheel must be a most awkward piece to stamp, as it has four branches. Handle bars are bent to gauge out of round steel, solid or tubular, by smiths in ordinary fires. The crank bearing brackets for tricycles, received in the form of stampings, are fitted up at the works. Cranks, now made detachable to facilitate their renewal if bent or broken, are stamped out of a specially tempered steel, their key-ways being cut by a small shaping machine. Pedals are made of steel with rubber treads.

The shops are remarkably clean, light, and airy. There are two machine shops, one exclusively for bicycles and the other chiefly for tricycles, all tools being made at the works. For drawing out steel, and for forgings of any considerable size, a drop hammer is employed. The drop is suspended from a band passing over a revolving pulley, which slips until the band is tightened by pulling on to it, when it lifts the drop, which is allowed to fall by releasing the band. All the parts are carefully examined at every stage, especially before being put together, and the finished machine is also tried and tested in every way before being finished by painting and nickeling. The coat of black paint is dulled with pumice powder and water, so as the better to receive the coloured lines, put on by hand with great exactitude, after which a coat of varnish is given. Bright parts, to be nickel-plated, are first washed in potash to remove the grease, and then immersed for a couple of minutes in a copper bath, because nickel will adhere more readily to copper than to steel. After the copper surface is cleaned with pumice powder, the part is immersed in the nickel bath for two hours, spokes being hung, several together, in a frame. The current for the electro-deposit is generated by three dynamos, one by Elmore and two by Carlyle. The warehouse offers an imposing sight, with its vista formed of four long rows of cycles finished ready to be sent away.

ROBERT MOLE AND SONS' SWORD AND MATCHET WORKS, BIRMINGHAM.

A "matchet" is a cutting instrument for gathering in crops, especially that of sugar cane, and generally resembles an Eastern sword in form, being wider at the lower end than near the handle, and having the cutting edge more or less rounded. It is the universal cutting tool in Central and South America and the West Indies; and each State has its own separate pattern, differing perhaps but very slightly one from another, but which must be rigidly adhered to in executing an order. The present head of the firm, Mr. Frederick Mole, has so large a collection of templates, and his men are so accustomed to making the various forms of matchet, that he is *facile princeps* in the trade. Moreover, by careful supervision he ensures a high quality; and all forging operations, both of swords and matchets, are performed day-work, grinding and finishing only being executed piece-work.

No inquiry is made as to the history of the steel bars obtained from Sheffield for making matchets. They arrive

system varies in a somewhat erratic manner with the span; sometimes one and sometimes another determines the maximum. Hence the determination of the greatest load to which a bridge may be subjected in the manner directed by the rules leaves a considerable opening for error, and affords an excellent example of the insufficiency of any rules, however perfect, to relieve the engineer of a large amount of responsibility. The origin of the rules may be traced in the parliamentary reports of the Board of Trade and of the Railway Commissioners, who, from 1846 to 1851, exercised the powers of the Board of Trade with respect to railways. From these reports it does not appear that previous to 1849 the inspecting officers had a defined rule for the strength of bridges, either of wrought or cast iron. In 1847, however, a Royal Commission was appointed in the following terms:—"To inquire into the conditions to be observed by engineers in the application of iron to structures subject to violent concussions and vibrations," and "to endeavour to ascertain such principles and to form such rules as may enable the engineer and mechanic to apply the metal with confidence, and to illustrate by theory and experiment the action which takes place under varying circumstances in iron railway bridges which have been constructed." The terms of this Commission clearly indicate that the interest of the engineer was to be studied as well as the safety of the public. The Commissioners were Lord Wrottesley, then president of the Royal Society; the Rev. Robert Willis, M.A., an eminent mathematician; Captain Henry James, of the Portsmouth Dockyard; and three civil engineers, Messrs. George Rennie, William Cubitt, and Eaton Hodgkinson. After examining the leading engineers and ironfounders of the day as to their experience and practice, and making numerous and elaborate experiments, the Commissioners reported that "legislative enactments which would fetter scientific men in the development of a subject as yet so novel and rapidly progressive would be highly inexpedient."

They, however, made certain recommendations with respect to cast iron bridges, which are substantially the same as the present rule for cast iron structures:—That the breaking weight should be six times the moving load, added to three times the dead load. They also made a further recommendation, applicable to all elastic horizontal bridges, that provision should be made for the increase of strain in bridges under 40ft. long, when subject to a rapidly moving load, as indicated by the increased deflection in such cases—a recommendation which until recent years was lost sight of. These recommendations were, immediately upon the publication of their report, embodied by the Railway Commissioners in a circular letter of instructions to their inspecting officers. On the day following the date of this letter Captain Simmons inspected the Torksey Bridge, a wrought iron box girder bridge, of two continuous spans of 130ft., designed by Mr.—now Sir John—Fowler, and objected to it as of insufficient strength. Its rejection was discussed by the Institution of Civil Engineers, and the Railway Commissioners were accused of applying to wrought iron the recently published recommendation of the Commission on Iron requiring a factor of six for cast iron bridges. At the same time, a lengthy correspondence took place between Mr. Fowler and the Commissioners, and Captain Simmons decided—after the examination of such examples as were available—that the bridge should be strengthened, so that the strain should not exceed five tons per square inch. In fixing this he admitted that there was no decided authority upon the subject, and that the variation in the circumstances of the construction of bridges prevented the application of an invariable law. He recognised as a principle the variation of the admissible strain in a bridge according to the proportion of live to dead load, a point which has been recently revived. In the end—after a special examination to test the continuity of the spans—the bridge was accepted with a strain, under the most favourable estimate, of slightly over six tons per square inch.

Between 1850 and 1858 the rule for cast iron bridges appears to have found general acceptance, while there is conclusive evidence of the absence of a defined limit for the strain in wrought iron structures. In 1858 a wrought iron tubular girder bridge over the Spey was brought before Captain—now Sir Henry—Tyler some time before its completion, and a lengthy correspondence ensued between Captain Tyler and Mr. Fairbairn with reference to its strength. This correspondence Captain Tyler laid before the Board of Trade, who on 30th March, 1859, issued a circular letter of instructions, fixing 5 tons per square inch as the proper limit of strain for wrought iron. Upon this Captain Tyler based his rejection of the bridge on the 30th April. It is very important to note that this rule was explained at the time by Captain Tyler to represent a factor of safety of four for combined moving and dead load. It has not since been altered, and in practice it is assumed to be applicable to all wrought iron, whether the quality be good or not. Among the numerous considerations suggested by the survey—after the lapse of over twenty-five years—of the period of which a brief sketch has been given, the most striking is the confirmation which experience has given to the conclusions of the Commission of 1847. Derived from the interpretation by skilled mathematicians of the results of experiments conducted by practical engineers, combined with the evidence of the ablest engineers of the time, their conclusions were based upon a solid foundation of fact and experience. Their recommendations, although jealously resented by civil engineers at first, notwithstanding the avoidance of legislative interference by which freedom was secured for the development of engineering science led, under the judicious interpretation of the inspecting officers, to the present rule for cast iron structures. This rule is good in principle because it derives the load—and consequently the stress—to which the structure may be subjected, from the actual strength of the material. The present rule for wrought iron has no such foundation, and it is indeed only due to the high professional attainments of the inspecting officers, and the sound judgment and great moderation with which they dealt with the difficulties which naturally arose when wrought iron first became generally used, that the present rule, introduced without special experimental research, has endured so long that it has obtained the sanction of what to younger engineers at least is an immemorial usage, taken for granted and stereotyped beyond reach of improvement. Its principal fault is in allowing a fixed limit of stress without regard to the quality of the material. This does not lead to serious results so long as the limit of five tons per square inch is understood to represent a factor of safety of four applied to iron having a breaking strength of not less than twenty tons, as explained by Captain Tyler in 1859; but it must not be forgotten that the rule itself is used by many who do not know its origin, and the absence of any stipulation as to the strength of the material leads naturally to the assumption that five tons represents the safe working stress for any quality of iron in the market, and many inexperienced engineers do so interpret and use it. It is hardly necessary to state that there are many qualities of iron for which such an assumption would be attended with considerable danger, but it is not so apparent that a bridge made of utterly untrustworthy material might not, under the ordinary tests, afford any indication of its insecurity. Such is, however, the case, and the safety of the public depends in this respect very much more upon the choice of a suitable material by the engineer than upon the Board of Trade rule. A fixed limit of stress without regard to the quality of the material also restricts the engineer in the development of economic design in the direction of a greater use of better material, such as angle and bar iron of superior strength and ductility. Nor does a fixed stress offer any inducement to the manufacturer to improve the quality of plates. These considerations apply with much greater force to the present rule for steel. As a material, steel is much more variable in its strength than iron, which renders the application of an invariable coefficient more objectionable. It is true that the Board of Trade, in accordance with a recommendation of the Committee of 1877, appointed at the instance of the British Association, allow in special cases the use of steel with a higher stress, but exceptions of this nature are naturally ill-adapted to the design of bridges of ordinary spans. The rules cannot be regarded as suited to the nature of the material, and there can be little doubt that they have operated to hinder the application of steel to uses for which it is admirably suited, and have thus exercised a prejudicial effect upon one of the leading industries of the present day. Unless the rules which determine limiting stresses or coefficients for iron and steel can be brought into conformity with modern knowledge of the properties of materials, and of the laws by which their application to construction should be regulated, their entire abolition would be preferable, because it would conduce to the advancement of engineering science, and the development of the bridge-building industries. The safety of the public need in no respect be compromised by the abolition of the limiting stresses, if the rules requiring the engineer to certify the quality of the material used were retained—and extended to apply to iron as well as steel—in order to provide the inspecting officer with all the information requisite to enable him to judge whether the stress to which a structure was subjected was within safe limits. Freed from the deadly influence of the fixed coefficients, private enterprise would establish standard rules for the determination of the stress to which different materials under varying conditions might safely be subjected, to the great advantage of the professions and trades interested in bridge-building, and having in future to compete with the Americans. On the other hand, there are many objections to such a course, which would practically amount to a reversion, after the experience of thirty years, to the condition of 1850. It is also to be feared that, during the time which must necessarily elapse before any rules obtained the sanction of a common assent, differences of opinion, causing much inconvenience, would probably arise between civil engineers and the inspecting officers of the Board of Trade—which is much to be deprecated. A course more worthy of the scientific attainments of English engineers would be the amendment of the rules, so that, while leaving to the engineer the greatest possible freedom in the choice of design and material, and leaving in his hands the responsibility for the correct determination of every effect of the loading of a structure which the most modern methods render calculable, they should determine for his guidance, by coefficients based upon experience, or, where practicable, upon experimental research, the proper allowance to be made severally for each of all those effects which are usually understood to be covered by the present arbitrary factor of safety. Rules so designed could not fail to exercise an elevating effect on the professional knowledge and skill of engineers by affording a more distinct conception of the effects for which the factors of safety provide, and by abolishing the use of coefficients of which neither the origin, scope, or intent are known to the user. The division of the factor of safety into many separate coefficients, some of which would vary with the quality of the material and character of the workmanship, would encourage good workmanship and the use of materials of a high class without restricting the use of materials of a lower class and less perfect workmanship for purposes to which they are adapted, and would thus be in the highest degree beneficial to the manufacturers' interest. These results can hardly be attained otherwise than by rules framed upon the recommendations of a Royal Commission who could bring to their aid the experience of the inspecting officers and of the leading engineers and manufacturers, and institute special experimental research to elucidate any doubtful questions. Such a Commission would indeed be but a revival of that of 1847 to complete the work which the former Commissioners were compelled to abandon in 1849 because the application of wrought iron to engineering structures was yet in its infancy, and steel in its modern form unknown; and the scope of their enquiry could hardly be better defined than in the terms of the former Commission. The draft rules appended have been prepared to show that the views above expressed are capable of taking a practicable form and to render more easily apparent the advantages claimed for them.

APPENDIX.

ABSTRACT OF SUGGESTED RULES FOR THE CONTROL BY THE BOARD OF TRADE OF THE DESIGN OF STRUCTURES OF WROUGHT IRON AND STEEL.

NOTE.—The formulæ and numerical values inserted in italics are intended merely as suggestions of theories requiring further investigation for their establishment, or as estimates of the values which experimental research or experience would assign to the various coefficients.

RULE 1.—Structures of wrought iron or steel to be so proportioned that the calculated stress in any part due to the weight of the structure, together with the moving load set at rest upon the structure, shall not exceed that specified under Schedule D. Stresses due to wind alone not to exceed *1·5* times, and stresses due to the combined effect of wind and load *1·25* times, the specified stresses.

RULE 2.—Provision to be made for moving loads upon main girders, platforms, and bracing, according to Schedules A, B, and C.

RULE 3.—All structures to be designed to resist lateral forces, including not less than *30* lb. per square foot for wind pressure. In lofty or exposed situations greater allowance to be made for wind.

RULE 4.—Engineer to certify both for iron and steel that the material used is, in his opinion, suitable for the purpose to which it is applied, and to supply a statement of all the tests to which it has been subjected, including in all cases those required for the determination of the working stress under Schedule D.

SCHEDULE A.

Equivalent uniformly distributed load for designing girders of which the cross section is varied; based upon the formula

$$w = 1{\cdot}60 + \frac{25}{S},$$

in which S = span in feet, and w = load in tons per lineal foot for one track estimated to produce at any point in a beam a moment of flexure equal to or greater than that produced by any arrangement of the heaviest engines and boiler trucks.

Span	8	10	15	20	30	40	50	60	80	100	Feet.
Load	*4·72*	*4·10*	*3·27*	*2·85*	*2·43*	*2·25*	*2·10*	*2·02*	*1·91*	*1·85*	Tons per ft. run.

SCHEDULE B.

Equivalent uniformly distributed load for designing bridges of uniform section and depth, based upon the formula:

For spans under 12ft. .. .. .. $w = \frac{36}{S}$

For spans of 12ft. and upwards $w = 1{\cdot}60 + \frac{25}{S + 5}$,

in which w = load in tons per lineal foot for one track estimated to produce a maximum moment of flexure equal to or greater than that produced by any arrangement of the heaviest engines and boiler trucks.

Span ..	8	10	15	20	25	30	40	50	60	Feet.
Load ..	*4·50*	*3·60*	*2·85*	*2·60*	*2·43*	*2·31*	*2·16*	*2·05*	*1·99*	Tons per ft. run.

SCHEDULE C.

Table of the greatest "panel" or cross girder loads derived from the formula:

For panels over 6ft. in length .. $W = 1{\cdot}60\,P + \frac{25}{2 + \frac{5}{P}}$,

in which W = panel load in tons for one track, and P = length of panel in feet.

Length of panel (P).	0 to 5	6	8	10	12	20	25	Feet.
Load (W)	*18·0*	*18·4*	*22·3*	*26·0*	*29·6*	*43·1*	*51·4*	Tons.

The above represents the maximum load on a single panel, but the greatest mean load on N consecutive panels might be taken as

$$W = 1{\cdot}60\,P + \frac{25}{N + 1 + \frac{5}{P}}.$$

SCHEDULE D.

Admissible stress in wrought iron and steel under varying circumstances.

I.

In cases where the material is subject to stress of one character only.

(*a*) Limited working stress under any conditions

$$a = \frac{t}{N\,C},$$

in which a, is the greatest stress to which the material may be subject under any conditions of loading;

t, the ultimate tensile strength of the material determined by experiment;

C, product of all the tabular coefficients of safety (p. 4 *post*) applicable to the particular case;

N, a coefficient intended to ensure that the greatest actual stress, in the extreme case of the coincidence of all the conditions detrimental to the resistance of the material, represented by the tabular coefficients, shall not reach the limit of elasticity.

	N.
For wrought iron	*2·25*
For steel, tensile strength under 30 tons per sq. in.	*2·00*
,, ,, ,, 32 ,,	*2·04*
,, ,, ,, 35 ,,	*2·11*
,, ,, ,, 40 ,,	*2·22*
,, ,, ,, 45 ,,	*2·35*
,, ,, ,, 50 ,,	*2·50*

As it is of the utmost importance that steel should be uniform in strength, if the greatest tensile strength when tested exceed the least by more than 15 per cent., the limiting stress shall be reduced.

Percentage of variation in tensile strength	16	20	30	40	50 or more
Percentage by which the limiting working strength should be reduced (arbitrary)	1½	7½	22½	37½	50

(*b*) Ductility required in order that any material may safely be subjected to the limited working stress (a) *to vary with the proportion in which the stress is caused by a varying or live load; and may be determined from*

$$\delta = 50\,(1 - \phi),$$

in which δ *is percentage of contraction of area of fracture under tensile stress, and* ϕ *(as in the Launhardt-Weyrauch formulæ) denotes ratio of constant to total load.*

ϕ =	*1·00*	*0·80*	*0·60*	*0·50*	*0·40*	*0·30*	*0·20*	*0·10*	*0·00*
$1 - \phi$ =	*0·00*	*0·20*	*0·40*	*0·50*	*0·60*	*0·70*	*0·80*	*0·90*	*1·00*
δ =	*0*	*10*	*20*	*25*	*30*	*35*	*40*	*45*	*50*

Materials which do not exhibit the ductility required by the conditions under which they are strained are only to be subjected to a stress $b = a\,k$, *in which* b *is the admissible stress in a material of which the actual contraction of area is* Δ, *used under conditions of loading for which the required ductility is* δ, *and* k *is a coefficient derived from the empirical formula*

$$k^{\frac{2}{k}} = \frac{\Delta}{\delta}.$$

Table of Values of k.

Ratio of actual to required ductility. $\frac{\Delta}{\delta}$	*Ratio of admissible to limiting stress.* k	$\frac{\Delta}{\delta}$	k	$\frac{\Delta}{\delta}$	k
		0·70	*0·859*	*0·35*	*0·694*
1·00	*1·000*	*0·65*	*0·836*	*0·30*	*0·667*
0·95	*0·976*	*0·60*	*0·813*	*0·25*	*0·640*
0·90	*0·950*	*0·55*	*0·790*	*0·20*	*0·612*
0·85	*0·928*	*0·50*	*0·766*	*0·15*	*0·578*
0·80	*0·905*	*0·45*	*0·743*	*0·10*	*0·537*
0·75	*0·882*	*0·40*	*0·719*	*0·05*	*0·483*
				0·00	*0·000*

II.

In cases where the material is subject to tension and compression alternately.

The admissible stress to be less than when subject to tension or compression alone, *and may be determined from the formula*

$$b^1 = b_o\left(1 - \tfrac{1}{2}\frac{Max\ B^1}{Max\ B}\right),$$

in which b^1 *is the admissible stress in a bar subject to alternate stresses of which Max* B^1 *is the numerically lesser and Max B the numerically greater, and* b_o *the admissible stress in the material for* $\phi = 0$. *This expression is derived from that of Dr. Weyrauch by substituting for the coefficient, derived from the primitive strength of the material by an arbitrary factor of safety, the value of* b_o *determined by the preceding formula with respect to the ductility of the material.*

TABLE OF COEFFICIENTS OF SAFETY.

I. For vibration shock and other dynamic effects. *For wrought iron or steel, minimum 1·33 for structures over 25ft. span, for 20ft. span 1·42, for 15ft. span 1·60, for 10ft. span 1·75.*

II. For unequal distribution of stress and secondary stresses. *Minimum for wrought iron 1·20, for steel 1·40. Additional for bracings generally:—In pin-jointed structures 1·05, in rivetted structures where the breadth of bars is less than 1-12th length of bay or depth of girder, depth of girder is greater than 1-8th span, and bars are not joined at crossings 1·10 In rivetted structures otherwise 1·15. Additional for steel plate girders 1·10.*

III. For ambiguity of stress or failure of continuity. *Minimum 1·00. For ambiguous systems of bracing 1·33, for continuous girders generally 1·16.*

IV. For errors in design and workmanship. *Minimum 1·03. Additional for punched holes:—In iron plate girders 1·05, in iron framed structures 1·15, in steel plate girders 1·15, in steel framed structures 1·30.*

V. For irregularities in section and rusting generally *1·03.*

(Product of minima coefficients for iron *1·70*; for steel *1·98*)

The specified coefficients of safety are not intended to include provision for increase of stress due to an obvious want of symmetry in the attachments or section of members, bending stress due to their weight, or liability of struts to buckling; these and other calculable additions to be made to the stresses estimated from external loading.

In the case of solid beams or plate girders the admissible stress to represent the extreme fibre stress, accepting the ordinary theory of bending.

Experimental determination of resistance to flexure is recommended in the case of solid beams of unusual section.

For solid round pins the extreme fibre stress may exceed the specified stress by *33 per cent.* in iron and soft steel, and *20 per cent.* in hard steel.

Shearing stress in general to be taken as *4-5ths* the admissible tensile stress in the same material, but when of different materials the shearing strength of rivets and pins to be based upon the strength of the materials of which they are made.

Coefficients applicable to members joined to be applied to joints.

Pressure on bearing area not to exceed *1·5* times the admissible tensile strength of the weaker material, whether of rivet, or pin, or that in which the hole occurs.

A NEW COKE OVEN.—A telegram from Birmingham, Ala., August 15th, says:—Advices from the Platt mines state that work on the coke ovens goes on with unabated activity. There are more than 100 nearly half done and a few almost finished. In these ovens is introduced a new feature, which, if reliable, will be a great advantage in coke making. Mr. J. H. Harris, the foreman of the works, has introduced it, and it is an invention of his own. Hitherto the flue in all coke ovens has been upward, but he has reversed this order, and makes this downward. This gives more intense heat, and the resulting difference is said to be in the length of time required to make coke. By the upward flue it can be made in forty-eight hours, and by the latter in twenty-four, just one-half. This is not the only advantage of the new feature. Underneath the new ovens there is a long archway to receive all the heat given off from the ovens, which, if conveyed properly, can be utilised in running machinery, thus applying a force which has up to this time been wasted. A sufficient amount of heat can be obtained from several hundred ovens to run a great deal of machinery. Twelve of the ovens are made according to this new idea, and if the test with these proves satisfactory, and its merits are shown conclusively, it will no doubt be utilised very extensively in all future coke oven building.—*American Manufacturer.*

ROBSON'S PATENT GAS HAMMER.

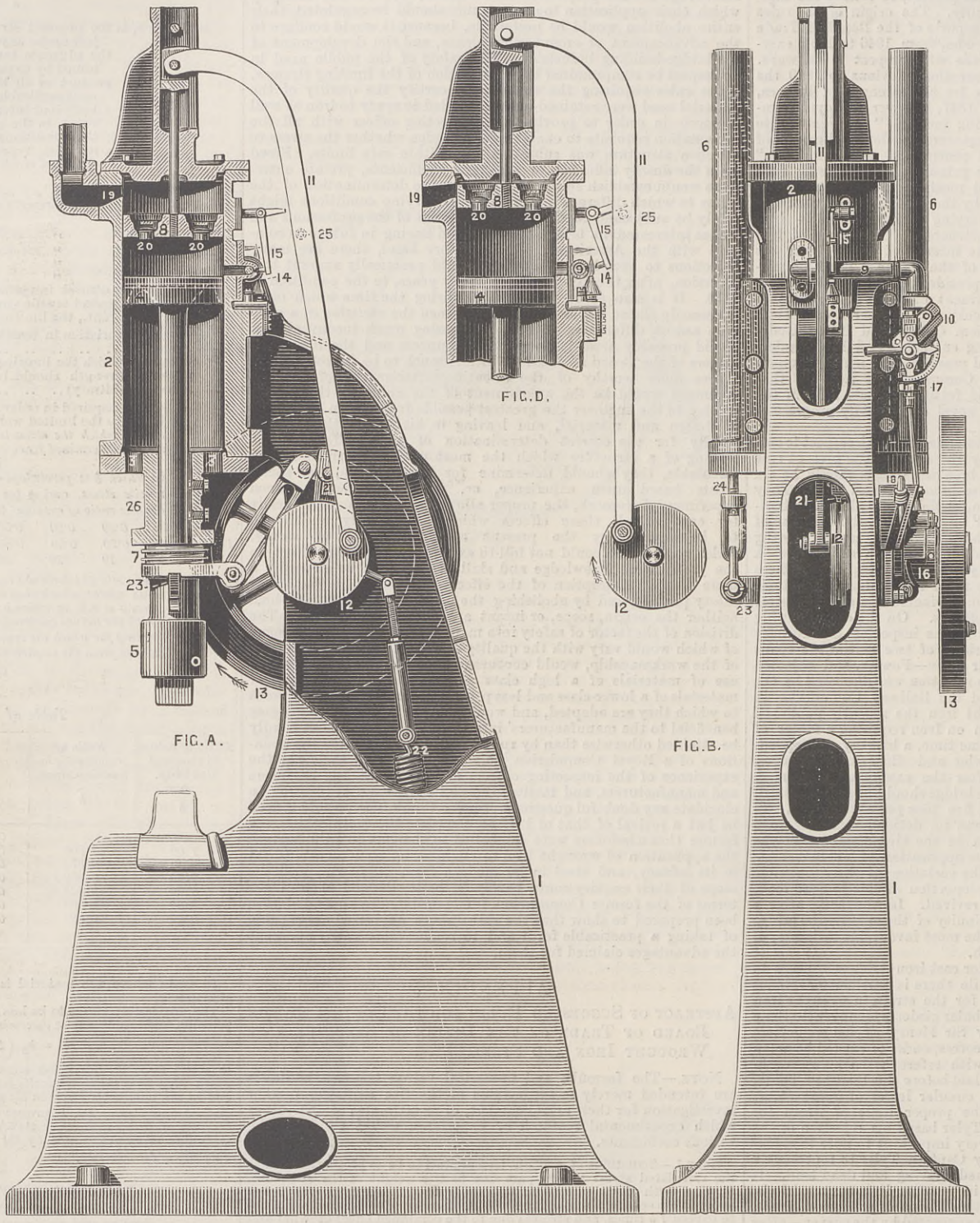
MESSRS. TANGYES, BIRMINGHAM, ENGINEERS.

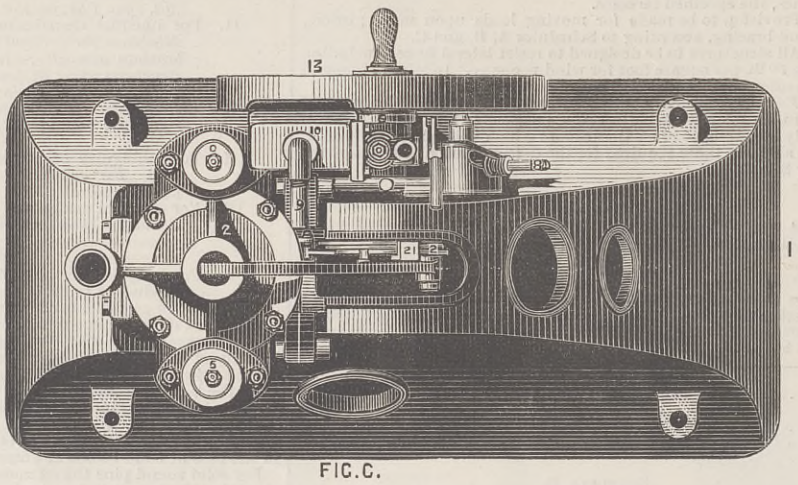
ROBSON'S PATENT GAS HAMMER.

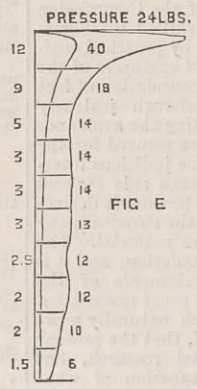
In our issue of May 29th, 1885 — page 424 — we shortly described and gave an external view of the first hammer manufactured on this principle. The apparatus was originally designed for use in circumstances where the employment of steam would be expensive, inconvenient, or impossible; but as stated in our notice, the results of trials in actual work were such as to warrant a sanguine belief that the apparatus would enter the market as a strong competitor of the steam hammer, even in places where, owing to the price of gas being very high, the conditions were altogether against it.

Since the appearance of our notice the hammer has been in some respects remodelled and its remarkable economy placed altogether beyond a doubt. The data which we are now in a position to give, and which have been furnished to us by Messrs. Tangye, are of such a character that practical men, we are sure, will be glad to be furnished with the fullest possible particulars of the apparatus. We therefore supplement our short preliminary notice of May, 1885, with the following detailed description:— Figs. A and B are side and back sections; Fig. C a plan; 1 is the pillar frame of good strong section, affording easy access to all parts attached to it; 2 is the cylinder, which is carefully arranged so that the most unskilled person may handle it without difficulty. The lower end is open to the atmosphere through holes 3, an arrangement which altogether obviates the difficulty common to most steam hammers, and which often results in the destruction of gland packing, joints, cylinder cover, &c., viz., the accumulation of water at the lower end of the cylinder. It also admits of the atmosphere flowing in and out through the action of the main piston 4, and so keeps the cylinder cool. It further allows the hammer piston to be readily taken out. The lower end of the cylinder is fitted with a suitable cover, which has a very long guide 26, and as no packing gland is required, this can be used to great advantage in dispensing with side and other guides; 4 is the main piston, which is made of the best hammered iron and is hollowed out at the lower side to allow the atmosphere to play upon it and also to reduce the weight; 5 is the hammer head, which is also made of best hammered iron, the lower end being bored to receive any tool that may be required. It is fitted with a cotter for holding tools in exact position. The main piston 4 is secured to the hammer head 5 by means of the long cross-bar 23, at each end of which is connected a shackle attached to the round bar 24, which passes through volute springs 6, the function of which is to raise the hammer head 5 to its highest position against buffers 7. The springs are made of the best drawn flat steel, which, when coiled, makes a very durable job. The convolutions are carefully kept clear of each other, and as eight springs are used on each side of the hammer, each individual spring, it will be seen, has very little to do, indeed, after the springs are set to take the weight of the piston and hammer head 5. The extreme movement on each is only $\frac{3}{4}$in.; and this is further reduced by the thickness of the iron on anvil when the hammer is in operation. As a matter of fact in ordinary use the movement of each spring varies, say between $\frac{3}{8}$in. and $\frac{3}{4}$in. Not a single breakage has taken place during many months' work, and in any case the cost of replacing a spring is excessively small. 8 is a displacer or charging piston, used for the purpose of expelling the exhaust gases and re-charging the cylinder with inflammable gas and air; as shown it is at half stroke, but supposing it to be at its lowest position, it then leaves a small clearance between its surface and the main piston 4. As it is moved upwards it draws a charge of gas and air into the cylinder, through the supply valve 10 and tube 9. This piston is actuated by a light connecting rod 11 attached to a disc crank 12, worked by a small hand wheel 13. When the connecting rod 11 has moved the piston 8 near to the end of its upward stroke, the projecting roller 25 being brought in contact with projecting arm on lever 15—as shown on Fig. D—raises the small valve attached to the lower end of lever 15, and uncovers a small hole in the tube 9. The continued motion of the piston 8 thus draws in the flame 14, which is always kept burning, and ignition takes place. The piston 8 has by this time reached and covered the exhaust port 19, so that the full force of the explosion is used in driving down the main piston 4. The piston now proceeds on its downward stroke, and instantly the exhaust port 19 is uncovered, the springs raise the main piston 4 to its highest position, and the exhaust gases are driven through the passages and valves 20 in piston 8, and out at the exhaust port 19. The pistons 4 and 8 being brought to their nearest positions and all exhaust gases being expelled, piston 8 commences to re-charge the cylinder. The force of the blow can be varied by means of the inclined cam 16 on the hand-wheel shaft, which opens the gas supply valve at any desired point in the stroke of the piston. By this means very light blows can be made to immediately follow those of the heaviest possible character, or can be alternated with them with the greatest accuracy. Lever 18 gives complete control over the action of the hammer, even when hand wheel is kept turning. It puts the supply valve instantly out of gear, or as quickly brings it into action, enabling the operator to miss or give any one of a series of blows. The lever and pawl 21 are for operating the hammer automatically. When the hammer head 5 strikes it takes the lever and pawl 21 down with it; the pawl thus grips the disc crank 12, and in its upward motion assisted by spring 22 attached to projecting arm of lever 21, turns the hand-wheel 13. Ordinary coal gas may be used; or, in case of the colonies, petroleum spray or vapour may be employed as the combustible fluid.

The hammer described is that known as the $\frac{3}{4}$ cwt. size, and has a cylinder of 7in. diameter, $6\frac{1}{2}$in. stroke. The maximum blow is very nearly that which would be given by a weight of 3 cwt. falling through a height of 1ft., and this can be repeated at the rate of 110 blows per minute. Fig. E gives two diagrams, one a light and the other of a heavy blow. The average pressure in the case of the latter being 15 lb. per square inch, and the cylinder having a diameter of 7in., with a stroke of $6\frac{1}{2}$in., it follows that the work done is 313 foot-pounds. The springs do slightly more work in returning the hammer head than its weight X into the movement, say, by about 6 foot-pounds, hence the work of the net blow is 307 foot-pounds. Extended test in practical smith work has demonstrated that over 2500 of the heavier blows referred to above can be given with one pennyworth of gas at half-a-crown per thousand—*i.e.*, the Birmingham price to small consumers—or over 4500 varying blows for the same consumption. This extraordinary economy will probably cause other obvious advantages of the gas hammer over steam, pneumatic, and power-driven hammers to be lost sight of, but they are many, and will occur on consideration to practical men: The absence of boilers, coals, ashes, and dirt. The readiness for work at any moment day or night. The fact that a few strokes can be made at any time at the same economical rate as when the hammer is used for a long spell. These and other advantages must in future be taken into consideration by those desirous of having the most economical, reliable, and handy tool for forge work. The hammer is well made, and the design appears to have been thoroughly considered with a view to strength and durability. It is now being shown at work at the Exhibition of Manufactures and Industries, Bingley Hall, Birmingham — Stand 125 — in connection with the meeting of the British Association.







JOHN SWAIN

CAR COUPLER INVENTION.

