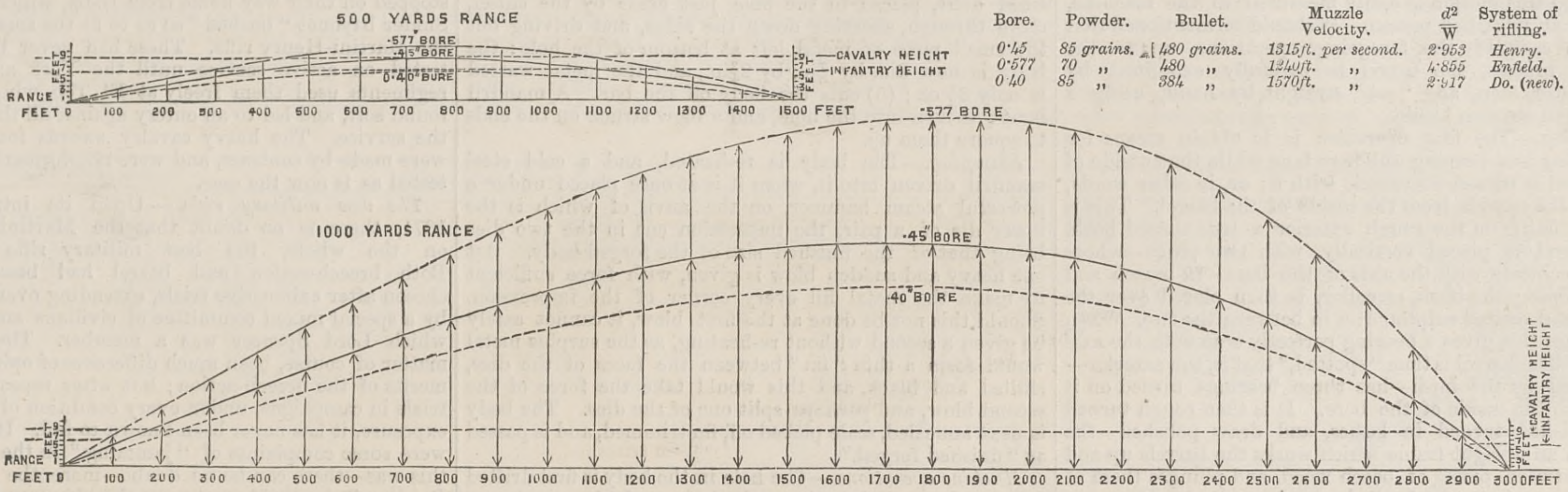
THE ENFIELD SMALL-ARMS FACTORY.

The visit to Enfield this week of the members of the Institution of Mechanical Engineers—accompanied by some 150 visitors from Belgium—affords us an opportunity of briefly reviewing the work now being carried on at that factory, as well as of describing the new rifle for the British Army, and comparing it with the arms in possession of the other European Powers, noticed and illustrated on pages 154 and 155.

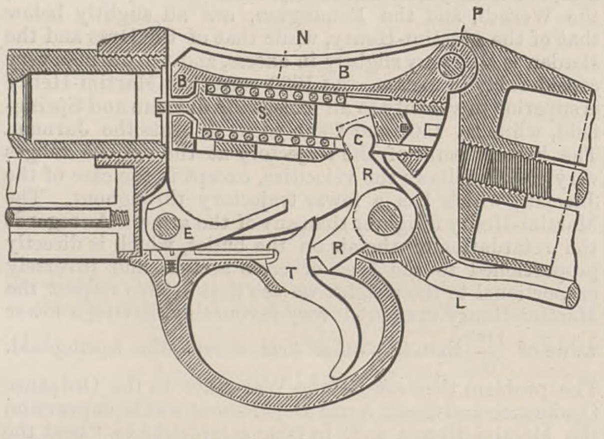
The Goverment Small-Arms Department has its headquarters at Enfield Lock, with a branch factory at Birmingham—this latter establishment being devoted to the repair of arms, as well as to the very important work of examining and testing the rifles, swords, bayonets, &c., supplied by the trade in various stages of manufacture, as well as when finished. At Enfield can be seen the various processes in the manufacture of the Martini-Henry and the new Enfield-Martini rifles, cavalry and artillery carbines, revolvers, triangular and sword-bayonets, cavalry swords and lances, in addition to minor articles of equipment. The most recent, and not least important, addition to the works consists of the extensive buildings for the manufacture of Nordenfelt and Gardner machine-guns, of which, however, only the smaller sizes—five barrels of 0·45in. bore—are at present made there, the large—1in. bore—sizes being supplied by contract, but rigidly tested and proved at Enfield both in a rough and finished state. Very considerable enlargements have also taken place in the shops connected with the older branches of work, and improved machines introduced for various processes, with the object, speaking generally, of combining increased accuracy, simplicity, and economy. Some of these will be noticed in detail.



Bore.	Powder.	Bullet.	Muzzle Velocity.	$\frac{d^2}{W}$	System of rifling.
0·45	85 grains.	480 grains.	1315ft. per second.	2·953	Henry.
0·577	70 ,,	480 ,,	1240ft. ,,	4·855	Enfield.
0·40	85 ,,	384 ,,	1570ft. ,,	2·917	Do. (new).

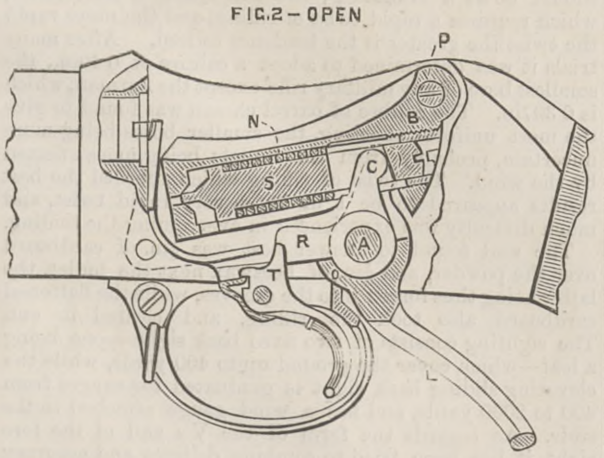
DIAGRAM OF TRAJECTORIES.

FIG 1—CLOSED AND FIRED



It would, indeed, be difficult to speak too highly of the beautiful automatic machinery employed, both for metal and wood work; resulting in great economy of skilled labour and perfect interchangeability of component parts, this latter being a point of the highest importance with military fire-arms. As it would be impossible, with the space at our command, to give an exhaustive description,

FIG.2—OPEN



we will take—as types of the work done—the chief processes required for the manufacture of a rifle of the newest pattern.

Description of the Enfield Martini-Henry rifle.—This arm consists of an entirely new pattern barrel, combined with the famous Martini breech-action, slightly modified, and an improved stock. Of the reasons for retaining this mode of closing the breech we will speak further on. The barrel is screwed into a shoe, or body, containing the breech-action, both made of steel, and the wooden stock is in two parts. The breech-action includes the mechanism for closing the breech, firing the cartridge, and extracting the empty cartridge case. The breech is closed by a block B—see Figs. 1 and 2—swinging or pivoting on a pin P, passing through the upper rear end of the body, the recoil being taken by the latter, and not by the pin. The cartridge is exploded by the striker S, which is driven by the strong spiral spring N within the breech-block. A lever L in rear of the trigger-guard acts by means of two horns on the breech-block, so that the movement of pushing this lever downwards and forwards causes the block to fall into the loading position, and to strike the lower arm of the extractor E—pivoted on lower forepart of the body—thus ejecting the cartridge case. At the same time, the lever, by means of a projection O on its short arm—Fig. 2—carries the tumbler R round until the trigger-nose falls into the "bent" or notch of the tumbler, thus cocking the piece, and likewise draws back the striker S, and compresses the spiral mainspring N by means of the "crane" C of the tumbler, which works in a slot cut through the striker. It will be seen that this single movement of the lever performs three operations, and it must be observed that the lever revolves freely upon the tumbler axis A. On returning the lever to its former position against the butt, the block is raised so as to close the breech, and the mainspring is still further compressed, since the tumbler does not move, but is retained and held firmly by the trigger-nose. The rifle is now fully cocked, and ready for firing, Fig. 3. On pulling the trigger the tumbler is free to rotate, the compressed mainspring is released, and it impels the striker forward against the cap in the base of the cartridge. The Martini-Henry breech action had an indicator outside the shoe connected with the square tumbler axis, which showed at all times whether the arm was cocked or not. This has had to be omitted in the new rifle, since it has a round tumbler axis; the square axis and hole were found liable to wear and become dangerous, but the round axis being part of the tumbler cannot wear. Moreover, to the new action has been added a safety-bolt, acting in the form of a screw and lever, which lifts the nose of the tumbler clear of the trigger. These are the only alterations worth noting. For the dimensions, &c., of the rifle see table B, page 156, which also gives those of the Martini-Henry.

Martini-Henry carbines are of two patterns—for cavalry, weight, 7 lb. 8oz.; for artillery, weight, 7 lb. 10½oz.; length, 3ft. 1¾in. nearly. The artillery pattern is fitted to take a sword-bayonet with a straight blade 2ft. 1¾in. long, having a saw back of forty-one teeth; both arms are precisely similar to the Martini-Henry rifle in calibre, twist, and form of rifling, and take the same cartridge, but the barrel is only 19in. in length.

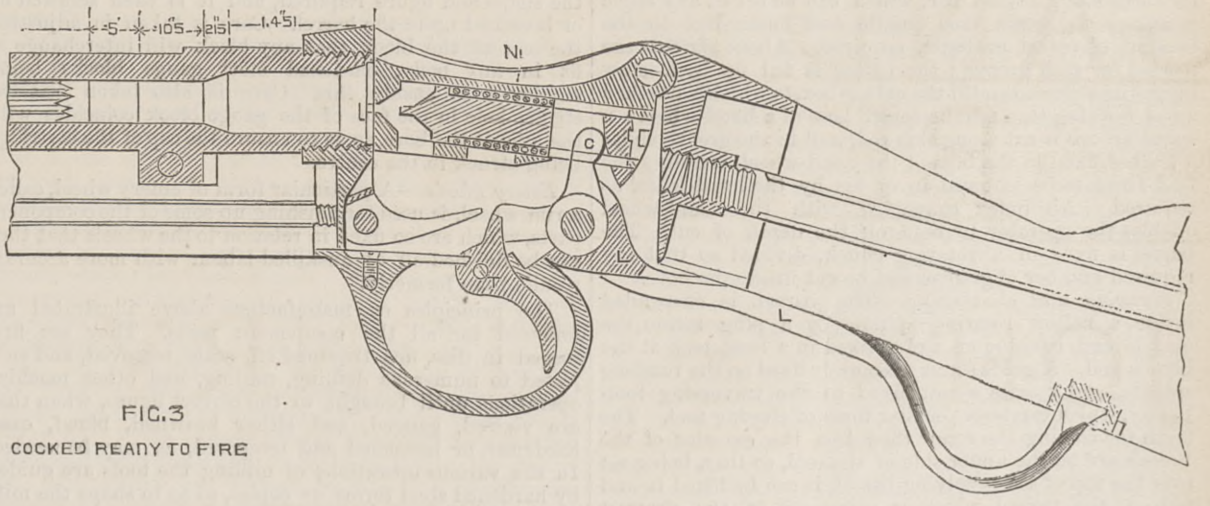


FIG.3

COCKED READY TO FIRE

THE ENFIELD-MARTINI RIFLE.

Manufacture: The stock.—The stock, which consists of two parts, the butt and fore-end, is made of Italian walnut, which is light, hard, and close in grain. The rough parts are procured by contract, and are most closely examined for nearly a dozen possible defects, the greater part of which consist of some injury to the tree or defect in growth. The last defect looked for is impregnation by salt water, and this, although unusual, is very important, as no method is known for removing the salt, and, if used for a stock, it will rust any steel or iron with which it comes in contact. This fact was strikingly illustrated in the case of some arms which had been damaged by sea water in a shipwreck a few years back. They were taken to pieces and thoroughly cleaned and put in good order by military armourers at a foreign station, but had scarcely been re-issued, when rust re-appeared on every part of the metal in proximity to the wood stocks. Finally, the arms had to be condemned and sent to England to be fitted with new stocks. This defect can be ascertained by dipping a shaving in a solution of nitrate of silver, when chloride of silver is precipitated. Green wood requires about three years to season, but the seasoning can be hastened by dessication in a room subjected to a heat of 60 deg., gradually raised to 90 deg., or 100 deg. Fah. If, as is usually the case, half seasoned when received, they can be made ready for use in some six or seven weeks. The stocks are sawn, turned, bedded, grooved and counter-sunk for the various parts by means of really beautiful copying machines, a metal copy guiding the tool. They are finally finished up by hand.

The barrel.—The barrel is made of soft or mild steel, prepared by the Siemens-Martin process, which gives a very uniform metal. The cylindrical barrel bars or ingots are obtained by contract in lengths of 15in., having a diameter of 1¼in.

Forging in the smithy.—The ingot is heated to a bright red heat, and passed through the barrel rolling mill, which consists of ten pairs of roll, arranged horizontally and vertically alternately, in which it is drawn out to the full length required—about 36in.—in a single heat, and tapered. These rolls are made of cast iron chilled through, and can roll 500 ingots per day. The solid barrel is next taken to the Ryder forging machine, where the "Knox form" is forged on the breech end, and the barrel cut to length. It is then pickled to remove scale, put through a straightening machine, "viewed"—examined—for straightness, and passed as "finished forged."

Barrel machine-room.—The ends of the barrel are clamp-milled for size and length, and to form bearings, and then drilled up about ⅛in. at each end, the diameter of the holes being about 0·38in. This last operation is called "entering the bore." Occasionally a barrel is drilled 1¼in., and is very carefully tested to see that the starting of the bore is true.

Drilling.—The barrels are placed three in a horizontal machine, in which they revolve at a speed of about 940 revolutions per minutes, the holes already made acting as guides for the half round or D bits, which work from either end of the barrel, and have a small longitudinal slot cut in them. Underneath the bits and to within ¼in. of their ends is placed a brass tube, ⅛in. in diameter, through which a lubrication of pure soap and water is forced at a pressure of from 60 lb. to 70 lb. per square inch, which forces the metal cuttings or "swarf" out at each end of the barrel; this brass tubing oscillates by means of a cam on the shaft connected to the driving pulleys—friction wheels—which shaft also works the feed slides at each end of the machine; the traverse of the slides is ⅛in. per minute. The bits drill about 6in. from each end, when the slides are drawn back and the bits pushed to the bottom of the holes ready to drill another 6in., and so on until they meet at the centre, as a rule not deviating more than from 0·005in. to 0·008in. These bits will each drill from two to three barrels without being sharpened, the operation taking from thirty-five to forty minutes. This machine has been thus closely described as it is a great improvement upon the vertical drilling machine until lately in use, which required five men to bore sixteen barrels per day, whereas the new horizontal one is attended to by one man, and can drill thirty barrels in the same time; the saving of expense in this single operation is about 1s. 6d. per barrel. After the barrel is drilled through the hole is enlarged 0·02 by means of a three-toothed drawbit, it is then passed on to the successive operations of rough boring and fine-boring." The bits for both these operations are square in section, but with two opposite sides slightly curved, and two opposite corners rounded off, the corners left square forming the cutting edges. In rough boring, an oak strip or spile is placed along one side of the bit, and in the fine boring a deal spile is used with long strips of writing paper placed between the spile and bit, so as gradually to broach out the barrel to the required diameter. There is also a last, or "finished boring," which is repeated thrice, and is not performed until after the exterior of the barrel has been finished, turned, and polished; it is rather of a burnishing character, producing a fine highly-polished surface, down which a shade is readily thrown by holding the barrel at the proper angle to the light. This enables a practised "viewer" to detect the least inaccuracy in the bore by the appearance of the edges of the shadow thrown down it—since shadows thrown off straight surfaces are projected in straight lines on any "true" surface on which they are cast. To ensure absolute certainty that no barrel shall be passed on for turning which has not the bore perfectly true, a mechanical test has been devised as follows: A steel rod is stretched taut between two horizontally fixed head-stocks, having collars in the centre and at one end, which fit the bore so that the barrel can freely revolve on the rod. If the bore is straight, the free end of the barrel will run perfectly true, but if not it will revolve eccentrically, and this motion is easily measured in the machine, even by an unskilled person. It should be mentioned that between each of the foregoing operations, up to the turning process, the barrel is carefully examined by skilled workmen, and "set" straight by hand, using a mallet and wooden block.

Turning.—The first operation is to obtain means for supporting and keeping the bore true while the outside of the barrel is turned concentric with it; or, in other words, to copy the outside from the inside of the barrel. This is done by fixing on the rough exterior a true-turned bush. The barrel is placed vertically, with two plugs—whose centres coincide with the axis of the bore—in breech and muzzle ends; the bush, or collar, is then placed over the barrel, and melted sulphur run in between the two. When it hardens this gives a bearing perfectly true with the axis of bore. The barrel is then "spotted," that is, the exterior—supported by the bush—has three bearings turned on it true with the inside of the bore. It is then rough turned and finished turned in lathes, and draw polished—the latter in an upright frame which works the barrels up and down between pieces of beech wood, and plunges them at each descent into a tank filled with oil and emery powder. They are now gauged, chambered for proof, and a screw thread cut to take the "butts" used for temporarily closing the breech during first proof. The system of turning now in use is greatly superior to the old method.

First proof.—A test necessary to detect inferior quality of metal, and flaws which do not appear on either exterior or interior surface. The charge for the Martini-Henry rifle is 7½ drams of powder, a lead plug of 715 grains, and over the latter a cork wad ½in. thick. Twenty barrels are proved at the same time, fixed in a cast iron proof battery.

Finished milled.—The seat for the front sight is now cross-milled and dovetailed, and the steel for the front sight is sawn to length and brazed on. The finished boring process already described now takes place; the barrel is again viewed and set, and is ready for rifling.

Rifling.—The cutter, of a suitable shape for the form of groove required to be cut, projects from a slot in the cutter-box, which is about 8in. in length, and fits the bore; it is drawn through the barrel by a rod fastened to one end of the box, the other end of the rod being coupled into the spindle of the traversing saddle. On this spindle is a pinion geared into a sliding rack carried by the same saddle; the end of the rack is fitted to slide backwards and forwards along a fixed bar, which can be set at any angle necessary to rotate the spindle and cutter-box to the amount of spiral, or twist, required. About six cuts are needed for each groove; the cutter is fed up by a screw tapped into the rear end of the cutter-box, to which is attached a rod working through the centre boss of a hand-wheel; a spiral groove is cut along this rod, and in the groove slides a feather fixed in the boss of the hand-wheel, enabling the feed-screw to be screwed in or out by the hand-wheel as required. An index connected with the hand-wheel enables the operator to read off the depth of cut. The barrel is fixed in a rotating chuck, divided so that any required number of grooves can be cut inside the bore.

Screwing and chambering.—The barrel is suspended inside a hollow rotating spindle by a plug inside the muzzle end, running on a plug fixed in a headstock at the breech end. A guide screw is securely fixed on the rotating spindle, and carries a nut fixed to the traversing tool-holder, which carries a peculiar form of chasing tool. The teeth for cutting the screw thread on the exterior of the breech are on the under side of the tool, so that, being set over the top of the revolving barrel, it can be lifted in and out of the thread which is being cut in the shortest possible time and distance without chopping the thread. The barrel is then driven from the finished screw, while the breech end is chambered inside for the cartridge. This consists in boring and rimering out the chamber in a lathe with various sized bits having longitudinal cutters. The dimensions of this chamber are tested by a set of four gauge plugs with great exactitude.

Second proof.—The barrel is now breeched up to the body, the breech action assembled for proof, and the rifle, so far completed, undergoes the second proof test, which consists of firing a charge of 5 drams of powder and a bullet weighing 715 grains. The barrels are proved in a battery somewhat similar to that used for the first proof.

Sighting.—The back sight-bed is soldered on to the barrel, and also secured by two screws. In this operation it has recently been found advantageous to apply the solder to the under side of the barrel as well as to the top. The reason of this is that the truth of the barrel may not be in the least affected; the solder underneath is of course removed when quite cold. In adjusting the position of the sight-bed on the barrel, the latter is laid in a machine, which determines the exact position of both back and fore sights with regard to the axis of the bore, for which also it is carefully examined in the viewing department.

Browning.—The body and barrel are separately "browned" in the usual manner, being first scalded in a solution of soda for twenty minutes, and then washed in clean water. The browning mixture is applied, and the parts are placed in a damp heat for one and a-half hours, when they are scalded again, and after cooling the rust is scraped off. This process is four times repeated, when the parts are cleaned and oiled. The whole takes about eight hours, producing a coating of oxide which greatly retards the formation of rust, and also is not so visible as bright metal.

The body, or "shoe."—The body is made from a specially tough description of mild steel. Bars of this metal, 4ft. to 5ft. in length, and 2in. by 1½in. in section, are obtained by contract.

Forging.—The body is blocked direct off the end of the bar by five blows under a 15-cwt. steam hammer. The effect of each successive blow is as follows:—(1) Marks out the rough figure, and measures off the quantity of metal required; (2) fullers in the sides of the body, ready to displace the metal when working the hole through it; (3) by means of a chisel in the upper die, splits the metal in the centre, driving out the sides of the body to fill the die, and leaving a deep impression of the hole to be made full-size at top; (4) drives a full-sized drift, placed in the hole just made by the chisel, clean through, shearing down the sides, and driving out the small piece of metal left at bottom of the hole; the body is now 3in. by ⅞in. by 2¾in., and the metal wasted is only 3½ oz.; (5) cuts the body off the bar. A mandril is now driven into the hole, and a blow struck on the ends to square them up.

Stamping.—The body is re-heated, and a cold steel mandril driven into it, when it is at once placed under a powerful steam hammer, on the anvil of which is the lower die of a pair, the impression cut in the two dies being that of the finished size of the forged body. But one heavy and sudden blow is given, with force sufficient to make the metal fill every corner of the impression. Should this not be done at the first blow, it cannot safely be given a second without re-heating, as the surplus metal would form a thin "fin" between the faces of the dies, chilled and black, and this would take the force of the second blow, and perhaps split one of the dies. The body is next annealed, scale picked off, fin trimmed, and is passed as "finished forged."

Machine operations.—The hole in the body is first drifted out by long slightly tapered drifts, which are drawn through it, and the hole thus produced is used as a base of operations for all subsequent work upon the body. Four bodies are now placed on a revolving cross-shaped fixing, the arms of which exactly fit the holes, while a transverse slide carrying two tool-holders, one on each side, turns up both sides of the four bodies at one operation; the sides are now equal in thickness, and true with the centre hole. Twelve bodies are next fixed on a revolving head, and the barrel ends are all cut square and true, the stock ends being similarly treated. The hole for the barrel is then drilled, tapped, the burr cleaned off, and the face eased, so that when a gauge is screwed on it stands exactly true. The body is now fixed by the adjusted face, and six axis or pivot holes drilled, three in each side; the drills run through hardened steel bushes fixed in the sides of the drilling jig. These axis holes, after being tested for accuracy, become, in conjunction with the large hole in the body, the base points for the remaining operations. A number of drilling machines cut away the metal, so as to form the socket to receive the stock butt; the hole for screw end of stock bolt—which secures the butt in the socket—is drilled and tapped. A number of minor drilling, tapping, and milling operations bring the body into the shape and figure required, and it is then screwed on or breeched up to the barrel. Care is taken in adjusting the seat of the block that any block will interchange or fit in any body, hardened steel gauge blocks being employed to ensure this. Care is also taken that the striker hole in the face of the gauge block coincides with the axis of the bore, so as to ensure the cap of the cartridge being struck in the centre.

Emery wheels.—A particular form of emery wheel, called a rim wheel, is used for finishing up some of the component parts, which are so fixed in relation to the wheels that they can be finished off by unskilled labour with more accurate results than formerly.

The principles of manufacture above illustrated are followed for all the component parts. They are first forged in dies, fins trimmed off, scale removed, and subjected to numerous drilling, milling, and other machine operations until brought to the correct figure, when they are viewed, gauged, and either browned, blued, case-hardened, or hardened and tempered, as may be needed. In the various operations of milling the tools are guided by hardened steel forms or copies, so as to shape the mild steel or wrought iron with great accuracy.

Testing bayonets and cavalry swords.—Since much criticism and discussion has recently arisen relative to the failure of infantry bayonets and cavalry swords in the hand-to-hand fighting in the Soudan campaign, it may be as well to detail briefly the very severe tests to which they are now subjected, whether made at Enfield or received from the trade.

Cavalry Swords: 1. *Vertical tests.*—The blades are placed in a machine with the blade vertical, when (*a*) it has to sustain a longitudinal weight or pressure of 32 lb. without in the least deviating from a straight line; (*b*) it has to support 36 lb. without going right down, *i.e.*, it must remain in a curve; (*c*) when pulled down so has to shorten its vertical height by 6in., by the application of a heavier weight, it must completely recover itself. The two last tests are repeated so as to curve the blade to the opposite side.

2. *Curve test.*—The blade is caught in a socket at the point and bent round a curved steel plate, when it must come back to the straight; this is repeated on the opposite side of the blade. This test is twice applied, first when hardened and tempered, secondly after polishing and when ready for mounting.

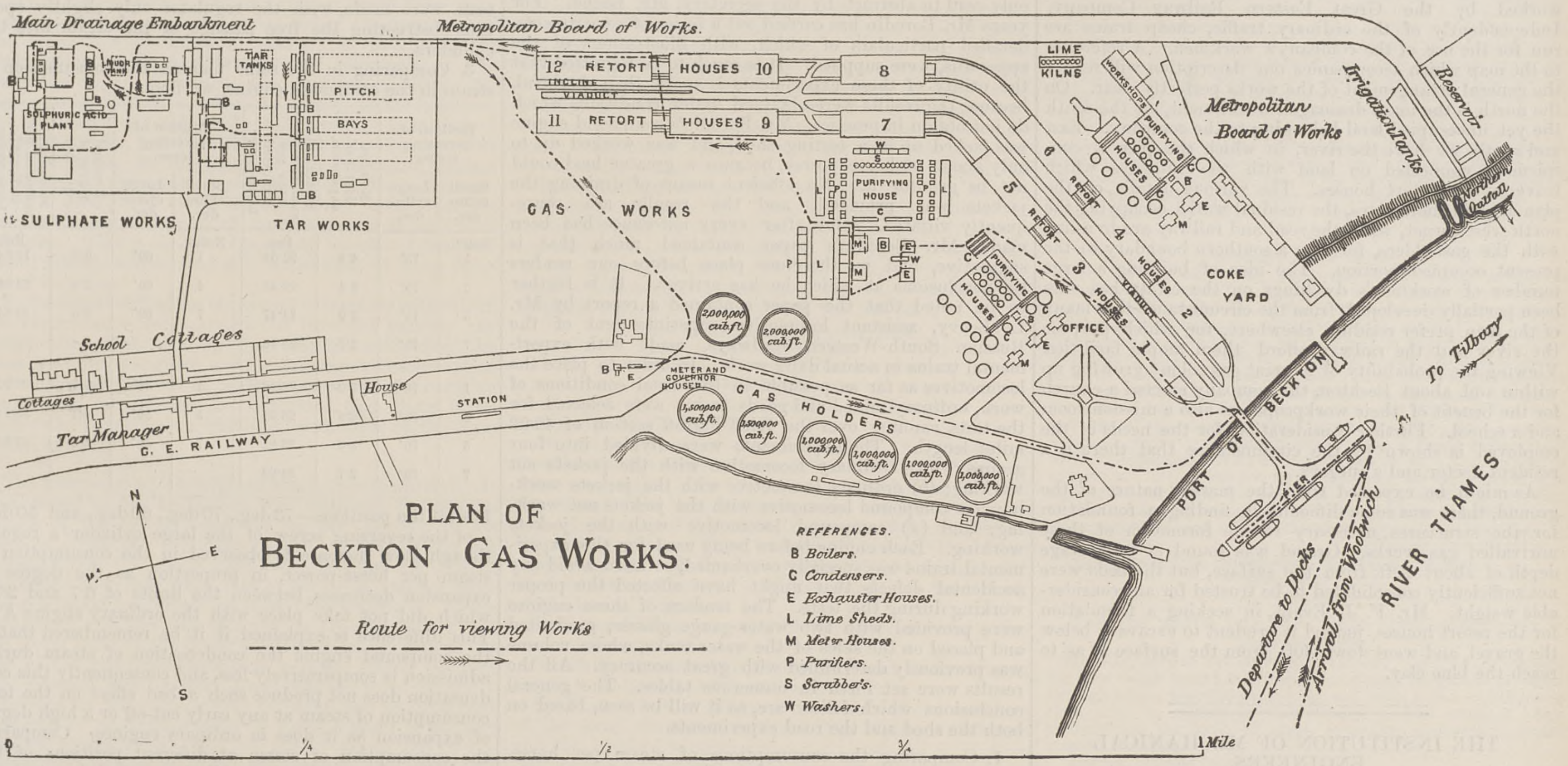
3. *Striking test.*—A strong steel spring liberated by means of a cam, gives the blade—which is inserted in a socket—a sudden blow on a block of oak; this is done to both edge and back. The sides are then struck by the same means a blow on a flat metal plate; the blade must not be in the least deflected from the straight by any of these blows.

Bayonets.—Both triangular and sword-shaped are tested in a similar way by means of a curved steel plate, which has to be used with each of the three sides in the case of the former weapon. They are also struck by hand, edge and back, on a block of oak. It will be remembered that a considerable proportion of the bayonets in the possession of some infantry regiments recently failed under these new tests. The explanation of this is that the earlier Martini-Henry bayonets weighed only half an ounce more than the Snider bayonet, although made 4½in. longer. This increased length was adopted to compensate in part for the decreased length of the Martini-Henry barrel, and it was not considered desirable to increase the weight. More metal was, however, afterwards added. The new Enfield-Martini rifle will be fitted with a very improved sword-bayonet, handy and strong, with a sharp point and keen edge. The particular bayonets, however, which proved defective in the Soudan, were those of two regiments stopped on their way home from India, which had the old Snider bayonet "bushed" so as to fit the smaller barrel of the Martini-Henry rifle. These had never been severely tested on active service until the York and Lancaster regiments used them freely at El Teb, when they were found soft, and led to an outcry against all the bayonets of the service. The heavy cavalry swords found defective were made by contract, and were not formerly so severely tested as is now the case.

The new military rifle.—Upon its introduction in 1871, there is no doubt that the Martini-Henry was, on the whole, the best military rifle in Europe. Both breech-action and barrel had been separately chosen after exhaustive trials, extending over three years, by a special mixed committee of civilians and soldiers, of which Lord Spencer was a member. There has, as a matter of course, been much difference of opinion as to the merits of the breech-action; but after repeated practical trials in campaigns, under every condition of climate and exposure, it has never been known to fail. It is true there were some complaints of "jamming" in the Soudan, but this was—there can be no doubt—more the fault of the Boxer coiled cartridges than of the rifle; and they would have jammed more in a rifle with bolt action, which gives no leverage to the extractor. However, other nations have not been standing still during the last fifteen years, and improved arms have been introduced into every European army. Table B gives the particulars of the dimensions, calibres, charges, rifling, and mode of breech-closing of the small-arms of the chief powers of the world, and Table C records their performances. It will be seen that, with the exception of the United States "Springfield" rifle—which is the same size—all the bores are smaller than the Martini-Henry; they all have a higher muzzle velocity than that arm, but at 500 yards the velocity of the Mauser, the Vetterli, the Werndl, and the Remington, are all slightly below that of the Martini-Henry, while that of the Gras and the Berdan is still very slightly in excess, and the Jarman very considerably in excess. At 1000 yards the Martini-Henry is superior in velocity to all except the Jarman and Springfield, while at 1500 and 2000 yards it beats the Jarman. The highest point of the trajectory at the various ranges very closely follows the velocities, except in the case of the Jarman, which has a lower trajectory throughout. The Martini-Henry is lighter than any of the arms. As regards the retardation of the air on the bullet, which is directly proportioned to the area of cross section, and inversely proportional to the weight, we see that in this respect the Martini-Henry compared very favourably, having a lower value of $\frac{D^2}{W}$ than any other arm except the Springfield. The problem then set by the War-office to the Ordnance Committee and Small Arms Department was to improve on the Martini-Henry, and, in fact, completely to "beat the record." An inspection of the figures in the tables against the Enfield-Martini rifle will best show how this has been carried out. Not only was it necessary to start with a high muzzle velocity, but to retain the velocity by keeping down the value of $\frac{D^2}{W}$ as low as possible. For this latter purpose the bullet should be as heavy as possible, while the bore should be at a minimum; but this means a long bullet, which requires a rapid twist of rifling, and the more rapid the twist the greater is the tendency to foul. After many trials it was determined to adopt a calibre of 0·40in., the smallest bore of any military rifle except the Jarman, which is 0·397in. The calibre of barrel chosen was found to give the most uniform shooting, the smaller bores being more uncertain, probably from the bullets being more affected by the wind. The twist of rifling which afforded the best results appeared to be 1 in 15—a very rapid twist, and much difficulty was experienced in overcoming the fouling.

The wad found to answer best was ⅛in. of cardboard over the powder, and ⅛in. of beeswax next the bullet, the latter being thus forced into the grooves, while the flattened cardboard also took the rifling, and cleared it out. The sighting consists of two fixed back sights—one being a leaf—which cover the ground up to 400 yards, while the elevating sliding back sight is graduated for ranges from 400 to 2000 yards, and has a wind gauge attached to the slide. As regards the form of the V's and of the fore sight, it has been tried to combine delicacy and accuracy with the necessary strength for a soldier's weapon to be used under every condition of active service. These points are, however, subject to modification from the results of the trials of the experimental rifles issued to different regiments. As before stated, the breech-action remains on the Martini principle by the express orders of the War-office. Besides the question of the actual superiority of this action to any other, it must be remembered that an entirely new breech-action would entail a most extensive series of experiments, resulting perhaps in a complete change of machinery for manufacture, all of which might prove useless should a magazine rifle be adopted in the near future. The modifications have been already described. As regards the stock, the butt has been made narrower, so as to fit the shoulder better, and the angle of inclination of the butt-plate to the axis of the piece made more acute, which would have a tendency to keep the muzzle down, producing much the same effect as a more bent stock. The fore end is no longer grooved to fit the barrel, but the barrel lies on the wood; so that it will be easier to keep the metal free from rust. The groove was found to be liable to hold water. A wooden hand-guard has been added to the rifle, so that, after rapid firing, the soldier need not burn his hand. This is an improvement which has been long advocated. The Enfield-Martini is likewise furnished with a "quick-loader," which hangs on one side of the shoe of the rifle, and holds six cartridges. These are acted upon by a zigzag spring, which forces each one in succession up an inclined plane, the head of the cartridge coming through an aperture in the lid, ready for the soldier to grasp and insert in the breech. With this apparatus it was found that six rounds could be fired in about twenty-five seconds, whereas in firing from the pouch it took over forty seconds to fire the same number of cartridges. The new sword bayonet has been described. The cartridge case is of solid-drawn metal. The penetration of the bullet is sufficient to pierce a ½in. iron plate at 200 yards, and the accuracy of the rifle very great, as is evidenced by the diagrams of the shooting.

The trajectory is very flat up to a range of 500 yards; at 1000 yards range the gain in flatness is evidenced by the diagram given, which also shows the great superiority in this respect of the Martini-Henry over the Snider rifle.



BECKTON GAS WORKS.

Twenty years ago the site now occupied by the Beckton Gas Works, visited on Thursday, the 19th inst., by the Institution of Mechanical Engineers, was a wild and desolate marsh. The Metropolitan Board had recently invaded the spot on the north and east by the construction of the embankment containing the great Northern outfall sewer, discharging into the Thames near Barking Creek. The locality might be described as East Ham Level, an extension of Plaistow Marsh. As the crow flies the distance would be rather more than seven miles from London Bridge. Considering the popular prejudice concerning gasworks, the spot was well chosen as the seat of the chief manufacture of gas for the supply of London. But considerations of a much more substantial character than this guided the counsels of the Gas Light and Coke Company, and doubtless had weight with Parliament when, in 1868, the Act was obtained conferring the necessary powers for the creation of the new establishment. In the same year Parliament adopted the policy of amalgamation, which went on progressively for some years afterwards, and resulted at last in the absorption of ten of the thirteen metropolitan gas companies into the one popularly known as the Chartered, the latest amalgamation being that of the London. There was a time, dating back to 1809, when the Gas Light and Coke Company was the only gas company existing in the world. Its charter was received in the year following. Its powers of supply extended over the cities of London and Westminster and the borough of Southwark. It was not permitted to acquire more than ten acres of land, and its capital was not to exceed £200,000, neither could it raise any money by borrowing. For years the gas rental was little more than nominal, the yield of gas from each ton of coal was very small; coke was the only secondary product deemed worthy of serious consideration, all other residuals were regarded as waste, and the price of gas was about 15s. per 1000 cubic feet. At a later period other gas companies came into existence, and the Chartered Company had to relinquish the Southwark territory. In 1860 came the Metropolis Gas Act, which limited each company to a defined district, and the position of the Chartered began to improve rapidly, culminating in the amalgamation which commenced in 1868. The company has now a paid-up stock and share capital of £8,103,000, with power to increase to £9,204,000. In addition it has borrowed to the extent of £2,186,000, and has power to go as far as £2,669,000. Altogether, including the accretion from premiums, the latest reckoning gives the capital account a total of £10,690,900. The contrast between these figures and those of 1810, are something like that which exists between the oak and the acorn.