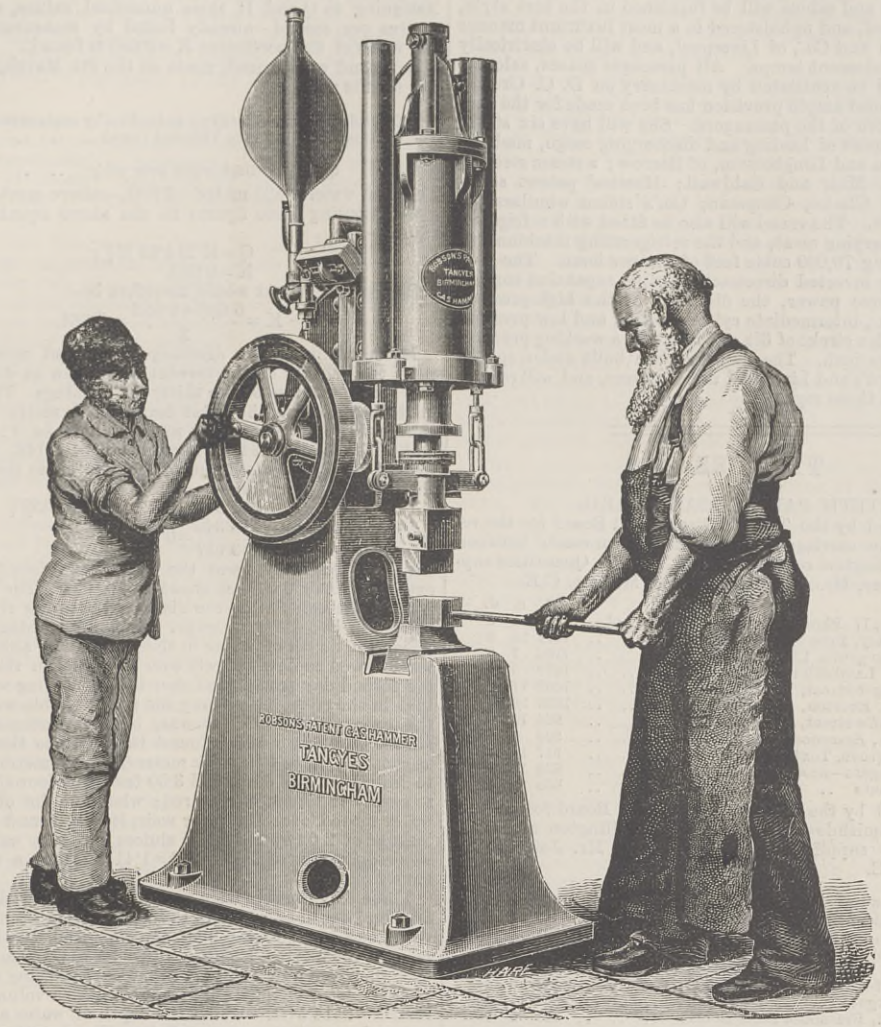
There is something almost melancholy in the ignorance of the average coupler inventor and the public generally, relative to the state of the art, the amount of work that has been done, and the number of patents that have been issued for inventions of this class.

This multiplicity has been brought about to a great extent by the casual ventilation that the matter has received in the newspapers. A great deal has been printed about the necessity of having some form of automatic coupler that will protect the trainmen from injury, and Railroad Commissioners and State Legislatures have been urged to take some action in the matter. Yet while all this was said and written not one word has been printed by these same journals regarding the requirements that must be met by the successful inventor.

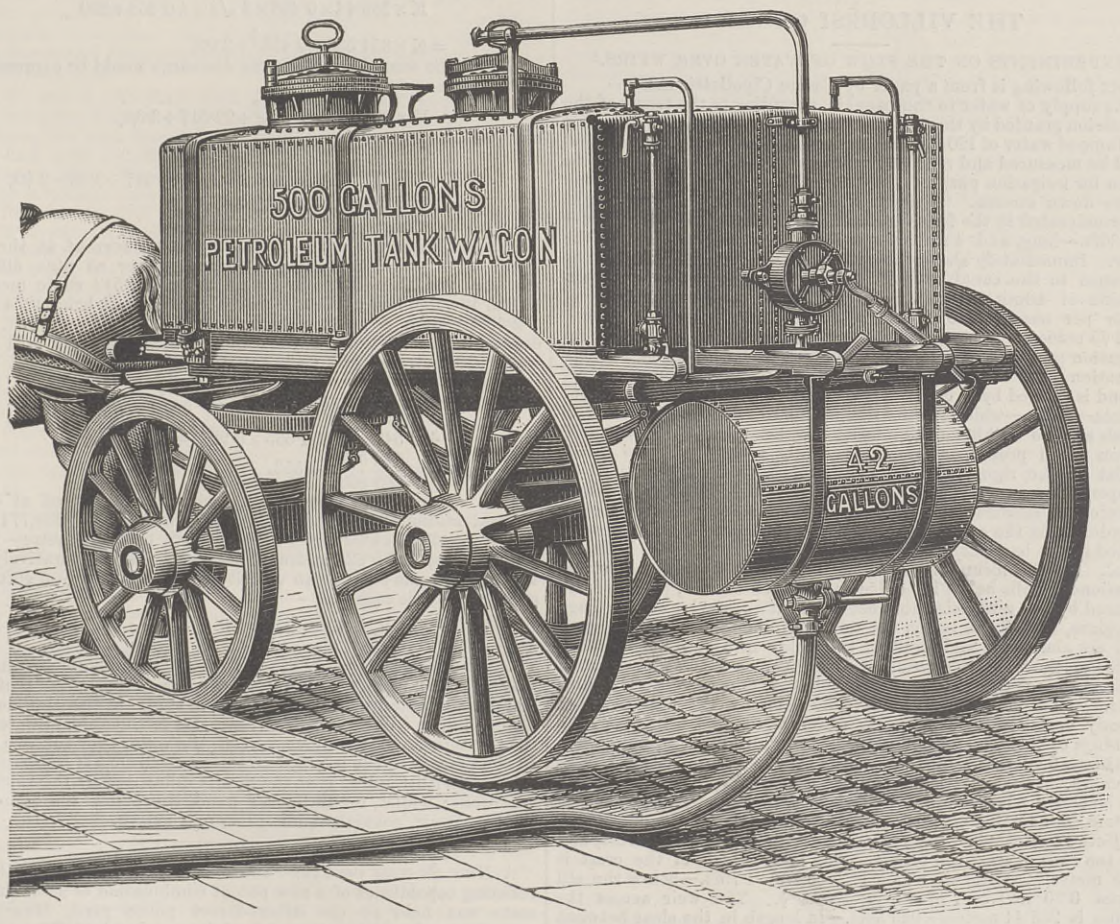
That it is an easy matter to construct a device that will attach itself to another of the same sort, when the two are brought in contact, is witnessed by the four or five thousand patents that have been issued. Farmers, doctors, lawyers, merchants, and a very few railroad men have entered the race; and each has been encouraged by the patent lawyer to whom the application was entrusted to prosecute the claim and pay the fee. And now that the ball has started there seems to be no chance of a stoppage. In the past two months of May and June the Patent-office issued sixty-two patents on car-couplers. Now, when the thousands that have preceded are taken into consideration it seems like a farce to think that any one of these sixty-two patents can embody any new or valuable features; and even if they do, what chance have they of success? Ignorance of the essentials, we repeat, is the probable cause of the trouble. What does the outsider whose only contact with a railway has been as a passenger, know of the true coupler requirements? He simply knows that the coupler must fasten two cars together automatically, and be released from the outside, but knows nothing of the strength of the draw-bar, the cushion in drawing and backing, the slack required for starting, the necessity of being automatic with all kinds and degrees of draw-heads, and above all, of the absolute necessity for few working parts. The result of the travail is a complicated piece of watchwork that is no more suited to the purpose than a baby carriage would be for freight service.

This was particularly evidenced by the hook coupler that was on exhibition at the recent Master Car Builders' Convention at Niagara, and which, by the very multiplicity of its parts

ROBSON'S PATENT GAS HAMMER.



PETROLEUM TANK WAGON.



and utter unsuitableness, attracted a great deal of attention. The inventor brought it on, all the way from Kansas, and had evidently strained his resources to their utmost in order to meet his expenses, confident that could this child of his be once seen, the whole railroad world would be at his feet for the privilege of adopting it. His contact with the cold, hard facts that confronted him and told him that he was far behind in the race, must have been a staggering blow, and yet it is what all but a dozen or more of our sanguine five thousand patentees must receive. The coupler fiend which has so long been the terror of our railroad officials must soon become one to the Patent Commissioners, unless a little honesty is infused into the average of patent lawyers and they can be induced to advise their clients not to try for a prize that is so far beyond their reach. But as this is a moral impossibility, it only remains to wait until the fever has run its course and died a natural death. —*American Journal of Railway Appliances.*

PETROLEUM TANK WAGON.

THE tank wagon for transporting petroleum in bulk which we now illustrate is the invention of Mr. E. Phillips, of Bishopsgate-street. It consists of a wrought iron tank, divided longitudinally, provision being made to prevent the wash of the oil. Each half contains 250 gallons, this quantity being the maximum allowed by the Government in the proposed Petroleum Bill for the shopkeeper to have on his premises without other restrictions than a properly constructed iron tank. The oil is filled through the manholes, which are so constructed as to allow for expansion. A gauge glass is attached to the end of the compartments showing the number of gallons in each. A valve from each compartment communicates with the measuring drum, which contains exactly 42 gallons, this being the average contents of a barrel. Fixed to the drum are two discs, which rise as the liquid flows in and shows when it is full. A rotary pump, the suction pipe of which goes to the bottom of the drum, and the delivery pipe from the top of the pump, is made to swing so as to go over the pavement 7ft. high; this is connected to a special rubber hose with unions which are coupled up to the pipe at the door of the shop. This pipe leads to the storage tanks, which may be in the yard at the back. When the tanks are in the basement the rubber hose is attached to the valve at the bottom of the drum; the oil then flows by gravitation. It will be seen by these simple means, a great saving of time, labour, leakage, and inconvenience, is obtained, and that the danger of keeping the oil in barrels in the shop is avoided. There is considerable saving of expense to the merchant as barrels become unnecessary. Several of these tank wagons are in use.

THE city of Newton, Mass., after a careful trial extending over a number of years, is now so well assured of the value of water meters as a waste preventer, that they have lately resolved that one be put in every house. To this end the city has ordered within the month 1000 in. Crown meters.

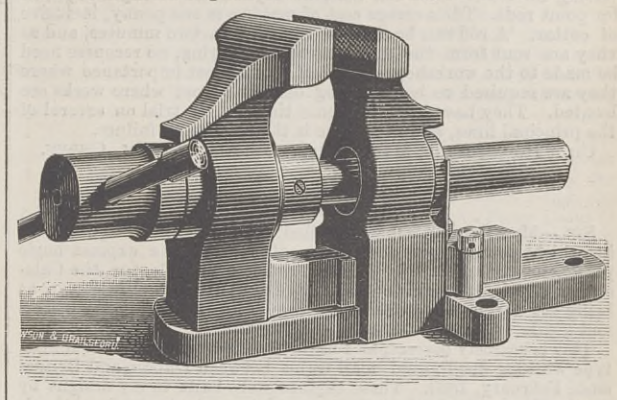
ORGAN AT THE LIVERPOOL EXHIBITION.

WE give an illustration this week on page 210 of the fine organ, by Messrs. Michell and Thynne, in the music-room of the Liverpool Exhibition. The manuals are placed at the right-hand side of the instrument, and our view shows the opposite side.

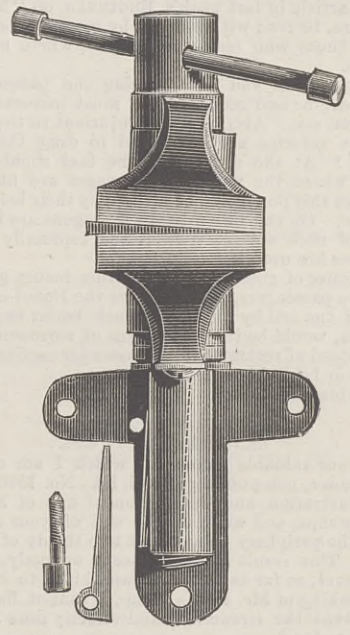
This organ was shown last year in the music-room of the Inventions Exhibition, South Kensington, but from various causes it was not finished, the solo organ, indeed, only having been added a short time before the Exhibition closed. The organ contains several novelties and improvements patented by the makers, to which we shall refer when completing our illustrations in another impression.

ASHFORTH'S SOLID TAPER GRIP VICE.

THE accompanying engravings illustrate a new vice, patented and manufactured by Mr. Ashforth, Bruce Steel Works, Sheffield. It is claimed that this possesses all the advantages of the old leg and



parallel vices, combined with greater strength in the eye—which is the weak place in most parallel vices—and the special advantage of a taper grip, by which any taper article is held with the greatest firmness and without the possibility of slipping. This grip is obtained by simply removing a wedge on the right-hand side of the vice, which can be done in a couple of seconds, and



the vice adjusted to either taper or parallel, to suit work in hand. The screw is boxed up, so that no filings can fall into it. The vice has been put together for strength and durability, the jaws and body being made solid from best Yorkshire wrought iron.

FLUTED CARBONS.—Sir James Douglass has brought out for arc lighting a new form of carbons which are held to give a higher efficiency than the ordinary cylindrical pencils now used, and to be especially applicable to the electric illumination of lighthouses. The carbons are fluted down the sides, but are made in moulds and baked, much in the same way as ordinary cylindrical carbons. The greater efficiency is mainly due to the fact that the new carbons do not "crater" at the points, and hence there is not the same loss of light from that cause as occurs in the round carbons. Many experiments have been made with them, and it is probable that they will be adopted for the intended flash lights of the St. Catherine lighthouse, England. Two De Meritens magneto dynamos—the same, in fact, which were used at the South Foreland experiments—are to be employed there, one for clear weather, and both together for thick weather.

UNIVERSITY COLLEGE, BRISTOL.—The session 1886-87 will begin on October 5th. Lectures and classes are held every day and evening throughout the session. In the chemical department, lectures and classes are given in all branches of theoretical chemistry, and instruction in practical chemistry is given daily in the chemical laboratory. Excursions to some of the mines, manufactories, and chemical works of the neighbourhood are occasionally made. The department of experimental physics includes various courses of lectures arranged progressively, and practical instruction is given in the physical and electrical laboratory. The department of engineering and the constructive professions is designed to afford a thorough scientific education to students intending to become engineers, or to enter any of the allied professions, and to supplement the ordinary professional training by systematic technical teaching. This department includes courses specially arranged for students intending to become civil, mechanical, electrical, or mining engineers, surveyors, or architects. Those who attend the mechanical engineering course enter engineering works during the six summer months, and, in accordance with this scheme, various manufacturing engineers in the neighbourhood have consented to receive students of the college into their offices and workshops as articled pupils. The engineering laboratory is provided with a powerful testing machine, and instruction in the use of tools is given in the workshop. Special courses in surveying are given, and excursions for field practice are frequently made. The department for geology, biology, and zoology includes various courses of lectures in all branches of those subjects, together with laboratory instruction. In the botanical department practical instruction is given by means of the botanical gardens, which contains upwards of 1000 specimens. Courses of lectures and classes are given in mathematics, political economy, logic, moral philosophy, modern history, English literature, Greek, Latin, Hebrew, French, and German. Medical education is provided by the Bristol Medical School, which is affiliated to the college. Several scholarships are tenable at the college.

LETTERS TO THE EDITOR.

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

NOVEL BELLS.

Sir,—I appreciate very much, and thank you for, the notice in your last issue under the above heading. I beg permission to say that bells on my system are not only musical, as you state, but have a volume of tone which cannot be produced by a cast bell of fifteen times greater weight. One very important point I ask to supplement. My bells can be produced at—proportionate to size—from one-half to one-fourth of prices now charged.

Junction-road, London, N., J. W. Hoffman.
September 7th.

GREEN'S COUPLINGS.

Sir,—By this I wish to thank you very much for your favourable notice of my point-rod joints in your issue of the 27th ult. It may possibly interest you further to learn that Messrs. Kirkaldy have just ascertained the average breaking points of four joints, made of 1in. wrought iron tubing, to be at 5074 lb., or as having no fewer than ten margins beyond the strength required for point rods. The average cost of making is one penny, inclusive of cottar. A rod can be fixed or replaced in two minutes, and as they are sent from the makers ready for laying, no recourse need be made to the workshop—a fact of the utmost importance where they are required to be laid long distances from where works are located. They have been for some time under trial on several of the principal lines, and in no case is there a sign of failure.

Croft House, Hyde, Manchester, Wm. Green.
September 6th.

SINGLE BOGIE ENGINES.

Sir,—My attention has been called to your issue of August 13th, in which you give a description of a very fine express bogie passenger engine built by Messrs. Neilson and Co. for the Caledonian Railway, in which it is stated that it is novel in design as being the first engine of the class combining single driving wheels and inside cylinders with a bogie in front.

This is scarcely correct, as I have had two engines of a similar type working our limited mail trains between Dublin and Belfast since February, 1885. These engines were built to my designs by Messrs. Beyer, Peacock, and Co., and have single driving wheels 6ft. 6in diameter with inside cylinders and a four-wheeled bogie in front, and are doing excellent work on a very low consumption of coal. Jas. C. Park.

Dundalk, September 6th.

MIXED TRAINS.

Sir,—The article in last week's Engineer on "Mixed Trains" will, I am sure, be read with interest by most of your readers, and especially by those who reside in Ireland, where such trains are very common.

I quite agree with you that placing the passenger carriages between the engine and goods wagons must increase the danger of accident as you say. Also, is it not injurious to the rolling stock if the lighter vehicles are compelled to drag the heavier ones behind them? At the same time, the fact should not be overlooked that where the passenger carriages are fitted with continuous brakes this power can be utilised by their being placed next to the engine. On the other hand, if wagons are interposed, the advantages of such a brake power, and especially where simple vacuum brakes are used, are lost.

If this practice of running mixed trains incurs greater liability of accident to passengers, why does not the Board of Trade strike at the root of the evil by forbidding such trains to be run? This, in my opinion, would be the best means of surmounting the whole difficulty, instead of recommending passenger carriages to be placed either before or behind in such trains. Subscriber.

Belfast, September 7th.

CENTRIFUGAL PUMPS.

Sir,—In your valuable journal, of which I am a constant and interested reader, you published—vol. lxi., No. 1590, of June 18th, 1886—an illustration and description of one of Mr. Hett's 9in. centrifugal pumps, and write at the end of your article:—"The velocity at the periphery being about two-thirds of the head due to gravity. This result is an apparent anomaly, and a similar result has never, so far as we are aware, hitherto been recorded." Without speaking of Mr. Hett's pump, I cannot find an anomaly in the fact that the circumferential velocity does not attain the velocity due to head.

I designed several centrifugal pumps and always found that the circumferential velocity of the disc does not need to attain the value of $\sqrt{2gH}$, where H is the total height, friction included, to be overcome, it only must be greater for a certain amount—depending on the inner and outer diameter of revolving disc—than $\sqrt{gH}$. At the same time I must say that I found in no book a correct, plain, and clear theory of centrifugal pumps according with practice, and shall, perhaps, not go too far in saying that most of the centrifugal pumps constructed are not the result of theoretical investigation, but rather of empirical trials. I worked out myself a clear and plain theory, and should be glad if you would allow me to put it under your critical eyes. Perhaps you may think fit to put it before your readers.

I am a young mechanical enginneer, bred at the Polytechnic School of Vienna; now with more than six years' practical experience. F. K.

Vienna, September 4th.

LAUNCHES AND TRIAL TRIPS.

A steel screw steamer was launched by Messrs. Schlesinger, Davis, and Co., from their shipbuilding yard at Wallsend on September 2nd. The vessel is named the Swift, and will be registered at the port of Ipswich. Her dimensions are, length between perpendiculars 110ft., breath moulded 19ft., depth of hold 8ft. 9in. The engines, with cylinders 17in. and 32in. diameter by 24in. stroke, will be fitted on board by the North-Eastern Marine Engineering Company at its Wallsend works. The ceremony of christening was performed by Miss Dora Hodge.

Messrs. Fleming and Ferguson, engineers and shipbuilders, Paisley, launched from their shipyard last week the second of the two powerful dredgers that they have constructed for the Preston Corporation, for the deepening and improvement of the river Ribble. The dimensions are: Length, 170ft.; breadth, 40ft.; depth, 10ft. She was named the Walter Bibby, after the chairman of the Ribble Improvement Committee. These dredgers are two of the most powerful yet constructed for this country, and are fitted with all the most recent and modern improvements.

The second of two large steamers, built to the order of the Pacific Steam Navigation Company, by the Barrow Shipbuilding Company, was launched on Tuesday morning. The Orizaba, which is now nearing completion, is the sister boat. Both of these magnificent steel vessels are intended, contrary to first anticipations, to trade between London and Australia in conjunction with the Orient Company's steamers. The Orizaba and the Oroya, for so the second boat was named, are the first of the large ocean-going steamers which have been fitted with the triple expansion engines. A great number of persons witnessed the launch, and the vessel as she left the ways was christened by Mrs. W. G. Ainslie. The dimensions of the new steamer are as follows:—The vessel is 460ft. in length, 49ft. in breath, and 38ft. 3in. depth, moulded, and has a gross register tonnage of about 6500 tons. She is rigged with four masts. The hull has been constructed on the longitudinal double bottom principle, and fitted with four complete closed-in decks all fore and aft, and a promenade deck extended to the ship's side. Her superstructures consist of a short poop and forecastle, and a long range of midship deckhouses. The deck erections and various 'tween decks have been fitted up to accommodate 124 first, 54 second, and 412 third-class passengers, as well as for officers and crew. The saloons and cabins will be furnished in the best style, panelled in hardwood, and upholstered in a most luxuriant manner by Messrs. A. Blain and Co., of Liverpool, and will be electrically lighted by 400 incandescent lamps. All passenger spaces, saloons, and staterooms will be ventilated by machinery on D. C. Green's principle, and the most ample provision has been made for the convenience and comfort of the passengers. She will have six steam winches for the purpose of loading and discharging cargo, made by Messrs. Waddington and Longbottom, of Barrow; a steam steering engine, by Messrs. Muir and Caldwell; Hasties' patent screw steering gear, and Clarke, Chapman, Co.'s steam windlass for working the anchors. The vessel will also be fitted with refrigerating chambers for carrying meat, and the refrigerating machine will be capable of cooling 70,000 cubic feet of air per hour. The ship will be propelled by inverted direct-acting triple expansion engines to indicate 6000-horse power, the diameter of the high-pressure cylinder being 40in., intermediate cylinder 60in., and low-pressure cylinder 100in., with a stroke of 6ft., adapted for a working pressure of 160 lb. per square inch. The ship has been built under special survey of both Lloyd's and Liverpool underwriters, and will receive the highest class in those registers.

TENDERS.

TOXTETH PARK LOCAL BOARD.

Tenders received by the Toxteth Park Local Board for the reconstruction of the carriage-way of Smithdown-road, between Salisbury and Wellington roads (contract No. 3). Quantities supplied by the engineer, Mr. John Price, Assoc. M. Inst. C.E.

	£	s.	d.
Catterall and Co., 17, Phœbe Ann-street, Liverpool	1567	14	0
Ireland and Hurley, Brae-street, Liverpool	1147	18	6
J. Garnett, Aspen-grove, Liverpool	1106	7	3
McCabe and Co., Lambeth-road, Liverpool	1079	5	0
R. Lomax, 3, Bagot-street, Toxteth Park	1062	17	9
R. B. Ballantine, Everton, Liverpool	1038	18	7
W. F. Inglis, Castle-street, Liverpool	964	12	0
Walkden and Co., Brasenose-road, Bootle	938	0	0
L. Marr, Aspen-grove, Toxteth Park	917	10	1
Jas. Evans, Parkgate—accepted	860	16	11
Engineer's estimate	950	0	0

Tenders received by the Toxteth Park Local Board for curbing and channelling Smithdown-road, between Wellington and Ullet roads. Quantities supplied by the engineer, Mr. John Price, Assoc. M. Inst. C.E.

	£	s.	d.
J. Garnett, Aspen-grove, Toxteth Park	462	5	5
Ireland and Hurley, Brae-street, Liverpool	412	14	6
R. B. Ballantine, Everton, Liverpool	388	3	6
W. F. Inglis, Castle-street, Liverpool	379	8	7
McCabe and Co., Lambeth-road, Liverpool	378	0	0
R. Lomax, Bagot-street, Toxteth Park	347	3	4
Jas. Evans, Parkgate	333	11	0
Walkden and Co., Brasenose-road, Bootle	329	0	0
Catterall and Co., Phœbe Ann-street, Liverpool	309	10	6
L. Marr, Aspen-grove, Toxteth Park—accepted	305	3	9
Engineer's estimate	50	0	0

THE VILLORESI CANAL.[1]

EXPERIMENTS ON THE FLOW OF WATER OVER WEIRS.[2]

The following is from a paper by Cesare Cipolletti, C.E.:—

The supply of water to this canal is, according to the terms of the concession granted by the Government, subject to the condition that a volume of water of 120 cubic metres—4237·98 cubic feet—per second shall be measured and returned into the Ticino, before any can be taken for irrigation purposes, and thus not interfere with existing rights down stream. To fulfil these conditions, the head works are constructed in the following manner:—A weir 289·44 metres—949·36ft.—long, and 4 metres—13·12ft.—high, is built across the river. Immediately above the weir, and on the left bank, is the entrance to the canal, a building provided with thirty sluices, capable of admitting 192 cubic metres—6780·67 cubic feet—of water per second into the canal, of which 72 cubic metres—2542·75 cubic feet—is the quantity granted by the concession for irrigation purposes, and 120 cubic metres to be returned as compensation into the Ticino. The 192 cubic metres of water per second is carried by a canal 600 metres—656 yards—long, and 52 metres—170ft.—wide, terminating in a basin, on the left bank of which are the buildings containing the head sluices to the irrigation canal proper, as well as those of a small private canal, whilst on the right bank is the measuring weir, over which the compensation water is returned to the Ticino. It was important therefore to establish with precision the coefficient of contraction, in order to fix the exact height at which the water should be maintained in the basin before admitting any water into the Villoresi canal. As the mean discharge of the Ticino during the winter occasionally falls below 120 cubic metres per second, powers were granted by the concession to erect works at the outlet of the Lago Maggiore, in order to retain the waters of the lake at times when they are abundant, and regulate their flow into the Ticino. The profile of the weir for measuring the 120 cubic metres per second is given at page 67—this quantity, however, is reduced to 112 cubic metres, as 8 cubic metres are drawn off by the private canal already mentioned. The crest, which is divided into thirty-six openings of 2·025 metres—6·65ft.—clear width each, by thirty-five partitions 0·08 metre—3·15in.—thick, is 72·90 metres—239·11ft.—in length. These partitions support a foot bridge. The openings can be closed when required by boards placed vertically, with the bottom ends resting against the up-stream side of the cill, which projects 12 centimetres—4·72in.—above the level of the crest, and the top ends against the bridge. The total width of the crest is 1·85 metre—6·07ft.—of which 1·45 metre—4·75ft.—below the cill slopes 0·20 metre—7·87in.—or about ¼. The weir across the Ticino is 289·44 metres—949·36ft.—in length in the clear between the abutments, with horizontal crest, and curved breast and back, as shown in cross section at page 68.

In order to establish the coefficient of reduction, to be used for calculating the discharge over the measuring weir, two measurements of the velocity in the canal, between it and the Ticino, were first taken by means of the Woltmann current meter, the results of which were further controlled by direct measurements taken with the same instrument at the weir itself. During these experiments, it must be observed, the whole volume of water brought down by the canal did not flow over the weir, part being allowed to enter the irrigation canal. The water is admitted into the canal from the basin by submerged openings, fitted with iron sluice gates, and, previous to the experiments to be now described, their coefficients of contraction had been determined, and found to be between 0·72 and 0·74, or a mean of 0·73; so that, in order to ascertain the exact volume of water that was being admitted into the irrigation canal, it was only necessary to measure the difference of the level of the water on each side of the sluices.

The first experiments were made on the 3rd and 4th January, 1885, the level of the water in the basin being 0·538 metre—1·76ft.—above the crest.

	Cubic metres.
The total flow in canal leading to basin—taken by actual measurement—being	65·754
Volume admitted into Villoresi canal	7·518
Quantity discharged over weir	58·236

The total clear width of overfall being 72·90 metres, the equation of the discharge would be—

$$Q = K\,72{\cdot}9 \times H^{\frac{3}{2}}\sqrt{2\,g\,H};$$

or

$$Q = K\,214{\cdot}91\,H^{\frac{3}{2}}.$$

Assigning to Q and H their numerical values, viz., 58·236 cubic metres per second—already found by measurement—and 0·538, the value of the coefficient K=0·685 is found.

A second experiment, made on the 9th March, gave the following results:—

	Cubic metres.
Total flow in canal leading to basin—by measurement	128·803
Volume admitted into Villoresi Canal	4·389
Quantity discharged over weir	124·414

Level of water 0·895 metre—2·93ft.—above crest.

Substituting these figures in the above equations, there would result—

$$Q = K\,214{\cdot}91\,H^{\frac{3}{2}};$$

or

$$K = 0{\cdot}683.$$

The mean coefficient would therefore be—

$$K = \frac{0{\cdot}685 + 0{\cdot}683}{2} = 0{\cdot}684.$$

In determining the discharge by direct measurement at the weir, the velocity of the current was taken at different depths at five stations in two of the thirty-six openings. The depth of water in the basin above the crest being 0·835 metre—2·73ft.—the discharge through one opening was found to be 3·103 cubic metres, and of the other 3·194, giving a mean of 3·148, which multiplied by 36 gave a total discharge of 113·346 cubic metres, which gives the following equation—

$$113{\cdot}346 = K\,214{\cdot}91 \times 0{\cdot}835^{\frac{3}{2}};$$

or

$$K = \frac{113{\cdot}346}{163{\cdot}617} = 0{\cdot}692;$$

which differs only from the coefficients found by the previous experiments by 0·008, or about 1 per cent. The coefficient of contraction for calculating the discharge over the river weir was established in two different ways. Taking advantage of two days in which the depth of water in the Ticino was alike; on the first it was allowed to flow entirely over the weir in the river, whilst on the second day part flowed over the measuring weir and part over that in the river, this being the most reliable way of determining the exact coefficient. It was, however, necessary to take into account the water which found its way into the river, which was ascertained to be 4·50 cubic metres, 1 cubic metre of which was due to leakage of the dam, and 3·50 from the four sluices which serve to empty the basin if required; when, on the other hand, all the water flowed over the river weir, it was found that there was a leakage of 2·09 by the head sluices into the canal, so that there was a difference of 3·50 − 2·09 = 1·41 between a full basin and an empty one.

These experiments were made on the 27th and 28th March, with an equal depth of water in the Ticino. On the first day the entire volume of water passed over the weir, the depth above the crest being 0·458 metre—1·50ft.—whilst on the second, part was passed over the river weir and part over the measuring one, with a depth of 0·77 metre—2·52ft.—corresponding to a volume of 99·517 cubic metres—3514·54ft.—whilst the depth of water above the crest was reduced to 0·218 metre—0·71ft. The length of this dam being 289·44 metres—949·36ft; the leakage 2·09 cubic metres—73·81 cubic feet—and the coefficient K, the equation of discharge on the first day was—

$$K \times 289{\cdot}44 \times 0{\cdot}458 \times \tfrac{2}{3}\sqrt{2\,g \times 0{\cdot}458} + 209$$

$$= K \times 854{\cdot}535 \times \overline{0{\cdot}458}^{\frac{3}{2}} + 2{\cdot}09,$$

whilst on the second day the same discharge would be expressed by the formula—

$$K \times 854{\cdot}535 \times \overline{0{\cdot}218}^{\frac{3}{2}} + 99{\cdot}517 + 3{\cdot}50,$$

from which

$$K \times 854{\cdot}535\left(\overline{0{\cdot}458}^{\frac{3}{2}} - \overline{0{\cdot}218}^{\frac{3}{2}}\right) = 99{\cdot}517 + 3{\cdot}50 - 2\,09,$$

or

$$K = \frac{100{\cdot}927}{178{\cdot}598} = 0{\cdot}565.$$

The measurements of the velocity of the current at the weir were taken with Woltmann's current meter at nine different stations, and the discharge found to be 422·542 cubic metres—14,922·49 cubic feet; the mean depth above crest being 0·74 metre—2·43ft.—with a mean velocity of 1·972 metre—6·46ft. The depth above crest to the surface of the comparatively still water was 0·928 metre—3·04ft.; the equation of discharge would therefore be—

$$422{\cdot}542 = K\,289{\cdot}44 \times 0{\cdot}928 \times \tfrac{2}{3}\sqrt{2\,g\,0{\cdot}928};$$

or

$$422{\cdot}542 = K\,854{\cdot}535 \times \overline{0{\cdot}928}^{\frac{3}{2}} = K\,763{\cdot}868;$$

or

$$K = \frac{422{\cdot}542}{763{\cdot}868} = 0{\cdot}553.$$

In a second experiment the velocity was measured at eleven vertical stations, and showed a total discharge of 239,771 cubic metres—8465 75 cubic feet—with a depth of 0·494 metre—1·62ft.—over crest, and 0·628 metre—2·06ft.—in the comparatively still water up-stream; the mean velocity was 1·667 metre—5·46ft.; the equation in this case was—

$$239{\cdot}771 = K\,854{\cdot}535 \times 0{\cdot}628^{\frac{3}{2}};$$

or

$$K = 0{\cdot}563.$$

This latter coefficient only differing from that found by the first method by 0 002, or less than 0·4 per cent. The coefficient definitely adopted was the mean of the three experiments, or 0·56. From these it will be seen that there is a considerable difference in the phenomena of the movement of the water over the two weirs. In the first, with the inclined crest, the coefficient is comparatively high, notwithstanding that the flow is influenced by the thirty-five partitions; whilst, on the other hand, it is below the average at the river weir, notwithstanding its great length.

1 "Proceedings" Institution Civil Engineers.

2 A description of this canal will be found in vol. lxxxii. "Proceedings" Institution Civil Engineers, p. 416.

A New System of Fire-proofing.—An exhibition of the fire-resisting capabilities of a new patent combination of steel and concrete was held at the Albert-street police yard, Manchester, recently, under the supervision of Superintendent Tozer, of the Manchester Fire Brigade. The combination is named "Titan-crete," and it is the invention of Messrs. Lee and Hodgson, who claim that it is specially adapted for the construction of columns, girders, floors, partitions, doors, shutters, or slabs, and that with it a perfectly fire-proof building may be erected. It has been long known that in fire-proof buildings as at present constructed the weakest parts have been the iron columns and girders, which, being subject to expansion and contraction when a fire occurs, give way at the most critical moment, and the building collapses. By this invention, pillars, girders, and floors are all made of concrete, which is well known to be absolutely fire-resisting, and the necessary strength is obtained by the employment under the patent of a combination of steel which supports and strengthens the concrete, and embodying at the same time absolute protection from the action of fire or water. A building had been erected in the police yards of ordinary bricks with a floor, or rather roof of slabs made of concrete and steel 6ft. by 3ft. 3in. thick, and resting upon girders covered with concrete. There were two window openings and a door, which was also made of concrete and steel. Inside were pillars made of the same material, 10in. in diameter, and capable of sustaining 100 tons. At 11.30 a.m. a fire was lighted, and kept burning, half a ton of coal being consumed. At 2.30 tarred wood was thrown in, and petroleum poured over it. A great blaze was thus worked up and kept going until three o'clock, when the fire was extinguished by the firemen. The trial was in every way a success. It was the best test of the kind yet witnessed in Manchester; the building remained intact after the fire had been burning three and a-half hours, and the pillars which were in the middle of the furnace were only stripped of their outer covering of plaster.