Beckton owes its name to Mr. Simon Adams Beck, who was governor of the Chartered Company at the time when the establishment was founded. The original design of the works is due to Mr. F. J. Evans, M.I.C.E., who was then the company's engineer. Both these pioneers have passed away, but the work they left behind continues to grow. Beckton, when first formed, consisted of four retort houses, four gas holders, four sets of purifiers, scrubbers and condensers, two boiler houses, two meter houses, two exhaust houses, a canteen, an office, workshops, stables, and stores, and a pier having a frontage of 385ft. It will be seen further on how immensely all this is exceeded by the present buildings and plant, the pier, for instance, being doubled in its frontage. Beckton now covers an area of 200 acres, and 300 acres remain available for future extensions, a singular commentary on the ten-acre limitation imposed in the days of George III. Situated on the Essex shore, near the lower end of Galleon's Reach, Beckton sends out into the Thames, to a distance of 400ft., a wrought iron pier supported on cast iron cylinders, and extending its arms right and left in the form of a T-pier, so as to obtain a frontage of 800ft. parallel to the course of the stream. Five steam colliers of the largest size may lie alongside at the same time, three on one side and two on the other, each berth being provided with three steam or hydraulic cranes and a movable steam crane. Altogether the unloading power is fully equal to 12,000 tons in twenty-four hours. In addition to the pier there are two jetties, and ample quay accommodation for smaller craft. The entire river frontage, exclusive of the pier and jetties, is 2600ft. Some of the steam colliers are of 2400 tons burden, and the maximum delivery of coals at Beckton is 30,000 tons in a week. In connection with the Beckton collier fleet, we may mention that some ten months ago considerable interest was excited by a proposal to employ these vessels in carrying off the sewage sludge from the metropolitan main drainage outfalls and discharging it into the North Sea. The project was devised by Mr. J. O. Phillips, the secretary and general manager of the Chartered Company, and at one time appeared likely to be adopted.

The pier to which we have referred joins a viaduct on the same level which forms a continuation of it on the shore. From this viaduct four branches, each carrying a line of rails, pass off, two on either side, each pair proceeding to a series of six retort houses. The main viaduct, which has a double line of rails, runs along the whole length of the space between the two series of retort-houses, a distance of three-quarters of a mile from the river to the end. The twelve retort houses very much resemble each other, though they are not all the same size. The largest is 510ft. long by 100ft. wide, and is capable of producing 5½ millions of cubic feet of gas per day. It has forty-five beds, each containing nine fire-clay retorts 20ft. in length, thus making a total of 405 retorts. Running through the house on either side are high and low level railways of standard gauge. By means of the high level railway coals are conveyed from the steamers alongside the pier to the coal stores within the house. The low level line takes away the coke drawn from the retorts. The rolling stock on these rails consists of locomotives and iron wagons. The extent of railway throughout the works is equal to twenty miles, and the number of locomotives employed is nineteen. The retorts are charged four times in the twenty-four hours, and their aggregate number throughout the works is 3179. The plant is capable of turning out rather more than 40 millions of cubic feet per day. The largest consumption of gas on any one day in the company's districts was 95,685,000 cubic feet, including gas made at other of the company's stations besides Beckton. The coal carbonised at Beckton is equal to 4 tons 8 cwt. 22 lb. per stoker per day. Steam and hydraulic appliances have been used for charging and drawing the retorts at the Beckton Works and at Nine Elms. West's apparatus has been the subject of very lengthened experiment at the former establishment, and Ross's at the latter. Both have been in a certain degree successful, though not entirely so.

A conspicuous feature in the Beckton Works consists of eight huge gasholders. Four of these have each a capacity of a million cubic feet, two others one and a-half million each, and the remaining two holders two millions each, or eleven million cubic feet in all. The gas is pumped out of the gasholders by means of eight large gas exhausters on Beale's rotary plan, each capable of pumping 250,000 cubic feet per hour. By these means the gas is propelled from Beckton to Westminster along two cast iron mains, each 48in. in diameter. Although Beckton is the establishment to which our attention is more particularly directed, it is necessary to look elsewhere as well. Other gasholders than those at Beckton are supplied from this colossal factory, and to a certain extent there is a mingling of gas made elsewhere with that from Beckton. There are ten other manufacturing stations, at each of which there is a storage of gas. The localities are as follow:—Bromley, Shoreditch, St. Pancras, and Fulham, each formerly belonging to the Imperial Company; Bow Common, formerly belonging to the Great Central; Haggerston, to the Independent; Nine Elms, to the London; Pimlico, to the Equitable; and Kensal Green, to the Western Company. In addition there are the Silvertown Works, formerly belonging to the Victoria Docks Company, and originally established by Mr. George P. Bidder. Of these the stations at Bromley, Shoreditch, St. Pancras, Fulham, Nine Elms, Bow Common, and if necessary Pimlico, are all connected with Beckton. There are also storage stations, where gas is not manufactured, at Agar Town, Bethnal-green, Battersea, Horseferry-road, and Vauxhall. Beckton gas is stored at all these except the last, which takes cannel gas from Pimlico. The districts of the company are usually worked separately, but, as a matter of prudence, all are connected by trunk mains and valves, thereby providing the means of giving and maintaining the supply everywhere in the event of accident occurring at any one station. All the stations and offices of the company are in telegraphic communication with each other. In addition to the manufacturing and storage stations, there are valve and governor stations at Goswell-road, London Fields, Blackfriars, and Westminster. Testing stations, under the control of the Corporation of the City and the Metropolitan Board, but maintained at the cost of the company, are in operation at twelve different points, and one more is ready for use in Lambeth. The total number of officers and men employed by the company, irrespective of the steam collier fleet, is about 9000, of whom 3000 are employed all the year round at the Beckton Gas Works, and 860 in the product works at that spot. The quantity of coal carbonised annually at the various works is about 1¾ million tons, of which more than half is consumed at Beckton. The yield of gas per ton of coal is 10,428 cubic feet. The increase in the quantity of gas sold by the company last year compared with the year preceding was a little over 4 per cent. The distribution of gas is effected through more than 1700 miles of main. A consumer in the vicinity of Wormwood Scrubs can without difficulty be supplied with gas made at Beckton, fifteen miles away. The districts through which the company supplies gas includes a portion of the southern side of the Thames, as formerly supplied by the

London, and the entire area of distribution is nearly sixty square miles. The total number of public lamps supplied by the Chartered gas is nearly 47,000. The entire make of gas in the last half-year, ending at midsummer, was very nearly 9000 millions of cubic feet, promising, therefore, something like 18,000 millions by the end of the year. Mr. George C. Trewby holds the responsible post of constructing and carbonising engineer for all the company's works.

In addition to all the buildings and appliances necessary for the purification of the gas at Beckton, a distinct portion of the establishment is devoted to the manufacture of residuals. The tar is made to yield up crude naphtha, carbolic oil, creosote oil, and anthracene oil. The first of these produces benzene and toluol, the second carbolic acid and creosote, the third naphthaline or albo-carbon, and the fourth anthracene and green oil. Ammoniacal liquor is treated so as to produce sulphate of ammonia, and another manufacture is that of sulphuric acid. Coke, of course, is turned out in large quantities.

This huge gas-making establishment on the banks of the Thames has an import and export trade of its own, and aspires to be called "the Port of Beckton." On the land side, the Beckton Works are connected with the metropolitan highways by means of a carriage road 40ft. wide and 2½ miles long, constructed and owned by the company. This leads from the works through a portion of the Essex Marshes to Canning Town, where it effects a junction with the Barking road. The company have also constructed and are the proprietors of a passenger railway, of the same length as the aforesaid road. The railway connects Beckton with the North Woolwich line, and is worked by the Great Eastern Railway Company. Independently of the ordinary traffic, cheap trains are run for the use of the company's workmen. A reference to the map which accompanies our description will render the general arrangement of the works perfectly clear. On the north is the main drainage embankment, on the south the yet unoccupied land belonging to the company. East and south we have the river, in which the pier is conspicuous, connected on land with the railways which traverse the retort houses. The various details of the plan explain themselves, the residual works occupying the north-west corner, while the road and railway are in a line with the gasholders, forming a southern boundary to the present occupied portion. The idea of building a large number of workmen's dwellings on the estate has only been partially developed, from the circumstance that many of the men prefer residing elsewhere, for which purpose the river and the railway afford them ample facilities. Viewing the probability of a great gas colony growing up within and about Beckton, the company erected a church for the benefit of their workpeople, as also a mission-room and a school. Further consideration for the needs of the employed is shown by the circumstance that there is a resident doctor and a surgery.

As might be expected from the marshy nature of the ground, there was some difficulty in finding a foundation for the structures necessary to the formation of these unrivalled gas works. Gravel was found at an average depth of about 20ft. from the surface, but the beds were not sufficiently consolidated to be trusted for any considerable weight. Mr. F. J. Evans, in seeking a foundation for the retort houses, judged it prudent to excavate below the gravel, and went down 40ft. from the surface so as to reach the blue clay.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The Institution of Mechanical Engineers, reciprocating the splendid hospitality of the Belgian engineers, who entertained their English professional brethren at Liége, three years ago, have this year met in London and invited a large contingent from Belgium. A committee, with Mr. Rennie as chairman, and Mr. H. Chapman as honorary secretary, was formed, and very satisfactory arrangements made for enabling the guests and the country members of the Institution to see something of the engineering industries of the metropolis and its neighbourhood.

On Tuesday morning the proceedings commenced in the lecture theatre of the Institution of Civil Engineers, Great George-street. There was a very full attendance. Mr. J. Head, the president, occupied the chair, and after some formal business had been transacted delivered his presidential address.

This address took unusual ground, and we regret that we have only space to give an abstract of it. Mr. Head directed his attention entirely to the causes which lead to the depression of trade. He pointed out that mechanical engineers had not a little to do with bringing about the present state of things, and had done their utmost to make possible what had actually happened. Besides the enormously-increased facilities for over production in the machinery and metal trades, and in shipbuilding, the same thing had occurred in very many, if not in all, other trades and manufactures by reason of improved mechanism. The president then went on to instance new applications of machinery for the purpose of increasing and cheapening production in various departments of manufacture. He then referred to the circumstance that with dearer material and dearer labour, and notwithstanding the cost of transit, American manufacturers could sell watches in England at a lower price than we could produce them for, which he considered to be our fault as well as our misfortune. The Swiss were also following in the same direction, and with the advantage of cheaper labour. We had in the main been the teachers of foreigners in the past as regarded mechanical science, and we must not be altogether surprised at the results. He then went on to consider the question of trade depression from various social aspects, and concluded by observing that the long hoped for revival of trade must, when it comes, proceed from the initiative of the moneyed class. A re-marriage was needed between the lately divorced interests, money and industry, and that reunion must be the outcome of a renewal of confidence. The loss of confidence by the moneyed class had no doubt been largely the fault of the industrial or trading class, and was the natural punishment for bygone follies and waste of various kinds. Mr. Head aptly illustrated his remarks with illustrations, some of them exceedingly happy, and he showed that Government interference of any kind appeared always to leave matters practically unaffected, circumstances being always too strong for Governments in the long run. We were presented with a picture of the survival of the fittest in manufacturing processes and undertakings strictly analogous to that indicated by Darwin as existing in the world of nature. Mr. Head covered a wide range, and his arguments were, on the whole, warmly accepted as sound by his hearers. The subject of Free Trade and Protection he touched lightly, pointing out, however, that the English system of poor-law was, to a large extent, the equivalent of Protection for industries abroad; and dealing with another aspect of the subject, he expressed surprise and regret that we should sell millions of tons of coal every year to the foreigner at prices so low that no one derived any advantage save the miner and the recipients of royalties. This he held to be simply a suicidal policy. At the conclusion of the address, a vote of thanks was proposed by Mr. G. B. Rennie and seconded by Mr. Carbutt, and carried with unanimous applause.

The president then called on Mr. Alexander Borodin, of Kieff, to read his paper,

Experiments on the Steam Jacketting and Compounding of Locomotives in Russia.

This paper was of enormous length, and therefore was only read in abstract by the secretary, Mr. Bache. For years Mr. Borodin has carried out a series of experiments, detailed particulars of which, with illustrations of the apparatus, were supplied. It is much to be regretted that the utility of these experiments is more than doubtful, because the results were obtained under conditions which do not obtain in practice. Mr. Borodin's compound engine was jacked up in a testing shed, and was worked up to only about 90-horse power, because a greater load could not be got for it. No efficient means of draining the jackets was provided, and the results are consequently vitiated. But after every allowance has been made, Mr. Borodin's paper contained much that is suggestive, and we therefore place before our readers the conclusions at which he has arrived. It is further to be noted that the paper contained a report by Mr. L. Loevy, assistant locomotive superintendent of the Russian South-Western Railways, made with experimental trains in actual daily work. In order to place the locomotives as far as possible in the usual conditions of work, ordinary mixed and goods trains were selected for the tests, running over the Kieff-Fastoff section of 40·92 miles length. The experiments were divided into four groups:—(*a*) Ordinary locomotive with the jackets not working; (*b*) ordinary locomotive with the jackets working; (*c*) compound locomotive with the jackets not working; and (*d*) compound locomotive with the jackets working. Each engine before being used for the experimental trains was specially overhauled, so as to avoid any accidental defects that might have affected the proper working during the tests. The tenders of these engines were provided with two water-gauge glasses, graduated and placed on the sides of the water tanks, whose volume was previously determined with great accuracy. All the results were set forth in numerous tables. The general conclusions which follow are, as it will be seen, based on both the shed and the road experiments.

1. Comparing the consumptions of steam per horse-power, as arrived at by totally different means in the testing shed and when running with experimental trains, we get the following table, giving the conditions of working without the steam jackets and with the same degree of

A. Ordinary Engines.

2nd notch. (Nominal degree of expansion 3·3 fold.) Boiler pressure.	Consumption of steam per hour per indicated horse-power in lbs.	Method by which test was carried out.	1st notch. (Nominal degree of expansion 4·5 to 5·0 fold.) Boiler pressure.	Consumption of steam per hour per indicated horse-power in lbs.	Method by which the test was carried out.
136·5	—	Experim'tal train, 1883. Engine A 22			Experim'tal train, 1883. Engine A 22
91·7	—	Testing shed, 1881. Engine A 21.			Testing shed, 1881. Engine A 21.
74·6	32·18	Testing shed, 1882 Engine A 22.	88·1	31·30	Testing shed, 1882. Engine A 22.
72·8	31·96		88·5	31·96	
68·2	31·08		86·7	31·96	
67·5	31·52		87·4	33·73	
67·9	34·61				
66·8	33·28				
64·7	32·62				
64·0	33·51				
63·64	34·39				
63·2	35·05				
56·8	35·05				

B. Compound Engine A 7.

Position of reversing lever; small cylinder 1st notch, large cylinder 60 deg. Expansion (nominal) 6·7 fold.

Boiler pressure.	Consumption of steam per hour per indicated horse-power in lbs.	Method by which the test was carried out.	
142·2	19·84	Experimental train, 1883	
110·2	24·69	Testing shed, 1881.	
108·4	25·13		

expansion. As here seen, the results obtained by wholly dissimilar methods during the trials made in the testing shed and with the experimental trains, during different years and with different engines of the same class agree with one another, and prove that the consumption of steam per horse-power during all the tests increases regularly as the boiler-pressure diminishes. The results of the tests carried out with the jackets at work are not referred to here because, as has been explained, the jackets were not working properly on the experimental trains.

2. Comparing the consumption of steam per indicated horse-power at different degrees of expansion, obtained with the ordinary engine A 22 when working without jackets on the experimental trains, we find—

Position of reversing lever	Nominal degree of expansion.	Consumption of Water per indicated horse-power in pounds.
1st notch	4·8	27·99 27·77
2nd ,,	3·3	26.67
3rd ,,	2·5	28·43
5th ,,	1·8	31 08
7th ,,	1·5	35·27
11th ,,	1·3	40·54

As here seen, the work done by the steam when running in the first notch is not only not more effective, but is even less economical than when working in the second notch, with a smaller degree of expansion; this conclusion is confirmed by the results obtained in the testing shed in 1882 and 1881. The consumption per indicated horse-power in the third notch—expanding about 2·5 times—is hardly greater than when working in the first notch—expanding five times. Thus the conclusion arrived at is confirmed by all the tests, namely, that it is undesirable to work with too large cylinders. Finally, it is seen that the work done in the seventh and eleventh notches—with 1·5 and 1·3 fold expansions—is attended with very little economy; but it must not be forgotten that these latter tests were made with the regulator only slightly open, thus obstructing the free passage of the steam into the cylinders.

3. Comparing in the same manner the consumption of steam in the compound engine, we find:—

Position of reversing lever. Small cylinder.	Position of reversing lever. Large cylinder.	Nominal degree of expansion.	Steam consumption per hour per indicated horse-power	Position of reversing lever. Small cylinder.	Position of reversing lever. Large cylinder.	Nominal degree of expansion.	Steam consumption per indicated horse-power per hour.
Notch.			lbs.	Notch.			lbs.
1	73°	4·5	22·04	1	60°	6·7	19·84
3	73°	3·4	22·48	4	60°	3·6	22·04
5	73°	2·9	24·47	7	60°	2·8	23·81
7	73°	2·7	25·13				
1	70°	5·0	22·48	1	50°	9·1	22·92
3	70°	3·6	23·58	5	50°	4·1	23·14
5	70°	3·0	23·81	7	50°	3·0	23·58
7	70°	2·7	24·69				

For all the positions—73 deg., 70 deg., 60 deg., and 50 deg.—of the reversing screw of the large cylinder a regular though slow increase is observed in the consumption of steam per horse-power, in proportion as the degree of expansion decreases between the limits of 6·7 and 2·7*; which did not take place with the ordinary engine A 22. This difference is explained if it be remembered that in the compound engine the condensation of steam during admission is comparatively less, and consequently this condensation does not produce such a bad effect on the total consumption of steam at any early cut-off or a high degree of expansion as it does in ordinary engines. Comparing the consumption of steam at different positions of the reversing screw of the large cylinder, we find that, with the same degree of expansion, the lowest consumption took place with the screw at 60 deg.—corresponding with an admission into the large cylinder during 58 per cent. of the stroke—this was observed at each position of the reversing lever of the small cylinder. This result might almost have been expected, taking into consideration the proportions of the two cylinders, 1 : 2 04. In order therefore to work under the most favourable conditions, the distribution of the steam should be so arranged that the admission into the large cylinder should be constant, no matter what may be the position of the reversing lever of the small cylinder, and that the admission to the large cylinder should depend upon the ratio of the volumes of the two cylinders. We must nevertheless remark that the variations in the admission to the large cylinder within the limits 50 deg. to 70 deg., corresponding with admissions of from 50 to 67 per cent. of the stroke, have very little effect on the consumption of steam. But on the other hand, if the admission of the large cylinder is less than 50 per cent. of the stroke, the expenditure of steam per horse-power increases sensibly, and becomes greater as the admission into the large cylinder is less. This can be seen by the tests made in 1883 with the compound engine in the testing shed, which gave the following results:—

Number of the test.	Mean boiler pressure.	Position of reversing lever and position of reversing screw. Small cylinder. Number of the notch.	Large cylinder. Degrees.	Nominal degree of expansion.	Number of revolutions per minute.	Indicated power.	Consumption of steam per hour per indicated horse-power.	With or without jackets at work.
	Pounds per sq. inch.					Horse-power.	Pounds.	
33	149·3	2	40°	9	82	68·5	29·32	Without
34	145·7	2	40°	9	78	59·8	29·54	,,
35	145·7	2	40°	9	58	51·6	26·45	With
36	96·0	5	40°	4	88	70·1	33·95	,,
37	96·5	5	40°	4	93	84·4	31·30	Without
38	86·0	7	30°	3·4	87	59·2	40·34	,,
39	84·2	7	30°	3·4	79	56·0	38·14	With

* In the test in which the position of the reversing lever was 1–50 deg. it appears that the expansion was carried too far—9·1 times.