RAILWAY MATTERS.

THE Senate of the United States has voted 300,000 dols. toward the construction of the Hennepin Canal, to connect the Mississippi river about Rock Island with the great lakes at Chicago.

IT is expected that the new line of railway from Lucknow to Sitapur will be ready for traffic by November next, and that the opening ceremony will be performed by the Lieutenant-Governor, Sir A. Lyall.

FOLLOWING its promise of last session of the Dominion Parliament, the Government has appointed a commission to inquire into the subject of appointing a permanent Railway Commission. The Commission of Inquiry appointed by the Government consists of Sir Alexander T. Galt, Mr. Schreiber, C.E., and Mr. Moberley, C.E.

THE *employés* of the London and North-Western Railway Company in the carriage department, both at Crewe and Wolverton, commenced working full time on Monday. All the engineers, fitters, and others in the locomotive department are still on short time, but the men trust the activity displayed in the carriage department will shortly extend to their own.

IN the early days of the Great Western Railway a hollow oak tree temporarily served as the station-house at Moreton, Herefordshire. It stood near the platform, and fifteen people could stand in its interior at one time. This tree was unfortunately blown down in 1848. Another primitive railway station we remember to have seen was on the Bangor section of the Belfast and County Down Railway. This was the body of an old railway carriage deposited by the side of the line.

THE Canadian Government has recently promised a land subsidy to the Winnipeg and North Pacific Railway Company, which has been organised to build a railway from Winnipeg to Fort Simpson by way of Fort a la Corne. A Bill to grant the company 6000 acres of land per mile for that portion of the road between Winnipeg and Fort a la Corne, and 10,000 acres per mile from that point to the foot of the Rocky Mountains, will, the Colonies and India says, probably be introduced next session.

IN July, 1886, there occurred on the United States railways a total of ninety-one accidents, in which twenty-three persons were killed and eighty-eight injured. As compared with July, 1885, there was an increase of fifteen accidents; a decrease of five killed and an increase of thirteen injured. The seven months of the current year to the end of July show a total of 593 accidents—213 killed and 827 hurt; a monthly average of eighty-five accidents—thirty killed and 118 injured.

THE Toronto *Mail* states that Sir John Macdonald arrived at New Westminster at one o'clock on the morning of the 14th ult., from Nanaimo, Premier Smythe and Mr. Dunsmuir accompanying the party, the latter placing his steamer at Sir John's disposal. The journey from Victoria to Nanaimo was accomplished in three hours, the distance being seventy-two miles. On arriving half way Sir John drove the last spike in the Vancouver Island railway. Several prominent citizens of Victoria accompanied Sir John to Nanaimo.

THE mineral traffic of the United Kingdom in 1885 kept up as regards volume, but there is a decrease of over a quarter of a million sterling in the receipts, which amounted to £15,246,200 in 1885, as compared with £15,528,600 in 1884. The average receipts per ton of mineral carried amounted to 1·6s. in 1885 and to 1·7s. in 1884, so that there has been a slight reduction under this head, although it is not clear whether this is due to the increased distance over which the goods were carried or to a reduction of the transport charges.

AT the end of 1884 there were 1790 miles of railway in Switzerland, including fifty-nine miles of cog-wheel, cable, or other mountain lines, less than four miles having been added during the year. They had cost £41,005,920, including £719,276 for the special mountain roads. The ordinary railways had cost £23,865 per mile, and the mountain lines £12,500 per mile. On the 1790 miles there were 189 tunnels, 1963 bridges, and 656 stations—one station for every 2·73 miles of road. The length of double track was 178 miles. Of the ordinary railways 25·9 per cent. was level, and of the mountain roads only 8·8 per cent.

THE introduction to "Poor's Railroad Manual for 1886," which has just been published, shows that 3131 miles of road were constructed during the year in the United States, the aggregate mileage for the whole country being 128,976. The capital stock of all railroads is 3,817,697,832 dols. The earnings of all roads equalled 772,568,833 dols. against 770,684,908 dols. for 1884. The introduction says the past year undoubtedly marks a point of lower depression in the earnings of our railroads in ratio to their cost and mileage than is likely to be witnessed for some years to come, the present year showing a considerable improvement upon the past.

THE United States are now sending abroad about 3,000,000 dols. worth of locomotives per annum, the total value of those exported in the last fiscal year being 2,819,946 dols. This, at an average of 10,000 dols. each, represented about 290 engines. In the fiscal year ended June 30th, 1882, the number of engines shipped did not exceed 133, the estimated value being 1,455,717 dols. Of the 282 locomotives exported from the United States in 1883-84, 65 went to the Argentine Republic, 49 to the United States of Colombia and Panama, 34 to Mexico, 32 to Brazil, 27 to the Dominion of Canada, 19 to Chili, 14 to Australia, 13 to Central America, 14 to Cuba, 6 to Spain, 3 to San Domingo, 3 to Sweden, 2 to Venezuela, and 1 to England.

THE first permanent electrical railway in Canada and one of the first in America, is now, says *Railway Life*, in full operation between Windsor and Walkerville, a distance of 1½ miles. The road is operated on the Vandepoele system, the same as that so successfully used in the shorter line at the Toronto Industrial Exhibition Park. The formal opening took place on June 9th last, amid great rejoicings. The proprietor of the line, Mr. John W. Tringham, has shown most commendable enterprise in pushing forward the work, and the results so far are believed to have been eminently satisfactory. Trains now run regularly between Windsor and Walkerville every fifteen minutes, and the service is reported by the public in the district to be everything that could be desired.

THE Eastern and Midlands Railway Company is rapidly pushing forward its new line from Holt to Cromer, a distance of ten miles, and the road will be opened for traffic early in 1887. The route passes over the common lands at Kelling and Salthouse through Waybourne to Cromer, a distance of about six miles. This section of the company's undertaking seems to be the most difficult and expensive of any corresponding distance along its entire system. The metals have been supplied by Messrs. Cammell and Co., of Workington, and are 70 lb. to the yard. They have been laid for a distance of about four miles from Holt to Waybourne, at which place the line takes an eastwardly direction after emerging from a cutting out of which 70,000 cubic yards of sand has been excavated, and then passing on to an embankment containing about 55,000 cubic yards of earth. The first station will be at Lower Sherringham, six miles from Holt, the second at Runton, eight miles, and the terminus at Cromer. Cromer station will cover something like eight acres. The road is single throughout, and at Cromer the platforms are to be constructed upon the "island" principle. The station premises will comprise a refreshment-room, waiting-room, booking-offices, station-master's residence and the usual offices, constructed in the old English style of architecture. The platforms are to be 250 yards long, and will be covered in with a roof of glass and slate. Mr. W. Marriott is the engineer, and, under his superintendence, the work is being carried out, Mr. R. M. Parkinson assisting him. The station buildings at Holt and Sherringham are being erected by Messrs. Bardell Bros., of Lynn, and those at Runton and Cromer by Mr. Leach of the same town. Mr, Wilson, of North Walsham, is building the bridges.

NOTES AND MEMORANDA.

GENERAL IGNATIEFF has presented to the Mineralogical Society of St. Petersburg a mineral recently found on his estate in the government Elizabethgrad. It belongs to the class of aluminites, and has not hitherto been found in nature. The Russian mineralogists have named it Ignatieffite.

THE largest body of fresh water on the globe is Lake Superior, 400 miles long, 160 wide at its greatest breadth, and having an area of 32,000 square miles. Its mean depth is 900ft., and its greatest depth is said to be about 200 fathoms, or 1200ft. Its surface is about 635ft. above the sea level.

SENET has devised a new process for obtaining aluminium, as well as copper, silver, &c., by electrolysis. He exposes a saturated solution of sulphate of alumina, separated from a solution of chloride of sodium by a porous vessel, to a current of six or seven volts and four ampères. The double chloride of aluminium and sodium is decomposed, and the aluminium is deposited upon the negative electrode.

THE Northern Railroad of France has found by experiment that nickel can be rolled upon soft steel plates in such a manner as to produce a material for lamp reflectors of equal brilliancy with those made of silvered copper. These reflectors are reported also not to rust, and owing to the greater strength of the material, to be less easily knocked out of shape. The cost is only 55 per cent. of the cost of silvered copper reflectors.

THE experiments of M. Baille show that temperature exercises an appreciable influence upon the value of the torsion-couple of wires. The couple diminishes very rapidly when the temperature increases; the variations amount to about one per cent. per degree Centigrade for aluminium and silver. Care is therefore necessary to maintain a constant temperature when making measurements with apparatus in which the effects to be measured are equilibrated by the torsion of a wire.

THE temperature of space is, at the present day, generally assumed to be much less than the lowest temperature yet produced by artificial means; and it is interesting to note the efforts made to produce extreme cold. Stewart on "Heat," p. 110, gives an example in which a temperature of − 140 deg. Cent. (− 220 deg. Fah.) was obtained; but very recently—Van Nostrand's *Eng. Mag.*, xxxv., p. 87—in solidifying oxygen, a temperature of − 200 deg. Cent. (− 330 deg. Fah.) is said to have been produced, which is only 131 deg. Fah. above absolute zero.

THE applications of aluminium are now considerable, and M. Bourbouze, a French physicist, has added to their number by employing an alloy of the metal with tin for the internal parts of optical instruments in place of brass. The alloy he employs consists of 10 parts of tin and 100 parts of aluminium. It is white, like aluminium, and has a density of 2·85, which is a little higher than that of pure aluminium. It is therefore comparatively light, which is an advantage for apparatus where lightness is desired. It can be soldered as easily as brass, without special means, and it is even more unalterable than aluminium to re-agents.

MR. A. A. CROZIER, of the University of Michigan, has published a thesis concerning the modification of plants by climate. It has brought together a great amount of scattered material upon this interesting subject, and—not the least valuable part of the paper—a full bibliography is given. Summing up the whole matter, the conclusion reached is as follows:—"It seems to be established that as plants move from the locality of their largest development toward their northern limit of growth, they become dwarfed in habit, are rendered more fruitful, and all parts become more highly coloured. Their comparative leaf surface is ofted increased, their form modified, and their composition changed. Their period of growth is also shortened, and they are enabled to develope at a lower temperature."

HYPOCHLORITES, when mixed with peroxide of hydrogen, instantly give off all their active oxygen, at the same time liberating the oxygen of the peroxide; therefore the active oxygen of either substance may be easily determined by using an excess of the other substance, and bleaching powder easily obtained. The apparatus used is the ordinary nitrometer. A solution is made of 10 grms. bleaching powder in 250 c.c. water, 5 c.c. = 0·2 grm. is poured into the flask of the apparatus, and an excess, say 2 c.c., of commercial peroxide of hydrogen placed in the inner tube. The flask is then connected with the apparatus, the solutions mixed together by shaking, and the amount of gas evolved measured off in the usual way. The whole operation is complete in from one to two minutes.

A CORRESPONDENT of the editor of the *Scientific American* replying to a question upon a durable whitewash says:—"The best wash that I have ever heard of is made as follows:—For one barrel of colour wash—half a bushel white lime, 3 pecks hydraulic cement, 10 lb. umber, 10 lb. ochre, 1 lb. Venetian red, ¼ lb. lampblack. Slake the lime; cut the lampblack with vinegar; mix well together; add the cement, and fill the barrel with water. Let it stand twelve hours before using, and stir frequently while putting it on. This is not white, but of a light stone colour, without the unpleasant glare of white. The colour may be changed by adding more or less of the colours named, or other colours. This wash covers well, needing only one coat, and is superior to anything known, excepting oil paint. I have known a rough board barn washed with this to look well for five years, and even longer, without renewing. The cement hardens, but on a rough surface will not scale."

PROFESSOR HEIM has made a careful survey of the Alpine glaciers, and reckons them at 1155, of which 249 are each longer than 7500 metres—more than 4⅝ miles. French territory includes 144 of them, Italian 78, Swiss 471, and Austrian 462. The total superficial area of these glaciers may be set down at between 3000 and 4000 square kilometres, or between six and seven times the area of the Isle of Man. The area of the Swiss glaciers is laid down in the official surveys at 1839 square kilometres; the bulk of the remainder falls to Austria. The longest of all is the Aletsch glacier, which is over 24 kilometres—about 15 miles—in length. As to the thickness of the glaciers, no reliable data are forthcoming. It may be remembered that Agassiz, in the series of investigations and measurements which he carried out on the Aar glaciers over forty years ago, excavated to a depth of 260 metres—over 853ft.—and had not got to the bottom. He estimated the depth of the Aar glacier at a point a little below the junction of the Finster-Aar and Lauter-Aar glaciers at 460 metres, or about 1510ft.

IN the *Archives de Genève*, Professor Brun has published an interesting study on the so-called lightning holes to be found in the High Alps. He and other investigators have found them at heights of from 3348 to 4000 metres, or between 11,000ft. and 13,000ft. above the sea level. Usually they are found on summits. Sometimes the rocky mass, which it is supposed has been vitrified in the passage of the electric fluid, presents the appearance of small scattered pearls, sometimes of a series of semi-spherical cavities only a few millimetres in diameter. Sometimes there are vitrified rays going out from a central point to a distance of four or five inches. Sometimes a block detached from the mass appears as if bored through by a cannon-ball, the hollowed passage being quite vitrified. The thickness of this vitrified coating or stratum never exceeds a millimetre, and is sometimes not more than the quarter of that depth. The varying colours which it presents depend on the qualities and composition of the rock. The same may be said as to its transparency. On the Rungfischhorn the glass thus formed by the lightning is black, owing to the quantity of actinolith which the rock contains. It is brown on La Ruinette, the rock consisting of feldspar mixed with gneiss containing chloride of iron. Under the microscope these lightning holes display many interior cavities, which must be attributed to the presence of water in the rock at the moment of melting by the electric discharge. This vitrified material has no influence on polarised light.

MISCELLANEA.

MESSRS. HARPERS, Limited, of Aberdeen, have removed their London office to 60, Queen Victoria-street.

MR. JOSEPH HAMBLET, of West Bromwich has received the order for the whole of the bricks required in the construction of the Tower Bridge over the Thames.

ON Monday, Mr. A. B. Forwood, Parliamentary Secretary to the Admiralty, commenced his investigation into the work of the civil departments of Portsmouth Dockyard, being accompanied by Professor Elgar, Director of Dockyards.

MESSRS. JOSEPH WRIGHT AND CO., Tipton, have determined to re-start their large cable and anchor works, which have remained closed during the last five years. These works are very extensive, and when in full work find employment for some hundreds of hands.

THE Birmingham Exhibition is proving an immense success. The attendances are exceeding the expectation of the promoters, and are so large that to prevent overcrowding in the evening it will probably be found necessary to close the admittance doors two or three hours before closing time.

THE Newcastle City Council, at a special meeting held on Wednesday week, decided to confer upon Sir William Armstrong, head of the Ordnance, Engineering, and Shipbuilding Works at Elswick, the honorary freedom of Newcastle-on-Tyne. Sir William's scientific attainments and great benefactions to the city were given as the reason for conferring the honour.

IT is made known that the Town Council of Bombay have accepted the tender of Messrs. Walsh, Lovett, Mitchell and Co., of Calcutta, Bombay, and Birmingham, for the total coustruction of the Taasa Duct—conduits, tunnels, pipe-line, pipe laying, and the bridges over the Bossein Creek, from Ghatkopar to Taasa Dam, at a cost of forty-two lacs of rupees—£420,000 nominal—and a bonus of 8000 rupees for every month. The contract is to be completed before 1st January, 1891.

IT has been decided to inaugurate on June 1st, 1887, in the machinery buildings and gardens of the Lima Exhibition, under the auspices of the Government of Peru, and with the co-operation of the Administrative Society of the Lima Exhibition and the Special School of Mines, a mineral exhibition, the principal object of which is to make known to the world the great mineralogical wealth of the country. All objects intended for the Exhibition will be exempt from every kind of fiscal and municipal duties.

SOME speculation is excited this week as to what may be the effect upon the American iron business of the falling off in the natural gas supply in Pennsylvania by reason of the earthquakes upon the continent. Should the supply of this cheap fuel to the Pittsburgh ironworks and foundries be cut off, the consequence will be to increase the cost of American production, and possibly to give English iron a somewhat better chance in the States. At present the revival in the American iron trade has not much affected the Birmingham district.

ON the Continent at one works an experiment of an interesting character has been made in order to prevent the evils arising from all the workmen being in funds at the same time. The staff is alphabetically divided into four groups, each of which is paid fortnightly; one on Tuesday and one on Friday of one week, the other two on the same days in the following week. The results are said to be satisfactory as regards the prevention of temptation to general excessive drinking, there being about 1400 hands employed.

THE employés of Messrs. Manlove, Alliott, Fryer and Co., of Bloomsgrove Works, Nottingham, assembled on Monday evening at the works, under the presidency of Mr. J. M. C. Paton, the general manager; Mr. E. A. Manlove, manager of the Glasgow house of the firm; Mr. Thos. Cantrell, Mr. W. Moss, &c., and presented a testimonial to Mr. Fred. H. Manlove on his attaining his majority. The testimonial, which consisted of a valuable epergne, bore the following inscription:—"Presented by the employés of the Bloomsgrove Works to Mr. Fred. H. Manlove as a token of their esteem on the attainment of his majority, August 9th, 1886."

AN international competition of machines and implements for the cultivation and the treatment of rural hemp will open at Ferrara on August 20th, 1887, and will be closed on the 31st of the same month. Inventors, manufacturers, and agents, national and foreign, can take part in the competition. An Executive Commission provides everything deemed necessary for the success of the competition. The machines and implements admitted to the competition are divided into the following classes:—Class 1, ploughs for deep works; Class 2, special hemp sowers; Class 3, breakers, scutchers, teazers, and shakers, single; Class 4, finishing breakers, performing by themselves the complete separation of the fibre from the rotten stalks, and yielding at least 200 kilos. of dressed hemp per hour at a cost of labour not exceeding in the whole 6 lire per 100 kilos. Medals and other awards will be made. Full information may be obtained at the Italian Consulate, 31, Old Jewry, E.C.

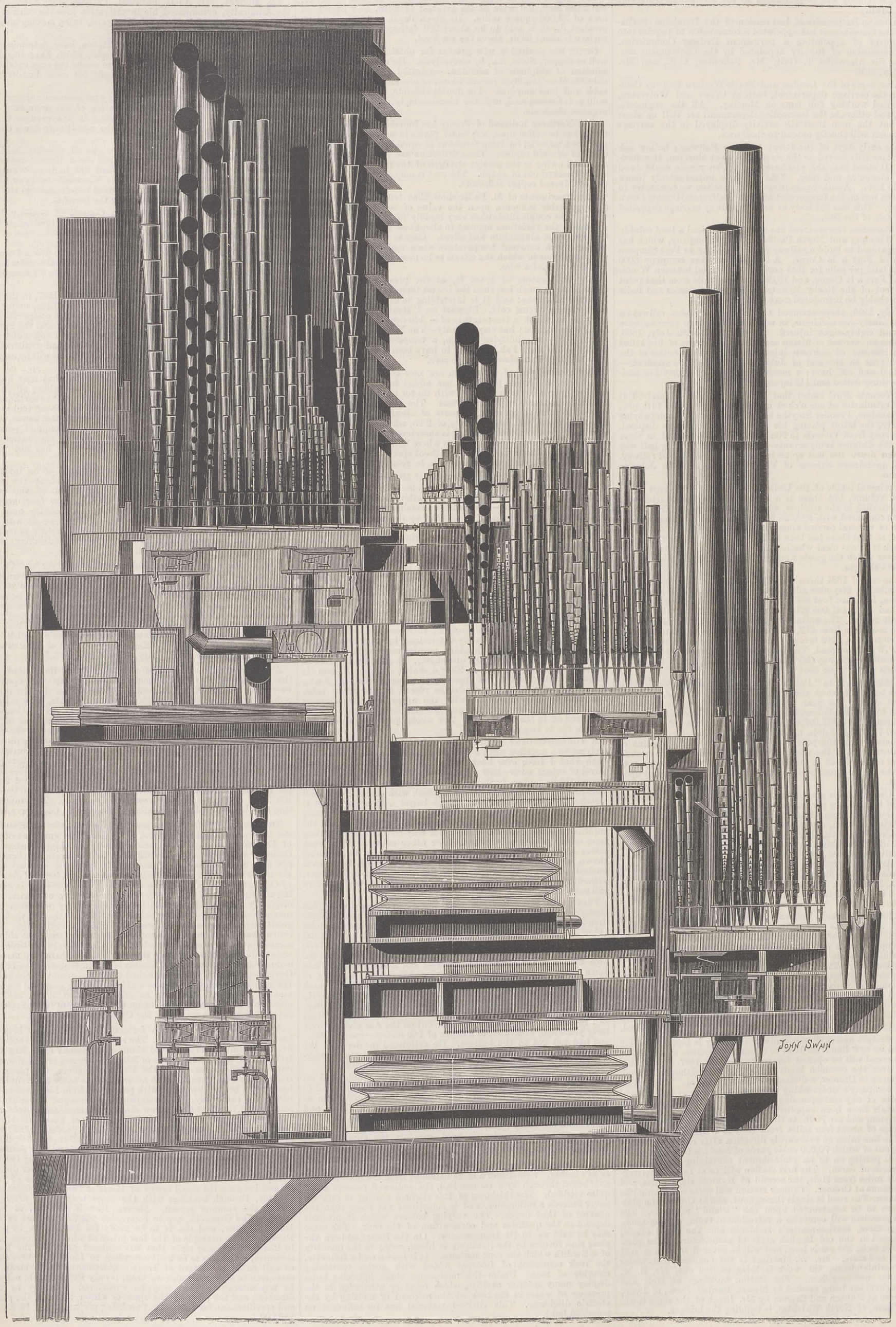
THE Spanish *Official Gazette* has published an order addressed to the Director-General of Customs, authorising the entry into Spain of English goods on a declaration made by the shipper before the Collector of Customs at a British port, the declaration to bear the *vise* of a Spanish Consul. According to law these *vises* are to be given free of charge. This resolution—says the *Liverpool Journal of Commerce*—seems to dispose effectually of a difficulty in carrying out the terms of the treaty between the two countries. As originally drawn, the stipulation in the treaty was that each manufacturer should verify before the local authority that the goods proposed to be shipped were of British manufacture. This course was objectionable, inasmuch as it involved upon the shipper some expense, unnecessary trouble, and a loss of valuable time. So serious did the matter appear that several merchants in the city communicated through the Chamber of Commerce with the British Goverment, who in turn approached the Government at Madrid on the subject, showing the unreasonableness of the proposed requirements. The result has been as officially stated above, and the merchants of Liverpool have reason to feel grateful for the spirited action taken in the matter by the Chamber of Commerce.

A NEW company has been formed to run steamers between Liverpool and the Isle of Man. The island is distant about seventy-five miles from Liverpool, and about equi-distant from England, Ireland, and Scotland, and has of late years become one of the most important seaside resorts in the United Kingdom, the passenger traffic having increased to such an extent that there are frequently four or five boats despatched with passengers from Liverpool to the island the same day. The company has arranged a conditional contract for two first-class screw steamers, handsomely fitted and furnished, having triple expansion engines of about 1500-horse power, and to be fitted with bilge keels which prevent rolling to a great extent. The dimensions will be—length, 225ft., breadth, 30ft.; depth, 13½ft., which dimensions and power are largely in excess of the present screw steamers on this station, and the company further intend building a first-class winter or spare boat of smaller dimensions, which will be useful for trips and the conveyance of passengers between the small towns of the island and to Douglas and Ramsey, through bookings with the large boats being arranged during the summer season. Messrs. Russell and Co., of Port Glasgow and Greenock, are to commence the first steamer on the 1st of October, and she is to be ready for her station by next Easter. As an example of the low prices at which steamers may be had now, we may state that the contract price for the large steamers, which are to be built according to Lloyd's highest class as well as to the Board of Trade requirements, and to steam at seventeen to eighteen miles an hour, is only £18,500 each, subject to any alterations that may be considered necessary by the directors, and the price of the spare or winter steamer, the plans and specifications for which are now being prepared, will be about £10,000.

ORGAN AT THE LIVERPOOL EXHIBITION.

CONSTRUCTED BY MESSRS. MICHELL AND THYNNE, ADDISON WORKS, KENSINGTON.

(*For description see page 207.*)



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CONTENTS.

TO CORRESPONDENTS.

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H. A.—*Messrs Rowan and Co., engineers, Glasgow.*

SMALLEY'S PATENT PISTON.—*For the words "springs are forced out," occurring in our description of this piston published last week, page* 183, *read "rings are forced out." There are no springs in this piston.*

STUDENT.—*You can obtain any of the lists of which you speak by writing direct to the head offices in Paris and Washington, and subscribing for them. You can consult them free at the Great Seal Patent-office Library, Southampton-buildings, Chancery-lane.*

J. S. MCL.—*The Free Library at the Great Seal Patent Office, Chancery-lane, is now open in the evening, and you will find there all the books you can possibly want. There is also a Free Library at the Guildhall. If you have time you can attend the classes at the City of London Guilds Technical School, Tabernacle-walk, Finsbury, for a very small fee.*

J. T.—*If you have served an apprenticeship in the shops of at least three years, you must get yourself appointed as third engineer in some cargo boat. After you have served* 365 *full days at sea, you can go up before a Board of Trade examiner at any principal port and pass as second engineer. Third engineers require no certificate. Another clear year of sea service must elapse before you can go up for a chief's certificate.*

PITCHOMETERS.

(*To the Editor of The Engineer.*)

SIR,—I should be glad if any of your readers could inform me who are makers of Macfarlane's pitchometers. J. A.
Dartford, August 31st.

FIELDS FOR EMIGRATION.

(*To the Editor of The Engineer.*)

SIR,—I shall be glad if any of your numerous readers can give me any information as to what part of the world would be the most likely for a young civil and railway engineer to succeed; also to whom to apply, and any further information. A WOULD-BE C.E.
Manchester, September 6th.

CITY OF LONDON AND SOUTHWARK SUBWAY COMPANY.

(*To the Editor of The Engineer.*)

SIR,—A rumour has lately gone the rounds of a certain portion of the City to the effect that a serious accident occurred upon the above works, resulting in the death of three of the workmen. Will you kindly allow me through the columns of your paper to contradict this rumour, and, moreover, state we have never had an accident of any kind since the commencement of the undertaking? W. I. S. MCCLEARY.
62, King William-street, E.C., London, September 3rd.

THE FESTINIOG RAILWAY.

(*To the Editor of The Engineer.*)

SIR,—In the article which you inserted in your issue of September 3rd, describing these works, we notice that you state that the Festiniog Railway was made by this company. This was not the case. We only manufactured at these works part of the railway carriages and wagons used on that railway. We believe the line was carried out entirely by Mr. C. E. Spooner, C.E., of Portmadoc, who is the present engineer of that company. ARTHUR L. SHACKLEFORD.
(Pro Brown, Marshalls, and Co.)
Britannia Railway Carriage and Wagon Works,
Birmingham, September 6th.

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

DEATH.

At his residence, 1, Bridgfield Villas, Twickenham, HARRY OLRICK, C.E., of 27, Leadenhall-street, in his 35th year.

THE ENGINEER.

SEPTEMBER 10, 1886.

THE TRADES CONGRESS.

THE Trades Congress is sitting at Hull, and on Tuesday morning Mr. Maddison, the newly-elected president, delivered his inaugural address. This address has been reported at greater or lesser length by our daily contemporaries, and we shall not attempt to reproduce it. It may be regarded as, in many respects, an important manifesto, and is well worth consideration. Mr. Maddison holds that capital and labour are essentially antagonistic; that capital has no existence apart from labour, and that capital has far too large a share of this world's good things, grinding down and oppressing labour. "According to the theory of the political economist," says Mr. Maddison, "the capitalist is the great motive power of the world's prosperity, and labour is altogether secondary. The worker has too often been regarded as simply a piece of machinery for producing capital. The truth is, nevertheless, however revolutionary the idea may seem to some, that the capitalist has no existence apart from labour. In a word, there is no capital but labour. Instead of capital and labour being separate, the former is but as the fruit and the latter the tree. The order of the natural world has been entirely reversed in the industrial world. The unfair conditions of labour exist to a greater or less degree in all countries—under the Autocratic Government of Russia, the Constitutional Monarchy of Britain, and the Republics of France and America. That shows that there is some cause existing by which the workers as a body are prevented from participating in the due and legitimate reward of their toil, and the workers of the world will soon ask, with an all-powerful voice, Is the labourer doomed by an eternal law to toil that others may enjoy the products of his industry?"

There is, we need hardly say, nothing new in all this, and there are some things in it which are true as well as old. But the statement, as it stands, is all the same, full of fallacies—or which are more dangerous, half truths. It is quite correct to say, for example, that capital is the product of labour; but all the labour in the world will not alone produce capital. Capital really consists of savings. If a working man spends his money as fast as he earns it he will never become a capitalist. If, on the other hand, he spends each year less than he earns then he will accumulate property and will become in a smaller or larger way a capitalist. Capital, then, is not the creation of labour alone, but the creation of labour and habits of saving. Furthermore, it does not appear that as the world is now organised it is possible for labour to achieve anything without the aid of capital. That is to say, modern labour must depend for its useful employment on the results of the thrifty habits of some person or persons who have gone before. If the capitalists were abolished to-morrow, and the money and property which they possess were to be equally distributed, the process would be robbery, and the result would be either disastrous in the sense that all manufacturing operations would be stopped and labour would come to an end for the time, or else by the natural progress of events it would begin to accumulate again in the hands of the thriftier members of the community. These are such truisms that it appears almost waste of time to pen them. It may be said, however, that Mr. Maddison does not really mean that capital should be distributed to the last penny, but only that it should get a smaller share than it gets now of profits—that, in other words, the labourer should get larger wages. This would be effected by the thorough cosmopolitan organisation of labour; by the refusal, in short, of all working men to accept wages as low as they are now. It would be quite practicable, we may assume, to carry out this resolve; what would be the result? Mr. Maddison assumes that the working man would be much better off than he is now. The truth is that he would not be anything of the kind. The result would be simply to degrade the value of gold. So long as the same quantity of consumable commodities was produced, the working man would be neither better off nor worse off, because of a rise in wages. The cost of everything made would increase in the same proportion. If he had double as much wages next year as he has now, he would find the value of everything produced by labour just doubled in value, for the value of everything now is fixed by the quantity wanted and available, and the cost of production. But Mr. Maddison holds that labour produces everything. Therefore if the cost of labour goes up, so must the price of everything. The value of gold would be diminished. But the capitalist of whom Mr. Maddison speaks does very little with gold. The capital of an engineering firm, for example, is largely represented by the tools and other machinery, and the buildings which it possesses. But as these depend in their turn for their value on the price paid for the labour expended in producing them, the capitalist would not suffer by the change, and the relations between labour and capital would remain just what they are now. The working men in the United States get higher wages than they do here, but if we are to believe them they are not one bit better off than English men. But no doubt Mr. Maddison's theory is that when wages went up prices should not go up at the same time, for the capitalist would have to pay the difference. There is no reason to think that this result could possibly ensue, unless, indeed, we lived on our past savings, which could have but one obvious end.

The truth is that the war of labour is not against capital, but against the capitalist. Foreign working men delegates are honest enough to say this openly. We do not assert that Mr. Maddison would wish to wage war against employers. But we are not quite sure that his sympathies do not run in the direction of such a war. Fortunately or unfortunately, capital accumulates in the hands of a comparatively small number of individuals; and the great majority do not see why the minority should be better off than they are. They see that the heads of firms live in better houses, and have more of this world's goods than they have, and they ask, Why is this? The true answer is that it is so because the money earned by capital goes into one pocket, while the money earned by labour goes into a great many. We have already on a former occasion called attention to this point. It is worth while to call attention to it again. We may suppose that there are two partners, who in a given engineering business make each £2000 a year. They will employ, say, 500 hands, each earning on an average, let us suppose, 30s. a week. The men say that in such a case capital is getting a great deal more than its fair share of profits. Let us assume that capital is to get no share whatever, and that the partners are only to be paid as managers, and get, because such men as they are are comparatively scarce, £500 a year each by way of salary. This leaves available for distribution among the men £3000 a year, or £6 per annum each—2s. 3½d. a week each. Here we have a case where capital gets no profit at all. But it does not appear that the lot of the working man would be sensibly improved. The word "profit" is greatly misused, and it may be shown that all wages are really profits. In such a concern as that of which we write, the wages paid would amount to no less than £37,500 a year, assuming the working year to consist of fifty weeks. Thus on the year's transactions labour would get very nearly ten times as much profit as capital, to say nothing of the fact that the entire loss of the capital was risked daily. Even Mr. Maddison will, we think, admit that, regarded from this point of view, capital does not get too much. The shoe pinches because the share that labour receives has to be divided among so many, while the share that capital receives is divided among a few. But this is a condition of affairs that organisation, or trades' unions, or legislation can never alter. It is inherent in humanity that some men should accumulate more property than others, and it will be so to the end of time.

Mr. Maddison getting away from the capitalists was on firmer ground. He would be glad if means could be adopted by which the trackless forests of Australia, America, and elsewhere could be peopled by industrious men and women "who by their labour would add to the prosperity, not only of themselves but of the world generally. Any such scheme, under direct Government supervision and entirely voluntary on the part of the emigrant, would, he was of opinion, be heartily supported by the Congress." Turning next to co-operation, he said this was one of the inevitable results of the present restlessness of the relations between capital and labour. "By that means capital would take its legitimate position as the servant of labour, and not, as too often now, as the dictator and oppressor of industry and toil." That was one of the subjects they would be called upon to discuss, and he had no doubt they would be able to show that co-operation was a necessary outcome of the Trades Union movement, always providing that any scheme of co-operation was conducted on the laws of strict union principles, and also that the promoters were men and women who had the confidence of the trade societies. It is impossible to take an exception to schemes of co-operation. Co-operative manufacturing concerns supply the best possible means of instructing working men in the first principles of political economy. No bloated capitalist here runs away with more than a fair share of the profits. Yet it is worth while to ask whether the gross receipts of the hands in co-operative works is greater per annum than it is on the ordinary system, and if so, how much. This is a point which we would be glad to see definitely cleared up.