So low an economy in the working of the engine is explained if we examine the diagrams from the small cylinder—particularly those taken when the admission to the large cyinder was smallest—which are very irregular in outline, owing to too much compression. These irregularities sometimes attain such a degree that the small cylinder is transformed into a regular brake, producing negative work. As was to be expected, the results of these tests prove that it is disadvantageous to give the large cylinder a smaller amount of admission than corresponds with the volume of the small cylinder.

4. Passing on to the question of the economy produced by the steam jackets on the compound engine, we arrive at the following conclusions:—(a) The steam jackets on the ordinary engine, while working in the testing shed in the first and second notches, undoubtedly gave a mean economy of steam of 16 to 13 per cent. In the experimental trains the jackets did not generally give satisfactory results, except when the ordinary engine was working in the first notch; but this must be attributed partly to the losses of steam necessary for warming up the walls of the jackets each time the regulator was opened, and above all to the defective drainage of the jackets, which probably transformed them into condensers. A better means of draining the steam jackets must therefore be sought for. (b) The compound system undoubtedly gave an economy of steam and of fuel. The amount of this economy varies sensibly with the conditions under which the engine is working, and in ordinary work it may be taken at from 15 to 20 per cent. The greater quantity of water evaporated per pound of wood in the tests with the compound engine cannot yet be attributed with certainty to the compound system; it may result from individual peculiarities of the boiler and of the fireman, and also from lack of sufficient accuracy in estimating the consumption of wood. Nevertheless, inasmuch, as the compound engine consumes less fuel when doing the same amount of work, it will consequently require less blast, and will less frequently need an injurious contraction of the blast-nozzle; and from this cause it is possible to utilise the fuel better in the boiler of the compound engine. Furthermore, the smaller consumption of steam in the compound engine allows of its taking heavier trains wherever there is already a surplus of tractive power as well as of adhesion. This is one of the principal benefits of the compound system, which must not be lost sight of when judging of its value.

5. Considering that the compound locomotive with which the experiments were carried out involved scarcely any complication, that building these engines costs about the same as ordinary engines, and that a decreased consumption of fuel lessens the cost of boiler repairs and of providing feed-water, &c., it may be concluded that there is an undoubted advantage in building locomotives on the compound system.

The discussion which followed was rather discursive. It was opened by Mr. D. Halpin, who criticised the general details of the system employed by Mr. Borodin in his shed experiments. Mr. Borodin had complained that his jackets played the part of condensers, but that Mr. Halpin contended was just what they ought to do, and the more steam a jacket condensed the more effective was it. In his own practice he had seen as much as 17½ per cent. of all the steam made in the boiler condensed in the jacket. It was of the last importance that a jacket should be kept well drained, and he complained that the traps generally employed for the purpose were deficient, and he submitted a sketch of an arrangement by which a small subsidiary injector placed to be acted on, not by steam, but by the feed-water on its way to the boiler, was employed to keep the jacket dry; the water so withdrawn from it returning with all its heat to the boiler. There were three things which affected the efficiency of a jacket, namely, the amount of expansion, the piston speed, and the amount of surface submitted to the action of the steam in the jacket. Without expansion the jacket did more harm than good. In very quick-running engines the utility of the jacket was small. The surface of metal in jacket should be increased by casting ribs on the outside of the cylinder liner to present a larger surface for the absorption of heat from the steam. He regretted that Mr. Borodin had not applied a proper brake, which he might easily have done, and so loaded his shed engine to 250-horse power instead of 90-horse power. He then criticised at some length the well-known Appold brake used by the Royal Agricultural Society, and he pointed out that the proper way to keep a brake pulley cool is to make it of trough section, the flanges being inside. This is to be kept full of water by a suitable pipe. The water would be carried all round, lining the whole by centrifugal force, and a pipe could then be employed to scoop out the inner lining, which would be less dense than the water further out, which would be cold. In fact the whole arrangement would be identical with that of the well-known creaming machine, hot water being skimmed off instead of cream. He pointed out that the results of the indicator diagrams taken by Mr. Borodin were probably wrong, because the pipe connecting the indicator with the cylinder was too long, and submitted two diagrams from actual practice to show the enormous errors which might result from that cause.

Mr. Davey, of Leeds, said that the value of the jacket had been keenly discussed for sixteen years, yet we were as much in the dark about it as ever, and suggested that some really satisfactory investigations should be carried out to settle the question of its value once for all. Jackets, he thought, should be large, so that the cylinder could be really immersed all over in a great body of steam.

At this point the meeting was adjourned, the president stating that the paper on "The Working of Compound Locomotives in India," by Mr. Charles Sandiford, of Lahore, would be read the first thing on Wednesday morning, when the discussion would be resumed. The members then proceeded to the Westminster Town Hall, where an admirable luncheon was served to nearly four hundred members and visitors.

Subsequently the party broke up, many of the members proceeding to the electric light works of Messrs. Crompton and Co., at Chelmsford; others going to the Royal Mint; and yet others to Messrs. Doulton's Pottery Works, Lambeth. In the evening there was a reception in the conservatory at the Colonial and Indian Exhibition, largely attended.

On Wednesday morning the proceedings were resumed by the reading of Mr. Sandiford's paper and its discussion. We have not room this week to reproduce either the paper or the discussion, as we have devoted so much space to an account of the celebrated Enfield Small Arms Factory and the Beckton Gasworks, the first visited on Wednesday by the members and visitors, and the second yesterday—Thursday—when no paper was read. We have not only given descriptions of the Enfield works, but in another page illustrations of all the principal military rifles in use, grouped in a way that we believe will not fail to interest our readers.

In the evening a dinner was held at the Criterion, Piccadilly, at which Mr. Jeremiah Head, President, presided. Among the guests were Sir Frederick Abel, Mr. William Anderson, Colonel Arbuthnot, Mr. E. H. Carbutt, Mr. Henry Chapman, Mr. Louis Sterne, Sir Philip Cunliffe-Owen, M. Degraux, M. Deshousses, M. Gillieaux, M. Goret, M. Adolph Greiner, Professor A. Habets, Colonel Eardley Maitland, M. Edouard Peltzer, Professor W. Chandler Roberts-Austen, M. Stévart, M. Timmerhans, M. Wittenhaur, and Mr. Edward Woods.

After dinner the President proposed the toasts of "Her Majesty the Queen" and "His Majesty the King of the Belgians," both of which were received with much enthusiasm. The next toast was that of "The Prince and Princess of Wales and the rest of the Royal Family," which was followed by the toast of the evening, "The Belgian Engineers." In proposing the toast, the President, after referring to some historical events which, he said, served as links in the bond of sympathy by which England and Belgium are united, added that the two countries were, no doubt, competitors in many ways, but they were none the less friendly competitors. The English had visited the Belgians, and had always received from them the utmost kindness and hospitality. Their friendship was one of no recent date, and he thought he was fully entitled, as their representative on that occasion, to look towards his friend on his right—M. Adolph Greiner—and, holding out his hand to him as the representative on that occasion of the Belgians, say, in the words of our Scottish poet,

"And here's a hand, my trusty friend,
And gie's a hand o' thine;
And we'll tak' a cup o' kindness yet,
For auld lang syne."

Loud cheers followed, during which the President shook hands with M. Greiner.

M. Adolph Greiner—representing M. L. Trasenster, President of the Société des Ingénieurs sortis de l'Ecole de Liége—responded. In the course of his speech he said that though the two countries were competitors in the general industry of the world, they were not competitors in other respects. They understood better than other people the truth of the saying that "Union is strength." The speaker concluded by wishing success to the Society of Mechanical Engineers.

Professor Habets, secretary of the Belgian Society, also responded to the toast.

Sir Philip Cunliffe-Owen next spoke, and, in the French language welcomed the guests from Belgium.

Sir Frederick Abel proposed the health of the members of the local committee, to which Mr. William Anderson and Mr. Henry Chapman responded; and Mr. E. H. Carbutt proposed the health of the President.

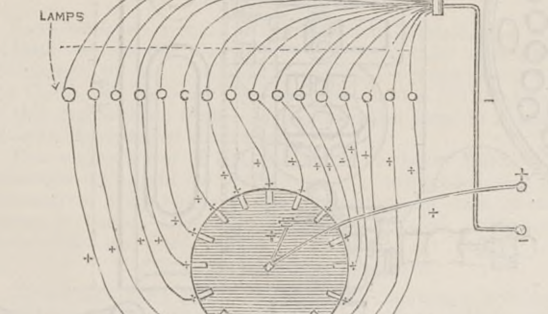
Mr. Jeremiah Head, who was received with loud cheers, acknowledged the toast, and the guests then separated.

LETTERS TO THE EDITOR.

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

MULTIPLE INCANDESCENT LAMPS FROM SOURCE FOR ONE LAMP.

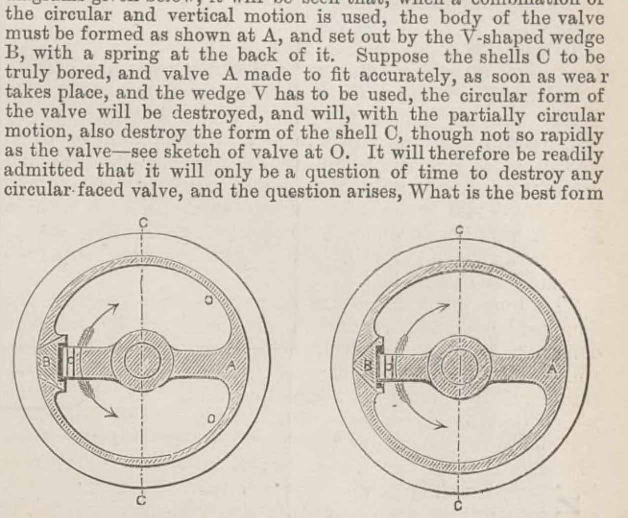
SIR,—I beg to send you a design of an economical electrical current distributor. The apparatus consists of the following:—A disc consisting of hard wood, or vulcanised fibre, around the edge of which are fixed a number of brass contact pieces—as per illustration—with binding screws, for connecting a wire from an incandescent lamp to. In the centre of the disc there revolves a metallic



arm, carrying at the end of it a brass brush to make contact with the contact pieces fixed on the disc. The revolving arm is to make about 2000 revolutions a minute, so that the current is switched on and off each lamp 2000 times every minute. Under these circumstances the whole of the lamps would appear to be continuously incandescent, owing to the persistency of retention of the retina of the eye; and the current necessary to keep all the sixteen lamps alight—as per illustration—would only be what is ordinarily required for one, say a current of 5 ampères and 100 volts. As the whole of this current would certainly pass through each lamp 2000 times a minute—each time the revolving brush made contact with the contact piece in connection with that particular lamp—it would appear as if it was a continuous current going through the filament of the lamp. If this would answer it would practically revolutionise electric lighting. JOHN PALMER.
10th August.

PISTON VALVES.

SIR,—Your kindness in allowing me space for noticing some of the faults in the Corliss valve as constructed, make me hope you will also extend the same for the piston valve. In the sketch diagrams given below, it will be seen that, when a combination of the circular and vertical motion is used, the body of the valve must be formed as shown at A, and set out by the V-shaped wedge B, with a spring at the back of it. Suppose the shells C to be truly bored, and valve A made to fit accurately, as soon as wear takes place, and the wedge V has to be used, the circular form of the valve will be destroyed, and will, with the partially circular motion, also destroy the form of the shell C, though not so rapidly as the valve—see sketch of valve at O. It will therefore be readily admitted that it will only be a question of time to destroy any circular-faced valve, and the question arises, What is the best form



for the face of a valve, to be used for high-pressure steam, having the usual motion? As an answer, it may be stated that experience has shown that no form is more applicable than a valve with the ordinary flat face and well-proportioned surfaces, having a grid cut-off valve carried on the back but worked at right angles to the said slide. The grid slider may be made with the ports as narrow as possible, thereby reducing the motion, and so cutting off the steam more rapidly than either the Corliss or piston valves can be made to do, and with less complication of parts. It must be understood that no attempt has been made to point out anything new in the above remarks; but in using high-pressure steam simple details are of great consequence when cost of repairs is taken into account; and this may be one reason why engineers have been so slow in using either of the forms noticed for marine engines.
Rochdale, August 16th. THOMAS SPENCER SAWYER.

SANDING APPARATUS.

SIR,—In the concluding paragraph of a leading article on "Locomotive Engines," in your last week's issue, we notice that in referring to the Caledonian Railway express engine shown at the Edinburgh Exhibition, you state:—"In this engine it will be seen that sand is used for perhaps the first time in England on scientific principles to secure adhesion." We beg to say that this is not so, as we have sanding apparatus—made under the combined patents of Holt and Gresham—fitted to engines on the Great Northern, Manchester, Sheffield, and Lincolnshire, and Midland Railways, and some of the engines so fitted have been running for a considerable time, giving most satisfactory results, a single engine fitted with our apparatus having as much adhesion as a coupled engine without it. We enclose you a circular giving the many advantages claimed for our apparatus, and shall be very pleased to supply any of your readers interested in the matter with further particulars. The quantity of sand used by the above apparatus is from 8 oz. to 10 oz. per mile. GRESHAM AND CRAVEN.
Craven Ironworks, Ordsall-lane, Salford, Manchester,
August 16th.

FLOW OF WATER THROUGH SMALL LONG PIPES UNDER HIGH-PRESSURE.

SIR,—In reply to the query by "Velocity" in THE ENGINEER, the time which would be taken to discharge 500 gallons of water through a 1½in. pipe 700 yards long, and with a fall of 100 yards from inlet to outlet, is, theoretically, sixteen minutes. Any inequality in the inside of pipes, or minute obstructions, would increase the time. T.
Glasgow, August 18th.

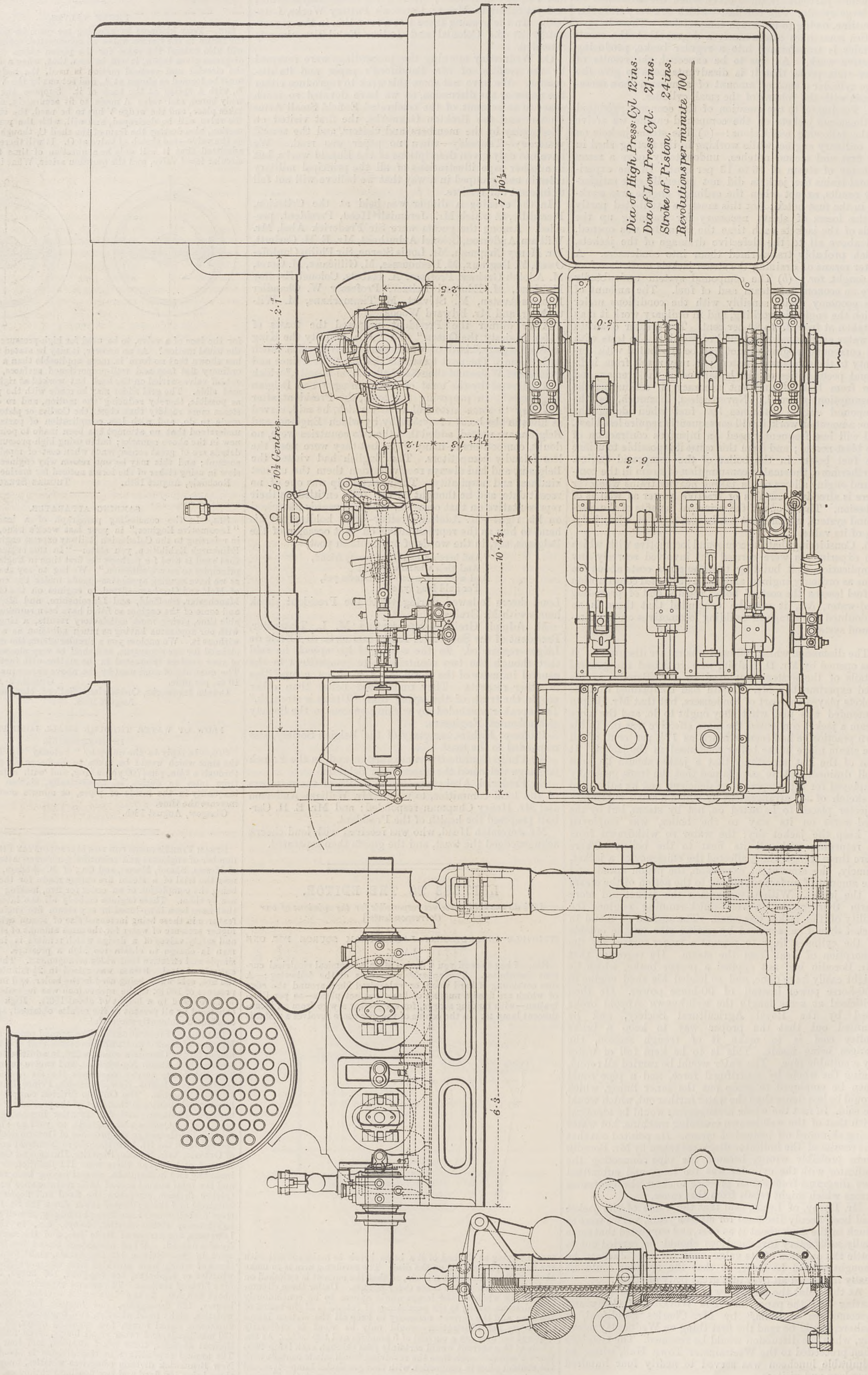
STEAM FIRE ENGINES FOR THE METROPOLITAN FIRE BRIGADE.—A number of engineers and scientific gentlemen attended the works of Messrs. Shand, Mason, and Co., of Blackfriars, London, to witness the trial of a steam fire engine made for the above brigade, being the completion of an order for five, making forty-six now in use by them. These engines embody all the latest improvements that have been introduced in any steam fire engine, the principal features in these being increased size of steam cylinders, so that a higher pressure of water for the same amount of steam is obtained, and safety valves of a design which renders it impossible for the man in charge to obtain too high a pressure. There is a very simple and effective feed-water arrangement. The axles are made entirely of steel. Steam was raised in 2¾ minutes from lighting the fire, cold water being used in the boiler, and in eight minutes a pressure of 100 lb. to the square inch was indicated, and a stream was projected to a height of about 160ft. High satisfaction was expressed by all present at the results obtained, and the trial was considered eminently successful.

CANADIAN LIGHTHOUSES.—The annual report of the Canadian Minister of Marine and Fisheries states that the number of lighthouses on the Canadian coasts is 526, in addition to 617 fire-signals, twenty-three steam fog-whistles, and twelve automatic fog-horns. The lighthouse service comprises the six divisions of Ontario, Quebec, Nova Scotia, New Brunswick, Prince Edward Island, and British Columbia. The Ontario division comprises the fixed and floating lighthouses in that part of the province of Quebec included between Montreal and the frontier line which separates the provinces of Quebec and Ontario, as well as all the fixed and floating lighthouses in the province of Ontario itself—that is to say, the lights on the St. Lawrence above Montreal and on the Lakes of Ontario, Erie, Simcoe, Superior, Huron, and Georgian Bay. At the end of last year there were 171 lighthouses in this division, including two in Manitoba, several having been erected last year, and the total annual cost of their maintenance was £14,200. The Quebec division comprises the fixed and floating lighthouses of Montreal and those situated lower down the St. Lawrence, on the river Richelieu and Lake Memphremagog, as well as all the floating lighthouses, steam-whistles, buoys, &c., in the Gulf of St. Lawrence, the Straits of Belle Isle, and the north-west coast of Newfoundland. When navigation closed for the winter there were in that division 149 fire-signals, eight floating lighthouses, three of which were provided with steam-whistles, seven steam-whistles or fog-horns, ten fog-guns, 107 buoys, 59 beacons, and nine lifeboat stations. The annual expenditure in this division is about £28,600. In the Nova Scotia division there are 152 lighthouses, 163 fire-signals, one floating lightship, twelve steam-whistles, eight hand-whistles, two fog-bells, three fog-guns, nine automatic signal buoys, five sounding buoys, 84 ordinary buoys, 430 mastheads, and other small buoys, seven fixed beacons, eight lifeboat stations, three relief stations, and four signal stations. The annual expenditure in this division is about £27,400. The New Brunswick division comprises whistles, buoys, and beacons, there being 100 fixed and two floating lighthouses.

40-H.P. SEMI-FIXED ENGINE, EDINBURGH EXHIBITION.

MESSRS. ROBEY AND CO., LINCOLN, ENGINEERS.

(For description see page 147.)



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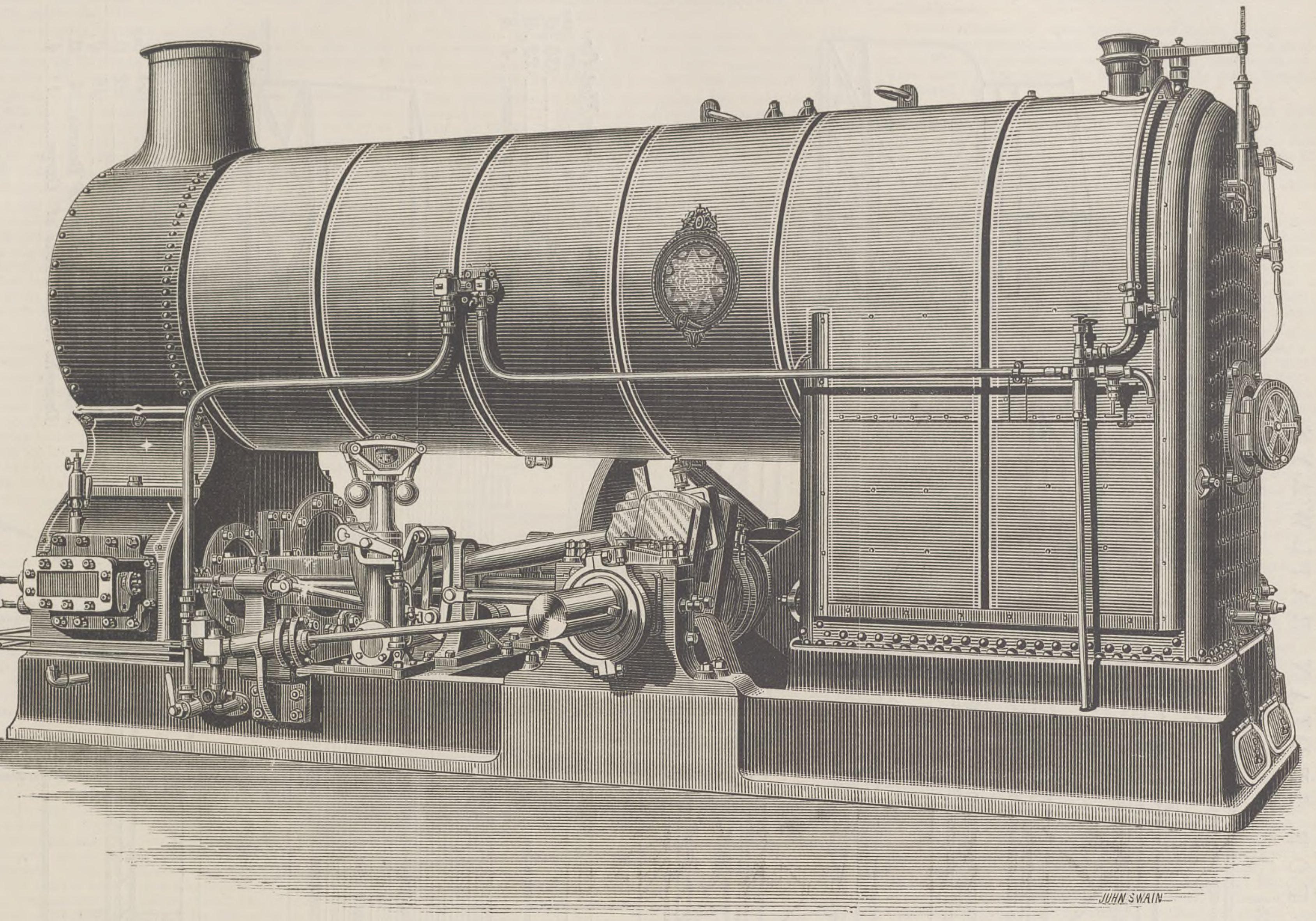


40-HORSE POWER SEMI-FIXED ENGINE AT THE EDINBURGH EXHIBITION.

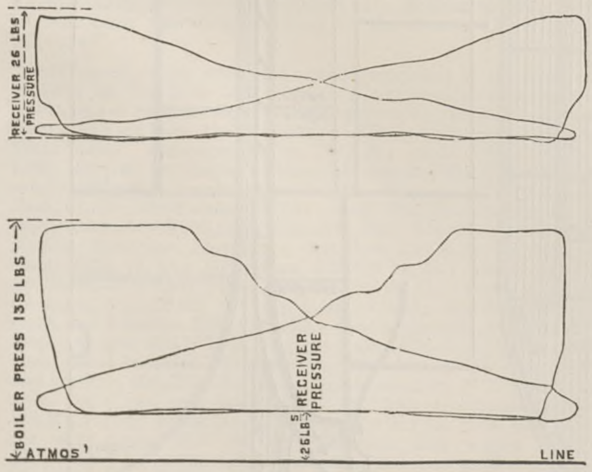
A LARGE proportion of the electric lighting is done at the Edinburgh Exhibition by a very fine semi-fixed engine by Messrs. Robey and Co., which we illustrate above and on page 146. The principal dimensions are as follows:—

Diameter of high-pressure cylinder	12in.
Diameter of low-pressure cylinder	21in.
Stroke of pistons	24in.
Revolutions per minute	100
Diameter of fly-wheel	7ft. 6in.
Width of fly-wheel	12in.
Diameter of crank shaft	6¾in.

The boiler is made to the following general dimensions:—

Length of external fire-box	5ft.	4in.
Length of boiler barrel	9ft.	11in.
Length of smoke-box	2ft.	6in.
Width of external fire-box	4ft.	9in.
Width of internal fire-box	3ft.	11¾in.
Length of internal fire-box	4ft.	6⅜in.
Height of internal fire-box	4ft.	10in.
Height of external fire-box	7ft.	3in.
Diameter of boiler barrel	4ft.	7⅞in.
Diameter of tubes		3in.
Number of tubes	64	
Thickness of plates in boiler barrel		½in.
Thickness of plates in external fire-box		9/16in.
Thickness of plates in internal fire-box		9/16in.
Thickness of tube plates		13/16in.
Total length of boiler	17ft.	9in.
Heating surface in tubes	527·5	sq. ft.
Heating surface in fire-box	91	,,
Heating surface in smoke-box tube plate	8	,,
Total heating surface	626·5	,,
Grate area	18	,,

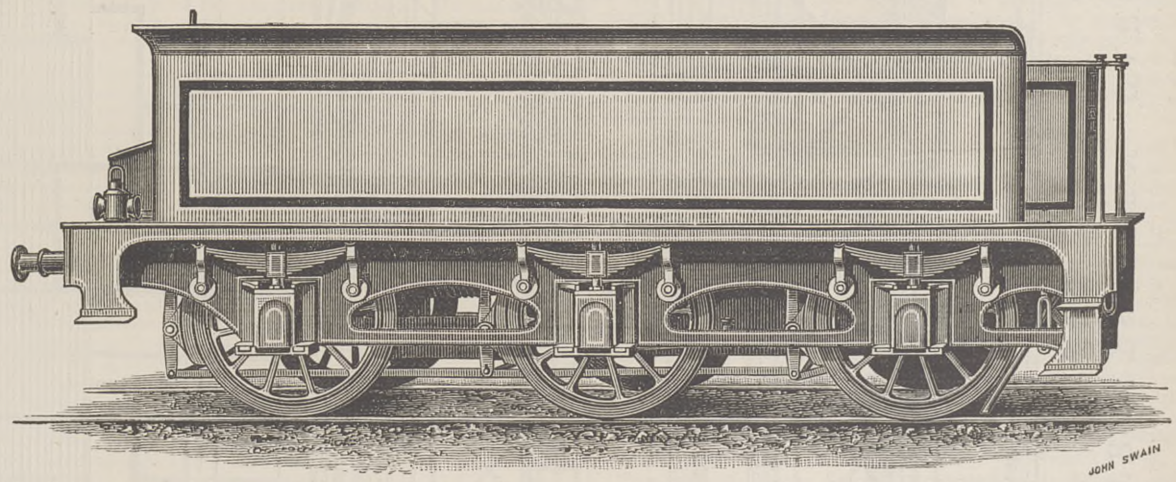
The engine is erected on a massive cast iron foundation plate, the fire-box of the boiler being carried on a prolongation of the



foundation plate forming the ashpit. The boiler barrel is carried by a crutch-shaped casting placed over the cylinders. The cylinders are fitted with liners and bored out perfectly true, the ends being bell-mouthed. The cylinders are fitted with loose covers at each end, the front covers having provisions for carrying the back ends of the slide bars. The engine is provided with a delicately adjustable high-speed governor controlling the cut-off valve of the high-pressure cylinder, the whole forming an automatic expansion gear by which the cut-off can be regulated from one-eighth to five-eighths of the stroke, with only slight variations in speed. This governor is illustrated to a large scale on page 146. We give reduced copies of two diagrams, which show that the action of the valve gear is very satisfactory.

The working pressure is 140 lb. per square inch, the boiler being tested by water to 300 lb. per square inch, and by steam to 150 lb. per square inch, being perfectly tight under these pressures. This engine is very carefully counterweighted, and the fire-box is fitted with a brick arch such as is used in locomotives. The finish is very good. In fact, it is one of the finest semi-fixed engines ever made, and will easily indicate 200-horse power. It is much under loaded at Edinburgh.

TENDER FOR EXPRESS ENGINE, CALEDONIAN RAILWAY.



TENDER FOR EXPRESS ENGINE—CALEDONIAN RAILWAY.

LAST week we published a supplement containing a longitudinal section and plan of the fine locomotive exhibited at Edinburgh by Mr. Drummond, locomotive superintendent of the Caledonian Railway. We now give on page 150 an elevation of this engine taken from a photograph and here to a smaller scale an engraving of the tender.

This engine is one of six with which the heavy fast northern passenger trains will be worked, and it is anticipated that these locomotives will give the utmost satisfaction, and this we see no reason to doubt. In another impression we shall publish additional drawings of this engine.

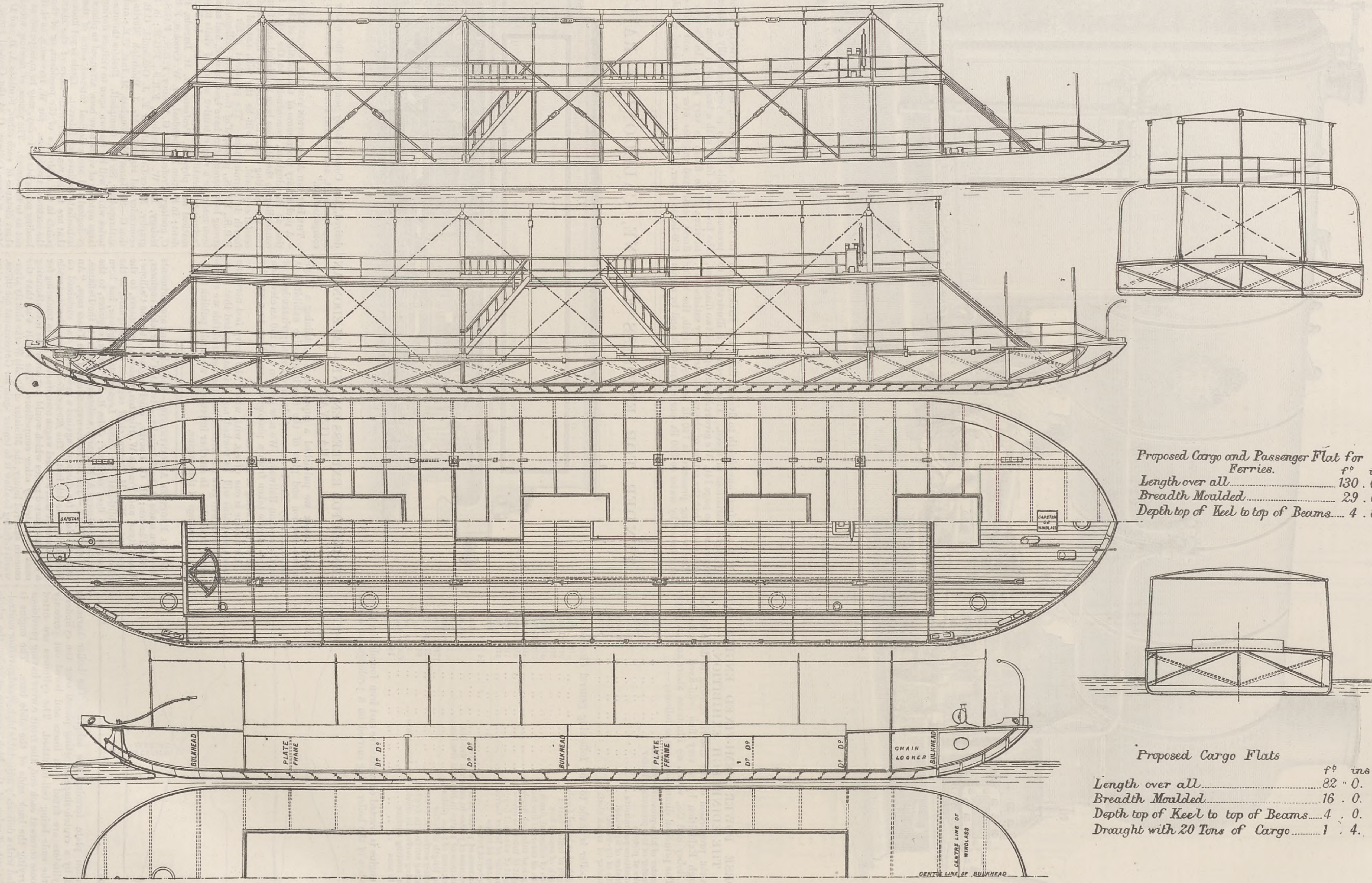
NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Ivie A. Couper, chief engineer, to the Phæton; H. G. Bourke, chief engineer, to the Calliope; James Ryan and Francis W. Highton, assistant engineers, to the Impérieuse; Wm. H. Brown, chief engineer of Coastguard, to the Shannon, additional; Mr. James Legate, staff engineer, has been promoted to fleet engineer; John R. J. Pedrick, engineer, to the Amphion; George A. Haggarty, assistant engineer, to the Defiance.

WHAT NEXT.—The Berlin correspondent of the *Times* says, "An unusual claim for damages against a newspaper was sustained on Wednesday, the 4th inst. The *Börsen Zeitung* some time ago made the statement that a Cassel wagon manufactory had in tendering for a contract quoted prices which would not cover the manufacturing costs estimated by other competitors. The result was that the concern suffered injury, the Minister of Public Works shortly afterwards refusing to allow it to tender again for Government contracts. A claim for damages was made against the newspaper, and, in view of the fact that a contradiction had not been published when desired, the Court to-day sentenced the editor to six weeks' imprisonment, and ordered the *Börsen Zeitung* to pay 6000 marks compensation."

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—A preliminary programme of the meeting of the British Association at Birmingham, commencing on the 1st of September, and concluding on the 8th, has been published, and from it it appears that the meeting ought to be one of the most satisfactory and successful ever held. It will be the 56th annual meeting, and the fourth in Birmingham. The president is Sir William Dawson, F.R.S., F.G.S., principal of the M'Gill College, Montreal. Very strong local committees have been formed, and arrangements have been made for a very extensive series of visits to places of manufacturing, scientific, and general interest. In Section A, mathematical and physical, Professor G. H. Darwin, F.R.S., is president; in Section B, chemical, Mr. W. Crookes, F.R.S.; in Section C, geology, Professor T. G. Bonney, F.R.S., F.G.S.; in Section D, biology, Mr. W. Carruthers, F.R.S., F.G.S.; in Section E, geography, Major-General Sir F. J. Goldsmid, C.B.; in Section F, economics and statistics, Mr. J. Biddulph Martin, M.A.; in Section G—Sir James N. Douglass, M. Inst. C.E.; and in Section H, anthropology, Sir Geo. Campbell. Besides the numerous manufactories which will be thrown open to visitors during the meeting, a large number of visits have been arranged to places and things of geological and archæological interest, some of the former having immediate engineering interest. Little is yet known of the papers that are to be read, and little more of the character or leading points in the addresses of the president, or of those of either of the sectional presidents. Sir W. Dawson's, as that of one of the leading geologists of to-day, may be anticipated as to subject, but not as to treatment. The places of meeting are all within a very short distance of each other, Sections A, B, and D being all at the Mason Science College, C at the Council house, E, F, G and H being in the parish offices and the School of Art.

CONTRACTS OPEN—CARGO BOATS FOR INDIAN RAILWAYS.

(For description see page 153.)



RAILWAY MATTERS.

THE Imperial South African authorities have commenced the survey of a proposed railway from Kalk Bay to Simonstown.

THE Victorian railway revenue for the past year is estimated at £2,300,000. The actual receipts to June 30th, 1886, were £6790 16s. 2d. above the estimate.

SOME of the English railways, as well as Colonial, are going in for steel sleepers. The Mexican Railway Company is also going to try them, and the Southern Mahratta Railway Company may as well follow suit, as it is going in for Bessemer rails.

M. GOTTELAND, chief engineer of the French Public Works Mission at Athens, has submitted to the Greek Government the plans of a projected railway from Nauplia ta Calamata, by way of Tripolitza. The line is to be 181 kilometres leng, and is estimated to cost 21,000,000f. The line from Kiatos to Xilocastion and Camaris, 21 kilometres, and that from Milos to Argos, 10 kilometres, will be open for traffic this autumn.

THE Dore and Chinley Railway, which was expected to be commenced this season, is to rest for a time. The present condition of trade, and other causes have induced the postponement of the work for a time. The engineers of the line, accompanied by a leading official of a neighbouring line, went over the route a few days ago, and were satisfied that no additional powers were necessary. The line will be of great advantage to Sheffield, not only in affording a second route to Manchester, but in opening up a beautiful part of Derbyshire.