The proceedings which followed Mr. Maddison's address were not of a specially interesting character, save in so far as they showed that there is some want of unanimity among the members. For example, there was difference of opinion as to whether it was or was not right that men should be permitted to contract themselves out of the Employers' Liability Act. On this we have not space to dwell. When the Congress has concluded its labours we may consider what it has taught the world.

PHYSICAL SCIENCE AT THE BRITISH ASSOCIATION.

THE addresses and lectures delivered and papers read during the present meeting of the British Association, supply food for thought, and lead up in many cases to deductions and conclusions possibly not foreseen by their authors. We have before us the utterances of many men standing high and possessing admirable reputations. They have set before us the theories and conclusions at which they have arrived after much labour. It is impossible not to admire the skill, ingenuity, and patience with which these men have sought to compel nature to reveal her secrets. It is equally impossible to avoid disappointment. The work has been so hard, the result so inconclusive and unsatisfactory. Is it not all vanity and vexation of spirit? We have in our midst a small body of men who are, to themselves at all events, the very salt of the earth; the very embodiment of all that is best and greatest in the world of science. Yet to what end do they work? How

far and in what way is the world the better of their labours? The answer must be, we fear, that it is not the better in any way. Old ground is gone over in a new way, and to those who dare to speak of things as they are and to estimate the value of work in terms of its results, the utterances of the British Association philosophers sometimes tend rather to excite pity than praise.

Let us begin with the address of the President. It is a history of the formation of the Atlantic Ocean. Let us assume that this history is entirely accurate, and ask ourselves what does a knowledge of that history lead to? Can it in any shape or way promote the happiness and prosperity of the human race? The answer must be that it can do nothing. The world would be, must be, in all respects after this history as it was before. But there is actually no certainty whatever that this history is true. From beginning to end it may be entirely inaccurate. Men not less able in his own way than the President of the British Association will reject all his assumptions as untenable. Cognate to this address is what is virtually a dispute between Professor Darwin and Sir W. Thomson. The latter fixed the age of our solar system at something comparatively small, a dozen millions of years or so. It cannot be more, we are told, or the theory of the conservation of energy breaks down. Professor Darwin refuses to be bound by such limits or considerations; the universe must be of an antiquity beside which Sir William Thompson's period is a little span. Which of the two is right? Who shall say? Is it of the smallest possible importance to us or to our children whether either or neither is right? In an old volume of the Philosophical "Transactions" is a report of a council meeting held to investigate the truth of the statement that a spider will not cross a line of ashes from the horn of a deer. The circle is drawn on a table, round which sit the councillors. A spider is obtained, placed within the charmed ring, and incontinently scuttles across it. There may be some error in this experiment, so the spider is caught and recaught, and trial is made over and over again, and the philosophers come to the conclusion that there is nothing in the statement—that, in a word, it is not true. There is a wonderful similarity between this experiment and Professor Rücker spending long hours and the best energies of a by no means feeble brain in measuring the thickness of a soap bubble. The old philosophers really did better work with their spider than Professor Rücker with his soap bubbles. They lived in the age of superstitions—people invested plants, stones, animals, with all manner of uncanny attributes. To prove that a spider would, against the popular belief, cross a ring of hart's horn ashes was to break down a superstition; and superstitions are like rows of bricks set on end, overturn one and a dozen fall with it. But when Professor Rücker had told his audience that where the black ring in a soap bubble occurs the film is but the thirty-sixth millionth of a millimetre in thickness he had advanced the sum of useful human knowledge by nothing. The figures he used convey no idea whatever to the human mind, and it is beyond Professor Rücker's powers or that of any other man living to prove that they are accurate. Their measurement is based first of all on a theory of light, still taught carefully in our schools and colleges as perfectly true, although it has long been known to those who are behind the scenes that it is at best but a shaky and imperfect working hypothesis. Are we to say that Professor Rücker shall not investigate the thickness of soap bubbles? Certainly not. But let us, like sensible men, estimate the value of his labours at just what they are worth. For ourselves, we can only regret that so able a man could not find more useful employment.

Let us turn now to Mr. Crookes' speculations on the nature of the elements. We are here face to face with labours of a very different kind. If it were possible to break up iron, oxygen, gold, &c. &c., into something else, or to find in nature that which combined would produce these things, the most important results to mankind might follow. We have to do here with a speculation of enormous possibilities, in which respect it differs very widely from Professor Rücker's investigations, and ought to possess much value. But when we come to read Mr. Crookes' address, we find ourselves confronted with little more or less than a poetical rhapsody, a disquisition which anyone with brains and a fine imagination might produce. Mr. Crookes introduces his hearers to primoidal matter, concerning the nature and characteristics of which neither he nor any one of his readers has the smallest conception. We are made acquainted with that great world of the might-have-been, dear to the soul of the cosmical philosopher, and about which anything may be said provided there is imagination enough and courage enough, and sufficient power of putting on one side little difficulties. An admirable example of the possession of this power is supplied by a recent and elaborate paper by Sir W. Thomson, on capillary attraction. The author does not hesitate for a moment to speak of attraction. He deals with the attraction of one particle or molecule or atom for another, and he speaks gravely and learnedly about attraction as a thing that must be, entirely oblivious to the fact that if attraction exists then the whole law of the conservation of energy is a myth; and power not only can be created but is created every day. It is enough to make Newton turn in his grave to hear a man of science talking gravely of molecules attracting each other. The proof that attraction is incompatible with the law of conservation of energy is extremely simple. Let us have two particles constituting a system. These particles attract each other, and being free to move they approach each other; therefore they obtain momentum, or in other words, energy which they did not possess before. But this energy has been developed in the system, not obtained from any external source, which is flatly opposed to the first law of motion. Again, the momentum thus imparted to the bodies can, by the law of the conservation of energy, never afterwards be lost; when the particles come into collision, they lose their momentum and are brought to rest, but the energy which they contained is converted into heat or some other form of energy. Thus every time one body causes motion by attraction in another body, or in itself, it creates energy, which is absurd; therefore there is no such thing as attraction. This is a digression. Let us return to the men of science at the British Association.

Are we to be understood to assert that there should be no such thing as scientific research? Certainly not; the more research the better. But let us not assume that the searcher after Nature's secrets is always to be glorified as a species of demi-god. In all the other relations of life a man is valued for what he does, for the results he produces; but it is not so in the case of the man of pure science. Large sections of the public are disposed to bow down and worship such men. Nothing that we can say is likely to disturb their equanimity. There can be no harm therefore in asserting that the man of "pure" science, the physical investigator, the "researcher," if we may coin a word, has up to the present done very little indeed to promote the well-being of the world. It is a noteworthy fact that to such men the world owes practically nothing. Even the inventions and discoveries of recent date, which most depend, it would be fancied, on scientific investigation for their origin, have sprung from the brains of men knowing nothing and caring less for research. The men of science somehow or another are always too late. When a machine has been invented they will explain the laws on which it works, and supply information, sometimes very valuable; but somehow they do not originate anything. Their functions are analytical. In synthesis they are nowhere. The practical man will take the man of research at his true value. He will make use of him. He will not give him large sums of money to spend on little, useless experiments, leading to nothing but the glorification of one man in the eyes of a small section of the world. He will turn him into better paths. He will employ him in working out the solution of problems of real importance; and a day may yet come when the speakers at the British Association will, one and all, be able to prove that they have been doing good work and making themselves useful. There will always be dreamers among us, and they will now and then make useful discoveries, and their writings and their work may be valuable; but these men will get on without State aid or "endowments." We leave them in peace, we wish them success, but we raise our voices in protest against so-called science put forward in a cloud of words—gigantic, high-sounding words, which deceive the unwary, while they excite a smile among those who know how hollow it all is, and how utterly useless in the long run most of the research work done really is. In the writings of one of the Fathers will be found a disquisition concerning the possible number of millions of angels that can dance on the point of a cambric needle. For angels, read atoms; and exit the saint, enter the modern philosopher.

MARINE BOILERS.

When the compound engine had been fully developed and perfected structurally for use at sea, it was said that no further improvement in engines was possible, and that the minds of men must be turned to improving steam boilers. Nothing whatever was done in this direction, however—that is to say, in the sense of augmenting the economic efficiency of marine generators. The invention of the corrugated flue by Mr. Fox, or, more correctly speaking, the development by that gentleman of machinery by which such flues could be manufactured with certainty and soundness at a reasonable price, rendered possible the use of pressures which, without such flues, could not be carried. Various other advances were effected in the structure of marine boilers; but whether made of steel plates $1\frac{1}{4}$in. thick or of iron plates $\frac{3}{4}$in. thick, whether the pressure be 150 lb. or 70 lb., the marine boiler as a steam generator is just what it was many years ago. We have the same huge circular flat-ended shell, the cylindrical furnace, the rectangular combustion chamber, and the comparatively large and short tubes, extending from the combustion chamber to the up-take leading to the chimney. The steam engine has, contrary to expectation, recently undergone new developments, and triple expansion promises to eject double expansion, just as this last turned the non-compound engine out of ships. It is not to be supposed, however, that no efforts have been made to improve the design of steam boilers. Every effort, however, made in this direction has resulted in failure, and it is worth while to say a few words to explain why.

It is obvious that for very high pressures, such as are now carried, boilers of the water-tube type seem to be best adapted; and accordingly such boilers have been tried. To say nothing of the failure of Jordan's gigantic experiment and disastrous failure of years ago, other and more promising systems have been tested. Boilers which performed well on land have been tried fully and fairly at sea. One very successful type of water-tube boiler was fitted to certain of the great Liverpool and Birkenhead ferry-boats, and was tried for years. All these boilers have been removed. It is not that they burn their tubes or waste fuel, or refuse to supply dry steam. In these respects they are fairly satisfactory. The defect which kills them is that they will not make steam enough. Space on board ship is limited, and it is of the last importance that as much steam as possible shall be generated in that space. But the water-tube boiler, at all events as hitherto constructed, will not, space for space, make more than about 60 per cent. of the steam that an ordinary marine boiler will supply. It is not so much that the water-tube boiler does not contain heating surface enough, as that the surface is not very efficient. In nearly all cases the heated products of combustion are compelled during one portion of their flight to the chimney to pass down among the tubes, instead of up, and the top surface of the tubes is practically quite useless for steam generating purposes. Hence a great portion of each tube is of no service. This may account for the fact in one way. Again, such boilers will not bear forcing. When they are large, and the quantity of coal burned per hour bears a small proportion to the total heating surface, they perform fairly well, are economical, and very safe; but such conditions do not exist at sea, and so the water-tube boiler has been taken on its merits and failed. Various other systems have been tested. Several promised well, but they have all been finally condemned; and it may be safely said that outside ships of war, nothing is to be found but the ordinary cylindrical or oval return flue double or single-ended boiler. Over and over the use of the locomotive boiler has been urged on shipowners. It has been tried and found wanting. The tubes have been a fruitful source of trouble by leaking, and the boiler is given to prime. Besides, it is essential that it should be worked with pure water, quite free from salt, and this cannot be had at sea unless expense and trouble are encountered, which shipowners do not like. There are no facilities at sea for washing out a boiler such as exist on every railway. The ordinary marine boiler will run for a couple of months without being opened or examined; not only will it do so, but it very often has to do so. This would be quite impossible with the locomotive boiler. For practical success at sea it is certainly known that there must be a large body of water in the boiler, and a large surface from which steam can liberate itself. If we take the case of a locomotive boiler working up to 500-horse power we shall find that the whole of the steam has to be given off from a water area of about 40 square feet. In a marine boiler doing the same work, the surface will be at least double as much. The locomotive boiler works without priming, no doubt because the water within it is violently shaken by the oscillation and jolting of the engine as it runs. No one has ever yet succeeded in getting as much dry steam out of a true locomotive boiler when fixed—that is to say, one with small tubes and plenty of them—as can be got out of a similar boiler running across country. The motion of a boiler at sea is totally different. Except in small ships in heavy weather, the motion is an easy roll, which would have practically no effect on a locomotive boiler. Our readers interested in this question will best understand what we mean if they will nearly fill a bottle with boiling-hot water, and cork it lightly. On then shaking the bottle, the cork will be blown out by the pressure of the steam liberated from the water by the shaking. It is quite true that locomotive boilers are used in torpedo-boats, but it is well known that, to use an expressive Scotch phrase, such boilers are "kittle cattle." They are always on the point of priming, and require the most judicious management to prevent it. The experience obtained with such boilers is not of a character which would justify their adoption in the mercantile marine.

Various forms of marine boiler have been tried in which the use of brick walls, or chambers, is involved in some way. These have all proved intolerable at sea. The marine boiler must be absolutely self-contained—a thing that can be hoisted in or out of a boat complete; and the only direction in which it seems possible that any change for the better can be found lies in reducing the diameter of the boiler shells and using more of them combined in some way yet to be found out. Mr. Howard, of Bedford, devised a boiler of this kind long ago, which was very fully tested by Lloyd's engineers. It did not comply with the necessary conditions; but it is not impossible that more may be done in this direction. Mr. Howard aimed at too much. He made his boiler shells too small. It would be very much better in one sense to use two shells, each 7ft. in diameter, with two furnaces in each, than to use one shell 14ft. in diameter, with three furnaces, if only it was possible. We are quite disposed to think that engineers would gladly adopt any change on existing boiler practice, if they could see that such a change would be for the better. But amateur boiler engineers have no chance of effecting such a change. It can only be done by some one who has a consummate all round knowledge of marine boilers, their management, their peculiarities, and the conditions under which they are worked in various trades. Unfortunately, the more a man knows about the modern marine boiler the less hopeful is he that he can improve upon it.

Akin to the subject which we are considering is forced draught, the object of which, as used in the Navy, is to augment the generating efficiency of a boiler; while in the mercantile marine it is proposed for use by Mr. Howden and others as a means of increasing economic efficiency. The matter has been very fully discussed before the North-east Coast Institution of Engineers, and very various opinions have been expressed. It is not too much to say that the practical information possessed concerning it is very meagre at present. In its simplest form forced draught means neither more nor less than a higher furnace temperature, and as this is not accompanied by an increase in heating surface there must be waste of fuel. Chimney temperatures as great as 1200 and even 1300 degrees have been registered, which are in themselves well calculated to produce a strong draught. What the effect of these excessive furnace temperatures is remains to be seen. There is, however, evidence to show that it is very destructive to tube ends, and that it entails difficulties and troubles of a serious character; that it is, in fact, inimical to the whole boiler in a high degree. In its less simple form the size of the grate is reduced, and only the same total quantity of coal is used per hour as without forced draught, so that the whole furnace temperature is not so much raised, but there is more localised heat. The question is how far the system may or may not be conducive of economy of fuel on the one hand, or bad for the boiler on the other. Theoretically there is nothing about the scheme which promises any saving of fuel which it would be worth while to risk a boiler to obtain. But experience is the foundation of all knowledge, and as experience is acquired with forced draught, the truth, whatever it is, will be made manifest. The results obtained up to the present moment have the fault of being too vague, too limited in their range of comparison, or too brief as regards the duration of the tests, to be of much value. Further experiment in this direction is desirable, and should be encouraged. There is, for example, considerable diversity of opinion as to whether the air ought to be forced into the furnace or "sucked" through the tubes; only experience can say which of the two systems is the better—that is, if either is superior to the other.

THE RICHMOND (SURREY) MAIN SEWERAGE SCHEME.

A DEFINITE stage has been reached in the arrangements for dealing with the sewage of the parishes of Barnes, Kew, Petersham, Mortlake, and Richmond. The Joint Main Sewerage Committee—consisting of six representatives of the Urban Sanitary Authority and six of the Rural Sanitary Authority—has arranged, at a cost of £2500, to prevent opposition from the Duke of Devonshire, Captain Popham, and the trustees of Mr. Pulman—three important landowners who have hitherto feared that their adjoining property would suffer from the erection of the proposed works. The committee's engineer has gone into the matter, and on Tuesday the Richmond Vestry, as the Urban Sanitary Authority, sanctioned its committee's proceedings. The arrangements embrace wharfage rights, rights of way, the widening of a bridge, purchase of land, and similar matters. It is announced that the Local Government Board inquiry for the necessary £50,000 or £60,000 to carry out the works will be held next month. It may be remembered that the scheme which sometime ago received the approval of the local authorities was that of Messrs. Mansergh, C.E., and Mellis, C.E. The buildings are to be of a plain farm-like appearance, not higher than 35ft. in any part except the stacks, and surrounded by a plantation of trees. The sanction of the Local Government Board is looked forward to with confidence, and the necessary engineering operations will be commenced as soon afterwards as possible. Much satisfaction was expressed in the district as soon as the proceedings of Tuesday's meeting became known.

MARINE ENGINES IN THE NAVY.

ACCORDING to the *Times* reporter, the barbette cruiser Impérieuse, Captain Fane, has made an extremely successful three hours' full-power trial of her machinery between the Isle of Wight and the mainland. "Her mean draught was 27ft. 6½in. The mean pressure of steam in the boilers was 88 lb., the vacuum 26in. and 27½in. in the starboard and port engines respectively, and the revolutions 83·6 and 85·2 per minute. The average power developed during the run was 4805·44 by the starboard, and 4913·92 by the port engine, giving a collective power of 9719·36 horses, and probably a little more when the calculations come to be revised. Although only ordinary coal was used on the occasion, the mean power indicated on the trial amounted to more than 1700 horses beyond the original contract. Her mean speed, as determined by four runs on the measured mile, amounted to 16·684 knots. The Impérieuse will leave Spithead on Saturday for a month's cruise in company with the Colossus." The Impérieuse is a ship of 7390 tons displacement, and her measured mile speed is given as 17 knots. We suppose that this was obtained when she was not in sea-going trim, for according to the statement above, a power of 1700 horses in excess of the contract power failed to get within a third of a knot of the nominal speed. It is desirable that the meaning of all this should be explained. Furthermore, it will be seen that the full power trial only lasted three hours. Even the ordinary miserable six hours was not attempted. Why? It is quite as desirable that the truth about engines should be elicited as the truth about guns, and the sooner there is a change made in the system of testing our ships and their machinery the better it will be for the country at large.

GAS PRODUCTION AND DISTRIBUTION.

SOME two years ago we gave in THE ENGINEER a short epitome of the report of a Durham gas company, choosing it because of its proximity to the coalfield. It may be interesting now to glance at a later report, and to mark the changes in its condition. The Hartlepool Gas and Water Company has a capital in the gas portion of its undertaking of rather over £150,000. In its last year, that ending with June, 1886, it carbonised or used about 16,590 tons of coals, of which all was common coal except some fifty-five tons of cannel. There were 117,230,000 cubic feet of gas sold at 2s. 6d. per thousand, whilst the gas sold for public lighting and under contract realised £3479. In all, inclusive of meter rents, the gas revenue was £18,089. The coals and carriage to works amounted to £6042, so that it would seem that the cost is not so low as might have been looked for in contrast with metropolitan companies, when the relative distances from a great coalfield is remembered. The cost of the gas as made—the mere manufacture—was £10,183, and the cost of distribution, &c., brought this amount up to £13,382. The gas production left certain residuals—some 7629 tons of coke, in addition to that used at the works, and for which £2500 was the sum received, and there were sums for breeze, tar—176,643 gallons sold for £541—and ammoniacal liquor. In all, then, the receipts for gas and gas products were £22,033, so that there was a profit of £8651 on that part of the company's operations during the year. The water sale did not yield quite so large a profit, but even with this drawback the company paid a good dividend. It would have been larger but for the fall in the value of residuals. In some degree this may be counterbalanced by the step to be taken in the manufacture of sulphate of ammonia and other products from these residuals; but it is clear that for a higher dividend, such as it paid in the past, this Durham Gas Company must look chiefly to a larger consumption both of gas and of water. It serves a large field in which trade has been depressed, but is now recovering, and in that recovery gas and water will be more in requisition.

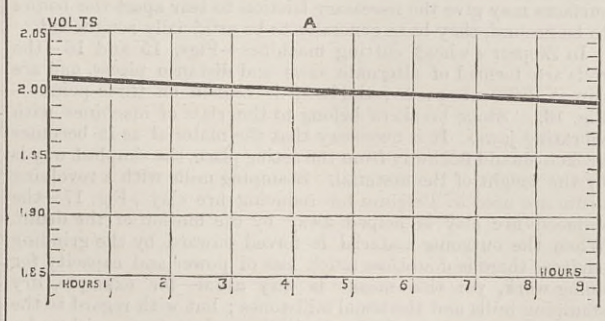
THE SOUND TUNNEL.

AN agent of the Paris bank, the Banque Maritime, has presented a proposal to the Governments of Denmark and Sweden for the construction of a railway tunnel between the two countries under the Sound. The plan, which has been prepared by a French engineer, M. Alexander Rothe, who for some time was employed at the Panama Canal, is for the tunnel to commence a little east of Copenhagen, run under the waterway called "Drogden," where the depth is about 24ft., to the island of Saltholmen in the middle of the Sound, thence under another waterway, "Flintrenden," where the depth of water is almost the same, terminating a little south of the town of Malmo, on the Swedish coast. The actual length of the tunnel under water is estimated at 6½ miles, and it is to be enclosed in a tube of cast iron. The rails will be double, and, it is stated, narrow gauge, which can hardly be correct considering that both the Danish and Swedish trunk lines, which are to be connected, are broad gauge. The cost of the tunnel is estimated at £1,250,000, and the engineer is confident of being able to finish the construction in the course of three years, though the concession stipulates for ten. Soundings have shown the stratum to be pierced to be chalk and flint, as the two above-mentioned names of the waterways indicate in Danish. Up to the present the concession has not been granted, but in all probability leave will be given shortly for the preliminary surveys, borings, &c. The concession is to be granted for ninety-nine years, with forty years monopoly. The promoters state that nearly the whole capital required for such an undertaking is available, it being supported, besides the above-named bank, by the Comptoir d'Escompte and the Banque de Paris. Naturally the scheme has been received with the greatest enthusiasm in the three Scandinavian countries, as it would of course facilitate communication and assist trade. It should especially become important as far as the Continent is concerned, when the German Canal between the North Sea and the Baltic is completed. That the tunnel, as has been started, is the first link in a through communication between Sweden and the Continent there is no prospect, as to tunnel the two Belts would be an undertaking which would be far too costly to pay. In fact, many competent persons in Scandinavia assert that the greatest obstacle to the Sound Tunnel is the vague prospect of its paying It should be borne in mind that the articles Sweden imports are drawn from countries so far distant from her that the tunnel would in no way benefit them, and mere local traffic could hardly sustain it. As yet therefore the Scandinavian Governments have contented themselves by asking for further particulars and guarantees for the prosecution of the undertaking.

ON THE TREATMENT OF SECONDARY BATTERIES.[1]

By BERNARD DRAKE and J. MARSHALL GORHAM.

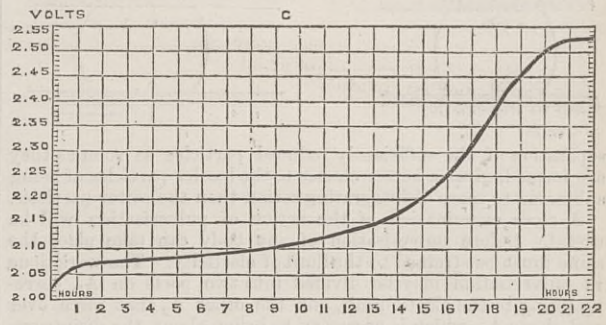
THE possession of a reliable means of storing electrical power is now universally recognised. For electric lighting, whether temporary or permanent, whether domestic or public, it is almost an essential—for the commercial application of electricity to motive power it is a necessity. The theory of secondary batteries or accumulators, by means of which this storage is attained, has already been so ably dealt with, and is probably so well known to all present, that it is unnecessary to enter into it in this short paper, the object of which is to bring to your notice some practical points of treatment which are essential in order to render secondary batteries commercially reliable. These points have been arrived at by experiments carried on by Mr. Gorham and myself in the course of the manufacture of the batteries of the Electrical Power Storage Company. The three main difficulties which we had to encounter were:—(1) The destruction of the lead grid or conductor. (2) The buckling or warping of the plates. (3) The falling out of the active material. These three failings, principally affecting the peroxide plates, militated seriously against the commercial success of accumulators, of which durability forms so important a factor. We therefore carried out a large number of experiments with a view to ascertain their various causes, and, by removing them, to render the secondary battery with which we had to do as reliable for durability as it already was in other respects. Here I may mention that these failings, although common, were by no means universal. For instance, the E. P. S. accumulators in the Bank of England have been in use more than two and a-half years, and continue to give excellent results. That they do so confirms the conclusions to which experiment has led us. We will take first:—(1) The destruction of the lead grid or conductor. This was the most serious difficulty to face, as on it depended the life of the battery. The prevalent idea was that it was due to overcharging; that after the peroxide plate was fully charged any further charge caused an evolution of oxygen which rapidly destroyed the grid. We therefore proceeded to charge some cells without cessation, in order to ascertain the exact amount of current which would entirely destroy the lead conductor or grid. It was soon evident that the process was, at any rate, a slow one; but the experiment



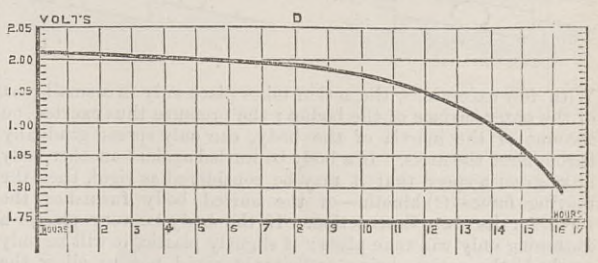
was continued, until the full prescribed current had been passed through, for more than two months. At the end of that time it was found that the lead conductor was practically as sound as before charging. The coating of fine peroxide formed on the surface was very thin; there was no sign whatever of buckling, and, further, the specific gravity of the solution, when the cells were left in their then fully charged condition, remained absolutely unaltered. The conclusion thence drawn was that the oxidisation of the grid caused by charging only penetrated to a very limited depth, and then ceased entirely, and that the coating of fine peroxide formed actually protected the grid, not only from deterioration by overcharging, but also from local action hitherto supposed to be unavoidable. It was then established that the life of the grids was not proportional to the amount of charging, *i.e.*, to the number of ampère hours put into a cell. Was it due to the number taken out? To ascertain this was the object of the next experiment. For this purpose a battery was divided into two halves, one of which A was repeatedly run out, and the other B was never discharged beyond the point at which the E.M.F. commenced to drop. This experiment also extended over a considerable time, but gave the instructive result that when exactly the same number of ampère hours had been taken out of each half, the plates in the first half A showed signs of expansion or growing, whereas in those of the second half B no change could be detected. The life of the grid then was also not dependent on the amount of ampère hours taken out, or on the work done, but on the treatment of the plates, first as to charging up, and afterwards as to total or partial exhaustion. Further, it was satisfactorily proved that there was no necessity to employ a conductor of unoxidisable material, providing the simple precautions were taken—First, to fully charge the cells; secondly, to avoid discharging them entirely. The second point to be considered is:—(2) The buckling of the plates. This had hitherto been attributed to two or three causes—charging too rapidly; discharging too rapidly; impurities in the acid or oxides employed. Experiment soon showed that the real cause must be sought for elsewhere. We found that the buckling was almost invariably accompanied by a hard white enamel—sulphate of lead—on the face of the plates, and further, that where the extra cells in a battery had received more charging than the remainder, the plates in these cells were frequently quite free from sulphate, and the consequent tendency to buckle, while the rest of the battery had failed. This proved that the enamelling could be prevented by charging, and was not due to impurities in the oxides or acid used; further, that when the plates were free from sulphate there was no tendency to buckle. Experiment also showed that in the case of the first use of cells, when the acid was first put in, the specific gravity dropped in spite of the charging, indicating the formation of sulphate; by persevering in charging the sulphate disappeared, and with it the tendency to buckle. The conclusion was then, that in order to avoid buckling of the peroxide plates, cells on their first use—whether new or after long disuse—should be charged incessantly until they are considerably overcharged. Hence the radical change in the instructions issued to users of the E.P.S. batteries. Whereas hitherto they had been specially cautioned against overcharging, they are now urgently required to overcharge new cells, and to charge incessantly. (3) The separation of the active material. In almost every case where this occurred the plugs of active material fell out of the plates in complete halves and in a very hard condition; and

[1] British Association, Section G.

analysis showed that they contained an excess of sulphate, due, as before explained, to insufficient charging. On the other hand, in a few instances the active material was found to have become disintegrated and fallen off in a fine powder, and this was specially observable when, on account of a leak in the receiving vessel and consequent frequent addition of water, the solution had become extremely weak. In this case practically no sulphate was present, and the mass lost cohesiveness. The conclusion is, then, that a certain proportion of sulphate in the material is necessary to bind it together, but that excess must be avoided. This due proportion once ascertained, the third difficulty is overcome for all the ordinary work of secondary batteries. It should be mentioned, however, that there is a constant demand for an accumulator which can be discharged without injury at an abnormal rate for special purposes. Such rapid discharge results at present in the scaling off of the oxides and destruction of the plates, but as it causes the formation of sulphate, which is the binding, not the disintegrating agent, the cause of the scaling, and therefore its remedy, must be sought elsewhere, and on this point discussion is invited. I venture briefly to recapitulate the conclusions to which our experiments have led us:—(1) That the life of the leaden grids or conductors, and their freedom from buckling, are in no way dependent either on the amount of charging or discharging of the cells. (2) That cells on the occasion of their first use, and also after long intervals of idleness, should be very fully charged, and in the first case incessantly. (3) That they should never, under any circumstances, be entirely run out, and, in fact, should not be discharged below the point at which the electro-motive force begins to drop perceptibly. (4) That the coating of fine peroxide formed during charging is actually a protection to the plate against the injurious effect of



overcharging, and against local action. (5) That a certain small proportion of sulphate is necessary to give cohesiveness to the active material, but an excess of it causes the oxide to separate bodily from the conductor. If the precautions here indicated be taken, we believe that the accumulators now made by the company with which we are connected will answer every ordinary commercial requirement during a very considerable time, but an accumulator is not at present known which, without sacrificing capacity and efficiency, will stand the extraordinary rate of discharge sometimes demanded. As we thought it might be of interest to give some reliable figures on the results which may be expected from cells as they are now made, we have, during the last few weeks, made very careful tests with some cells taken at random from stock and worked in accordance with the practical requirements of an electric light installation. It will be seen from the curve marked A, which is the mean of six consecutive discharges, that the E.M.F. is practically constant during a discharge of such duration as the cells would ordinarily be called upon to give, namely, nine hours—the fall of E.M.F. during this period amounting to only ·02 of a volt. When the cells were discharged for 4½ hours, left standing for a day, and then discharged for another 4½ hours, the result was exactly the same as when the discharge was continuous, both as regards E.M.F. and efficiency. In fact, we were able to obtain a short time back from a similar cell, left fully charged for a month, an output of 380 ampère-hours. The charging of the cells under test was always continued for about an hour after the gases commenced to be given off, so as to comply with the requirements of our working instructions, and to keep the plates in good order. This naturally reduced the efficiency or return both in ampère-hours and watt-hours; but in spite of this over-charging the result of six consecutive charges and discharges gave an efficiency of 90 per cent. ampère-hours and 80 per cent. watt-hours. Curve D shows the capacity of the cells in ampère-hours when discharged at 25 ampères rate, and is the mean of two continuous discharges. It will be noticed that with 10 per cent. drop of E.M.F. the capacity is over 400 ampère-hours, and that the maximum output given in the lists of the company is reached with a drop of under 5 per cent. in E.M.F. The curve marked C shows the rise of E.M.F. during the

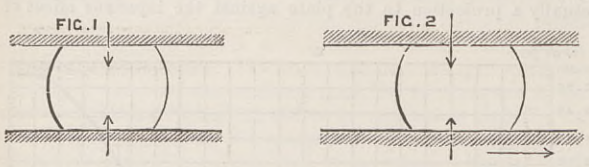


charge, the current being throughout kept constant at 22 ampères. It will be seen that at the commencement of the charge the E.M.F. required was only 2 02 volts, that after 220 ampère-hours had been put in, representing about half the charge, the E.M.F. had risen to 2·13, and that when the cells were giving off gases freely the E.M.F. was as high as 2·53 volts. This curve will no doubt be of interest to those who manufacture dynamos for use with secondary batteries, as it shows clearly the range of E.M.F. for which provision has to be made if the current is to be kept constant. In most instances, however, we arrange for a maximum E.M.F. of 2·5 volts per cell to be charged, and allow the rate of charging to be diminished as the cells become full. The cells tested were of the 15 L type, and contained seven peroxide plates weighing 36 lb. in all, and eight of spongy lead weighing 33½ lb. These plates are not made to give the maximum output from the minimum of weight, but the chief consideration is durability coupled with efficient working. They give a capacity of about 5 ampère-hours per pound of plate, which in the S-type plates is increased to 6½ ampère-hours per pound for tramcar work; and where durability is of minor importance there is no difficulty in obtaining considerably higher results. The internal resistance of a single cell was measured during discharge and found to vary from ·0012 ohm when the cells where fully charged, the ·0026 ohm when discharged, to 10 per cent. drop of E.M.F. This was tested by observation of the volts, first on open circuit and afterwards discharging at a known rate, but owing to the tendency of the cells to rapidly recover their E.M.F. when left partially discharged, it is somewhat difficult to get reliable results after the E.M.F. has dropped to any extent. We are convinced that the above figures are absolutely trustworthy, as the strictest precautions were observed by Mr. Butler, the head of our laboratory, in calibrating the instruments used and checking the results. The current was measured by frequent readings of a Siemens' dynamometer, checked by a voltameter, the two being found to agree within 1 per cent. The E.M.F. was measured with a reflecting galvanometer calibrated by means of Clarke's standard cells and freshly-made Daniel cell, the total resistance of the galvanometer circuit being 40,000 ohms.

PULVERISING MACHINES.

Professor von Hermann Tischer, of the Technical High School, Hanover, recently published—*Zeitschrift des Vereins Deutscher Ingenieure*—some interesting and, in several respects, suggestive considerations of the action of pulverising machines in general, and on stone-breaking machines in particular. From his writings we extract much of what follows, and believe it will be found interesting to many of our readers.