A NEW railway line to Foxdale, from the St. John's Junction of the Manx railway system, was opened for traffic on Saturday last. The line, which is about two and a-half miles in length, was constructed by Messrs. Hugh Kennedy and Sons, Glasgow. The engineers were Messrs. Forman and M'Call, of Glasgow. The line runs in a southerly direction between St. John's and Douglas, through pretty scenery, and will lead ultimately to direct connection between the North and Port Erin and Castletown. It will be worked by the Manx Northern Railway Company, who convey lead ore from the Foxdale mines to Ramsey for shipment.

ON the 12th inst. the London *Daily Telegraph* had a letter running thus:—"Sir,—Yesterday—August 11th—there was delivered at Chappel, on the Colne Valley Railway, an enormous consignment of steel rails from the Continent *via* Parkeston. The makers' names appeared to be 'Diamond and Worthingham' (?) On every rail was visible the following:—'Cammell Sheffield Toughened Steel, W. 1886, sec. 239.' Sheffield steel from Germany!—I am, sir, S. W. B., Colchester, August 12th." This latest "scare" admits of easy explanation. The consignment was the second of a series to be sent by Messrs. Cammell and Co., from Worthington, and was part of an order secured some time ago by that firm from the Colne Valley and Halstead Railway. It was shipped by the steamer Diamond from Worthington to Parkeston quay, Harwich, for transport thence to the nearest station on the Colne Valley and Halstead line. "G. W. B." has discovered a "bogey."

THE railway returns of the United Kingdom for 1885 were issued on Wednesday. They are of special interest, as they are a most accurate index of the state of trade. The returns show that during the year 1885 there was an increase of 305 miles in the total extent of the railways open in the United Kingdom, of which 272 miles were constructed in England and Wales. The increase in the total paid up capital for the year 1885 amounted to £14,394,000 sterling, of which about £12,000,000 has been raised on account of English railways. The increase of capital only represents an average of £47,100 per mile of line constructed during the year, or if we reckon England and Wales alone, about £44,100 per mile. The average capital expenditure incurred for the railways of England and Wales up to the end of 1885 was, however, about £50,000 per mile; so that the mileage added during 1885 would appear to have entailed a lower capital expenditure per mile than the average of our English lines, showing that the capital expenditure incurred on behalf of English railways during 1885 was limited to works connected with the new railways under construction, and that the very considerable capital outlay usually incurred on behalf of already existing mileage, such as the rebuilding or extension of stations, the widening of existing lines, or the additions to rolling stock, has been almost entirely dropped for the time being.

IN an address to the Glasgow Chamber of Commerce, Mr. W. Birkmyre remarked, regarding railways in India and revival of trade, that Mr. Rendall had stated in evidence before the Parliamentary Committee of 1884, that no country in the world required railways more than India. He further gave it as his opinion that railways would be a large source of revenue to the country; and finally, he stated that he should like to see 50,000 to 60,000 miles of railways constructed gradually and carefully. At present there are 12,376 miles constructed, and the average rate of construction has been at the rate of 375 miles per annum. "On the map of India before you we have delineated a portion of the country a little larger than France, 520 miles long by 400 miles broad, with but two roads, and one railway 149 miles in length, and of a gauge 14in. less than the tramway gauge at St. Vincent-street. In the language of the Bengal Chamber of Commerce:—'The greater part of this country is an expanse of fertile soil, where grain and oil seeds, cotton and tobacco, might be grown in enormous quantities were facilities only given for this agricultural produce to find a market. But at present there is no access to this country from Calcutta by rail. The province is practically closed to all foreign trade with this side of India; there is no outlet for the surplus corn produced, nor any means by which English salt or English piece goods can penetrate into the interior of the country.' In this district there are enormous coalfields, and virgin forests, at present useless to the country. At the point marked Billaspur wheat may be purchased, according to the *Imperial Gazette* of the Central Provinces, year after year, at about 6s. a quarter. Whilst a neighbouring province was afflicted with famine, no grain could be sent from this district, owing to the absence of roads and railways."

THE report to be presented to the proprietors of the Cornwall Railway on the 27th inst. contains a comparative statement of traffic, and of revenue receipts and expenses, for the past half-year, from which we take the following:—Miles open, main line, 65½. Train miles: Passenger trains, 171,199; goods ditto, 130,939; total, 302,138; the engine mileage includes 35,292 miles, making a total of 337,430. Number of passengers: First-class, 8857; second-class, 47,941; third-class, 336,541; total, 393,339. Goods, 77,445 tons; minerals, 66,906 tons; total, 144,351. Number of live stock, 20,270. Receipts: Passengers, first-class, £2033 3s. 9d.; second-class, £6198 5s. 4d.; third-class, £22,473 9s. 1d.; season tickets, £1013 11s. 9d.; total passengers, £31,718 9s. 11d.; parcels, horses, carriages, &c., £8841 1s. 2d.; mails, £5190; merchandise, live stock, and minerals, £26,162 3s. 9d.; sundry accounts, £864 17s. 8d.; total receipts, £72,776 12s. 6d.; per train mile, 4s. 9¾d.; per mile open, £1111 1s. 10½d. Expenditure: Maintenance of way, works, and stations, £10,275 6d.; percentage on receipts, 14·12; per train mile, 8¼d.; per mile open, £156 17s. 5d.; locomotive power, £10,376 7s. 4d.; percentage on receipts, 14·26; per train mile, 8¼d.; per mile open, £158 8s. 4¼d.; carriage and wagon repairs, £2327 11s. 7d.; percentage on receipts, 3·20; per train mile, 1¾d.; per mile open, £35 10s. 8½d.; traffic expenses, £8852 0s. 9d.; percentage on receipts, 12·16; per train mile, 7d.; per mile open, £135 2s. 11d.; general charges, £1546 8s.; percentage on receipts, 2·12; per train mile, 1¼d.; per mile open, £23 12s. 2¼d.; law charges, £74 17s. 9d.; compensation, £187 15s. 7d.; rates and taxes, £1126 1s. 7d.; Government duty, £996 8s. 2d.; special trains, £50 14s.; total working expenses, £35,813 5s. 3d.; percentage on receipts, 49·21; per train mile, 2s. 4½d.; per mile open, £546 15s. 4¼d. Profit on working account, £36,963 7s. 3d.; percentage on receipts, 50·79; per train mile, 2s. 5¼d.; per mile open, £564 6s. 6¼d.

NOTES AND MEMORANDA.

THE six healthiest places last week were Derby, Hull, Bristol, Brighton, Huddersfield, and Nottingham.

FLANGES jointed with a cement of cast iron drillings and filings, mixed with sulphur and sal ammoniac moistened with water, have been found to become quite inseparable.

THE deaths registered during the week ending August 14th in twenty-eight great towns of England and Wales corresponded to an annual rate of 18·9 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year.

THE production of copper throughout the world last year is estimated at 221,715 tons, as compared with a corresponding production of 217,483 tons in 1884, and 153,057 tons in 1880. The largest copper-producing countries last year were Australia, 11,400 tons; Chili, 38,800 tons; Germany, 15,250 tons; Japan, 2000 tons; Spain and Portugal, 45,949 tons; and the United States, 74,050 tons.

A PHOSPHORUS emulsion composition for match tips is made by soaking 2 parts of glue in water until soft, adding water to 4 parts, and melting the glue in it by the aid of a water bath at 20 deg. Fah. Remove from the fire, and add gradually 1½ to 2 parts of phosphorus, agitating briskly to form an emulsion. Add 4 to 5 parts of chlorade of potash, 3 to 4 parts of powdered glass and colouring agent, all in very fine powder. Stir until the whole is completely cold.

IN London, 2655 births and 1505 deaths were registered last week. The annual death-rate per 1000 from all causes, which had been 22·0 and 20·4 in the two preceding weeks, declined last week to 18·9. During the first six weeks of the current quarter the death-rate averaged 20·6 per 1000, which was 1·0 below the mean rate in the corresponding periods of the ten years 1876-85. In Greater London, 3405 births and 1913 deaths were registered, corresponding to annual rates of 33·5 and 18·8 per 1000 of the population.

THE reason why a solid substance at a low pressure cannot be heated above its melting point is that there is a definite vapour tension corresponding with each temperature, and, inversely, a definite temperature corresponds with a given pressure, above which the compound cannot be heated. Thus, in the case of mercuric chloride, with a melting point tension of 420 mm., the following corresponding pressures and temperatures were found: at 20 mm., 200 deg.; at 130 mm., 240 deg.; at 250 mm., 265 deg.; at 370 mm., 270 deg. These numbers are only approximate, and are intended to show that a definite pressure exists for every temperature.

AT the residence of the Earl of Lovelace, East Horsley Towers, Surrey, where Messrs. Le Grand and Sutcliffe, London, are boring an artesian tube well, the upper greensand has just been reached, at the depth of 825ft. from the surface. The chalk was first met with at 33ft., as the site of the boring is but a short distance from its outcrop, hence its total thickness has now been demonstrated to be 792ft. Contrary to the general rule, very little water was found in the upper chalk, and it was not until 500ft. was reached that a good supply was obtained. Below this depth the chalk proved practically waterless. The water when first touched stood at 119ft. below surface, and as the boring progressed rose to within 106ft., or nearly 200ft. above Ordnance datum; but upon piercing the upper greensand it fell to 117ft. The flint beds extended down to no less than 380ft. into the chalk, after passing through which the boring tool employed has been a cylinder 40ft. in length, which rotates automatically, and can be lowered 800ft. and raised to the surface in the short space of 30 min. The total depth at present reached is 840ft.

IT is estimated that there are now in Paris 16,044 incandescent lamps, and 2225 arc or Jablochkoff lights. The *Bulletin Internationale de l'Electricité* gives an analysis of the effect of this large number of lights on the Parisian Gas Company. Admitting that each incandescent lamp replaces one jet of gas, and that each arc light is equivalent to ten ordinary burners, an estimate which the *Bulletin* considers very moderate, and one which gas manufacturers themselves cannot regard as exaggerated—this would represent in round numbers 38,300 gas burners lost to the Paris Gas Company. At the rate of 140 litres of gas per hour these burners would consume 5362 cubic metres, taking them to be lighted on an average for four hours a day during the whole of the 365 days of the year. This would amount to 7,755,520 cubic metres, which at the rate of 0·30 centimes per cubic metre, would put into the coffers of the company 2,326,656f. To this must be added what would be obtained from the sale of residual products of this great quantity of gas if the electric light did not exist.

THE quantities of heat generated by the combustion in oxygen of one gramme of hydrogen and of carbon, are stated to be as follows, the unit employed being the quantity of heat which is required to raise the temperature of one gramme of water from 0 deg. to 1 deg. Centigrade:—Hydrogen, 33,881 according to Andrews, and 33,462 according to Favre and Silbermann. Carbon—product CO_2—wood charcoal, 7900 Andrews, 8080 Favre and Silbermann. The percentage composition of a fuel having been ascertained by analysis, its calorific power can, therefore, be determined by calculation. Thus, in the case of a fuel consisting only of carbon and hydrogen, if we multiply the amount of carbon and the amount of hydrogen by the respective numbers expressing the calorific power of carbon and of hydrogen, and add the products, the sum represents the relative calorific power of the fuel. When oxygen is present in the fuel a deduction has to be made, and if we assume that it is the hydrogen which is rendered ineffective by combination with the oxygen, then, as in water, the oxygen is combined with one-eighth of its weight of hydrogen, we have to deduct from the hydrogen of the fuel one-eighth of its weight of oxygen. Calculated on the basis of the figures of Favre and Silbermann already given, the evaporation unit for hydrogen is 62·658, and for carbon 14·691.

A PAPER on the "Relation Between the Absolute Boiling Points and Specific Volumes of Liquids," by J. A. Groshans, is given in the *Journal of the Chemical Society*. The author in continuation of his observations on the law of density numbers given in the same Society's journal, points out that if the values for $T\frac{n}{M}$ and of $v_s\frac{n}{M}$ are the same for any liquids, then the same volume of these liquids will yield the same volume of vapour v_t at the boiling point. The instances cited are propyl ether, ethyl valerate and ethyl succinate. But $v_t = 81{\cdot}78\frac{T}{v_s}\left(81{\cdot}78 = \frac{22327}{273}\right)$, *i.e.*, the volume of two grammes of hydrogen under standard conditions of pressure and absolute temperature; if then for T be substituted $P\frac{M}{n}$ and for v_s, $Q\frac{M}{n}$ (comp. p. 195); then $\frac{v_t}{v'_{t'}} = \frac{P}{Q} \times \frac{Q'}{P'}$; in the particular case in which $P = P'$ and $Q = Q'$; then $\frac{v_t}{v'_{t'}}$, or expressed in another form as $d_s = \frac{v_s}{M}$, then $\frac{d_s}{d'_{s'}} = \frac{n}{n'}$. This equality of volume of vapour from equal volume of liquid can be predicted from the law of density numbers. It is further shown that in the case of analogous mono-substituted derivatives of the hydrocarbons, for instance, the monohalogen derivatives of benzene, the numerical values for $T\frac{n}{M}$ and $v_s\frac{n}{M}$ are the same; hence equal volumes of these liquids will give equal volumes of vapour at the boiling points. Conversely, the values of the density numbers of the halogens are directly calculable from the values of v_t. So also for every halogen-atom introduced into the molecule the values for the constants $T\frac{n}{M}$ and $v_s\frac{n}{M}$ increase in arithmetical progression.

MISCELLANEA.

A BRITISH Iron Trade Association return of the production of Bessemer steel ingots in the United Kingdom during the half-year ending the 30th June, 1886, compared with that for the corresponding half of the previous year, shows a net increase of make in 1886 of 89,565 tons.

THE production of open-hearth steel ingots during 1885 was 583,918 tons; the production for the first half of 1886 is at the rate of 94,552 tons per annum in excess of the production of 1885. This increase has again, as in 1885, chiefly taken place in the Cleveland district.

THE American wheat crop is finally estimated at about 425 million bushels this year; it is equally notorious that the reserve stocks of old wheat are about 65 million bushels less than last year. The result is that the quantity available for export in the ensuing season will probably not be equal to, and certainly not exceed, the amount exported last year, viz., 11,700,000 quarters of wheat and flour.

THE Consul-General for Italy informs us that the International competition of pumps and apparatus for the appliance of remedies against cryptogams and insects injurious to cultivated plants has been transferred from Udine to Florence, and it will be held in the latter city in the ensuing month of October. Applications from intending competitors should be sent in not later than the 10th September next to the Horticultural School at Florence.

THE publication of the correspondence respecting the assistance which is, or might be, rendered to trade by her Majesty's diplomatic and consular representatives abroad, and the arrangements recently made for expediting the issue of trade reports from these officers, has called the attention of a large number of persons interested in trade and trade organs to these reports. The Secretary of State for Foreign Affairs wishes it to be known that these publications may be purchased, either directly or through any bookseller.

IN New South Wales the manufacture of bricks, encaustic tiles, drain-pipes, and other descriptions of pottery, is carried on by the aid of steam-driven machinery. Near Sydney several potteries have been started during the last two years for the purpose of producing domestic earthenware, the local clays used for that purpose being equal to any in the world, and requiring no admixture. Compared with English pottery houses, who have so much trouble in employing machinery, New South Wales starts with an advantage.

THE Belgian-Russian project is now definitely arranged, and the contract was signed at Warsaw a few days since, between the Cockerill Company and the Warsaw firm of Lilpopp, Rav and Co. The combined firms will form a share company, with the object of establishing two large works, one at Nikolagew for shipbuilding, and the other at Jekaterinoslaw as steel and accessory works, the material for which will be procured from the neighbouring mines. The firm of Lilpopp, Rav and Co. bind themselves to cease their production at Warsaw and give their undivided attention to the new works. The plans for the latter are already finished, and the buildings, &c., are to be commenced this month.

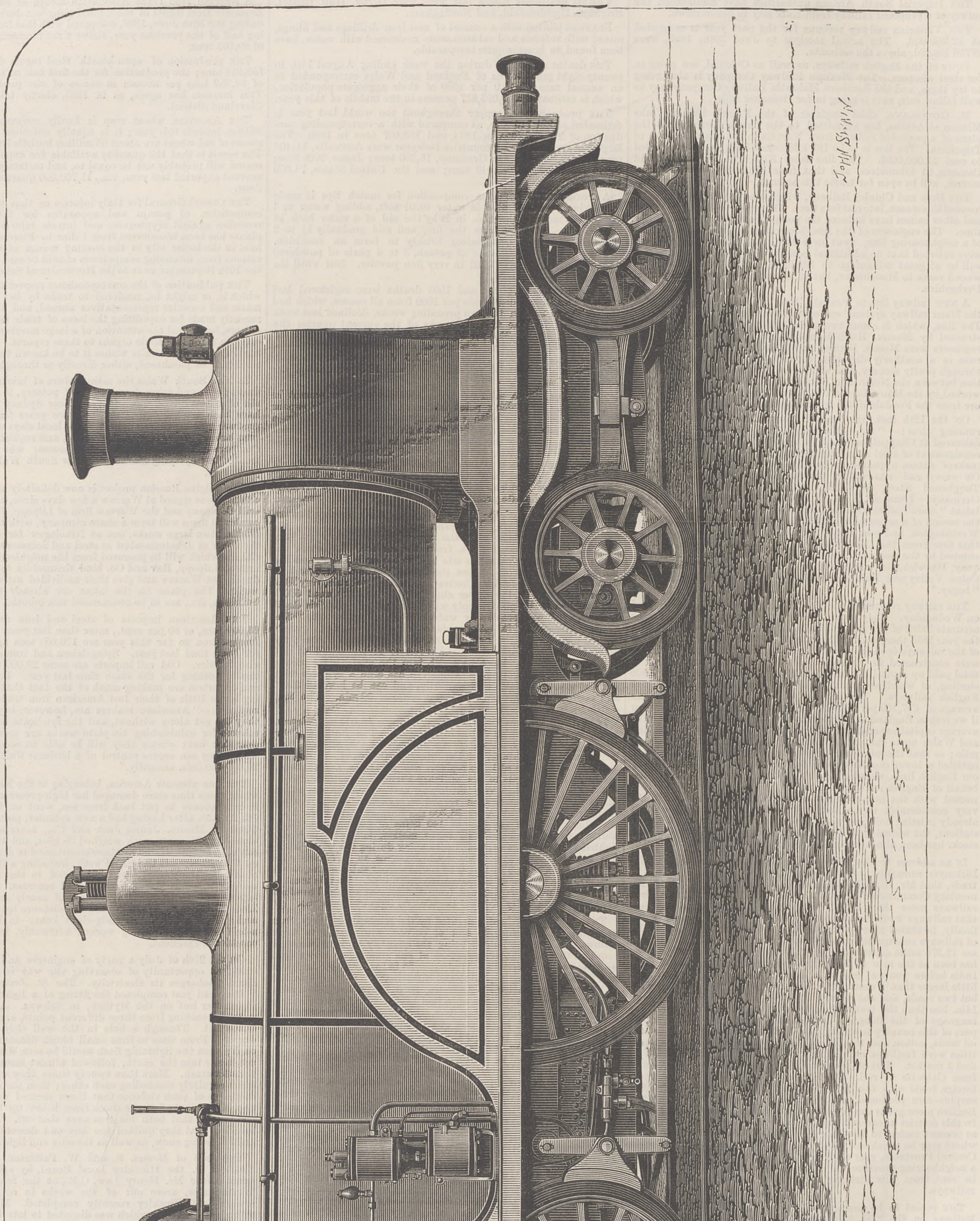
THE American imports of steel and iron rods this year are 65,000 tons, or 80 per cent., more than last year. Importations of foreign iron so far this year are 120,000 tons against 35,000 tons for same time last year. Spiegeleisen and iron ore shipments are also heavier. Old rail imports are some 20,000 tons against practically nothing for the same time last year. Foreign rail makers and exporters are making much of the fact that they are recovering some little of their lost American iron trade. The *Steel Age* remarks:—"American makers are, however, buying nothing that they can get along without, and the syndicate having in hand the scheme for establishing tin-plate works are more confident than ever that next winter they will be able to secure legislation by which they can secure control of a business which will amount to 20,000,000 dols. annually."