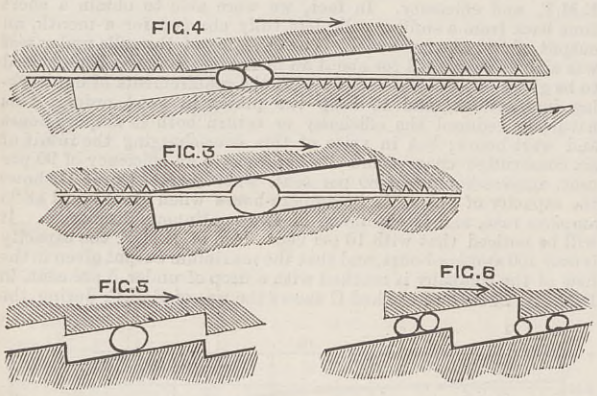
Before discussing the different machines themselves, it will be better to call attention to the characteristics of pulverising, and to introduce a few practical examples. Pulverisation is seldom pushed to extremes; usually a certain definite size of the reduced particles is desired, and sometimes it is only for tearing apart substances which exist in masses hanging together. This is, perhaps, better named disintegration; the nature of the substances, its tenacity, texture, &c., render it necessary to use different treatment—for example, the material used for making paper requires to be torn to pieces so as to produce a fibrous pulp, others, such as ores, to be reduced to fine granular powders. In the former case, the disintegration must take place in a longitudinal direction, or along the lines where the masses or bundles of fibres are weakest. In some substances a step-by-step or gradual reduction will produce a fairly regular result. Even from an unhomogeneous body the more gentle action of gradual reduction, combined with the



separation of the sufficiently reduced particles as soon as they are formed, gives a better chance to the harder particles of being subjected to more disintegrating action than the softer particles.

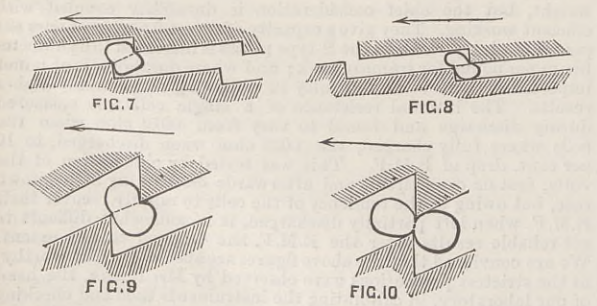
A close examination of the action of pulverisation will be useful. Before pulverisation of any body can take place the same must be strained to the limit of elasticity. The work done in pulverisation may be divided into two parts on A_1, corresponding to the elastic limit, and the other A_2 that force over and above A_1, which is necessary to bring about the disintegration. It is not easy to separate the two forces clearly in either very brittle or very elastic bodies, but they may be easier separated in bodies which are sufficiently tenacious to allow of "flow" of the particles of which they consist. Taking two substances, one—glass—whose elastic limit is small, and therefore is considered a brittle substance, and another with a wide elastic limit—india-rubber—it will be easily seen that loss of power expended in disintegrating a mixture of particles of the two substances would occur, because the work that would break up the particles of glass would simply be lost on the india-rubber, therefore for economical pulverising it is essential to deliver the material to the pulverising machine in as homogeneous condition as possible.

The speed with which the pulverising action takes place influences the magnitude of the elastic limit, in that the internal friction of the body—of the particles forming the body—increases with the speed of the action. The speed also influences the "flow" of the particles. A quick action causes this disintegration to happen sooner than a slow action, so that for reducing somewhat tough or pliable bodies a quick action is of advantage.

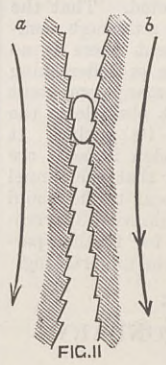


With few exceptions, the action takes place only in a small part of the outer surface of the bodies; the pressure thus exerted, on account of the inertia of the body, can only spread gradually throughout the mass. If a body be hurled against another body at so great a speed that it may be considered as rigid, then the moving force—(?) kinetic—of the hurled body furnishes the force for its own destruction. If the body be very plastic a flattening only will take place; if slightly plastic, it will be only cracked, the action being sufficiently rapid not to allow the particles to flow. But the whole force of the hurled body only acts on that part of the same which strikes on the surface of the resisting body, so that the body is unequally acted upon. Suppose a body to lie between two rigid surfaces—Fig. 1—and let the surfaces be forced together at first within the elastic limits of the body, on further forcing the surfaces together the body will continue to alter in form; if plastic it will flatten out into a cake, or if the movement of the surfaces be too quick to allow the particles to flow, the body will be split into many fragments. Bodies may be flattened out by slow action that would be split into fragments by quick action.

The pressure which is exerted by the acting surfaces on the body between them is not distributed quite equally over the

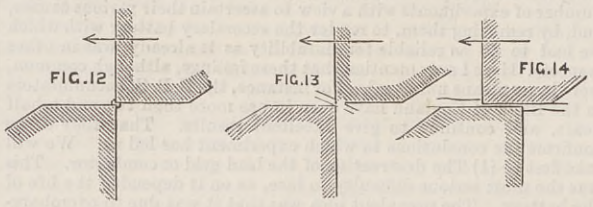


same, on one side there is the internal friction of the smallest particles of the body in opposition to the regular transmission of the force; the friction of the crushed body on the surfaces hinders the movement of the same along these surfaces. According to Kick's researches (*Dingler's Poly. Journ.*, 1877, vol. 224, p. 465) the particles form into sliding cones, supporting themselves on the pressure surfaces with their points towards one another, so that to a certain extent the body is wedged asunder. One cannot reckon on a perfectly uniform result with



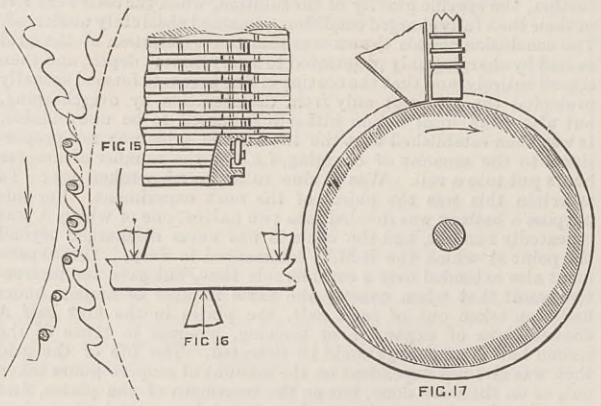
pressure only between surfaces as just described. Unhomogeneous bodies split along the weakest place, perhaps in a plane of crystallisation. As examples of pulverising by simple pressure, stamping mill and crushing rolls run at equal periphery speeds may be cited.

If the surfaces are pushed whilst they are approaching each other—Fig. 2—and if the friction of the body on them be sufficient, it will roll between them, and will soon be torn asunder in a direction parallel to the direction of the pushing action. Sometimes during what is called grinding action an unobserved tearing action takes place. Supposed to be acted on by two opposing forces on opposite sides of the body whilst it is not in a condition to follow this pair of forces by rolling, part of the body will follow one force and part the other force, and a separation will take place along the plane of the weakest place, supposing that the two acting forces are sensibly parallel to each other. This fact is made use of in preparing paper pulp and in the reduction of corn. Such action takes place with rollers running at different periphery speeds, and with millstones. The action of millstones is clearly shown by the cross sections—at right angles to the furrows—in Figs. 3 and 4, and does not need description. The shearing action, with sharp-edged furrows running in an opposite direction to Figs. 3 and 4, is shown in Figs. 7, 8, 9, and 10. The action is different when the surfaces are furrowed, but with furrows much smaller in proportion to the grain than before. Fig. 11 shows a cross section of a pair of grooved rolls, such as are used for breaking corn in high milling break rolls. The roll *b* is supposed to travel twice as fast as the roll *a*. It will be seen that the grains of corn are held on the furrows of *a*, and are sheared off by the sharp edges of *b*. The action of the beaters in the paper pulp machines is somewhat



similar. The edges of the acting surfaces of these machines are shown in cross section, Figs. 12 to 14. If the bundles of fibres lay across the edges, a pinching action will result; if the distance apart of the beaters be sufficient and the disc be moved, the friction will tear apart the fibres, Fig. 14, and the separation will take place along the weakest place. In order that grinding surfaces may give the necessary friction to tear apart the bodies to be ground, they have generally to be artificially roughened.

In Zippser's wheat cutting machines—Figs. 15 and 16—the rolls are formed of alternate saws and distance pieces, and are run at different speeds; the body is broken on three points—Fig. 16. Stone-breakers belong to the class of machines with vibrating jaws. It is necessary that the material as it becomes broken should fall away from the acting place, the simplest way is by the weight of the material. Stamping mills with a revolving drum are used in Belgium for reducing fire clay—Fig. 17—the reduced fire clay is helped away by the motion of the drum. When the outgoing material is forced onward by the grinding surfaces there is doubtless much loss of power and capacity for doing work, yet this means is very usual—for example, dry stamping mills and the usual millstones; but with regard to the latter, there is a great difference in the action of over and under running millstones. Broken corn, "Schrot," will safely run down an incline of 45 deg.; fine flour requires a much steeper angle; whole corn a less steep angle, so that 45 deg. may be taken as the mean. The frictional resistance of the just



mentioned materials is sensibly equal to the weight. Taking 120 revolutions per minute as the average speed for the under running stone, the throwing out force *s*, the radius *r*,

$$\text{then} \qquad S = \frac{m \cdot v^2}{r} = \frac{G}{g} \cdot r \left(\frac{2 \cdot \pi \cdot 120}{60}\right)^2$$

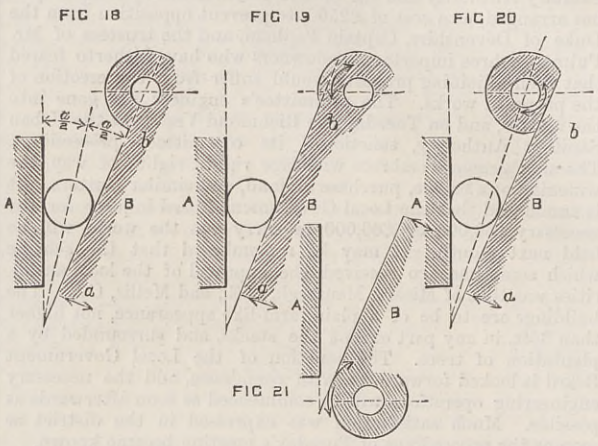
where m = the mass of the body, G the weight, g the well-known number 9·81, v the periphery speed corresponding to the radius r, then if the throwing-out force equals the weight of the separated particles,

$$\frac{G}{g} \cdot r \left(\frac{2 \cdot \pi \cdot 120}{60}\right)^2 = G$$

$$r = \left(\frac{1}{4\,\pi}\right)^2 \cdot g = G$$

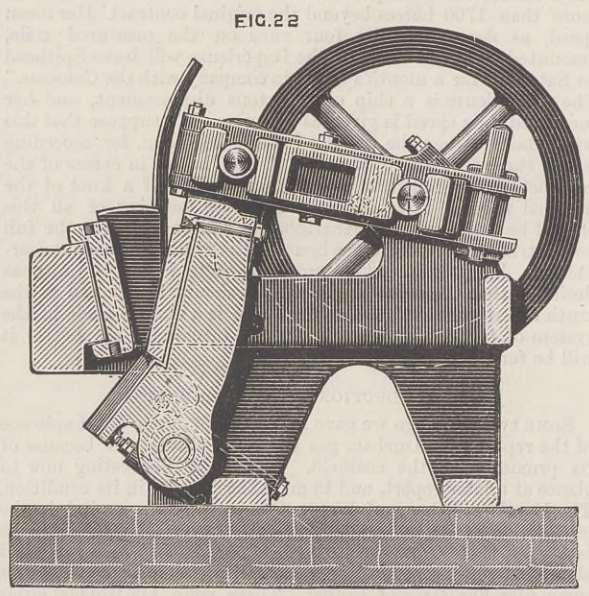
that is to say, that at 60 mm.—2⅜in.—distance from the centre of the under stone, the throwing-out force with the stone running at the speed named is sufficient to send the meal forward. This force increases with the radius, and soon becomes so great that the meal will fly out through the furrows without being reduced, unless the form of the furrows be correctly designed—Kick, "Die Mehlfabrication," 2nd edition p., 137. It is quite otherwise with overrunners here, certainly the throwing-out force has influence, but not to so great an extent, as the meal participates in the circular motion of the upper stone as they lie on the fixed lower stone; the forwarding action is also due to the crossing of the furrows. Much discussion has been expended on the best form and position of the furrows, but of late years this has been found to be of secondary importance, and has been thoroughly entered into by Professor Kick—*op. cit.*

To assist the exit of the reduced material from the sphere of action water has been used—for example—in ore stamping, paper making, &c., and currents of air have been used with advantage in corn grinding, for the twofold purpose of forwarding the meal and for keeping it cool. According to Kick ("Geretz der Proportional Widerstände," 1885, p. 1) the effective power used is independent of the method employed. The mechanical work

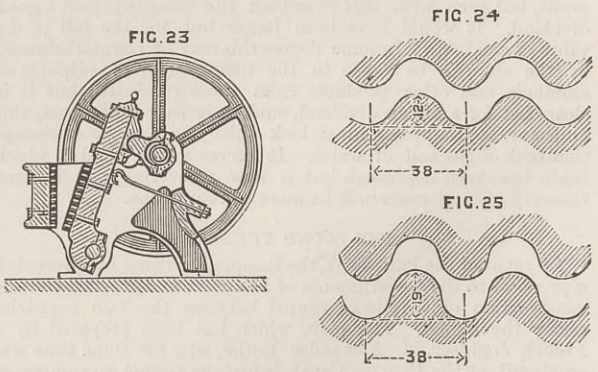


used by the machine varies between wide limits, the friction of the machine itself greatly varies, and so also does the internal friction of the body to be reduced. Unfortunately very few if any data are to hand as to the power required. Such experiments are both costly and troublesome.

In breaking up a body with machines with vibrating jaws, such as Blake's stone breaker, the action is not purely that of crushing, it is more of the kind represented in Fig. 16, the breaking on three points, as the jaws are usually furnished with corrugations, or rather with wavy surfaces. These machines were invented by Eli Witney Blake, of New Haven, Conn., U.S.A., in the year 1858. In the oldest form the motion was given to the jaw by a crank acting on a knee lever by means of a link, a double-armed lever, and a thrust rod. Later



on the link acted directly on the knee lever. Other varieties of lever arrangements have been used, of which more will be said anon, and we will first describe the jaws themselves. Fig. 18 shows a cross section of one form of jaw; *a* is the fixed, *b* the vibrating jaw. The angle α must be such as to prevent the material from being thrown out upwards. Sometimes the angle is as great as 27 deg., so that the value of friction must be about 0·24. With such an angle there is danger to the workmen of pieces being thrown out. A smaller angle, about 20 deg., is found to be safer. On observing Fig. 18 it will be seen that as the jaw moves forward any point in its surface on the line *a b* will also move slightly upwards, this upward motion arising from the position of the centre of motion. A slight rolling or gliding action of the body on the surface will result from this motion, so that the whole of the motion will not be used in pressure on the material. Fig. 21 shows a different position of the centre of motion. Here it is

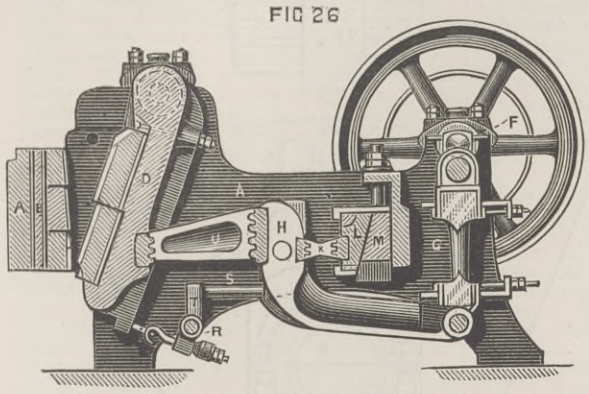


situated at the bottom of the movable jaw, so that instead of tending to move the material upwards, there is a slight tendency to move it downwards; but it will be seen that in such an arrangement as in Fig. 20, the entrance of the material is somewhat hindered; but this is obviated by placing the centre of motion as in Fig. 21. This arrangement is used by Dykhoff, Mehler, and Malter.

Mehler's machine is shown in cross section in Fig. 22, and an outline of George Malter's in Fig. 23. The form of jaw with regard to the nature of the surface to produce a more or less pure crushing action is important. Quite smooth surfaces are now rarely used. The surfaces are usually made with longitudinal waves or corrugations. Cross sections are shown in Figs. 24 and 25. A slight difference in the form of the corrugations makes a considerable difference in the action. The first cross section, Fig. 24, is suitable for brittle substances, and the second form, Fig. 25, is suitable for angular road metal, with furrows or corrugations 65 mm., 2½in. pitch, 12 mm., ½in. deep. A shivering action is given, but with 20 mm., ⅝in. deep, less small stuff is made. The wear of the jaws is considerable, so that it is usual to make them removable and of the hardest possible material, such as chilled cast iron. The distance between the jaws at the top naturally determines the size of the pieces which the machine will take and the distance between

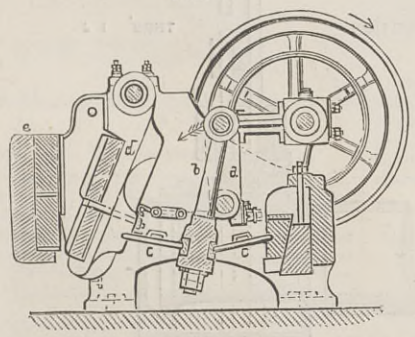
them at the bottom the size of the broken pieces; this distance is adjustable to 20 mm., $\frac{1}{16}$in. The stroke of the movable jaw at the bottom is about 5 to 15 mm.—$\frac{1}{4}$in. to $\frac{1}{2}$in. The knee lever or toggle is the most usual means of transmitting the motion to the jaw, but as it will only give pressure in one direction a spring is provided to bring the jaw back. Some-

FIG 26



times, however, levers have been introduced to bring the jaw back, ostensibly for saving the loss of power in compressing the spring. The knee lever has been much varied. The newest form of Marsden is shown in the section Fig. 26. The crank shaft F acts on the lever H by means of the connecting-rod G; the axis of the lever H is supported in the frame in one direction only, that is, vertically, but is free to move horizontally, and is adjusted by the wedge blocks L and M, against which one end of the piece X rests; the other end of X rests on the lever H; the toggle U transmits the motion to the jaw D, and gives many small supplementary blows during the forward motion of the jaw, and is supposed to imitate the action of hand breaking, but there does not seem to be any proof of this similarity in the motion. The cheek plates are inserted in the movable jaw in the usual manner, and are held in the fixed

FIG.27



jaw by the plate B. The return motion of the movable jaw is given by a rod and lever, and is equalised by rubber buffer W. A machine of this kind, with the mouth 200 mm. by 380 mm. —8in. by 15in.—running at 250 revolutions per minute, will break 6 tons of the hardest basalt—to what size is not given—per hour, and requires 4-horse power.

Another unusual system of levers by Baxter is shown in Fig. 27. The connecting-rod is attached to the upper end of an arm a, swinging at its lower end on a fixed bolt; the rod b is also attached to the upper end of a, the toggles c c lie in the lower end of b. It will be easily seen that the movable jaw will approach the fixed jaw e with a jumping motion; but simplicity is certainly not a characteristic of this machine, whatever the advantages of the complex motion may be. Bigge arranges the lever so that it receives motion from both above and below, thus giving twice as many blows as the crank make revolutions.

The practical value of these stone-breakers consists in their capability of breaking-down large lumps of hard material into small pieces of the size of walnuts, or even hazelnuts, and it is not fair to treat them as capable of doing anything further, and they are often successfully used for reducing large pieces to a size suitable for further reduction by other more refined machines. The power required and amount turned out is shown in the next table.

From the Actien-Gesellschaft Humbolt, Kalk, near Cologne.

Number of machine	1	2	3	4	5	6	7	8
Size of mouth in inches { length	4	6⅜	8	9⅞	12⅝	15¾	19¾	31½
Size of mouth in inches { breadth	2	3¼	4	5	6¼	7¾	9¾	19¾
Driving pulley in inches { diam.	10¼	12¼	15¾	18½	21⅝	24¾	27½	39⅜
Driving pulley in inches { width	2⅝	3¼	3¼	3⅝	4⅜	5⅛	5⅞	7⅞
Vibrations per minute	50	50	200	200	200	200	200	200
Horse-power required	0·1	0·2	2	3	5	7	9	16
Hourly turnout in tons { 1in.[1]	0·05	0·1	1	1·5	2·25	3·5	5	10
Hourly turnout in tons { 2in.	0·1	0·2	2	3	4·5	7	10	20
Space occupied by machine in inches { length	44	56	60	67	75	85	98	133
Space occupied by machine in inches { breadth	52	60	44	49	48	65	75	93

[1] Width of opening between jaws at bottom, or size of pieces.

C. Mehler's Stone Breaker, Aachen.

Number of machine	1	2	3	4
Size of mouth in inches { length	23⅝	17⅜	12⅝	6⅜
Size of mouth in inches { breadth	13	8⅝	6⅝	3¼
Driving pulley in inches { diam.	23⅝	15½	11¾	9⅜
Driving pulley in inches { width	6	4½	4	3¼
Speed per minute	200	200	200	200
Horse-power required	12 to 14	8—10	4—6	1—2
Hourly turnout in tons { size of pieces 1in.	6	4	2·5	0·6
Hourly turnout in tons { produced 2in.	12	8	5	1·2
Space occupied by machine in inches { length	85	70	56	44
Space occupied by machine in inches { width	56	47	39	31

Pulverising may be effected by combined shearing and rubbing. Alden's ore-breaker, the jaws of which are shown in section, Fig. 28, has a peculiar action. The jaws are swung on fixed bolts a a at the top, and are connected together at the bottom by a link. Motion is given to the link by a crank and connecting-rod, so that the jaws move backwards and forwards through small angles. This motion gives a rubbing action, and the machine is used to reduce ores to fine powder, but it must be difficult to produce an even result. Gardiner's and Bullock's machines are similar, and Wolf has introduced the arrangement

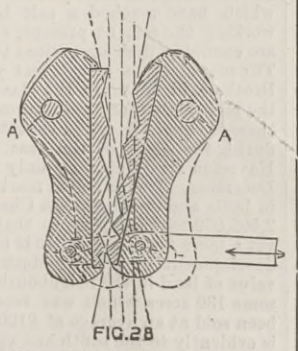
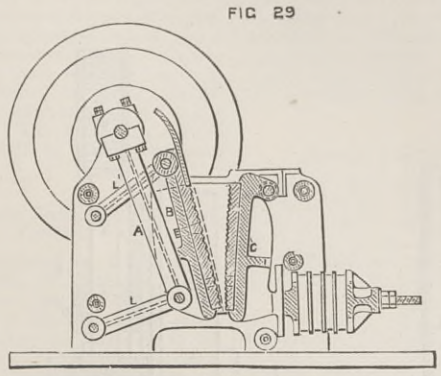


FIG.28

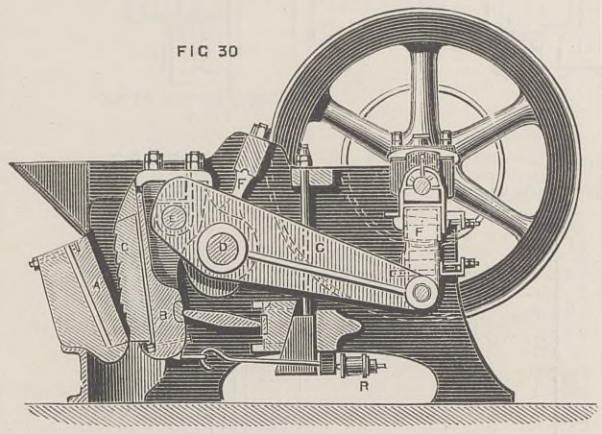
shown in Fig. 29. The connecting-rod a moves the jaw b, the ink l carries it towards the jaw c, behind which a buffer is placed to allow of the accidental entrance of an unbreakable

FIG 29



piece to move this jaw back so as to avoid risk of breakage. Marsden has attained very nearly the same motion, but in a more durable manner, by the arrangement shown in Fig. 30. The connecting-rod F transmits the motion of the crank P to the lever C, which swings

FIG 30



on the strong bolt D, the friction is reduced by the link I, the lever C takes hold of the jaw B by the bolt E, and gives it a kind of circular motion; the jaw B is supported against a toggle resting against an adjustable block; a complex up-and down to-and-fro motion is thus given to the jaw B. A machine

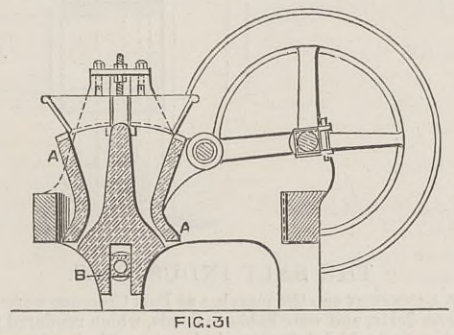
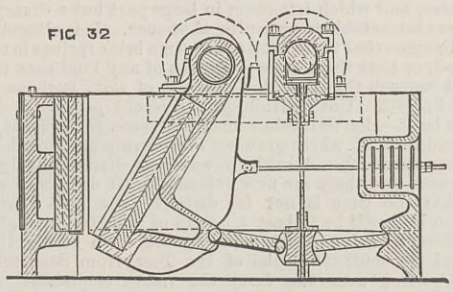


FIG.31

FIG 32



of this kind with a mouth 380 mm. by 180 mm.—15in. by 7in.—running at 250 revolutions per minute, will break 6 tons of the hardest basalt per hour using 4-horse power. Huet's stone-breaker has jaws moved backwards and forwards, and at the

FIG.35

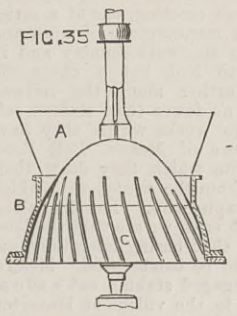
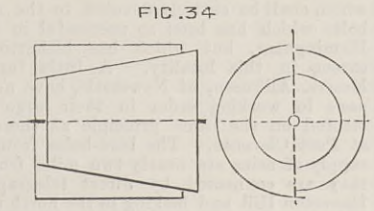


FIG.34



same time are revolved on each other; the work might be much easier done with rolls running at different speeds. Humboldt's machine reminds one of the pestle and mortar—it is shown in Fig. 31—the jaws a a are in the form of a rectangular box, the

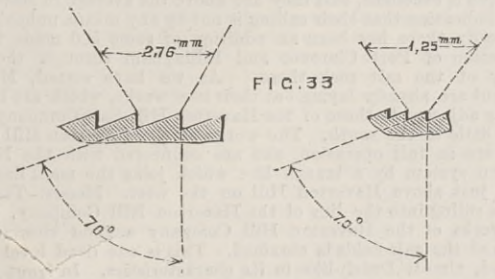


FIG.33

action is clearly shown in the figure. The wear and tear in this machine must be very great. Averly's machine, shown in Fig. 32, differs but little from those already described. Other similar machines are those of the Prinz Rudolph Iron Company and of H. Gruson.

METALLIC SLEEPERS.

WHATEVER be the fastening adopted for metal sleepers, it must be better than any hitherto employed for timber sleepers, is the conclusion arrived at by an engineer who took an active part in the early trials of metal sleepers on the Belgian State Railways. In any case cotters should be preferred to bolts, the threads of which rust up, so that it becomes impossible to tighten the fastening by screwing up the nuts. If the rails are thus securely fastened to the sleepers, the impact of passing trains is transferred to the whole surface of contact between the sleepers and the ballast, and diminished by being evenly distributed. Although cast-iron chairs may have broken with double-headed rails, owing to the jaws being too high and to the action of wooden keys, there is nothing to fear with flange rails and iron cotters; moreover, chairs possess too great advantages to be lightly abandoned. If chairs be retained, it seems only reasonable to arrange, on either side of a pair of them, bars of such a section as shall offer great resistance to deflection, with a symmetrical form and the greatest possible width, which conditions are fulfilled by bars of Z section.

Figs. 1 and 2 of the accompanying sections show two forms of sleeper made up of Z bars, devised by a former railway manager, now at the head of a large manufacturing establishment in Belgium, but who wishes to remain *incognito*. He prefers the

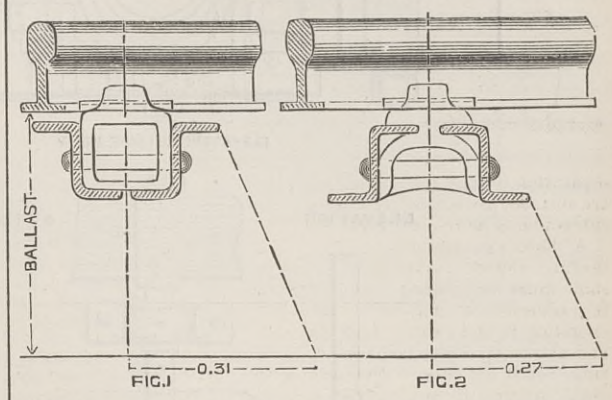


FIG.1 FIG.2

form shown in Fig. 1, because it can be packed at two levels, first in the middle and then on the outside, while giving the greatest difference of level between its outer edges and the soil below the ballast, so that the load and shocks are distributed over a considerable width of soil. The cotters are made of iron, split while hot by the saw, so that the ends may be bent over to prevent any withdrawal; but experience has shown that, when they are fitted at an angle less than that of friction, they do not come out, so that it will only be necessary to bend back the points of a few cotters to each rail. When the Z bars are rolled of such iron as will not deflect under a strain of four tons to the square inch, weighing with their fastenings 1 cwt. 3 qrs., they may be turned out for 10f., or 8s. The moment of inertia will be 6·646, the moment of deflection 729316, and the ratio of moment of inertia to the distance of the most strained fibre at the centre of deflection will be 120837.

Instead of Z bars, rolled joists, such as are used for the frames of railway wagons, or high rails, like those shown in Fig. 3, may be used with good results, and coarse gravel ballast would certainly not rise between the two bars. Better still, old rails, which, especially those of steel, are a drug in the market, might be used with advantage to form the sleeper shown by Fig. 4, which, after their term of service, would be nearly as valuable for re-melting as a specially rolled sleeper. The old rails would be cut into two lengths of about 8ft., and rivetted one on each side of the pair of chairs, so that the weight of the sleeper would

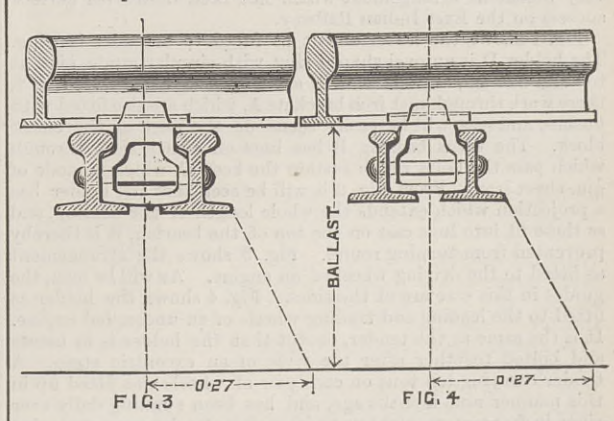


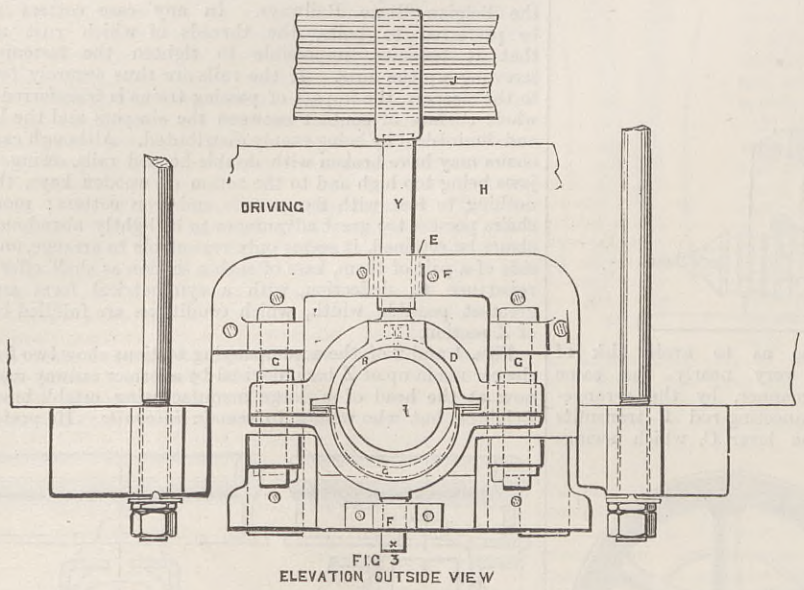
FIG.3 FIG.4

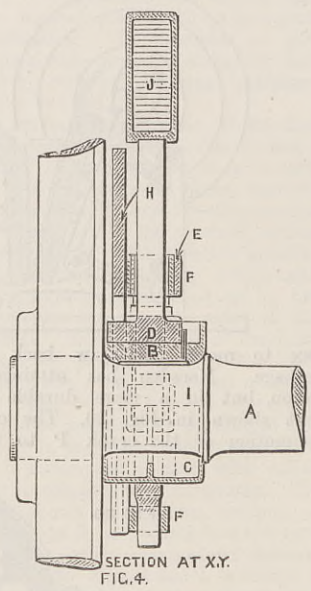
be rather over 3 cwt. While the sleeper made of Z bars, arranged in the form of a trough, gives a bearing at the formation level of 62 centimetres, or 2ft. wide, that composed of Z bars in the form of a reversed trough, and those made up of joists and old rails, give a bearing of 54 centimetres, or 21in. wide.