THE fine steamer America, belonging to the National Company, which some time since damaged her high-pressure engine, and had in consequence to put back from sea, went on trial on Saturday, 7th August, after having had a new cylinder, piston-rod, and piston fitted by Messrs. James Jack and Co., Liverpool. The casting alone for the new work weighed 26 tons, and the work involved can only be appreciated by those accustomed to deal with machinery on this scale; but the entire work, including a thorough overhaul of all the machinery, was completed in the most satisfactory manner in eight weeks from date of contract. The America ran beyond the South Stack, a distance of nearly seventy miles from Liverpool, and on her return did the distance between the Skerries and the Bar Light Ship—forty-eight knots—in less than two and a-half hours. Everything worked admirably, and the result was considered excellent.

ON the 27th of July a party of engineers and workmen had an excellent opportunity of observing the way in which a thunder-cloud discharges its electricity. The *St. James's Gazette* says:—"They had just completed the fitting of a lightning-conductor at the shelter hut on the Mythen, in Schwyz. A heavy storm was seen approaching from three different points, and they took refuge in the hut. Through a hole in the wall they could see the conductor. From time to time small bluish flames appeared hovering on it; then the lightning flash would be seen descending along the conductor into the earth, followed almost instantaneously by the thunder-crash. More than twenty times they watched the phenomena regularly succeeding each other; then there was an electrical discharge of such violence that there seemed to be a recoil, and two of the party felt the shock from below up to their hips, and one fancied that both his legs were shot off. The men were so terrified that they quitted the hut and descended the mountain amid blinding snow, as well as thunder and lightning."

THE case of Messrs. S. and W. Pattinson, Ruskington near Sleaford, *v.* the Hinckley Local Board, by arbitration, recently heard before Mr. Henry Law, C.E., at the Surveyor's Institute, Westminster, arose out of the works in connection with the sewerage of Hinckley recently completed. Messrs. Pattinson's claim of £1948 19s., which was disputed in lots by the Board, was partly for extra materials and work rendered necessary by their meeting with running sand in laying down the sewers, and partly in respect of reductions made by the Board for compensation for surface damage paid to the occupiers of the land across which the sewers had been carried. The arbitrator sat on the 9th and 10th July, and again on the 16th July to hear the evidence. Mr. Cripps—instructed by Messrs. Faithful and Owen, Solicitors, Victoria-street, Westminster—appeared for Messrs. Pattinson, and Mr. Hugo—instructed by Messrs. Samuel Preston and Son, Solicitors, Hinckley—for the Hinckley Local Board. The Arbitrator has since made his award, by which he adjudges Messrs. Pattinson nothing in respect of their claim.

A CHECKING apparatus for indicating and checking distances travelled by passengers on tramcars, omnibuses, cabs, and other vechicles, is being made by Mr. H. Woolfe, of Barrington-road, Liverpool. The apparatus is small, and is to be fixed in a conspicuous position at the entrance of the car, and connected with the axle or wheel. The hand on a dial indicates the distance travelled. A gong on the top of the apparatus sounds every quarter of a mile, and the figures on the stamping or checking apparatus alter every quarter of a mile, corresponding with the number of miles indicated on the dial. The passenger on entering the car receives from the guard a ticket, which is stamped by the apparatus, with the number of miles then shown on the indicator. This ticket is retained until the passenger gets off, when a glance at the indicator shows exactly how far he has travelled, and pays accordingly. The guard again stamps the ticket and the difference between the two numbers stamped thereon is the distance travelled, which must be accounted for by the guard when he delivers up his tickets at the office every journey.



BOGIE EXPRESS ENGINE, CALEDONIAN RAILWAY.

MESSRS. NEILSON AND CO., GLASGOW, ENGINEERS.

(For description see page 147.)

CONTENTS.

THE ENGINEER, August 20th, 1886. PAGE

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, must be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever will be taken of anonymous communications.*

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

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

J. D. (Portsmouth).—*You will find a complete set of dimensioned and detailed drawings of torpedo-boat engines in our fifty-seventh volume.*

H. J. M.—*The statement is to be found on pages* 28 *and* 29 *of the Blue-book "On Mines and Minerals" for* 1885, *published by Eyre and Spottiswoode, London. Price* 2s. 9d.

W. G. B.—*We cannot say after this lapse of time what was the precise reason for rejection, but recollection is to the effect that it intended to describe some invention of the writer's, but that it failed to make it in the least intelligible.*

C. J. R. (Clapton).—*The compensating gear now used in traction engines and tricycles is known to engineers as "Jack-in-the-box gear," and was invented many years ago by the late Richard Roberts for use in a spinning mule which he invented.*

A CONSTANT READER.—*A* 20*ft. breast wheel on a* 10*ft. fall will give you results within* 10 *per cent. as good as you will get out of any other form of motor. It is for you to say whether you feel disposed to incur a heavy expense in order to effect a saving of* 10 *per cent. If you will send a sketch of the existing wheel we may be able to suggest some improvements in it.*

D. L.—*We have already pointed out that the whole question turns on the time employed. The work to be done in reducing the thickness of the sheet is the same, no matter how it is effected. If flat surfaces were employed to squeeze the sheet out as you suggest, then the operation would be performed in much less time than when rolls are used of ordinary dimensions; and for this reason, and for no other, much more power would be required.*

ERRATUM.—*A typographical error occurred in our last impression. The mechanism described on page* 129 *as Vross' machine for charging and drawing retorts, made by Messrs. Tangyes, of Birmingham, should have been described as Ross' machine. We may add that the mistake was due to want of legibility in the manuscript supplied to us by Messrs. Tangyes. It is impossible for a proof reader to correct the spelling of proper names. We call attention to this fact because it is one frequently overlooked by our correspondents.*

MALLEABLE IRONFOUNDING.

(*To the Editor of The Engineer.*)

SIR,—I shall be obliged if any of your readers can give me the names and addresses of makers of Lorn refined charcoal iron, and iron ore ground ready for use; both required for the manufacture of malleable castings.

FOUNDER.

August 16th.

TECHNICAL SCHOOL IN FRANCE.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give the address of a technical school or college in France where a youth of eighteen can acquire a knowledge of the French language, and marine engineering, and some chemistry at the same time?

O. P. Q.

August 16th.

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

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

THE ENGINEER.

AUGUST 20, 1886.

MARINE ENGINES IN THE NAVY.

THE charges recently brought against certain Government departments involve matters and questions so serious and so important that a full investigation is imperatively demanded, and will, we have no doubt, take place in one form or another. The fact that it is possible for such charges to obtain a hearing is mainly due to the comparative secrecy with which successive generations of Government officials do their work. If the secrecy did not exist, if everything was done, every contract made, every experiment performed in the full light of day, then the practice of the departments would, we may assume, at once refute accusers. We do not say that nothing can be urged in defence of the existing system. There are, no doubt, numerous and good reasons why the authorities should be reticent on certain points. But the use of a system does not justify its abuse; and we believe that it admits of being proved that much more publicity might be given to the doings of the War-office and the Admiralty than is now the practice with considerable advantage to all concerned. It is not our purpose just now to refer at length to the War-office. We wish to direct attention to another great spending department, and we hasten to add with pleasure that what we have to say in no way reflects on the competence, the honesty, or the probity of those concerned. The point we raise is very simple, Are the engines, boilers, and machinery of our ships of war what they are generally believed to be, or are we living in a kind of fools' paradise, and reposing our faith and the safety of the nation on a delusion?

It is perfectly well-known that the propelling machinery of our men-of-war is not only very light, but that every possible endeavour is made to still further reduce weight. This is the popular belief. Let us see precisely what it means. We can only measure weight in marine or other steam engines by comparing weight with power. The same engine may in this sense be either light or heavy, according to the amount of work got out of it. A set of engines and boilers weighing 500 tons may be regarded as very light if 10,000 indicated horse-power are developed; it would be very heavy indeed if the engine indicated 1000-horse power only. Now taking Mr. Sennett as a competent authority—which he admittedly is—and turning to the second edition of his valuable treatise "On the Marine Engine," we find that the weight of all the multifarious machinery in a modern man-of-war, in the shape of steam engines and boilers does, not exceed 2 cwt. per indicated horse-power with forced draught. We are told, furthermore, that the forced draught augments the efficiency of a boiler by 66 to 70 per cent. Consequently engines which weigh 224 lb. per indicated horse-power with forced draught, will weigh about 380 lb. without it. The efficiency of a war vessel is very largely affected by her speed, and if her high speed depends on forced draught for its existence, it follows logically that the efficiency of the ship so far will depend on the satisfactory performance of the forced draught system. If this is not quite satisfactory in every way—if, in a word, the results obtained on trial cannot be obtained uniformly, with certainty, and at any time, then the efficiency of the ship is less than it pretends to be. If we look at the figures given in our last impression, a number of entries will be found like this:—"Benbow, 17 knots; constructor's estimated speed with forced draught." This kind of statement applies to a considerable number of our latest and presumably our best ships. Without forced draught the speed of the ship would of course be smaller—possibly 15 knots, or a little less. The two knots or so are no doubt well worth having. The question is, is it safe to reckon on getting them when they may be most wanted? This leads directly to another question, which is—Is the machinery now in our ships of war of such design and proportions that even without forced draught it can be relied on to perform its duties for long periods at a time when worked up to its full power?

We shall set one or two facts before our readers, and ask them to draw their own deductions. The first is that in design, proportions, and weights, the engines of a modern man-of-war have no true analogue in the merchant service. The engines in a man-of-war, whatever their power, are smaller, and lighter, and more cramped for room than they are in any merchant steamer. It may be urged that this is the result of the peculiar conditions under which they have to be used, and that we must take our chance that they will work all right when wanted. Against such an argument as this we have, of course, nothing to urge. Those who make it look honestly at the facts of the case. But this is not the view taken by the Admiralty or their advisers. These gentlemen hold that the marine engines of men-of-war are the best in the world, and that the practice of the commercial marine is all wrong. This, it will be seen, is taking very high ground, and against this view of the matter we enter our protest. We hold that the superintending engineers of our great ocean companies—such, for example, as the Cunard Company—know perfectly well what is best for them; and that they have deliberately rejected the system of design adopted by our dockyard officials because experience has told them that their own methods are better than those of the dockyards, and they can point with satisfaction to the results they obtain. The engines of the Etruria, for example, run without stop or trouble for a week continuously just as hard as they can be driven. The same thing may be said of hundreds of engines in the mercantile marine. It cannot be said at all of any engines in a modern man-of-war. A six hours' full-speed trial is the maximum exertion they are called upon to make.

Furthermore, there is not at this moment half-a-dozen sea-going steamers in existence, excluding the Royal Navy, to which the forced draught system is applied. The mail steamer Ireland is the most prominent example outside Mr. Howden's practice that we can call to mind, and the engines on board the Ireland will drive her at over her contract speed without the aid of forced draught at all. Indeed, the fans are used rather to ventilate the stokeholes than to force the fires. A water-gauge of less than ½in. is all they are called on to produce; and even if they were worked at full power it must be borne in mind that the maximum duration of a run is not more than four hours. While, then, the ablest and most experienced marine engineers in the world are feeling their way with the greatest caution in adopting forced draught, we find the Admiralty applying it to great war ships with the utmost freedom, and staking the success or failure of their designs on a system concerning which only the most limited experience is possessed, and that experience, be it understood, not altogether satisfactory.

If our readers have followed us thus far they will understand now that we bring two definite charges against the Dockyards, namely, that they are using machinery much smaller, lighter, and more cramped in proportion to the power developed than dare be adopted in the mercantile marine; and that furthermore they are freely adopting the forced draught system of urging furnaces without adequate and necessary experience of the results to be obtained from it. Again, a third charge is involved in this, namely, that if machinery is now too small and light for the power developed with natural draught, it must be still worse off with forced draught. It will, no doubt, be urged that we are completely in error, and that the shipowners and engineers of this country are far too slow and too conservative—that they have not "go" enough, nor sufficient originality. Such statements carry their own refutation, and require no comment. Against the further argument that the engines of our war ships are all perfect, or nearly so, as machinery can be, we reply that this is a statement which has no foundation but pure assumption. Until an engine has been tried, no one can tell whether its performance will be satisfactory or not. But there is not a set of propelling machinery in any modern man-of-war which has been worked up to its full power for even a single week together. Can any of our dockyard readers name a vessel, not a troopship, which has steamed at full speed for a distance of even 1000 miles? If so we shall be glad to have particulars. As to the forced draught, on which so much is made to depend, has a run exceeding six hours ever been made with forced draught? How many runs of even four hours have been made without a breakdown of some kind? Has not one of the latest additions to the navy come recently to utter grief in the engine-room? Are the Admiralty prepared to send a man-of-war for a trip across the Atlantic, with instructions to get across as fast as it is in the power of steam to take her? Of course not. We have been told that it is quite unnecessary to be able to run a ship of war at full speed for more than a few hours at a time. But is it not conceivable that it might be of the utmost importance to place a large squadron at some point within a few hours? Let us suppose that a Russian fleet threatened the shores of Scotland while the Channel fleet was cruising at the South of Ireland, what would speed be worth then? It is, however, mere waste of paper to argue that if our ships are fitted with engines which can only be worked up to maximum power for a few hours, they are not what they ought to be, or what the country believes them to be.

The reticence of the Admiralty authorities is such that the nation is in complete ignorance concerning the performance of the machinery for which the taxpayer pays so large a price. No one save the dockyard authorities and the contractors is ever allowed on board during a trial, if, indeed, we except the representative of one non-technical journal, presumably not an engineer, and with his mouth sealed by the very nature of the conditions under which he is permitted to be on board. Of the successes achieved we hear freely enough; of the failures we never hear, unless they result in so serious a break down that absolute silence becomes impossible. Be it understood that we attach no blame to individuals, nor do we for one moment assert that the marine engines of our ships are not as well made and of as good material as it is possible to find. On the contrary, they are marvellous examples of what consummate skill and a large expenditure can produce. We complain that this machinery is called upon to achieve impossibilities, and that the dockyard authorities either do not know or do not care that they are impossibilities. The trial trip of a man-of-war finds its precise analogue in a race horse. The fleet creature traverses his three or even four miles at a tremendous pace, but he could not continue the exertion for a quarter of an hour. If our readers were behind the scenes and really knew what takes place in the engine and boiler-rooms of a man-of-war making her six hours trial, they would have no difficulty in tracing the resemblance between the ship and the horse.

We shall probably be told that we are exaggerating, and that matters are really much better and more satisfactory than we represent them. No mere assertion will suffice to prove this; nothing will upset our arguments but a definite statement of the results of a prolonged sea trial with forced draught, and, of course, at full speed. If the Admiralty can be induced to make such a trial under conditions which will leave no doubt of the impartiality of the report which should follow it, we shall not have written in vain.

THE SCIENCE AND ART DEPARTMENT AND THE OFFICE OF WORKS.

PERHAPS no civil department of our Government has been more often or more severely criticised than the Science and Art Department at South Kensington, nor, indeed, has any borne adverse comment with greater indifference. That it has done good to a certain extent few can deny; but that it has utilised its powers to the uttermost or to the best advantage few will be found to admit. Just at present, South Kensington and the Office of Works are at war, and the cause may be stated as follows:—One of the self-imposed duties of the South Kensington authorities is the collecting of models of various kinds, drawings, and samples of manufactures. As these are gathered together they are euphemistically called scientific and technical collections, and are supposed to be used to illustrate the lessons given by the educational staff of the Department. Hostile critics declare that many of the things collected are almost, if not altogether, valueless, and ought to be got rid of. They assert that this Department, from motives of jealousy of other educational institutions, possesses itself of every curio, of every model, or example of any new process, rather than let any rival school or college get them, and that it is so eager in this pursuit that it purchases—not to mince matters—a great deal of perfectly useless lumber. If, for example, the opinions of foreign visitors are to be held of any value, the unfavourable impression given to them by the contents of the Patent Museum—the gallery of building appliances, the mechanical collection, naval models, and casts of fish—ought to open the minds of those in authority, and induce them to make a change for the better. Constant additions to the collections have entailed the necessity of considering how more house room is to be provided for their reception, and three years ago the leading officers of the Science and Art Department were invited to consider this question. These gentlemen, of course, have faith in the things they have gathered together, and accordingly laboured to devise means for their disposition. Their reports were sent in to the Office of Works, where they were duly pigeon-holed, no action being taken. In the beginning of 1884 an Inter-departmental Committee was formed to consider and report upon the scope of the scientific and technical collections with the view of suggesting some plan, or plans, for housing them in the existing buildings at South Kensington; or else in others to be built on their site and the adjoining ground, now in the possession of the Government. The Committee were also to consider whether a good deal of weeding could not be effected with advantage. The members of the Committee were Lord Lingen, Sir Frederick Bramwell, Colonel Donnelly, R.E., Mr. A. B. Mitford, and Sir Francis Sandford, who, however, never attended. This Committee naturally availed themselves of the results of the labours of the preceding Committee. In their report, for example, they say, "Considering that the members of that Committee were selected on the responsibility of the Government for their competence as authorities in their respective branches of science, and considering their detailed inquiries, we assume their conclusions as the basis of our recommendations—that is to say, an area of 120,000 square feet should be provided for the display of the collections which have in general to be created, with a further provision of 40,000 square feet, which it was calculated would be required in ten years." Mr. Taylor, of the Office of Works, explored the land available, and reported that by an outlay of £43,500 the country could obtain 80,200 square feet of flooring for the display of anything sent there; while a further expenditure of £54,000 would provide a building with 33,750 square feet of additional space. All this, however, being inadequate, it was explained that there was an opportunity of spending £125,000 more without moving from the strip on the south side of the Horticultural Gardens. Thus it will be seen that the total suggested outlay amounts to, in round numbers, £222,500. The Committee set all this forth in a report dated July 27th, 1885. Now it so happens that South Kensington has power to expend money on buildings quite irrespective of the Office of Works; but the latter is of opinion that this power is not always wisely used. For the present we confine ourselves to a statement of the state of affairs between the two Departments, we will comment thereon presently. The Office of Works does not approve of the building projects of the Science and Art Department. Probably foreseeing what was coming, Lord Lingen and Sir F. Bramwell retired, leaving Mr. Mitford, of the Office of Works, and Colonel Donnelly, to settle the dispute in which the inquiry has resulted between them, as to the erection of the suggested new buildings. Mr. Mitford, on the one part, contends that it is premature to think of erecting something like a mile of galleries on the west side of Exhibition-road before the ugly buildings on the east side have been removed; observing moreover, that proper management will render the buildings on the east side sufficient for the legitimate growth of the Science and Art Department. Having expressed this opinion, Mr. Mitford proceeds to attack Colonel Donnelly in another way by explaining the nature of the illegitimate work which the Department hopes to carry out some day, and avers that the estimated cost will be doubled, that those who recommend the costly proposed extensions are chiefly professors in the Normal School of Science, and asserts that it is shown that the official scientists are carrying out the South Kensington policy of centralisation. Mr. Mitford also contends that the practical teaching value of South Kensington is overrated; asserting boldly that practical gardening cannot be learned by means of artificial flowers, nor farming by means of wax models, observing that no one would engage a bailiff on the strength of a Kensington certificate; neither can a man become a builder by wandering through endless galleries of terra-cotta, ironwork, and drain pipes. He also roundly asserts that providing gratuitous advertisements for traders, and stables for the white elephants of inventors and companies is no part of Government business. Mr. Mitford is himself one of the largest patrons of the building trades in all England, therefore his opinion on such matters must command attention. He says that no intending purchaser would go to South Kensington to be guided in a choice of goods.