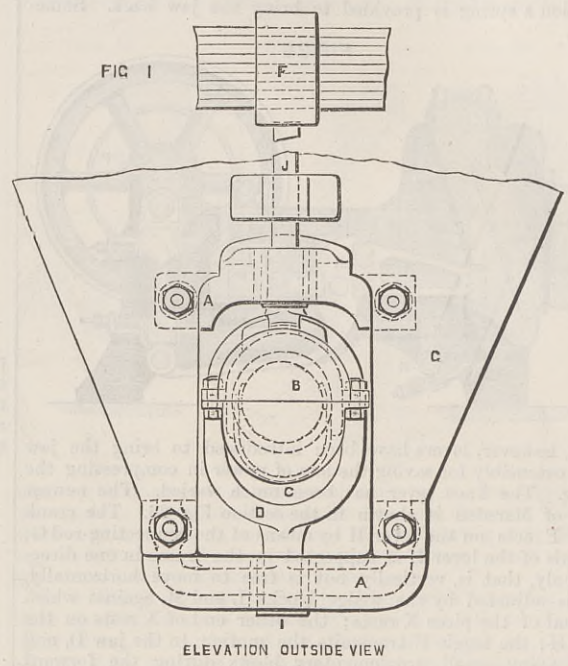
As to the question whether sleepers should be made of iron or steel, our anonymous author concludes his pamphlet, which has lately been issued in Brussels, by observing that, though for rails and tires, which are subject to friction as well as deflection, steel is undoubtedly preferable; it has disadvantages in cases where resistance to flexile strain only is required, as in the case of bridges and sleepers. Steel is apt to become cold-short in winter, and it also requires special precautions while cooling on leaving the rolls, besides which a pour of steel may be bad, so that a lot of sleepers would require minute testing. In any case, a sleeper made of steel with higher tensile strength than 26 tons to the square inch will not stand long. But the use of iron sleepers in preference to those of steel would be a god-send to the Belgian iron masters at the present time, for iron is made from indigenous ore or pig, whereas the raw material for steel has to be imported.

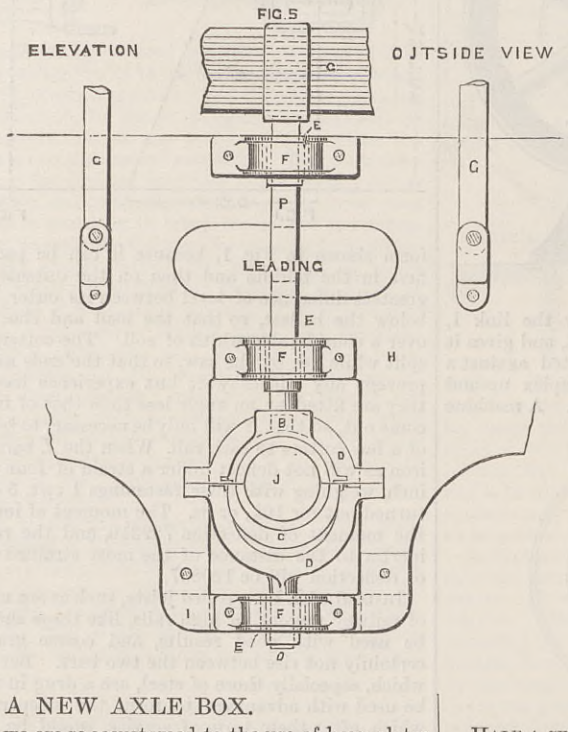
AN ELECTRIC LIGHTED OIL STEAMER.—The new German steamship Gluckauf, which arrived at New York recently from Newcastle, was built expressly for the oil traffic, and will carry oil in bulk across the Atlantic. The oil which she will land in Europe will be conveyed in tank cars to the leading markets. This will enable American oil to compete with Russian oil, which is sent to the markets in a similar manner. The Gluckauf measures 2297 tons gross and 1508 tons net; she is 299ft. long and 36ft. beam. There are sixteen tanks for oil in the hold. These tanks have a capacity for 2600 tons of petroleum. The vessel is barkentine rigged. The only openings into the hold are manholes in the deck. The engines and boilers are in the after part of the vessel, and are cut off from the oil tanks. In order to insure further safety, the vessel is lighted throughout by electricity.

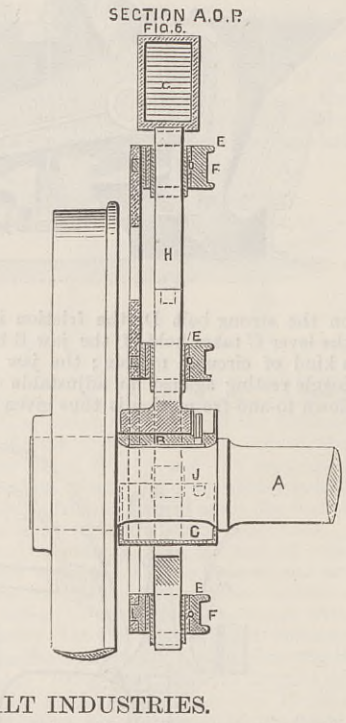
WATKIN'S AND STRACHAN'S PATENT AXLE-BOX, EAST INDIAN RAILWAY.

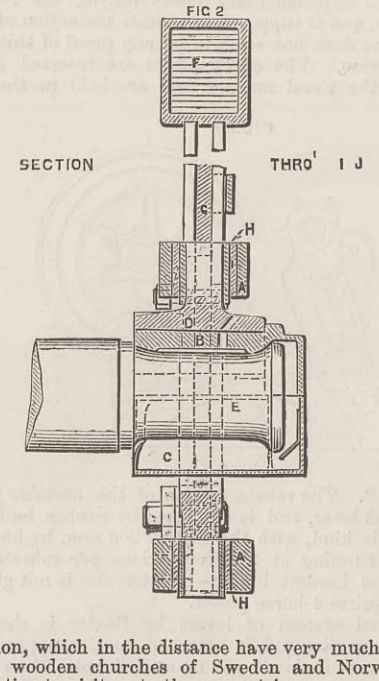












A NEW AXLE BOX.

IN this country we are so accustomed to the use of horn plates to keep railway axle boxes in position that it seems difficult to believe that they can be superseded. We illustrate, however, a very ingenious arrangement which has been tried with perfect success on the East Indian Railway.

Fig. 1 shows the arrangement as fitted to a tender bearing. The holder D is an oval-shaped ring with circular guide pins at top and bottom, and fitted with steel or iron bushes H, Fig. 2, these work through cast iron brackets A, which are also fitted with bushes, and—as will be easily seen—do the work of the cheek block. The brass bearing B has lugs on either side, through which pass the bolts which sustain the keep C, which is made of $\frac{1}{4}$in. sheet iron. From Fig. 2 it will be seen that the holder has a projection which extends the whole length of the bearing, and as these fit into lugs cast on the top of the bearing, it is thereby prevented from turning round. Fig. 3 shows the arrangement as fitted to the driving wheel of an engine. As will be seen, the guides in this case are at the sides. Fig. 4 shows the holder as fitted to the leading and trailing wheels of an uncoupled engine. It is the same as the tender, except that the holder is in halves and bolted together after the style of an excentric strap. A tender carrying ten tons on each pair of wheels was fitted up in this manner nine months ago, and has been running daily ever since in front of an 800-ton train, and up to the present no sign of wear has shown itself. It was thought that these guide bushes would quickly wear away; but such is not the case in practice, and it is thought they will wear even longer than the cheek blocks. A mail engine and tender has been fitted up in this way, and is now running the mail train between Allahabad and Cawnpore. The engine is one of Beyer and Peacock's make, 15in. cylinders, 6ft. driving wheel. It has 14 tons on the driving wheels, 9 tons on the leading, and 7 tons on the trailing. It is drawing a train of about 300 tons at a speed of about forty miles an hour.

The advantages claimed for this invention are that it is less than half the weight of the axle box and cheek blocks. The bearing and the bushes are the only wearing parts and are easily replaced, thereby effecting a great saving of labour; on account of its lightness it is easily handled by workmen. The brass can be changed without lifting the engine; the keep being easily detached, affords the driver of a train the facility of examining an axle within a few minutes. When once a frame has been fitted with these brackets the wheels are not so liable to get out of square with the frame, and the renewal of the bushes sets the wheels square without any trouble such as is experienced with fitting up cheek blocks. It dispenses with the necessity for the use of heavy machinery such as is needed to machine large axle boxes. The invention has been patented by Mr. John Strachan, district locomotive superintendent, and Mr. F. Watkins, locomotive foreman of the East Indian Railway.

THE BASIC PROCESS.—G. Hilgenstock, of Hoerde, read a paper at the general meeting of the Association of German Ironmasters on June 27th on the composition of basic Bessemer steel cinder, and gives the results of experiments showing that the phosphorus probably first is eliminated as tribasic phosphate of iron, which in the presence of lime is converted into $_4Ca\ O\ P_2O_5$. This explains why so high a percentage of lime must be added

THE SALT INDUSTRIES.

HALF-A-CENTURY ago the marshes at Port Clarence were a portion of the river delta, and were liable to floods, which rendered them unproductive, and which left them in large part but a dreary morass, which was intractable to agricultural science. It is altogether a fallacy to imagine that there were at any time brine springs in the neighbourhood, or that there were evidences of any kind that there was situated beneath the earth a huge bed of salt, such as was discovered in 1862. Until within quite a recent period—a decade of years at least—the Saltholme marshes were remarkable only for their dead level of wheat-growing and turnip-growing land, some 5000 acres in extent. All this, however, is changed, as by a magician's wand, and there are now evident in all directions abundant signs that the time is not far distant when Port Clarence and Haverton Hill will be as busy a centre of industry, though happily of a different kind, as is furnished by the town of Middlesbrough itself and the southern banks of the Tees, from Stockton to the sea. Crossing over the ferry the visitor acquainted with the former characteristics of the district will be astonished at the sudden revolution which has taken place. The Anderston Foundry has grown to an establishment of large proportions, and already employs hundreds of men. We are pleased to learn that this company has recently received large orders, and promises to be busy for at least nine months to come. In addition to the ordinary foundry business, a large new shed is now erecting, one of a series which shall be entirely devoted to the manufacture of nuts and bolts which has been so successful in the west country and in Birmingham, but which has hitherto had but a chequered career in this locality. A little further along the railway Messrs. Allhusen, of Newcastle, have no fewer than sixteen salt pans in working order in their large works which they have erected on the same principle as those of Messrs. Bell Bros. at Port Clarence. The bore-holes from which they draw their supply of brine are nearly two miles from the works, with which they are connected by direct telegraph wire. Passing along Haverton Hill and looking to the north-east, we see that the land is dotted with tripods, which is a sign that boring operations are now being carried on, or are about to be commenced. Messrs. Tennent and Co., of Newcastle, are engaged staking out a site at their new salt works, in a field close to the village of Haverton Hill, which, from being a decaying hamlet, is suddenly assuming all the dimensions of a town. Two or three streets of new houses have been built, and all seem in a fair way of being occupied by respectable and cleanly tenants. The salt workers appear to be a superior class of artizans, and, from all that we have seen, their physique is excellent, and they are above the average in stature, a plain indication that their calling is not by any means unhealthy.

Already there has been an addition of some 500 made to the population of Port Clarence and Billingham through the discovery of the salt rock there. As we have stated, Messrs. Tennent are already laying out their new works, which are immediately adjacent to those of the Haverton Hill Salt Company on a site a little to the south. The works of the Haverton Hill Company are in full operation, and are connected with the North-Eastern system by a branch line which joins the main line at a point just above Haverton Hill on the west. Messrs. Tennent have a siding into the line of the Haverton Hill Company. From the works of the Haverton Hill Company a good view of the whole of the salt fields is obtained. This is one dead level tract of land, almost Dutch-like in its characteristics. In front there are rich pastures and swelling cornfields, divided from each other not by the ordinary hedge with which we are familiar in Yorkshire, but by narrow sluggish rills of water, which are in some cases affected by the tidal flow of the adjoining river. The several bore-holes of Messrs. Bell Brothers lend a picturesque element to the landscape, as these are, in nearly all cases, enclosed by a wooden erection, which in the distance have very much the appearance of those wooden churches of Sweden and Norway which are so attractive to visitors to these countries.

The salt beds are in the form of a basin, and rest in a large hollow or depression, and that is the reason why salt may be found in plenty over a large area, whereas perhaps at a stone's throw from the nearest bore-hole it may be searched for in vain. In the South Durham salt bed this has been proved to be the case, for the successful bore-hole of Messrs. Tennent is within a few hundred yards of the site where Messrs. Allhusen proved by their boring operations that salt was non-existent. As we have stated, it is from the western side of the salt field that we can best judge its extent and capacity of future development. From here to the furthest bore-holes on the east, that of Messrs. Bolckow and Vaughan, near Grangetown, it will be a distance of fully two miles, taking a direct bee-line, from north to south, over an area at least a mile in diameter, giving an average thickness of 100ft. for the bed. In the works of the Haverton Hill Salt Company, salt for the table and export purposes is made, as well as the rougher kind of salt, which is used in the chemical manufacture and for agricultural purposes. Two large pans are devoted to the manufacture of table salt alone, and for this the company finds a ready market in the towns and villages between the Wear and the Tees. The special article of manufacture is Indian salt, which is made for the West Indian market. South Durham and Cleveland salt can be produced at a much lower rate than in Cheshire, and as the Cheshire field is some thirteen miles distant from the nearest water way, this gives local manufacturers a great advantage over their old-established rivals. Coal, too, is cheaper in South Durham by some two shillings per ton, and this is a great element in the cost of manufacture. In visiting these salt works we noticed that every precaution was taken to exclude the "Paul Prys" of trade and commerce on the look-out for hints, as in most cases boards are posted up notifying that in no case will a person be admitted except on business, and that trespassers will be prosecuted. The salt manufacturers are not likely to show all the resources of their establishments, and any detail in new and improved machinery, to any foreigner who may be anxious to question them on the subject.

There are at present fourteen different and distinct companies at work in the district, each company having a bore-hole of its own. All the bore-holes at present in use are the property of four firms. There are five firms at present at work or getting ready, of which number Messrs. Tennent are the latest. The bore-holes at present sunk or working are as follows:—Messrs. Bell Brothers, five; Messrs. Allhusen, four; the Haverton Hill Salt Company, three; Messrs. Bolckow, Vaughan, and Co., two. Other companies which have not yet got started have two bore-holes down and two going down, so that in reality there are only sixteen bore-holes as yet which have reached a salt bed. All the companies which are working the salt at present, except the Haverton Hill Company, are confining their operations to the manufacture of chemical salt. The manufacture of salt last year was as follows:—Messrs. Bell Brothers, 51,871 tons; the Haverton Hill Salt Company, 1026 tons; the Newcastle Chemical Company, 1040 tons. In connection with these it should be noted that Messrs. Bell Brothers were working during the whole of the year, whereas Messrs. Allhusen and the Haverton Hill Company only worked one month, commencing in December. The principal markets for salt products are to be found in India and America. In Cheshire the annual output amounts to 2,500,000 tons per year, so that the make in South Durham is as yet a mere fleabite of what it is likely to become. Of course, this development of a new industry has had a great effect upon the value of land in the neighbourhood. We were told of an estate of some 130 acres which was recently bought for a trifle, but has been sold at an average of £1000 per acre. The dip of the salt bed is evidently to the south and east, as it is nearest to the surface at Haverton Hill and deepest down at Eston Junction, the difference

in depth being 600ft. at least in favour of the more western site. The deep wells must cost twice as much as the shallow, whilst the risk is trebled. We have heard of bore-holes costing nearly £10,000; we will not say whether the figures are fictitious or not, but it is certain now that these may be made at a much less cost than this, probably under £1000.

The operations carried on by Messrs. Bell Brothers occupy perhaps the largest portion of the salt field. As that firm was the first to utilise the discovery of salt, they were also the first to erect chemical works on a large scale to utilise it in the soda manufacture, in which, we believe, they have been singularly successful. When the coal trade went down the iron trade arose and gave new life to Middlesbrough; now that the iron trade is apparently in a state of decline salt has come to our rescue. With the river close by, and the coal of South Durham in close proximity, the Cleveland salt manufacturer will be enabled to successfully compete with his rivals, no matter where they may be placed, and the make of salt for this year, instead of being only 60,000 tons, will total up to 200,000 tons, this great development being in itself but a faint index of the forward march of the future.—*Newcastle Daily Exchange.*

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

(*From our own Correspondent.*)

THE ironmasters' meetings in Birmingham to-day—Thursday—and in Wolverhampton yesterday suffered in the matter of attendance by the holiday season being still on. The reports brought to 'Change spoke of but little alteration in the demand at the manufactured ironworks on the week. The demand continues perceptibly within the supply, and it is not possible to run the mills anything like full time in other than a minority of instances.

The shipping trade is fairly brisk in some of the branches, more particularly in sheets, bars, and hoops. There is, however, abundant room for further improvement, and inquiries are more numerous than the actual orders booked. The reason for this is not far to seek; it is to be found in the want of strength in prices which induces merchants to make offers that it is impossible for ironmasters to accept if they are to see any profit. The Australian and New Zealand markets continue the best export buyers. Canada and South America rank next, but the Indian demand keeps very quiet. This is not to be wondered at when it is remembered that the effect of the depreciation of silver on the rate of exchange is to add 49½ per cent. to the cost of goods shipped from this country. It is only on Government and railway account that there is any life at present in Indian trade.

The trade in galvanising sheets is well sustained, and this branch has a healthier appearance than any other. A rise in prices is, however, greatly needed. Quotations of galvanised iron of 24 w.g., f.o.b. Liverpool, do not generally rise beyond £10, and f.o.b. London, £10 2s. 6d. to £10 5s. per ton. For 26 w.g., 20s. to 30s. per ton additional is asked, and for 28 gauges further 30s. Black sheets are £6 to £7 for 24 g. and 26 g. respectively at local makers' works.

Black sheets of the Woodford brand are quoted, f.o.b. Thames or Mersey, £7 for 20 b.g.; £8 10s., 24 g.; £10, 26 g.; and £10 10s., 28 g. Woodford Crown close annealed sheets are £9 10s. for 20 g.; £11 for 24 g.; £12 10s., 26 g.; £13, 28 g. Woodford best are £11, £12 10s., £14, and £14 10s. for the various gauges as above; double best qualities are £1 10s. per ton additional, and treble best are quoted £14 10s., £16, £17 10s., and £18 respectively. Siemens-Martin close annealed sheets are quoted £13, £14 10s., £16, and £16 10s. for gauges as before; and charcoal iron, £16, £17 10s., £19, and £19 10s.

Bars and hoops are in moderate sale, and at the Netherton Works of Messrs. Noah Hingley and Sons, and at a few other of the best iron establishments, a steady out-turn on export and home account is going on. Marked bars are £7 12s. 6d. to £7 for first qualities. John Bradley and Co., who, by reason of the exceptional character of their iron, are able to command more money than any other house in the trade, price all bars above ⅝in. £9 10s., which is £2 10s. above the price of the other marked bar firms. Hoops they quote £8 10s., which is £1 per ton advance on other firms; and sheets and plates, £10, which is £1 10s. more than any other best makers are asking. Rounds and squares up to ⅝in. are quoted at £8, an advance upon the terms of other firms of £1 per ton.

Mitre iron, rolled by Philip Williams and Sons, of Wednesbury Oak Works, is a uniform 5s. per ton less than the make of other list houses. Bars of ⅝in., round or square, or ½in. to $\frac{9}{16}$in., round or square, and flats 1in. by ⅝in. or ⅞in., are £6 15s., as against £7 by other firms. Strips from 1½in. to 6in. broad, £7 5s., and angles and plating bars also £7 5s. Sheets of 20 w.g. are £7 15s.; 24 g., £8 10s.; and 26 g., £9 10s. Wednesbury Oak branded qualities are quoted at £1 less than mitre.

Medium and common bars are changing hands at £6 down to £5 10s. for the former, and £5 down to £4 12s. 6d. for the latter. Angle and tie iron are in moderate request, but competition from Cleveland and other ironmasters is carrying off many of the orders. Hoops are £5 5s. to £5 10s.

The reason assigned by the North of England ironmasters for a reduction in wages—namely, increased German and Belgian competition—is commented upon by ironmasters here, who anticipate having to follow the example of the Northern trade in the wages matter. For several years past the present difference of 6d. per ton in puddlers' wages between this district and the North of England has been recognised as practically a normal state of things, but Staffordshire makers cannot permit of any larger difference existing in favour of Cleveland.

It is matter for gratification that though Messrs. Nettlefolds are intending to cease the manufacture of iron and steel and of iron and steel wire rods and wire in Shropshire, yet that the works will not lie idle. Mr. Benjamin Talbot, who up to recently held the appointment of managing director of the Haybridge Iron Company, is making arrangements for taking over the works with his sons so soon as Messrs. Nettlefolds remove to South Wales. As the Castle Works are laid out in modern fashion, and are in themselves a splendid plant, Messrs. Talbot and Sons may look to make their new venture a success.

Sellers of Derbyshire and Northampton pigs keep firm, though consumers point out that Cleveland pigs are scarcely so strong upon the week. Derbyshire and Northampton sellers, however, refuse to accept contracts at late minimum rates, and for certain brands 1s. to 2s. per ton advance is quoted. Sales are being negotiated with consumers who had not previously covered all their needs, but the new business is not being generally effected at the full rise quoted. Best Northampton pigs are quoted 35s., and Derbyshires 35s. to 36s. per ton, delivered here; local pigs are 30s. to 32s. 6d. for common foundry and 27s. 6d. to 30s. for common forge. The firmness in the hematite market is well maintained, and vendors speak cheerily of prospects.

The coal trade shows no signs of a revival at present, and the pits are hardly working half-time. Thick coal at the Cannock Chase collieries is now selling at as low as 5s. 6d. per ton at the pits for best house purposes. Forge is 4s. 9d. to 6s., according to selection. Mill coal is 6s. to 7s., and furnace 7s. to 9s. per ton.

Electric lighting has recently been adopted with great success at the Cannock Chase collieries above and below ground. The surface works extend over five acres, and some of the underground workings where the light is in operation are at a distance of 620 to 700 yards from the shaft. An original feature in connection with the installation is the utilisation of old iron and steel pit ropes for main and branch cables.

The small chain makers of Old Hill and Cradley Heath are struggling with indomitable perseverance to secure the 3s. 6d. list. Although they have only entered on the fifth week of the strike their condition has become one of acute destitution, and nothing but starvation will attend a continuance of the struggle into the winter months. It is the general impression that if a recognised list of selling prices could be arranged, the difficulty which is now so formidable would be overcome. The underselling between masters and middlemen would be abolished, and the workman in turn would not be required to recoup his employer of loss by sacrificing a part of his earnings.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—A fairly steady tone may be said to characterise the iron trade of this district. The recent upward movement in prices has not made any further progress, but it has not gone back to any appreciable extent, and although buyers, having no large pressing requirements, are rather disposed to wait than pay the full prices now being asked, business is practicable on more favourable conditions to makers than was obtainable a few weeks back. The situation may be briefly summed up as this—makers on the one hand believe that the restriction of the output will enable them to command better prices until there is some really legitimate improvement in trade, and although they are not doing much at present, they are not disposed to go back to the low rates they have recently been compelled to accept to effect sales; on the other hand, consumers—except that finished iron makers are getting rather more work, for which, however, they are unable to command any better prices—have no largely increased requirements, and although there is apparently a belief that the lowest point was touched by the recent minimum rates, they are indifferent about buying at the advanced prices now being asked. The question is whether restriction of the output will be sufficient to keep up prices. Buyers seem rather inclined to the opinion that it will not, and in this they are to some extent supported by the fact that merchants who hold iron bought at under present rates are here and there seeking business by underselling the makers. The recent upward movement has, however, undoubtedly had the effect of bringing more business into the market; hesitating buyers have given out orders which probably would otherwise have been held back indefinitely, and users of iron have been induced to extend their purchases beyond the mere hand-to-mouth requirements to which their transactions have been restricted of late. The one thing still wanting, however, is a real improvement in trade. In some quarters a more hopeful tone seems to prevail, but it can be traced to no actually substantial foundation, and there is a continued absence of any really encouraging outlook for the future.

There was a fairly good attendance on the Manchester iron market on Tuesday, but only a small weight of business was reported. Lancashire makers of pig iron were holding to 36s. 6d., less 2½, as their minimum quoted price for delivery equal to Manchester, but it was only on occasional special sales that they were able to get this figure, buyers in most cases holding back any orders they may have to give, unless they could place them at something like late rates. For district brands delivered here, 35s. 6d. to 36s. 6d., less 2½, represent about the average quoted figures for forge and foundry qualities, with one or two brands to be got at perhaps a trifle less. With regard to the restriction of output which has been talked of, there seems to be some uncertainty. One of the Lincolnshire firms has damped down, but the others who were to take a similar step have not yet done anything in this direction. As a result, buyers are naturally doubtful as to how far the restriction will really be carried out, and decline to give the full prices which makers are quoting. For outside brands offering here makers are still asking about 1s. to 2s. per ton above late rates, and although comparatively little or nothing can be done at the advance, they are not at all anxious sellers.

Hematites are firm at about 51s. to 51s. 6d., less 2½, for good foundry qualities delivered into this district, and on the basis of these figures a few sales are being made.

In the manufactured iron trade there is more business stirring. To some extent this is probably due to the fact that two of the large Staffordshire works have stopped making, which would, of course, tend to throw some increase of orders into the hands of Lancashire makers. On hoops and sheets some of the local forges are very busy, and there is also more doing in bar iron; but although makers are in a stronger position to the extent that they are not under the necessity to cut prices so excessively low as they have been doing recently, they are not able to command any actual advance, and, delivered into the Manchester district, the current market rates remain at about £4 17s. 6d. for bars, £5 5s. for hoops, and £6 10s. per ton for sheets.

Amongst ironfounders a rather more hopeful feeling seems to prevail, and here and there they are better supplied with work than they have been recently. To secure orders, however, prices are still cut excessively low. Cast iron columns delivered into the Manchester district can be got at £4 15s. to £5 per ton, and cast iron pipes at about £4 12s. 6d. per ton. In girder work prices have gone up a little, Belgian girders delivered here being now quoted at about £5 5s., and English makes at £5 15s. per ton.

Rather more work is coming into the hands of some of the engineering firms in this district, and boilermakers are getting busier. There is, however, still no general improvement to report, and machine toolmakers who are, perhaps, better off than most other branches of industry, have difficulty in replacing the orders that run out, whilst to secure new work prices have to be cut extremely low.

In districts like this, where works have to draw a water supply from such polluted streams as the river Irwell, an efficient means of filtration is a matter of considerable importance, and of late a good deal of attention has been paid to the manufacture of filters capable of dealing with large quantities of water. Messrs. Walter Glover and Co., of Salford, have recently made this a speciality at their works, and under Bell's patents high and low-pressure filters of various types have been introduced. One of their latest improvements is a horizontal filter swung between a couple of standards, and which forms a double filter working at high pressure. One of these filters, which has been successfully at work for the last six or eight months, I had an opportunity this week of seeing in operation at Mr. J. Walton's bleach works, in Pendleton, where it has been put down for filtering the Irwell water for boiler purposes. This filter is in the form of a cylinder, 3ft. in diameter and about 4ft. in length. Two compressed filter-beds, separated by an open space, occupy the centre of the cylinder. The foul water is admitted by a valve at each end of the cylinder, and is forced through the filter-beds into the centre open space by which they are divided, from whence it is discharged pure water. In this case the water from the Irwell is pumped into the filter at a pressure of from 60 lb. to 80 lb. per square inch, and is discharged through the filter at the rate of from 3000 to 4000 gallons per hour. The satisfactory manner in which the filter did its work was sufficiently demonstrated by a comparison of the fearfully polluted supply drawn from the river and the pure supply afterwards discharged for the works' requirements; but perhaps quite as important a matter as the efficient abstraction of the impurities from the water is an equally efficient and ready means of cleansing the filter beds from the filth and impurities which they must necessarily have absorbed, and this is effected in a very simple manner. To clean the filter, the action of the water is simply reversed by closing the two inlet valves and sending water direct into the central space between the filter beds through the medium of the discharge pipe; by this means the impurities which may have become imbedded in the filtering material are forced out and find a passage from the filter through a couple of valves placed at the bottom. Or another method of cleansing can be resorted to for frequent application, and this is effected by simply raising the levers of the slush valves at the bottom, and the water entering the filter in the ordinary way scours out the filth accumulated on the outside of the filter beds, a quickly-repeated opening and closing of these valves giving an ebullition of the water which causes it more effectually to scour away the dirt. As an indicator of when the filter-beds are becoming choked with dirt and require cleansing, an ordinary pressure gauge has been ingeniously applied to the top of the filter; as the filter-beds become choked with impurities more pressure is, of course, required to force the water through; this is at once recorded by the gauge, and the attendant has simply either to lift the slush valves or reverse the action of the water as required. This operation of cleansing the filter, which, where it has to deal with Irwell water, is absolutely necessary twice every day, I saw applied, and for simplicity and effectiveness it is certainly a very important feature. The adoption of the horizontal in the place of the usual vertical position for the filter is also a great advantage, as it enables every part of the filter to be got at readily, and it can be swung to any angle desired, whilst it is further a decided improvement in securing an equal pressure on the filter beds. The test which the filter has been put to in procuring a pure supply of water from so polluted a source as the Irwell is perhaps about as severe as it could well undergo, and that it has given entire satisfaction during the period it has been at work may be taken as a sufficient guarantee of its efficiency.

The coal trade remains in much the same position as reported last week; for all descriptions of fuel the demand continues very slow with prices unchanged, but, if anything, tending towards firmness in anticipation of the approaching winter demand.

Barrow.—I have to report this week the maintenance of the improved demand for pig iron reported last week. There is a disposition on the part of buyers to place orders largely for forward delivery, and makers are selling on these terms to a fair extent at the increased values now quoted, viz., 42s. 6d. to 43s. per ton net at makers' works, prompt delivery for mixed parcels of Bessemer pig iron net at makers' works, and 41s. to 41s. 6d. for forge and foundry descriptions More sales of the latter class of iron have taken place lately, and it is probable that ordinary hematite will be more fully used for general purposes than of late. The low value of this description of iron, when compared with its quality and usefulness in places where common iron has invariably been used, is likely to lead to increased sales, while on the other hand Bessemer samples are largely used by steel makers, who in their turn are busy and likely to use a large weight of this metal in the manufacture of rails, tin bars, and ship steel, which fortunately at the moment have been well bought. There is a steady activity in the steel trade all round, and it is likely that the advance which has been noted in prices will be maintained. A large number of orders have been booked, and in the rail trade especially there is a good look out. The West Cumberland Iron and Steel Company has acquired the Barepot Tin-plate Works at Workington, with a view of remodelling them, in order to manufacture lighter steel goods from rail cuttings and other material produced in the manufacture of heavy steel at the large works of this company. This course was taken years ago at Barrow, by the establishment of the wireworks of Messrs. Cookes and Swinnerton, who removed from Sheffield, and a satisfactory trade has been done, because the material is not only cheap but it is at hand, and there is no cost of carriage. Tin bars are in good request; ship steel is also in fuller demand. No improvement can be noted in the iron shipbuilding trade, and no new orders have been booked—indeed, very few are on offer. The activity in marine engineering is maintained, but the general trade is quiet. Iron ore in fuller demand, and prices are firmer, though not quotably higher. Coal and coke steady, and in larger sale. Shipping is well employed.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market held at Middlesbrough on Tuesday last was but thinly attended, and prices generally showed a tendency to recede. Buyers seemed altogether indisposed to make contracts except for insignificant lots, and even for these they would not give previous prices. Makers in vain demanded 30s. per ton for No. 3 g.m.b.; no one would give more than 29s. 9d. or at most 29s. 10½d., and that for prompt use. For delivery over the last quarter of the present year, 30s. 3d. to 30s. 6d. was usually demanded, but scarcely any sales were effected. The present difference between No. 3 foundry and No. 4 forge qualities is about a shilling per ton. The chief causes assigned for the weakened tone of the market are:—Firstly, the disquieting political news as regards the Eastern Question; and secondly, the considerable increase in stocks which took place last month. On the other hand, shipments from the Tees have during the last few days been in excess of what they were a year ago, the quantity sent away up to Monday last having reached 15,487 tons. The stock in Connal's Middlesbrough store is still on the increase, nearly 3000 tons having been added last week. Warrants are quoted at 30s. per ton, but no transactions have recently taken place.

The finished iron trade continues in the same languid condition in which it has long been. Bars are offered at £4 7s. 6d. to £4 10s., angles at £4 5s., and ship-plates at £4 7s. 6d. per ton free on trucks makers' work, less 2½ per cent. discount. Steel makers have sufficient work to keep them going, but complain bitterly that prices are unremunerative. No more than £3 12s. 6d. per ton can be got for rails of heavy section, and for plates to Lloyd's tests £5 15s. is still about the market price.

The extension of the Middlesbrough dock, which has for a long time been in progress, is now rapidly approaching completion. On the 3rd inst. Mr. J. Jackson, the contractor, commenced to cut away the bank of earth separating the new part from the old, thereby permitting the water to flow in and fill the former. The next operation will be to dredge away the bank, which will then be mostly submerged. This will require several weeks to complete. The cranes, staithes, &c., for the new part are well forward. The entrance lock also, which some time since was the cause of considerable difficulty and anxiety to all concerned is now making satisfactory progress. The area of the old and new part of the dock will together amount to eleven acres.

A meeting of the Standing Committee of the Board of Arbitration was held at Darlington on the 2nd instant. After routine business was disposed of, and certain petty disputes arranged or withdrawn, the employers informed the operative representatives that the time had arrived when another reduction of wages was imperatively necessary. They said they were at a serious disadvantage, as regards their foreign competitors, in four principal ways. In the first place, the latter paid lower wages; in the second, their men worked longer hours; in the third, they paid lower royalties, and in the fourth, lower railway rates. The first item only lay within the jurisdiction of the Board of Arbitration to deal with, and hence their claim. The operatives, represented by Mr. Cullen, contended that the present rates of wages should be left undisturbed, and thought the employers should seek the relief they needed from royalty owners and railway companies. Finally the following minute was entered on the books, viz., "The operative members the committee express themselves as willing, in order to retain the trade in the country and in the district, to recommend their constituents to accept a reasonable reduction in wages, provided concessions are also obtained from railway companies and royalty owners."

The possibility of carrying petroleum in bulk with advantage is now proved by the arrival at Giestermunde, near Bremen, of the s.s. Glückauf, recently built for this special purpose by Sir W. G. Armstrong, Mitchell and Co., of Newcastle-on-Tyne. The Glückauf had on board 900,000 gallons of mineral oil which had never been put in casks at all. The condition of the cargo was found on arrival to be all that could be be desired, and there seems now no reason why this mode of transit should not be made use of to an unlimited extent. Sir W. G. Armstrong and Co. have in hand a sister vessel to the one under consideration, and other builders are moving in the same direction. Seeing that petroleum can be put f.o.b. in the Black Sea for slightly over 1d. per gallon, and that it

sells retail in London at about 6d., it is evident that there is ample room for a fall of the price. A multiplication of special petroleum tank vessels would seem to be alone required to effect this desideratum.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron market opened very flat this week, but improved somewhat on the issue of the Board of Trade returns, which showed that the exports of pig and manufactured iron had made some improvement. Business is, however, in an unsatisfactory condition. The past week's shipments of pigs were 9192 tons, as compared with 8952 in the preceding week, and 7877 in the corresponding week of 1885. There has been rather more doing with the United States, Canada, and Italy, but the shipments elsewhere are small, and merchants state that inquiries do not show any indication of an improving demand for export. The stocks of pigs continue to increase in Messrs. Connal and Co.'s stores.

Business was done in the warrant market on Friday at 39s. 6d. cash. Monday's market was flat at 39s. 5d. to 39s. 3d. cash. Tuesday's market was flat in the forenoon at 39s. 3½d. to 39s. 3d., but there was a slight improvement to 39s. 4d. in the afternoon. Transactions occurred on Wednesday at 39s. 4½d. to 39s. 5d. cash. To-day—Thursday—business was done at 39s. 4½d. to 39s. 5d. cash.

The current values of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s. 6d.; No. 3, 41s.; Coltness, 47s. and 42s. 6d.; Langloan, 43s. and 41s.; Summerlee, 44s. 6d. and 41s.; Calder, 45s. 3d. and 41s.; Carnbroe, 41s. and 39s.; Clyde, 42s. 6d. and 39s. 6d.; Monkland, 40s. 6d. and 36s. 6d.; Govan, at Broomielaw, 41s. and 36s. 6d.; Shotts, at Leith, 43s. 6d. and 43s.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 42s. and 39s. 6d.; Eglinton, 39s. 6d. and 36s. 3d.; Dalmellington, 40s. 6d. and 38s.

Four furnaces, which were put out of blast lately at Carnbroe for repairs, are again blowing. Two have been put out at Coltness, and one at Quarter.

The hematite pig market is likely to be affected by the increase that has taken place in the price of Bilbao ore, which is now advanced to 6s. 6d. per ton, f.o.b. in Spain, while the freight to the Clyde has recently risen from 4s. 4½d. to 5s. and 5s. 3d. a ton. Whether this increase will so affect the prices of Scotch hematite pigs, made with Spanish ore, as to give Cumberland pigs a better chance in the Scotch market, remains to be seen. For some time the Scotch makers have been able to keep the field with the manufacturers of steel, in consequence of the charges for shipment or railway carriage of the North-West of England iron.

There is a prospect of another order for cast iron water pipes coming from Bombay to Glasgow.

A fair quantity of iron and steel goods was shipped from the Clyde in the past week to foreign ports.

The restriction in the output of coals by the miners is still being felt in the coal markets to such an extent as to reduce the aggregate shipments as compared with those of this time last year. During the past week the shipments from Glasgow amounted to 21,184 tons; Greenock, 2481; Ayr, 5152; Irvine, 2330; Troon, 5502; Burntisland, 16,062; Leith, 4910; Grangemouth, 11,055; and Bo'ness, 4395—total, 73,081, as compared with 87,306 tons in the corresponding week of 1885. Coals are dearer all round, the f.o.b. prices being raised since the beginning of the agitation among the colliers by 6d. to 1s. per ton, while an advance of 3d. to 6d. has taken place in the prices to the inland consumer.

The colliers held a great meeting on Saturday at Motherwell, attended by about 10,000 persons, at which addresses were delivered in support of the movement for improving their position by Mr. Bradlaugh, M.P., Mr. Stephen Mason, M.P., Mr. Donald Crawford, M.P., and others. The resolutions adopted were:—"That this meeting of miners and iron and steel workers regret the long continuance of low prices of coal and iron, and, as a consequence, inadequate wages; that we urge upon our representatives the immediate necessity of establishing by law the adoption of the eight hours' system; that as the evading of the Truck Act is so largely in vogue in this country, we hope that energetic means will be at once taken to suppress this monstrous evil. That this meeting desires to thank Mr. Stephen Mason, M.P., for his endeavour to reform the royalty rents which hang so heavily on the working classes in this country; and we further urge upon all miners and iron and steel workers the absolute necessity of having the most complete and national organisation."

A conflict has begun between some of the ironmasters and their miners. The prices of pig iron not having shown any improvement alongside the advance in coals, the ironmasters state that they are not in a position to concede the advance, as it would materially enhance the cost of producing the iron. In the case of the Coltness Iron Company, it has been resolved to put out two furnaces rather than give the increase of wages. The position of matters is complicated by the fact that one or two ironmaking firms, who are making pigs for delivery into store, have agreed to pay the advanced rate of wages.

There are several contracts for steel girder bridges in the market for Scotch railways.

During the month of August 138 vessels, with an aggregate tonnage of 125,085 left the Clyde, the arrivals in the same time being 120 vessels, of 110,171 tons, being a reduction of 21,225 tons in the sailings and of 17,206 tons in the arrivals, contrasted with those of August, 1885. The sailing tonnage for the eight months of the present year was 1,044,887, against 1,107,212, and the arriving tonnage 853,870, against 936,271 tons in the same period of last year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

It is reported that a steamer has foundered at sea laden with Cardiff coal, which spontaneously ignited. Considering the fiery character of some of the Welsh seams it is remarkable that more care is not taken with it at sea. With ordinary care there is not the slightest danger; but it is evident that a cargo of 2000 or 3000 tons in bulk requires more care than the ordinary seaman is capable of giving, and hence all coal vessels should be built with the best scientific arrangements for ventilation. This is the second mishap of late, and it is possible that many a lost collier which has disappeared mysteriously went down in mid-ocean from the same cause.

The coal trade continues to indicate some hopeful features of a change. There is partial activity; some collieries remain unaffected, but a few are doing a brisk trade. Harris' Deep Navigation turned out 30,000 tons in the last four weeks, and the manager tells me he hopes to reach 1500 tons a day shortly. Harris' Deep Navigation is the deepest colliery in Wales. Its depth to 4ft. landing is 694 yards, and to the 6ft. landing 730 yards. The pressure is, of course, immense, and hence the great difficulty met with up to the present, but the new manager, Mr. Price, under the skilled direction of Mr. Foster Brown, is literally turning the corner. Some idea of the pressure may be seen from the fact that solid masonry at the arches put in one week became in the next so much dust. The new colliery at Ynyscaedngwg is progressing well, and as there is ample capital, with the experience derived from those who have essayed deep sinkings with insufficient scientific appliances, it may be expected to figure amongst the leading ones.

Ynysyfeio, which has been idle on account of a dispute with the men, is now working again, and Dowlais and Plymouth collieries are busy, the former sending off large quantities to Birkenhead, and the latter are so active that men are working overtime. Cyfarthfa collieries are not so brisk as this, and for several days last week ten of the largest Rhondda collieries also were idle. On Monday the Ocean collieries were idle, and the men held a mass meeting to protest against the method of tipping into the screen. The contention of the men—most unjustifiable, to say the least—is that the management wishes to increase the breakage so as to get more small. This shows the prejudice and ignorance still existing amongst the majority of colliers. Not only is it the interest and the wish of coalowners to get as much large as possible, but to get it in best condition possible, and I have noticed at several large collieries of late that men are now kept for "dressing off" the coal on trucks, so that buyers shall have as little shale as can be.

Notices have been issued at Gelli House-Coal Colliery, which mean reduction or stoppage. Gwrhay Colliery dispute is ended.

The tone of the coal trade is improving at the ports, and prices, at Cardiff in particular, are firmer. Last week sales of Monmouthshire coal at Cardiff were effected for 7s., and the impression was it would have been better to let it remain uncut. Rhondda coal quotations are 8s. 6d. to 8s. 9d.; some sales at 9s. Small steam easier; best, 5s.

Mr. Hosgood, formerly of Plymouth Works, is one of the subscribers in the new Berthlurgd Brickworks, Swansea.

Little is doing in steel rails. Two small clearances—one cargo, 670 tons, from Newport for Kungsbacka, and one from Swansea to South America—are all that are reported this week, and home railways are too busy with their excursion season to think of renewals, or of the steel sleeper, except in a few cases. I see, however, that the Welsh steel-makers are going in strongly for foreign ore. Blaenavon, Tredegar, Dowlais, Rhymney, are in particular amongst the chief buyers. The syndicate formed in Bilbao may tend to increased price; hence a freer demand.

A very compact wireworks, fitted with latest machinery, is in the market. In good times it would not have remained idle, but speculation is tardy at present, and the decline in the tin-plate trade has not improved matters.

August totals show a marked falling off, and as I hinted last week, a reduction of wages is imperative and seems generally to be regarded as such by the men.

Notice has been issued at the Worcester Works, one of the principal near Swansea; and in some others arrangements have already been effected without notice, such as a concession by the men of so many sheets per box to the employers.

Buyers are offering large orders, but at low prices, and it is believed that a few of the more needy makers have booked for 12s. 6d. Quotations are at 13s. and 13s. 3d. cokes and Bessemer steels. Siemens' steels, best brands, are at 13s. 6d.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The Sheffield Town Council had before it on Wednesday the report of the Trade Inquiry Committee appointed to investigate the charges of false marking brought against Sheffield manufacturers and merchants. The committee, in its report, found that several of the charges had been proved, and recommended that the Council should petition in favour of further legislation on the subject. A long and animated discussion took place, in which it was urged that the committee had been equally divided, and that the report, as adopted, was passed at a meeting when two of its leading members were absent; otherwise, the tie which resulted on the first motion for its adoption would have been confirmed. An amendment referring the report back to the committee to have the report of the minority included in it was adopted, and the whole subject will probably come up again. It was pointed out that the wholesale charges brought against Sheffield manufacturers of selling German wares as Sheffield goods had completely broken down, and that the report itself exonerated respectable Sheffield manufacturers from such practices. It was proved that German goods, believed to be sold as of Sheffield make, were purchased from ironmongers and other merchants in distant towns.

The Cutlers' Feast on Thursday last was as successful as usual, and several guests had next day the opportunity of witnessing a number of our interesting industrial processes. On Saturday evening the Master Cutler, Mr. G. F. Lockwood, gave a dinner to his workpeople in the Cutlers' Hall, when about 600 were present. The workmen, in congratulating their employer on becoming Master Cutler of Sheffield, presented him with a pair of silver candelabra and the Mistress Cutler with a gold bracelet set with pearls and rubies. The presentations were made by Mr. W. Stones, chairman to the committee representing the workmen, who also proposed the health of the Master Cutler, to which Mr. Lockwood responded.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

Although the blast furnaces in Silesia have been increased in size and in all respects much improved, the depressed condition of the market has caused all calculations based upon this to be illusory, and even the blowing-out of six blast furnaces in the last half-year has not had the desired effect of raising the prices of pig iron, and even the low price of M. 39 p.t. for forge pig does not tempt buyers to come forward and buy in bulk, as there is so little confidence in matters speedily taking a turn for the better. Foreign purchasers, however, have paid M. 43 p.t. for special qualities. Again, the low price of castings forbids the founders to give more than M. 45 for ordinary, and M. 48 to 50 for better sorts of foundry pig. The rolling mills have an average output for the time of year, all at very low prices; indeed, within the year the price has fallen to M. 87·50 to M. 90 p.t., special sorts fetching M. 1 to 2 more money. Coke plates, it is feared, will get below the present figure of M. 135 p.t. The zinc works are obliged to lessen their production, not from want of orders, but scarcity of calamine. From Westphalia the outlook is no better, and the steel-works are the worst off of all, because, as mentioned last week, the orders for rails and sleepers are nearly worked off, and at present the State railways are seeking no new tenders; and as regards sleepers there seems to be a hitch somewhere, which is also to the detriment of the steel industry, for the Administration at Elberfeld has just sent out tenders for 72,000 wooden sleepers, and it would appear that the German railways were returning to them in preference to those made of steel. In fact it is difficult to understand how the rail trade of this country is likely, in the near future, to revive. When it is considered that Germany is already well covered with railways, that only moderate lengths of new lines, and these for the most part secondary ones, are made each year, that the traffic is comparatively light and steel rails of longer endurance than iron, so that renewals are less frequent than, say, in England, where the waste of metal is 1 to 0·6 kilo. per metre of rail per annum; that this country is hemmed in by protected ones on all sides except Holland and Switzerland, which do not require large quantities; that competition beyond sea at present prices would mean a loss; and lastly, that when domestic orders are given out there are a great number of large works to compete for them; then it seems clear that a great general "boom" must come from some distant part, of which there is no sign at present, if the rail trade here is to become again a prosperous one. The significant fact that Borsig could see no future here for locomotives, appears to a great extent applicable to rails also. As regards rolled bars and girders, the orders are momentarily satisfactory, and a number of works will be occupied for some time in executing them; but as only a part of the works are occupied, low-priced offers are still abundant from these less favoured ones; therefore prices cannot rise. The thin sheet works are also better employed on autumn orders, but prices are not affected by this at present. Plates are neglected, and the makers only half-way employed. Steel wire rods are in better demand from abroad, but the trade, as a whole, is anything but prosperous.

As every one at present avoids increasing his works or laying down new ones, the machine shops, foundries, construction and boiler works have still few orders on hand. Forge pig is in no great request, the low-priced Luxemburg brands taking the lead and depressing the price of other sorts; but as they have now got down almost to cost price, there is not much margin for going lower, and so the noted prices are likely to remain some time. Foundry pig, for the three sorts, 43 to 50; white forge, 39 to 41; Bessemer, 40 to 43; basic, 38; spiegel, 45 to 46; Luxemburg forge, 28 to 29; rolled bars, 90 to 95; fine-grained, 110; angles and tees, 100 to 105; girders, 85 to 90; iron wire rods, 102 to 106; in steel, 105 to 110; hoop iron, 100 to 105; ordinary boiler plates, 130; best, 138; sheets, 123 to 125; fine-grained, 170; charcoal, 200; steel rails, 120 to 125; mine rails, iron, 80 to 90; in steel, 94 to 108 M. p.t. Sea freights are rather lower, so it is hoped the native ores, now in so little request, will soon again be able to compete with their foreign rivals. The prices remain as formerly noted.

The six groups of ironworks produced in July—forge pig and spiegel, 144,312 t.; Bessemer, 38,053; basic, 68,233; foundry, 26,849, or 280,347 t. in all against 317,774 t. for July, 1885. From 1st of January to 31st of July 1,933,575, against 2,133,123 t. last year.

Thd present prices of coals and cokes are:—Lumps, 7·40 to 8·40; gas, 6·40 to 7·80; good slack, 5·50 to 6·20; fine ditto, 2·60 to 3·20; for coking, 3 to 4; anthracite, lumps, 8·50 to 10·50; slack, 4·40 to 5·20; patent coke, 8·50 to 9·50; ordinary coke, 6·50 to 8·40; smalls, 6·50 to 7·50. The market was dull for coke, but more brisk for coal.

It is somewhat remarkable at first sight that just at a time when the iron mining and smelting industry has been, and still is, languishing everywhere, there should be such confidence in the future, and such large sums of money at disposal to make important developments in old mines and works and establish new ones in the Saar and Lorraine district. Yet such is the case, as a few examples given below will testify. It is with the object of putting the works into a position for more successfully competing in the markets of the world. When it is considered that the ores here, oolitic principally, are the cheapest and most abundant, the blast furnaces the largest in Germany—including Luxemburg—producing pig iron now selling to a profit at 28s. p.t., and that there is rail and water carriage from them to the seaboard, then this does not appear an unreasonable undertaking; and as this may be regarded as the Cleveland district of Germany, though not quite so well favoured as to carriage as its prototype in England and not on so grand a scale, it will be interesting to many of your readers to know something of what their rivals are doing.

In Düdelingen—Luxemburg—a new steel works on an extensive scale was set to work with best results, only a very few weeks ago. In Redingen, near Deutsch-Oth—Lorraine—the new blast furnaces, belonging to the Dillinger Works, on the river Saar, will shortly be blown in. The Dillingen works were the first to make tin-plates in Germany, and still make the largest quantity perhaps. The share company—A. Pescatore and S. Foude—got into difficulties some time since, but it appears the Banque Liégeoise is coming to their assistance, and then their Rümelinger blast furnaces will be carried on more vigorously than before.

Since Messrs. Lamarche and Schwartz have acquired all the shares in the iron mines round about Gros-Moyeuve, Wallmeringen, &c., which formerly belonged to Belgian proprietors, they have added to, and started in April last, a second blast furnace at their ironworks, Maizières, situated near Metz, in the plain watered by the Moselle. Messrs. Lamarche and Schwartz now possess the largest area—3000 hectares—of mining property in Lorraine, with the one exception of Messrs. de Wendel et Co. in Hayingen. The output of the mine Orme, near Moyeuve, is shortly all to be smelted at the furnaces of Maizières, and in order to transport the ores to the works the proprietors have laid on a wire rope railway of 6 kilos. in length, erected by Bleichert and Co., of Leipzig, which will be in full working order in September. A similar rope railway will shortly be in operation to bring the ores from the mine Glückauf, near Deutsch-Oth, to the Luxemburg furnaces near Etsch, on the Alzette river. At the works of the Brothers Stumm, of Neuen Kirchen, on the Saar, another rope railway, 3 kilos. long, has been erected to transport the coal from the Government mines Heinitz-Dechen to the coke ovens of the firm. This is the second railway of the kind the firm has established, the former one, which is employed to carry away the slag and cinders from the blast furnaces and rolling mills, having worked very satisfactorily for a considerable time. This speaks well of the advantages of a rope railway as compared to an ordinary one for these purposes, as there has existed all the time a regular railway from the Heinitz-Dechen mines to the works of the Brothers Stumm at Neuen Kerchen, and yet they have gone to the expense of this private rope railway. The same reasons also induced a mining company Frankinholz, near Bexbach, to lay one on in preference to building an ordinary railway from their mines to the Bexbach railway station. Other similar rope railways have been erected at the St. Ingbert Ironworks—Brothers Kraemer—the Finner Works to cross the river Saar to the Louisenthal railway station, and at the Odenwald mines of the Messrs. de Wendel and Co.

Alongside the ironworks of the Brothers Stumm, Brothers Kraemer, and the Volknennen Company, those of the Burbach Company must be mentioned, for here the first rolled girders were made of such multifarious sections and in such large quantities in Germany; besides, these works have been brought to such a high pitch of perfection, in a technical point of view, that they are destined to take a still higher place than they have hitherto done in the world's markets. The productiveness of the mines in the Algringer valley, near Hayingen, belonging to these works, has encouraged the proprietors to increase the number of their blast furnaces by three within the last year or two, to put up at them Cowper hot-air stoves, and 150 new coke ovens, with such a complete apparatus for washing the coal previous to coking, as is probably nowhere else to be found on the Continent. They also increased the number of their puddling furnaces from 54 to 72, put down two new trains of rolls, altered the old ones, and erected machinery of the very best and newest pattern to drive the whole, and established workshops for fitting up materials for the marine—armour plates, &c. Added to this, they constructed a narrow-gauge railway 5 kilos. long from the works at Burbach, in the direction of Forbach, for the removal of their slag and scoriæ. The Brothers Stumm are also engaged in adding to their present works an extensive set of mills for rolling all kinds of the smaller sections of iron, out of pigs made from the clay ores of the district. Then, again, the ironworks Quint, near Treves, and those of Karcher and Westerman, near Ars, on the Moselle, are being improved and enlarged beyond their present capacity. To these must be added the Lorraine Ironworks, which appear to be already sufficiently well mounted to require no present increase or improvement, which have orders on hand to carry them on for a length of time to come.

The French ironworks just on the other side of the border are equally desirous of entering into the world's competition, which they will be enabled to do, provided they can obtain reduced freights on the coke and coals from Westphalia. In this connection it may be mentioned that the Comité des Forges de France is endeavouring to promote an International Exhibition of Railway Permanent-way Materials, and quite recently an invitation has been sent by members of the Paris Chamber—and, indeed, by the Chamber itself—to the works above mentioned, which have had great experience in these special articles, to procure their participation in the undertaking. The introduction of iron and steel sleepers on the French railway system will be most acceptable to the German iron industry, for it will keep the French works engaged at home, and cause them to compete less in other markets.

If the Moselle were canalised—of which there is some talk—from Metz to Coblence, the Saar from Enzdorf to Conz, as also the Sauer and the Alzette from Wasserbillig to the ironstone basin of the Escher, then this district and that of Luxemburg combined would become by far the most important iron-producing one in Germany.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, Aug. 28th.

THE rush of orders for machinery is encouraging the machine shop and foundry interests of the State. A bridge is to be built across the Hudson river next season, which, with railroad connections between the New England and Middle States, will cost 10,000,000 dols. The Baltimore and Ohio Railroad Company will expend a large sum of money on terminal improvements at Staten Island, a few miles below the city. The Norfolk and Western Railroad Company will prosecute extensive and costly improvements at its terminus in Virginia. The Pennsylvania Company has set apart a large fund for commodious and extensive improvements along its entire line. Other trunk lines will be liberal purchasers of material during the coming winter. Purchasing agents have been quietly placing orders for lumber, iron, steel, machinery, cars, and locomotives. There are possibilities of a general scaling up of prices. Steel rails and merchant iron cannot advance because of foreign selling prices. Several kinds of material have improved and production is absorbed. A sale of 8,000,000 lb. of copper is to be reported. Exports for the year, 11,750,000 lb. refined and 39,000,000 lb. matte and ore.

Bessemer pig is nominally 19 dols. ex ship Eglington, and 17 dols. 75c. ex yard; spiegel, 25 dols. 50c. for 20 per cent. Old rails are very scarce and hard to get. Quotations, 20 dols. to 21 dols.; blooms, foreign, 24 dols. to 24 dols. 50c.; steel rails, 34 dols. 50c. Imports of tin-plate this year, 1,550,000 boxes; Straits tin, 5800 boxes; pig iron, 61,000 tons at this port and 16,000 tons at Philadelphia, 48,000 tons at Baltimore, and 23,000 tons at Boston. Steel wire rods, 36 dols. 50c.; imports for the year, 71,000 tons. Home makers are agitating for higher duties. Receipts of foreign blooms and billets at this port this year 12,000 tons, and of old rails 17,000 tons.

NEW COMPANIES.

THE following companies have just been registered:—

Patent Lock Nut Company, Limited.

This company was registered on the 27th ult. with a capital of £50,000, in £5 shares, to carry on business as manufacturers of and dealers in nuts and bolts of all kinds, and also as mechanical engineers, iron and other founders, and metal workers. Two unregistered agreements will be adopted. The subscribers are:—

	Shares.
A. Ray, 11, Clement's-lane, E.C.	1
H. Turner, 1, Hartham-road, Tottenham, clerk	1
D. Motten, 125, Camden-road	1
A. N. Chew, Edithville, Beckenham, clerk	1
T. H. Bloom, 8, St. Thomas-square, Hackney, clerk	1
E. T. Botwright, 23, Sutton-place, Hackney, accountant	1
H. D. Brooke, 8, Ella-road, Crouch-hill	1

The number of directors is not to be less than three nor more than seven; qualification, fifty shares; the subscribers are to nominate the first. The directors will be entitled to an annual sum not exceeding £50 each out of the profits remaining after payment of 5 per cent. per annum dividend, and a further sum of £50 each for every additional 5 per cent. divided amongst the shareholders.

Moldacot Royalties Trust, Limited.

This company proposes to enter into an agreement with Albert Douglas Moll and John Charles Cottam for the purchase of certain royalties in respect of an invention for sewing machines, and to carry on in the United Kingdom and British Colonies, the United States of America, or elsewhere, the business of sewing machine manufacturers and mechanical engineers. It was registered on the 27th ult. with a capital of £75,000, in £5 shares, with the following as first subscribers:—

	Shares.
W. Lichfield, 61, Leyspring-road, Leytonstone, secretary to a company	1
F. W. Melbourne, 95, Boyson-road, Camberwell, clerk	1
E. Fickling, 67, Shaftesbury-road, Islington, law stationer	1
J. Grunell, 9, Gloucester-terrace, Edmonton, accountant	1
A. C. Dockrill, 88, Winston-road, Newington-green, clerk	1
R. L. Golding, 52, Victoria-road, Holloway, chemist	1
W. C. Godbold, 26, West-square, Southwark, tailor	1

The number of directors is not to be less than two nor more than five; qualification, forty shares; the subscribers are to appoint the first and act *ad interim*; remuneration, £150 per annum to each director, with an additional £50 per annum for the chairman, and a further remuneration equal to 2½ per cent. of the net profits in any year in which 20 per cent. per annum dividend is paid.

New Isle of Man Steam Navigation Company, Limited.

This company proposes to carry on business as shipowners, and as carriers to and from the Isle of Man. It was registered on the 1st inst. with a capital of £50,000, in £5 shares. The subscribers are:—

	Shares.
*H. W. Lowe, 7, East India-avenue, merchant	1
*W. B. Soundy, 19 and 20, Water-lane, E.C., steam shipowner	1
W. Beaufoy, 68, Fenchurch-street, passenger agent	1
*C. Jamieson, Litherland-alley, Liverpool, shipowner	1
R. T. Curphey, 22, Fenwick-street, Liverpool, corn and flour merchant	1
R. R. Greene, Liscard, Cheshire, accountant	1
*R. R. Douglas, 35A, Castle-street, Liverpool, insurance manager	1

The subscribers denoted by an asterisk are the first directors, and Mr. P. H. Cowley is appointed manager. The remuneration of the directors and manager will be as follows:—1 per cent. on the paid-up capital if the dividend for the current year shall not amount to 6 per cent. on such capital; 2 per cent. if the dividend shall exceed 6 per cent. and not amount to 7½ per cent., and 3 per cent. if the dividend shall exceed 8½ per cent. Half of such remuneration will be paid to the manager as his fee, from which amount he will defray office and clerical expenses, provided that the manager's remuneration shall not be less than £120 in any year. The remaining half of the said remuneration will be divided amongst the directors.

Regent Portable Electric Lamp and Lighting Company, Limited.

This company was registered on the 27th ult. with a capital of £85,000, in £5 shares, to purchase from Mr. Ephraim Charles Burgess upon terms of an agreement of the 9th ult. an exclusive licence for the manufacture and sale in the United Kingdom of the voltaic primary battery, known as "The Regent," patented by Mr. Samuel William Macquay (No. 15,040, dated 8th December, 1885) for all purposes in connection with electric lighting. The purchase consideration is £17,500 in cash and £27,500 in fully-paid shares. The subscribers are:—

	Shares.
Major E. G. Graham, 22, Great Coram-street	1
O. D. Leslie, Reading, law student	1
C. E. Meldenhall, 27, Aytoun-road, Stockwell, law clerk	1
W. H. Toynbee, 79, Mildmay-grove, Islington, editor	1
A. Evans, 5, Wheathill-road, Anerley	1
R. Angus, jun., 41, The Parade, Shepherd's-bush, accountant	1
A. T. Angus, 69, Holland-road, accountant	1

The number of directors is not to be less than three nor more than seven; the subscribers appoint the first; qualification for first director, 10 shares, and for subsequent directors 50 shares; remuneration—chairman £300 per annum, and each director £100 per annum, and a further sum equal to 3 per cent. of the net profits available after 8 per cent. has been paid to the shareholders.

Sidmouth Gas Company, Limited.

This company proposes to manufacture and supply gas in the parishes of Sidmouth, Salcombe Regis, and Sidbury, Devon. It was registered on the 28th ult. with a capital of £15,000, in £10 shares, 300 of which are 5 per cent. preference shares. The subscribers are:—

	Shares. Ord.	Pref.
*T. Douglas, Belford House, Underhill-road, Dulwich	1	—
W. Hastings, 110, Cannon-street, solicitor	—	1
*J. G. G. Radford, Sidmouth, solicitor	—	1
E. Foster, 21, John-street, Adelphi, coal factor	1	—
J. A. Orchard, Sidmouth, solicitor	—	1
W. A. Surridge, Auckland-road, Upper Norwood	1	—
*J. Hough, Cobham, Surrey	—	1

The subscribers denoted by an asterisk are the first directors. Mr. T. Douglas is appointed managing director at a salary of £50 per annum. The qualification of Mr. Douglas will be the holding of shares or stock of the nominal value of £1000, and of the other directors shares or stock of the nominal value of £100. Mr. W. H. Hastings is appointed secretary.

Anglo-American Fresh Meat Supply Company, Limited.

This company was registered on the 27th ult. with a capital of £100,000, in £1 shares, to trade in cattle and live stock of every description, and also in every kind of agricultural and land produce, and to carry on in the United States the business of land and colonisation agents, farmers, graziers, &c. An unregistered agreement of the 7th July with the Columbus and Texas Meat and Ice Company will be adopted. The subscribers are:—

	Shares.
C. E. Hodson, 3, The Gables, Hampstead, N.W.	1
W. H. Harrison, 41, Flaxman-road, Brixton, commission merchant	1
F. H. Relph, 101, Leadenhall-street, land agent	1
R. S. Fawcett, 101, Leadenhall-street, merchant	1
G. P. Armstrong, 18, Laurence Pountney-hill, merchant	1
L. B. Northcote, 120, Belgrave-road, S.W.	1
W. L. Bernard, St. John's, Forest-hill, statician	1

The number of directors is not to be less than four nor more than nine; the subscribers are to appoint the first, and pending such appointment Mr. F. H. Relph will manage the company. Mr. Relph is appointed managing director for seven years at a salary of £800 per annum, with a commission of 5 per cent. on all net profits, together with all travelling expenses reasonably incurred. The remuneration of the ordinary directors is to be £1200 per annum, free of income-tax, with an additional £100 for each 1 per cent. dividend over 10 per cent. per annum. To any director who may go to America on the business of the company, the board may pay a special remuneration not exceeding £250 in addition to hotel and travelling expenses.

Douro Gold Mines, Limited.

This company proposes to acquire two concessions granted by the Crown of Portugal for working gold and silver mines known as Cume de Serra de Montezelo, and Cume de Serra de Faco, situate in the Valley of the Douro, Portugal. It was registered on the 1st inst. with a capital of £100,000, in £1 shares. An unregistered agreement of the 18th ult. between the Foreign Mining Association, Limited, and John Dowle Jones, its liquidator, of the first and second parts, Thomas Morton Johnson, of the third part, and James Fitzpatrick (as trustee for this company) of the fourth part, will be adopted. The subscribers are:—

	Shares.
C. Tottenham, 1, Grosvenor-place	1
T. M. Johnson, Oporto, engineer	1
R. McIlwraith, 138, Leadenhall-street, merchant	1
C. A. Scott Murray, J.P., Danesfield, Marlow	1
Dyson Weston, 138, Leadenhall-street, merchant	1
R. Macmillan, 138, Leadenhall-street, clerk	1
W. Jordan, Albion-grove, Stoke Newington	1

The committee of management is not to exceed nine members; the subscribers are to appoint the first; remuneration, £2 2s. each for every board meeting attended until the ordinary general meeting in 1886, when the future remuneration of the members of the committee will be determined; qualification, 250 shares; 50,000 shares will be issued to the vendors as purchase consideration; 30,000 shares will also be issued, credited with 16s. as paid-up upon each.

Edward Cockey and Sons, Limited.

This is the conversion to a company of the business of gas engineers, contractors, and iron-founders, carried on by Henry Cockey and Francis C. Cockey, at the ironworks, Frome, Somerset. It was registered on the 30th ult. with a capital of £20,000, in £10 shares. The subscribers are:—

	Shares.
W. A. Padfield, Exeter, engineer	1
Henry Perry, Stonebridge, manufacturer	1
H. Channon, Frome	1
J. Lowe, Weymouth, manager of gasworks	1
G. Garnett, C.E., Gasworks, Ryde	1
H. Hams, Frome, woollen manufacturer	50
R. Fish, Manor Park, Streatham, gas engineer	50
J. Ruside, Hyde, near Manchester, engineer	50
Henry Cockey, Frome, engineer	250
F. C. Cockey, Frome, engineer	250

The number of directors is not to be less than six nor more than nine; qualification, twenty-five fully-paid shares, or £250 in paid-up capital.

Improved Cement Company, Limited.

Upon terms of an agreement of the 27th July this company proposes to acquire certain British and foreign patent rights relating to improvements in the manufacture of hydraulic and other cements, mortar, artificial stone, and other similar substances; also for an improved process for rendering cements hydraulic, *i.e.*, capable of setting and hardening under water. The British patents are numbered and dated respectively—No. 152, dated 10th January, 1883, and No. 8153, dated 6th July, 1885. The company was registered on the 26th ult. with a capital of £20,000, in £10 shares. The purchase consideration is £15,000 in fully-paid shares. The subscribers are:—

	Shares.
*R. Bosse, Brunswick, Germany, architect	1
Franz Wolters, 4, Ludborn-road, Brixton, chemist	1
*J. Selwig, Brunswick	1
H. Luther, Brunswick	1
*E. Larsen, 26, Mark-lane, merchant	1
*C. Charleton, 25, Great Tower-street, cement manufacturer	1
*Peter Mumford, Royal Flour Mills, Vauxhall, miller	1

The number of directors is not to be less than five nor more than seven; qualification, fifty shares or £500 stock; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

PRESSURE EXERTED BY WATER IN THE SOIL.[1]

THE following is an abstract of a paper in the "Zeitschrift für Bauwesen," by L. Brennecke.

"The author gives the results of a number of experiments, which were undertaken principally with a view to determining the influence exerted by capillary attraction in diminishing the pressure of water in various kinds of earth, especially sand of different size of grain, and of clay, it being assumed that the water can only find its way by suffusion through the mass, and that there are no large fissures present. Reference is made to various authors as regards their opinion on this subject, and the amount of deduction which under circumstances may be made from the theoretical pressure of ground water in designing lock floors, &c.

"An observation—recorded by Beer—in regard to a filter basin at Magdeburgh in 1880 is quoted, bearing upon the amount of frictional resistance to water pressure offered by the ground, even where, as in this instance, of coarse gravel. The basin in question, 178ft. — 54·24 metres — in breadth, had been constructed with a concrete floor of 1ft. 7½in.—0·5 metre—in thickness, and was kept filled with water to counterbalance the pressure of the external ground water. On the occasion mentioned the water was pumped out to a level of 2in.—0·05 metre—above the floor, when a slight upheaval of portion of the latter being noticeable the basin was quickly refilled. The level of the external ground water was 7ft. 10½in. above the under side of the concrete floor, and the weight of the floor was equal to a column of water of 3ft. 9in. high; therefore supposing the full pressure due to the height of the ground water had been active, it would consequently have required a depth of water in the basin of 4ft. 10½in., instead of 2in., to preserve stability. Other examples of the varying resistances of different earths to water pressure are mentioned, viz.: At the coal mine, Wormrevier, some years since, when carrying out some shaft repairs with the aid of pneumatic pressure, on reaching a depth of 48ft. below the surface of the ground water in a saturated clay sand, an air pressure of ¾ atmosphere instead of twice that amount was sufficient to exclude the water; and at the Rheinpreussen mine near Homberg, in 1865, the caisson was sunk with a pressure of only 2½ atmospheres to such a depth as was calculated to require a pressure of 8 atmospheres. In the latter instance, however, a sudden increase of the water pressure led to a most disastrous accident by bursting the air lock. It is suggested that the water was held back for some time by the thick beds of clay which it was known had been passed through, but finally found its way through these by channels around the outer skin of the caisson. In the previous case quoted, the author is of opinion that as only half the calculated air pressure was requisite, that probably half the column of ground water was supported by the air pressure, and the remainder by capillary attraction. Details are given of laboratory experiments upon sands of various size of grain, together with a number of formulas and tables, giving the corresponding height of the capillary column."

1 "Proceedings," Institution of Civil Engineers.

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.

31st August, 1886.

11,051. RECEPTACLE for POISONS, T. Mayhew, London.
11,052. DATING RAILWAY TICKETS, W. Smith, London.
11,053. ADJUSTABLE SAFETY FRICTION REEL for FISHING PURPOSES, J. G. Burne, Portsmouth.
11,054. MAKING and BREAKING ELECTRICAL CIRCUITS, A. Thompson and R. O. Ritchie, London.
11,055. RAILWAYS, D. Smith, Birmingham.
11,056. APPARATUS for TREEING, &c., BOOTS, &c., W. W. Watts, Dublin.
11,057. STANDS to hold BOTTLES, &c., E. Thompson and J. W. Dixon, Sheffield.
11,058. RAILWAY CARRIAGE SIGNAL, S. G. Dutton, London.
11,059. COUPLING and UNCOUPLING RAILWAY TRUCKS, G. Turner, Ashton-under-Lyne.
11,060. ELECTRICAL APPARATUS, J. Roots, London.
11,061. OIL LAMPS, J. Roots, London.
11,062. HINGING, &c., WINDOW SASHES, W. Johnson, Scalloway.
11,063. BURNING LIQUID FUEL for STEAM BOILERS, T. Smith, Newcastle-on-Tyne.
11,064. SCREW and LEVER MOVEMENT for CHAIRS, &c., J. A. Mills, Brighton.
11,065. STOPPERING BOTTLES, J. de Baere, Sheffield.
11,066. CUTTING FILES, &c., J. Crossley, Sheffield.
11,067. AUTOMATICALLY FLUSHING WATER-CLOSETS, B. Haigh, London.
11,068. EXTRACTING OIL and WATER from WASTE FISH BLOOD, J. F. Johnstone, London.
11,069. TREATMENT of SPENT SOAP LEYS, &c., A. H. Allen and B. Nickels, Sheffield.
11,070. OBTAINING GREATER HEAT, &c., more rapidly in BOILERS, J. A. Walker, London.
11,071. LOCOMOTIVE ENGINE WHEELS, G. Alston, Glasgow.
11,072. TRACK CLEARER and WHEEL GUARD COMBINED, W. Strong, St. George's.
11,073. DOG'S MUZZLES, A. Garstin, London.
11,074. STRETCHING BOOTS and SHOES, H. Levy, London.
11,075. SUPPORTING, &c., LAWN TENNIS NETS, &c., F. H. Ayres and A. Foster, London.
11,076. LOCKS for WINDOWS, &c., J. Morson, jun., London.
11,077. RUNNING GEAR for VEHICLES, W. P. Thompson.—(*G. E. Bartholomew and E. Armant, United States.*)
11,078. DEVICES for FACILITATING the laying of ASPHALT CONCRETE PAVEMENTS, A. L. Barber, London.
11,079. CONSTRUCTION of ROOFS of FURNACES, J. F. Slack, London.
11,080. BALE FASTENINGS, E. Barrow, Liverpool.
11,081. BOTTLES and STOPPERS, O. Sumner, London.
11,082. MANUFACTURE of ARMOUR PLATES, W. Annable, Sheffield.
11,083. TRANSPOSING PIANO, A. Mauro, London.
11,084. PULPING, &c., ENGINES, J. McFarlane, Glasgow.
11,085. PROPULSION, &c., of VEHICLES, V. D. de Stains, London.
11,086. PORTABLE BUILDINGS, J. C. Gsottbauer, London.
11,087. CONSTRUCTION of FIREPLACES, &c., W. Smith, London.
11,088. COMBING MACHINES, J. H. Whitehead, London.
11,089. ROLLS for ROLLING H IRON, H. Sack, London.
11,090. PROPELLING CANAL BOATS, A. Schausten, London.
11,091. BRICKS, TILES, &c., J. C. Anderson, London.
11,092. SECURING DOOR KNOBS to SPINDLES, F. Garon, Southend.
11,093. SECRETAIRE BOOKCASE, H. Mayo, London.
11,094. CANISTERS, &c., for PROVISIONS, R. Lehmann, London.
11,095. CLEANING or BEATING CARPETS, H. H. Lake.—(*F. H. Good, United States.*)
11,096. COTTON WASTE PICKERS, J. P. Hillard and W H. Goldsmith, London.
11,097. CARDING MACHINES, H. H. Lake.—(*W. Schofield, United States.*)
11,098. BOILER CLEANERS, J. Bond, jun., London.
11,099. ELECTRIC RAILWAYS, P. M. Justice.—(*The United States Electric Company, United States.*)
11,100. REGULATING the FLOW of ELECTRICITY, W. C. Goldner, London.
11,101. SECONDARY BATTERIES, T. J. Jones and W. H. Tasker, London.
11,102. HEEL PROTECTORS for BOOTS, I. R. Sanford, Boston, U.S.
11,103. MACHINES for PREPARING COTTON, &c., W. H. Richardson and T. R. Marsden, Manchester.
11,104. DELIVERING CIGARETTES, &c., R. Whittaker, London.
11,105. REGULATING the ELECTRO-MOTIVE FORCE of a DYNAMO, G. K. Winter, Arkonam, East Indies.
11,106. ENGINES for COMPRESSING AIR, D. Greig, London.
11,107. DEPRESSING or RETIRING GUN CARRIAGES, J. Y. Johnson.—(*La Compagnie Anonyme des Forges et Chatillon et Commentry, France.*)
11,108. APPLYING WOOD for COVERING SURFACES, P. P. de la Sala, London.
11,109. HYDRAULIC LIFTS with COMPOUND ACTION, C. F. Archer, London.

1st September, 1886.

11,110. OPERATING HEALDS of LOOMS for WEAVING, J. S. Loynd and H. Smalley, Halifax.
11,111. JACK STRAPS employed in LOOMS for WEAVING, J. Watson, Manchester.
11,112. STOPPERING BOTTLES, &c., C. H. Fernley, Manchester.
11,113. SPINNING, DOUBLING, &c., MACHINERY, J. Harrison, Manchester.
11,114. OVER-EDGE SEWING MACHINES, W. Webster, London.
11,115. STEAM BOILERS or GENERATORS, G. Gwinnett, London.
11,116. CALENDAR, J. W. Willis, Henley-on-Thames.
11,117. RECEIVING COIN and AUTOMATICALLY DELIVERING ARTICLES in EXCHANGE, J. S. Farmer, Manchester.
11,118. FRAMES for PREPARING COTTON, &c., J. Dugdale and G. Haworth, Manchester.
11,119. REVOLVING FLAT CARDING ENGINES, B. Ormerod and G. Haworth, Manchester.
11,120. COUPLINGS for SHAFTING, J. F. Davies and W. Kenyon, Manchester.
11,121. AUTOMATICALLY SECURING WINDOWS, H. S. Harris, Birmingham.
11,122. PERAMBULATOR BODIES, L. L'Hollier, Birmingham.
11,123. RACQUETS for TENNIS or other GAMES, B. Morris, Halifax.
11,124. CUTTING or SLOTTING KEYWAYS, &c., J. Tushaw, London.
11,125. HALTERS for HORSES or CATTLE, B. Dearden, Halifax.
11,126. HANSOM CABS, E. F. Sage.—(*A. C. Sage, New South Wales.*)
11,127. BUTTONS, G. Twigg, Birmingham.
11,128. HEATING and COOLING MILK, A. Drummond and J. McAdam, Glasgow.
11,129. SPINDLES and WIRES for WINDING MACHINES, &c., E. Reavill, London.
11,130. COUPLING LINK, H. Campkin, London.
11,131. SPRING ENGINE or MOTOR, W. Allan, Leeds.
11,132. BEDSTEADS, &c., C. W. Gebhard, Birmingham.
11,133. STEAM PUMPS, R. Hulme and E. Lund, Manchester.
11,134. RETORTS, J. Jones, Edinburgh.
11,135. LIGHTING CIGARS, A. F. Hawksley, Manchester.
11,136. ANTIHEATING LUBRICANT, O. E. Pohl, Liverpool.
11,137. TUBULAR PNEUMATIC ACTION for ORGANS, G. Adams and F. Marshall, London.

11,138. EXTRACTING FAT from BONES, &c., T. Berliner, Berlin.
11,139. GLOW-LAMPS, C. Sœl, Berlin.
11,140. EXPLOSIVE COMPOUNDS, R. H. Punshon, London.
11,141. CHENILLE FABRICS, J. Lyle, jun., Glasgow.
11,142. INDICATING the ARRIVAL, &c., of WORKPEOPLE, A. H. Jakins, London.
11,143. WALKING STICK, &c., HANDLE for MEASURING DISTANCES WALKED, A. J. Willis, London.
11,144. PRESERVING WOOD, F. Dixon, London.
11,145. APPAREL or DRESS EQUIPMENTS for EXPLORERS, &c., W. A. F. Blakeney, Glasgow.
11,146. RAILWAY CHAIRS, H. J. Haddan.—(*F. Coblyn, Belgium.*)
11,147. BRACES, R. Lewis, London.
11,148. CANDLES, J. Pettigrew and F. A. Glaeser, London.
11,149. TENSION PULLEYS, T. Harrison and C. White, Bradford.
11,150. MEDICO-ELECTRICAL APPARATUSES, J. R. Hard, London.
11,151. CASEMENT WINDOWS, E. V. Harris, London.
11,152. PRODUCING MURIATIC ACID, B. J. B. Mills.—(*The Verein für Chemische Industrie, Germany*)
11,153. UMBRELLA FRAMES, A. MacMillan, London.
11,154. SCREWS or BOLTS, W. P. Ward.—(*C. Furbish, United States.*)
11,155. POCKET CALENDAR, W. H. Dowland, London.
11,156. METALLIC BARBED HURDLES, E. and E. Price, London.
11,157. CHAFF and LITTER CUTTERS, J. Williams.—(*The Ofverum Estates Company, Sweden.*)
11,158. REDUCING LUMPS of ICE into SHAVINGS, G. A. Wilkins, London.
11,159. SECONDARY BATTERIES, &c, F. C. Hills, London.
11,160. AIR and WATER ENGINES, R. Disher and G. Harper, London.
11,161. PRODUCING LIGHT by INCANDESCENCE of REFRACTORY MATERIAL, F. L. and W. S. Rawson, London.

2nd September, 1886.

11,162. CONTROLLING ELECTRIC CURRENTS, W. Rowbotham and F. S. Worsley, Manchester.
11,163. GONGS for BICYCLES, &c., T. F. Ware, Birmingham.
11,164. DYEING TEXTILE FABRICS, W. E. Heys.—(*H. Danzer, A. Simian, and De Marcien, France.*)
11,165. TREATING NIGHT SOIL, J. B. Hannay.—(*R. W. E. MacIvor, New South Wales.*)
11,166. ROTARY ENGINE, H. Boyd. London.
11,167. DELIVERY of PREPAID GOODS, F. C. Lynde, Manchester.
11,168. BRUSHES and BROOMS, W. S. Beresford, Birmingham.
11,169. FILTER PRESSES, J. Williamson, Glasgow.
11,170. VENTILATORS, J. D. Watson, Glasgow.
11,171. MONUMENTAL SLABS, C. Mapleson and W. J. Rolls, London.
11,172. WRENCH ATTACHMENTS, W. A. Kelly and C. H. Hubbell, East Tawas, U.S.
11,173. BUTTON-HOLE SEWING MACHINES, A. Anderson.—(*The Singer Manufacturing Company, U.S.*)
11,174. COUPLING for the HARNESS of DRAUGHT ANIMALS, &c., H. R Landon and I. Hurn, London.
11,175. PORTABLE METAL MUSIC STANDS, &c., W. J. Riley, Birmingham.
11,176 SADDLES for BICYCLES, &c., F. Hughes.—(*G. Rothgiesser, Germany.*)
11,177. MARKING CHOCOLATE CREAMS, &c., H. J. Haddan.—(*R. Wichmann, Germany.*)
11,178. MARINE BOILER and other FURNACES, J. R. Fothergill, London.
11,179. APPLICATION of ELECTRICITY to SPECTACLE FRAMES, J. T. Leighton, London.
11,180. SPRINGS for CARRIAGES, &c., J. U. Burt, London.
11,181. COLLARS, &c., H. Morgan, London.
11,182. CORD-HOLDER for BLINDS, E. Tonks, London.
11,183. ATTACHING HANDLES to CARPET BROOMS, U. Kleiter, Birmingham.
11,184. HINGING GUARD BEADS to WINDOW SASHES, D. F. Saunders, London.
11,185. ELECTRICAL DISTRIBUTION, W. C. Goldner, London.
11,186. HANDLE for MECHANICAL TOOLS, W. H. Hall, London.
11,187. ACTUATING ANIMAL FIGURES, W. H. Hall, London.
11,188 SHOVEL, C. S. Snell, London.
11,189. TRANSPARENT MATERIAL or PAPER, J. W. Saynor, London.
11,190. TRANSFERRING from PHOTOGRAPHIC NEGATIVES to ZINC PLATES, C. B uch, London.
11,191. KNITTING MACHINERY, J. W. Lamb and S. Lowe, London.
11,192. TREATING WOOL FAT to produce UNGUENT MATERIAL, H. W. Langbeck, London.
11,193. ROTATING SIEVES, O. Imray.—(*H. Simon, Switzerland.*)
11,194. ELECTRICAL MOTOR E CAPEMENT for CLOCKS, H. Davey, London.—*19th July*, 1886.
11,195. GATHERING FABRICS, W. H. Gramolt, London.
11,196. FACILITATING STARTING of TRAMCARS, W. P. Smith, London.
11,197. FUSES for PROJECTILES, T. Nordenfelt, London.
11,198. TRAMCARS, &c., T. E. Knightley, London.
11,199. SEWING MACHINES, J. L. Lüders, London.
11,200. ENVELOPE MACHINES, S. A. Grant, London.

3rd September, 1886.

11,201. EYES for HOLDING STAIR RODS, F. A. Harrison, Birmingham.
11,202. HANDLES for KETTLES, &c., E. Fisher and H. W. Ludlow, Birmingham.
11,203. WRINGING MACHINES, A. Cowie, Glasgow.
11,204. RUBBER TIRE WHEELS, J. Shaw, Manchester.
11,205. MINERS' SAFETY LAMPS, W. Fairclough, Manchester.
11,206. PORTABLE COUCH for SURGICAL OPERATIONS, J. Kehoe, Dublin.
11,207. FINISHING COTTON, &c., M. Hilton, Prestwich.
11,208. EXTRACTING MOISTURE from WOOD, &c., H. Wilson, Stockton-on-Tees.
11,209. TUBES and BOBBINS, S Wilson, Dublin.
11,210. ROD and WINDOW BRACKET for ADVERTISING, R. Atkinson, London.
11,211. REDUCING ALUMINA into METAL, C. J. L Leffler, Sheffield.
11,212. MANUFACTURE of VELVETS, &c., F. H. Wilke, Bradford.
11,213. BOW-CLOSURES for PURSES, &c., H. Lehmann, Germany.
11,214. ELECTRIC CONTROLLING APPARATUS, C. Bonnenberg and M. Koyemann, Germany.
17,215. STEAM MOTOR, W. Schmidt, Germany.
11,216. EVOLVEMENTS of TORPEDO FINDERS, J. R. Holmes, London.
11,217. PRESSING TEXTILE FABRICS, E. Outram and J. Miller, Halifax.
11,218. FASTENING BUTTONS to WEARING APPAREL, C. B. Voissey, Liverpool.
11,219. EGG BEATERS, J. G. Wilson.—(*G. H. Paine, United States.*)
11,220. LEVELLING INSTRUMENT, G. Falter, sen., and J. Falter, jun., London.
11,221. TRANSPORTING PERSONS, &c., A. H. Williams, London.
11,222. SEWING MACHINES, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
11,223. SIGNALS for TRAMWAYS, T. Whitby, Liverpool.
11,224. SCHOOL SLATES, S. Jones, Liverpool.
11,225. UNIONS for HOSE, F. A. Michael, London.
11,226. METALLIC PACKING for PISTONS, J. H. Smith, London.
11,227. STEAM TRICYCLES. J. Schweizer, Switzerland.
11,228. GLASS COVERS and STANDS, W. Cutler, London.
11,229. WRITING and DRAWING PENS, J. Hickisson, London.
11,230. A DENTIFRICE, A. M. Clark.—(*G. A. Richard, France.*)
11,231. CUTTING PHOTOGRAPHIC PLATES, B. J. Edwards, London.
11,232. FRONTS, &c., E. Burton, London.
11,233. BRISTOL STONEWARE, H. Doulton, London.
11,234. BELT PULLEYS or DRUMS, A. B. Perkins, Bradford.
11,235. DISTRIBUTING GRAIN, &c., G. F. Redfern.—(*G. Brandon, France.*)
11,236. FOLDING CARRIAGES, W. Singer, London.
11,237. FANCY-CLOTH LOOMS, E. Edwards.—(*E. Weller and T. Bauer, Germany.*)
11,238. COMPOUND METALLIC PACKING, J. S. Starnes, London.
11,239. ELECTRIC BATTERY, H. Carter, London.
11,240. GROOVING STRAWBOARD, &c., N. B. Chadwick, London.
11,241. AIR REFRIGERATING MACHINES, E. Hesketh, London.

4th September, 1886.

11,242. EFFECTING the ELECTRO CHEMICAL GENERATION of CHLORINE in METALLURGICAL OPERATIONS for the EXTRACTION of GOLD from its ORES, D. G. Fitzgerald, London.
11,243. SCARVES and NECKTIES, J. and W. Smale, London.
11,244. FILTER-PRESSES, A. W. Anderson, London.
11,245. MAKING and ORNAMENTING BASSINETTES, W. H. Brassington, Manchester.
11,246. BOILER for ECONOMICAL GENERATION of STEAM, H. Boyd, London.
11,247. ENGINES, L. Sanderson, London.
11,248. RAISING of LAMP GALLERIES, F. R. Baker, Birmingham.
11,249. WITHDRAWAL of CORKS from BOTTLES, J. C. Gossell. Birmingham.
11,250. EARTHENWARE, &c., SOCKET PIPES, S. H. Sparkes, Wellington.
11,251. APPARATUS for GOVERNING STEAM and other ENGINES, W. D Ferguson, Glasgow.
11,252. BUCKETS for LOADING, &c., SHIPS' CARGO, J. Dowell and W. Wilson, Glasgow.
11,253. SIDE SCUTTLES, E. J. Preston and E. W. de Rusett, London.
11,254. ROTARY BRUSHING BOOTS, KNIVES, &c, A. E. Haslam, Manchester.
11,255. PRODUCING PLUSH STRIPES DURING WEAVING, A. Barstow, Manningham.
11,256. VENETIAN BLINDS, W. Allan, Glasgow.
11,257. APPLYING POWER to BICYCLES, &c., J. C. Garrood, Folkestone.
11,258. RAILWAY TRUCKS and WAGONS, H. Williams, Glasgow.
11,259. SELF MEASURING COCK for LIQUIDS, T. Parkinson, Blackburn.
11,260. ECONOMISING FUEL in KITCHENERS, F. Botting, London.
11,261. PASTING MACHINE, C. J. Flawn, London.
11,262. CULLET for MAKING GLASS, &c., C. J. Allport, London.
11,263. FASTENING KNIFE BLADES, &c., to HANDLES, G. H. Wells, London.
11,264 METALLIC TUBES for FIRE-BOXES, &c., of STEAM BOILERS, R. A. Hardcastle, London.
11,265. SELF-ACTING COUPLING for RAILWAY CARRIAGES, R. W. Rundle and T. Allen, London.
11,266. HANGING SASH WINDOWS, J. H. Jones, Manchester.
11,267. EXPANSION GEAR of STEAM ENGINES, C. Scott and H. Hodgson, Lancashire.
11,268. DRY CLOSETS and COMMODES, T. D. M. and K. W. King, London.
11,269. MOTOR ENGINES, J. J. R. Humes, London.
11,270. STEAM ENGINES, F. Bosshardt.—(*C. A. Umbach, France.*)
11,271. INTERCEPTING NOISES CAUSED on FLOORS, &c., F. Bosshardt.—(*A Grenouillet, France*)
11,272 SPRING CHECK for the STOP RODS of LOOMS, L. Sutcliffe, Halifax.
11,273. INKSTANDS, &c., C. H. Job, London.
11,274. FISH HOOKS, S. James, London.
11,275. LAMPS BURNING LIGHT, &c., OILS, J. Hinks, London.
11,276. SUBMARINE MINES, D. Campbell and G. L. Schultz, London.
11,277. BUTTON, H. Agar and T. S. Griesbach, London.
11,278. PRODUCING CUT NAILS, L. Glaser, London.
11,279. ASCERTAINING, &c., DIMENSIONS, T. Knowles, Manchester.
11,280. MOVABLE BULWARKS or RAILS of SHIPS, J. H. Boolds and E. Shearer, London.
11,281. WORKING DIRECT-ACTING SEWING MACHINES by the FOOT, C. E. Masterman, London.
11,282. VELOCIPEDES, E. G. Sheward and J. E. Wilson, London.
11,283. FLOOR CLOTHS, H. M. Steinthal, London.
11,284. PRESSES for PRESSING JUTE, &c., J. Watson, London.
11,285. VALVES for GAS and OIL MOTOR ENGINES, F. W. Crossley, London.
11,286. FIELD STOVES, A. S. Tomkins, London.
11,287. MANTELS for INCANDESCENT GAS LIGHTING, A. Paget, London.
11,288. AUTOMATIC ALARM APPARATUS for INDICATING VARIATIONS of TEMPERATURE in FACTORIES, &c., A. A. Clark.—(*La Société Française Protectrice contre les Incendies dite, L'Avertisseur Electro-Automatique, France.*)
11,289. FURNITURE for DOOR LOCKS, T Elsley, London.
11,290. AUTOMATIC PRINTING ELECTRO-TELEGRAPHIC INSTRUMENTS, A. J. Boult.—(*P. L. Lamure, France*)
11,291. ELECTRO-PLATING, R. K. Boyle, London.
11,292. LOCKS, &c., T. Galloway, London.
11,293 VEGETABLE FIBRES for MAKING PAPER, &c., W. B. Nation, London.
11,294. TOPS or COWLS for CHIMNEYS, &c., T. Whitehead, Liverpool.
11,295. SPECULUM, W. S. Watson, Liverpool
11,296. SEATINGS and RINGS for BOTTLES, &c., H. Barrett, London.
11,297. DRAWING and SHAPING the EDGES of HAT LEATHER, &c , J. Eaton, London.
11,298. BILLIARD TABLES, F. E. Renouf, London.
11,299. POCKET SEWING MACHINES, J. Holroyd and the Moldacot Pocket Sewing Machine Company, London.

6th September, 1886.

11,300. TREATING MINERAL OILS with ACIDS, A. C. Thomson, Glasgow.
11,301. OBTAINING OIL from SHALE, &c., A. C. Thomson, Glasgow.
11,302. BLEACHING FIBROUS MATERIALS, &c., H. Ledger, Leek.
11,303. PREPARATION of FURNACE SLAG, E. Larsen, Liverpool.
11,304. FILTERS, C. Hird, Halifax.
11,305. PHOTOGRAPHIC DARK ROOM LAMPS, H. Lucas, Birmingham.
11,306. FLAT-STRIPPING APPARATUS for CARDING ENGINES, H. Wuchner, Manchester.
11,307. SAFETY LAMPS, W. Clifford, Sheffield.
11,308. AIR PRESSURE and VACUUM LOCK, M. Wood, Liverpool.
11,309. FILE-CUTTING, W. Handley, Leeds.
11,310. PRIVIES and WATER-CLOSETS, A. M. Fowler, Manchester.
11,311. TOPS and STOPPERS of BOTTLES, &c., J. Meeson, Sheffield.
11,312. ORNAMENTER, T. C. Pyett, London.
11,313. RAILWAY CARRIAGES, P. Dietrich, Berlin.
11,314. SUSPENDING, &c., LAMPS, H. Adeane, London.
11,315. CRICKET BATS. R. F. J. C. Allen, London.
11,316. AUTOMATIC FIRE-EXTINGUISHING VALVE, G. Macfarlane, London.
11,317. ELECTRIC CALL and FIRE ALARMS, H. J. Haddan.—(*C. M. Barnes and N. E. Baker, United States*)
11,318. TAKING off the OUTSIDE BARK of BAMBOO CANE, C. Waters, London.
11,319. RAILWAY COUPLINGS, M. H. Blanchard, jun., London.
11,320. FIRE-EXTINGUISHING APPARATUS, H. J. Allison.—(*L. D. Stone, United States.*)
11,321. TWISTING MACHINES, G. L. Brownell, London.
11,322. SPRING in FLAT STEEL, P. A. Dobis, London.
11,323. SANITARY DUST-BIN and CINDER SIEVE, F. Paget, London.
11,324. DISPLAYING the ELECTRIC LIGHT on STEAMSHIPS, &c., H. Bradley, London.
11,325. FURNITURE, &c., H. Tipper and H. J. C. Summerville, London.
11,326. HAIR CURLER, G. H. Hill, London.
11,327. TAPS or VALVES, G. Wood, London.
11,328. WASHING FABRICS, C. R. Crane, London.
11,329. WIRE FENCES, J. Horrocks, London.
11,330. GAS FITTINGS, S. Chandler, sen., S. Chandler, jun., and J. Chandler, London.
11,331. VELOCIPEDES, A. Duncker, London.
11,332. FOUNTAIN or RESERVOIR PENS, M. Wettich, London.
11,333. BANKERS' CHEQUES, &c., C. Jackson, London.
11,334. WASHING MACHINES, A. J. Boult.—(*C. W. Dennis, Canada.*)
11,335. CONDENSING STEAM, &c., R. Romaine, Liverpool.
11,336. VEHICLE SPRINGS, A. J. Boult.—(*J. B. Armstrong Canada.*)
11,337. ELECTRICAL MAKING and BREAKING CONTACTS, S. C. C. Currie and I. A. Timmis, Westminster.
11,338. SCREW JOINTS or COUPLINGS, T. W. Shotton, Burton-on-Trent.
11,339. SHUT-OFF VALVES for PIPES or MAINS, J. Sturgeon, Birmingham.

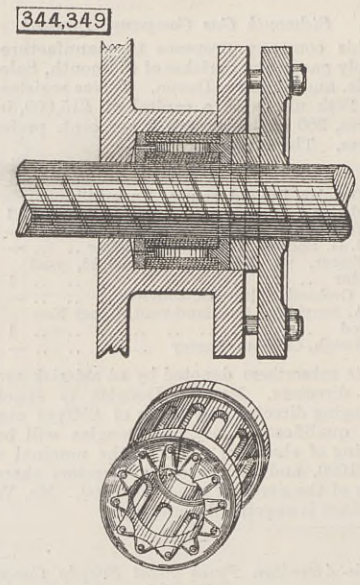
SELECTED AMERICAN PATENTS.

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

344,349. STUFFING-BOX, *Alexander H. Clark, Fond du Lac, Wis.—Filed April 23rd*, 1886.

Claim.—(1) A packing cylinder for a stuffing-box, the said packing cylinder having an internal and external ring of packing, and a series of channels adapted to conduct steam between the two rings of packing, substantially as set forth. (2) The combination, with a stuffing-box and gland, of a packing cylinder adapted to rest in snug contact with an annular seat in the stuffing-box, the said packing cylinder having an inner and outer ring of packing and a series of channels leading from the edge of the piston-rod bore to the space between the rings of packing, substantially as set forth. (3) In a stuffing-box, a packing cylinder provided with inner and outer recesses adapted to receive packing, a series of openings connecting the two recesses, and steam conduits leading from the said openings to the edge of the piston-rod bore on the inner end of the packing cylinder, substantially as set forth. (4) In a stuffing-

344,349

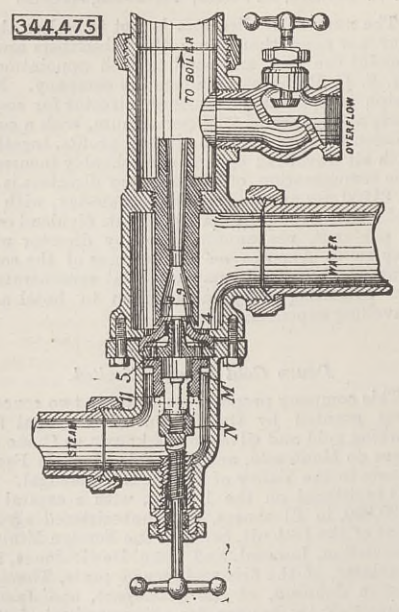


box, a packing cylinder provided on its inner end with a series of perforations communicating with openings in the shell of the cylinder and channels leading from the ends of the perforations to the edge of the bore, the said channels gradually increasing in size as they approach the bore, substantially as set forth. (5) The combination, with a stuffing-box, a packing cylinder having external and internal rings of packing, and a series of channels adapted to conduct steam between the two rings of packing, of a gland and devices for forcing in the gland into contact with the packing cylinder, substantially as set forth.

344,475. INJECTOR, *Walter L. Cheney, Hartford, Conn.—Filed June 1st*, 1885.

Claim.—(1) In an injector, the combination, with a pair of fixed concentric nozzles, of the annular valve M, having an interior space communicating with one of said nozzles, a passage closed by said valve and leading to the other of said nozzles, and a valve arranged to close the interior of and to lift the said

344,475



annular valve, substantially as set forth. (2) In an injector, the combination of plate 4, having nozzle 9, plate 5, having nozzle 8, passage 7, and a seat for valve M, valve M having valve seat 11, valve N means, substantially as described, for operating valve N, and means, substantially as described, for operating valve M from valve N, substantially as set forth.

344,343. ELECTRIC INCANDESCENT LAMP, *Charles E. Buell, New Haven, Conn.—Filed February 24th*, 1880.

Claim.—(1) The combination of an internal exhausted globe, an external exhausted globe, an incandescent filament, and leading-in wires passing through and sealed into both globes, substantially as described. (2) The combination, in an electric lamp, of a loop of carbon inclosed in an exhausted globe, which is inclosed in a second exhausted globe, each globe being sealed separately, thereby securing the inner vacuum from leakage of air from without, substantially as described. (3) The combination, in an electric lamp, of a carbon loop inclosed in double exhausted globes which are sealed separately, and metallic connections passing through the globes and sealed therein, the

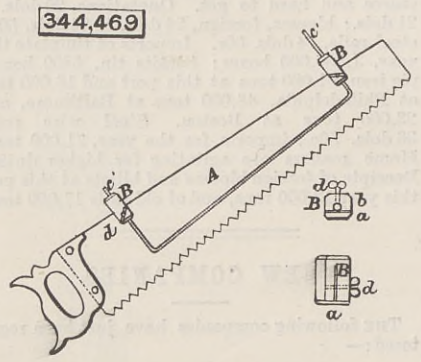
344,343

whole arranged in such a manner as to prevent the heating of the outer globe and expansion and contraction of the conducting wires in the outer sealing, substantially as described.

344,469. SAW GAUGE, *William H. Wilson, Westfield, N.Y.—Filed October 7th*, 1885.

Claim.—The saw gauge, substantially as herein described, consisting of the clamps B B, each having a vertical slit *a*, the vertical hole *b*, one side of which

344,469

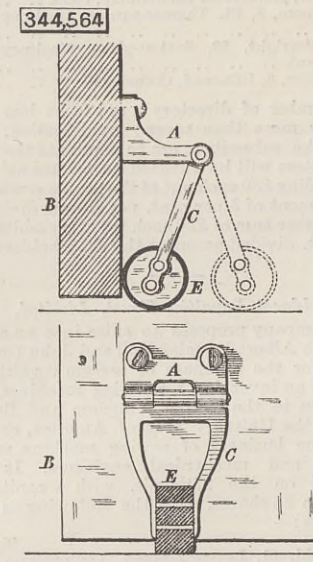


opens into the slit *a*, and the connecting wire *c c*[1] bent as described, the ends *c*[1] setting in the holes *b b*, and held in place against a saw blade by the screw *d*, as specified.

344,564. DOOR CHECK, *George N. Clemson, Middletown, N.Y.—Filed March 25th*, 1886.

Claim.—The combination, with the door B, of the forked bracket A, secured to the lower part thereof, the swinging arm C pivotted at its upper end in the fork of the bracket and forked at its lower end, and the elastic pad E rigidly secured in said fork, the dis-

344,564

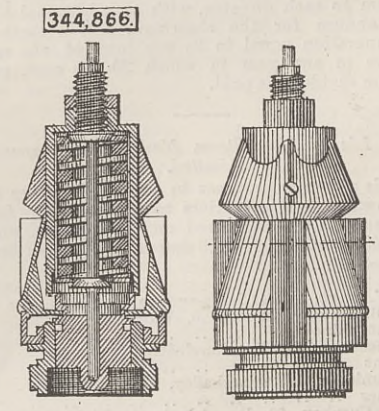


tance from the axis of the pivotted arm to the floor being less than from the axis to the lower face of the elastic pad, whereby the weight of the door will act on the arm and pad to produce sufficient friction on the floor or carpet to hold the door in any desired position, substantially as set forth.

344,866. SAFETY VALVE, *George W. Richardson, Medford, Mass.—Filed August 10th*, 1885.

Claim.—(1) In a safety valve, the hinged plates adapted to be moved by the escaping steam and to assist in raising the valve, the said plates being mounted upon a ring connected with the spring casing, substantially as shown and described. (2) In a safety valve, the hinged plates surrounding the valve seat and combined with the spring casing and valve, and governing the openings between the valve seat

344,866.



and the atmosphere, substantially as and for the purposes set forth. (3) In a safety valve, the combination of the valve, the tension appliance, the spring casing, the hinged plates mounted upon a ring formed on or with said casing, and the flanges, substantially as shown and described. (4) In a safety valve, the combination, with the hinged plates, of the adjustable regulator mounted and made movable upon the spring casing substantially as shown and described.