Colonel Donnelly's reply to all this amounts to the statement that Mr. Mitford must be aware that the action of the Department and its communications take place under official sanction, and its documents are signed by the Lord President; that the Department has sources of information not accessible to Mr. Mitford; and Colonel Donnelly adds that the country generally does not agree with Mr. Mitford as to the value of wax vegetables as a means of instruction. Mr. Pole wrote to Mr. Mitford, requesting him to attend a meeting where the two reports were to be discussed. Mr. Mitford replied that it was extremely irregular to attach to his separate report an *ex parte* criticism by another member of the Committee; and he asks:—"Is it or is it not a fact that for some years past successive Governments had endeavoured to keep in check the encroachments of the Science and Art Department on the west side of Exhibition-road? That it has over and over again been peremptorily ordered by the Treasury to give up possession of the western galleries, but has never obeyed, opposing to authority a dumb and active rebellion?" He also asserts that the number of visitors is over-estimated. "According to Colonel Donnelly," says Mr. Mitford, "there is an attendance of 500 a day, but they must, if they are there, have the gift of invisibility."

The ground of contest between Mr. Mitford and Colonel Donnelly put into a concise form amounts to this: The former opposes the spending of more money on buildings for educational purposes until the process of weeding the collections is effected, and until the existing accommodation is shown to be utilised to the best advantage. Colonel Donnelly, on the other hand, apparently does not think there are any weeds in his collections; that his sources of information enable him to be a better judge than Mr. Mitford of what system of education in science and technical subjects is best, and consequently of what appliances are required. £223,000 is, however, a large sum, and must come, if expended, directly or indirectly, out of the ratepayers' pocket, and ratepayers will, we fancy, want to see a better and more satisfactory reply to Mr. Mitford than Colonel Donnelly has yet given. His reference to the powers that be, under whose authority he or his Department acts, resembles Spenlow and Jorkins a little too much. In these days of sifting things out, the ratepayers are hardly likely to allow Colonel Donnelly to pose as Mr. Spenlow and refer to his chiefs as so many Jorkins, all-powerful but not to be seen or questioned. We are inclined to think that those who will be called upon to find the money for the proposed buildings will insist on receiving a satisfactory reply to the question, "*Qui bono?*" In this connection we would like to know something of the results achieved by the Science and Art Department in the shape of the worldly success of the students educated there. What percentage of them have made their mark in the industrial world? How does South Kensington as a source of educational training compare with other and less well endowed establishments in respect of the subsequent careers of its pupils? Although science is highly respected in this country in its abstract aspect, there is, nevertheless, happily a growing conviction that due knowledge of its practical application is of the first importance to the young man who has to earn his bread; and notwithstanding Colonel Donnelly's reply, we still agree with Mr. Mitford that wax or any other models will not suffice to teach practical gardening; neither will galleries of terra-cotta and ironwork instruct a student in practical building. In these days, parents who are professional men, or men who have to put their sons out in life as gentlemen, have seldom means to do more than invest a certain portion of their income in giving an education to them. They scrutinise pretty closely the rival claims of different schools in the endeavour to secure for their sons the best educational value possible or attainable for their money, and we question if the majority of fathers would or do send their sons to South Kensington in preference to other schools.

CLYDE SHIPBUILDING.

Notwithstanding the gloom which continues to enshroud the shipbuilding and engineering industries of the Clyde in common with most other districts, an occasional ray of light penetrates the thick veil and helps to make the situation more bearable if it does not impart much hope of a speedy dispersion of the heavy clouds. One such circumstance is the order recently booked by Messrs. Caird and Co., of Greenock, for a new steel screw steamship of as much as 7000 tons measurement for the Peninsular and Oriental Steam Navigation Company. This will be the largest vessel ever produced at Greenock, and Messrs. Caird are losing no time in making a start upon her. Another circumstance from which satisfaction is being drawn in prospect is the fact of the Fairfield Shipbuilding Company being in negotiation with the North German Lloyd Company for the construction of three additional steamships for their fleet, such as have just been completed for that company by the same firm. Negotiations are as yet incomplete; but it is fully expected matters will be satisfactorily arranged at no distant date for the carrying out of this important contract. Messrs. R. Duncan and Company, Port Glasgow, have been entrusted recently with an order for two steamers, each of 1600 tons, for a New York firm, the engines for which will be furnished by Messrs. Muir and Houston, Glasgow. Messrs. Charles Connell and Co., Scotstown, have also secured the order for a steel sailing vessel of between 1600 and 1700 tons for a Glasgow firm. For the London and Edinburgh Shipping Company's direct steam service between London and Leith, Messrs. J. and G. Thomson, Clydebank, have just contracted to build a steel steamer of 1600 tons, somewhat similar to the company's highly-successful steamer Iona, also built by Messrs. Thomson about three years ago. The Clydebank firm have been kept active for a considerable time with work for our own and other Governments. They recently launched for the Spanish Government the torpedo cruiser Destructor, which in design embraces many somewhat novel features, and for the Russian Government a sea-going torpedo boat 100ft. in length, yet with engines of 1400-horse power. This latter craft on a recent trial for speed attained the striking result of twenty-two knots. Messrs. Thomson are pushing forward with the man-of-war for Spain, contracted for several months ago; and they have still to finish the last of the six torpedo cruisers for the British Government and the engines for the Aurora. Messrs. R. Napier and Sons' establishment at Govan is solely taken up with Government work. The two belted cruisers Australia and Galatea, for our own Government, are approaching the launching stage of completion, while the engineering works of the same firm are fully occupied with the engines for these vessels and for the war ship building by the Russians. The latter engines will be the most powerful of the triple expansion type yet completed, as they are to indicate 13,000-horse power. Messrs. Alexander Stephen and Sons, Linthouse, have five vessels on the stocks, all well advanced in construction. Messrs. Russell and Co., Port Glasgow, are, as usual, well employed with sailing ships. While the foregoing indicate what is being done in the principal works employed, nevertheless the greater number of the yards—including one or two of the largest establishments—are badly off. Messrs. Denny Bros., Dumbarton, have for many months past contrived to keep their large works in operation—with a greatly reduced staff, however—chiefly by building light draught paddle steamers and barges for Indian and South American river service. Most of such work has consisted merely of the metal hulls, temporarily fitted in the yard, and afterwards shipped and re-erected abroad. Messrs. Inglis, Pointhouse, have only two medium-sized steamers on the stocks, but continue to do cleaning and repairing work on their patent hauling slip. The total amount of tonnage on hand at present is only about 97,000 tons, compared with 110,000 tons at this time last year, and 150,000 tons at the end of July, 1884. As many as fifteen shipyards, or over one-third of the total number employed in ordinarily brisk periods, are practically closed, many of them positively so, and handed over to the caretaker. Some have now been in this position for two years or more, with no prospect of resumption; while a few are not altogether without hope of being profitably employed at no distant date. Of the establishments referred to, three are in the Port Glasgow district of the Clyde, three are in Dumbarton, three in Paisley, two in Whiteinch, and the others singly in other districts.

THE EXPORT RAIL TRADE.

The possibility of orders coming from the United States for railway material is directing attention to the export rail trade, and to its changes. The iron rail trade is evidently approaching extinction, for in the first seven months of the present year only 7870 tons of iron rails were exported. Germany, Holland, Italy, Mexico, Peru, and British North America—all of which were once large buyers of iron rails—have taken none all through the year. Russia took four tons only, and the bulk of the rails were sent to the British East Indies and the Argentine Republic. It is worthy of notice that the declared value of the iron rails exported this year has been over £6 per ton. In the steel rail trade there is now an increased shipment, but not enough to make the year's total above that of last year. In the first seven months of this year the steel rail exports amounted to 280,842 tons, or about 21,000 tons less than last year. There is a falling-off in the Russian demand when contrasted with that of the past year; also in that from Sweden and Norway, Spain, Egypt, Brazil, Chili, British North America, British East Indies, and the group of smaller customers classed in "other countries." On the other hand, the United States increased its purchases from 4843 tons to 19,299 tons; Australasia and British North America bought more freely; and the Argentine Republic, Mexico, and Italy were amongst the countries taking quantities in excess of those of the past year. It is worthy of notice that the average declared value of the steel rails for the year so far is slightly under £5 per ton. It is possible that the exports to Spain may have been kept down by the new treaty's lower dues; and the war necessities of the past explain the decline in the quantity sent to Egypt. But the general tenor of the return is to show that the rail trade depends much less than it used to do on the European continental demand; and that a larger share of our trade in rails is done with more distant nations which cannot fully meet their own requirements. In the month of July we sent 6162 tons of railway material to the United States—one of the earliest shipments—on account of the orders given out, and one which seems likely to be the pioneer of others. India, Australasia, and British North America, are amongst the chief of the other recent buyers of rails; but the demand is as yet far below the average from the bulk of the countries we have been wont to supply with rails. The railways in the United States have felt the benefit of a revival before those in this continent can, and the orders which have been given out have been most acceptable here. They will fill up the work at our steel mills during the time of the re-invigoration of the demand from other countries, and it is possible that for a considerable period we shall find our steel exports to the United States and to America generally considerably increased. But it is noticeable that it is a demand which more and more is for steel rails, and that the older form of the article is only in use in special cases, and in small quantities, and its extinction promises to be a work of no great time.

LITERATURE.

Electric Transmission of Energy, and its Transformation, Subdivision, and Distribution. A Practical Hand-book. By Gisbert Kapp, C.E. London: Whittaker and Co. 1886.

It would often be very convenient and useful if a practical and economic system could be designed to enable us to actuate machinery by means of energy generated at a distance from the spot where it was utilised. Natural forces now wasted would then contribute their quota to the sum of civilisation. The idea of transmitting energy by means of electrical apparatus is by no means new. Pinkus, in his patent of 1834, speaks of "transmitting or extending motive power," and to do this he employs "magnetic attraction;" but his meaning hardly corresponds with our meaning of the words. In 1837 Berry went a step further; but perhaps the first successful attempt, so far as our Patent-office is concerned, is to be found in Cooke and Wheatstone's patent of 1837. When we speak or write of transmitting energy now, we are apt to think of transmitting hundreds or thousands of horse-power, and to forget that a telegraphic needle, a bell hammer, &c., actuated at a distance by means of electricity—or, in fact, by any other means—are in reality practical, successful examples of the transmission of energy. The question of electrical transmission, as in telegraphic operations, was very closely investigated in the early days of long cables, the outcome of such investigation being the mirror instrument designed by Sir William Thomson. The energy transmitted by electrical means through long cables was insufficient to actuate the ordinary instrument; hence the birth of the mirror. When we restricted the electrical transmission of energy to large quantities, we had to wait for the advent of the Gramme improvement on Pacinotti's invention. The dynamo brought this method of the transmission of energy within the bounds of practice, just as it brought the possibilities of electric lighting.

Mr. Kapp in his book restricts the discussion almost entirely to the use of the dynamo, and here, being upon familiar ground, he works with a masterly knowledge of his subject. Before describing the contents of the book, we must enter a firm and emphatic protest against the claim put forward on account of Marcel Deprez as being "the first to demonstrate that energy can be transmitted electrically over long distances." If Mr. Kapp will build a telescope six times as big as the Lick telescope, and mount it in as good a position, we foretell that he will see more and further by its aid than any one has previously done with any other "telescope." Probably, too, he would be made an F.R.S., and get the Cross of the Legion of Honour; but we fail to see that for doing this he could claim to be put on the same scientific pedestal as Herschel. Deprez's work reminds us of that of the ant in Twain's "Tramp Abroad"—there is a lot of labour, but to us it seems badly directed, and without tangible results.

To return, however, to the book. Mr. Kapp premises that "there are two purposes for which the electric transmission of energy is of great value. The one comprises all cases where hitherto inaccessible sources of natural energy are by its means rendered accessible, and the other comprises all cases where the source of energy itself is accessible, but where it is desired to distribute it to a number of independent small working centres"—page 5. In both cases there are other than electrical systems to be considered, and in any specific case the engineer has to decide which system is the best. This book, so to say, enables the engineer to obtain the necessary information on the subject, so far as the electrical system is concerned. It tackles the subject as a whole, commencing with discussing the elementary principles upon which the electrical apparatus is constructed, continuing by describing the apparatus, and concluding with estimates of cost and special applications of the system.

We do not know that we are called upon to consider the value of scientific theories referred to when noticing a book of this kind, but our duty is rather to point out what is in the book, and say whether, to the best of our belief, the information therein is in accordance with the most modern teachings of science. However, we may be permitted to ask those who propound theories to test them from a practician's point of view. If, for example, magnetisation of a bar of steel consists in directing the axis of all its molecules into one particular direction, will not this somewhat interfere with its tensile or its compressive strength? Does magnetisation so interfere, and if so, to what extent? It would seem feasible, if the Rev. A. J. Stevens' theory of molecular structure is correct, that magnetisation might strengthen steel or iron and not weaken it. The book refers to various theories in order that the reader may better understand the practice followed in construction. It also refers to the units at present in use for electrical measurements; but in dealing with the nomenclature we could have wished that "pressure" had been used in lieu of "potential." It is so used later on in the book. Chapter II. introduces us to "Barlow's wheel" and the dynamo of Professor Forbes constructed recently upon this principle; then discusses certain ideal as well as actual forms of armature, chiefly in relation to the electromotive force obtainable. Then we have a chapter on the connection between dynamos and motors and various theoretical considerations, followed by one on the various types of field magnet and armature. Whatever the author has to say upon these subjects will be read with interest, because he has made them a special study, and has been successful in applying in practice the conclusions he has arrived at from experimental and theoretical considerations. Besides the generator and the motor, a system of electrical transmission requires a conductor or conductors. This part of the system is equally, if, indeed, it is not more, important than the others, and has in the work received due attention.

Perhaps the portions of the book which appeal directly to practical men are those which compare the important systems of transmission and consider their cost. The systems compared are the (1) electric, (2) hydraulic, (3) pneumatic, and (4) the wire rope system. With regard to cost, the author adopts the figures of Herr Beringer, pointing out that "the figure of merit for each system is the price which has to be paid for one-horse power at the receiving station." When commercial efficiency alone is considered "for distances less than five kiloms. transmission by wire rope is more economical," beyond this distance the preference must be given to electric transmission. When capital outlay is considered, for short distances electric transmission shows a high cost; but for longer distances compares favourably with other systems, and has the greatest advantage "where the energy has to be transmitted over a long distance." Coming, however, to the crucial point, the cost per horse-power at the point of utilisation, the author arrives at the following conclusions, page 236:—(1) It pays to transmit cheap water-power, by wire rope if the distance is less than a mile, and electricity if the distance is a mile or more. This applies to all powers. (2) It pays to transmit cheap steam power if the amount of energy required at the receiving station does not exceed 10-horse power. If the distance is less than a mile, use wire rope transmission, for distances of one mile and upwards up to two or three miles use electric transmission. Beyond this limit a small local steam or gas engine is preferable.

At the present time the hauling of tram-cars seems to be the most important development of the transmission of energy. The use of horse traction is cruel and costly. On this head Mr. Kapp gives the figures from Mr. Zacharias, which show the capital outlay for electrical apparatus on the Reckenzaun plan with secondary batteries to be slightly in excess of that for horses, while the working expenses are only about half as great with the electric as with the horse traction. The author seems rather to favour the Reckenzaun system, while we should prefer that adopted by M. Volk at Brighton, at any rate up to a three mile length. Mr. Zacharias might well be asked why he adopts only a 20 per cent. depreciation of batteries, and it would be interesting if the author stated more especially how he came to agree to this figure. We doubt if there exists at present any manufacturer that would guarantee a five year life for such batteries. Indeed, the only feature of this book we are inclined to find fault with is that the author frequently gives too much prominence to experimental results, and too little to the results obtained in actual practice. Thus, in the great majority of cases where tram-car haulage has been practised, the work has been done without the aid of accumulators, which undoubtedly add largely to the dead weight to be carried, and so far as we know have never been successfully adopted in other than experimental work. We have looked at this book more from the commercial than from the scientific point of view, because the future of electrical transmission of energy depends upon the enterprise of commercial men and not so much upon men of science. The latter have carried the work to a point, as is admirably shown by Mr. Kapp in this work, where the former should take hold. The difficulties in the way of using this system are not from the lack of fairly good generators or motors, but from difficulties arising in distribution, which are more likely to be avoided by experience derived from practice than by any other way.

CONTRACTS OPEN.

CARGO BOATS FOR THE NORTHERN BENGAL AND SIND-SAGAR RAILWAYS.

The Northern Bengal Railway Company solicits tenders for two cargo boats according to the drawings on page 148. The boats are to be built in steel, galvanised; to be of spoon shape at bow and stern.

Dimensions.—Length on main deck, 130ft.; beam, moulded, 29ft.; depth at centre from top of beam to top of keel, 4ft. 8in.; draught of water with all stores and general equipment on board, about 11in. The general appearance and arrangements of vessel to be in conformity with the drawing.

Plating.—Of mild steel, Siemens-Martin. The plates to be of as long lengths as possible, the longitudinal seams lap-jointed and single rivetted, the vertical seams butt-jointed, the straps are to be $\frac{1}{16}$in. thicker than the plates they connect, and to be double rivetted. The strakes of plates to be worked alternately in and out, the spaces between the outer strakes and the frames to be filled in with solid liners the same width as frames, and the thickness of the adjoining plate. All butt straps and vertical edges of plates to be planed. The whole of hull plating, excepting keel plates, to be 5 lb. to the square foot.

Keel plates.—Two in number, one below each longitudinal bulkhead, to be 24in. by 10 lb. to the square foot, securely rivetted to gunwale angle at stem and stern.

Frames.—To be steel angles spaced 24in. apart, $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., securely rivetted to hull plating. Each frame to be joggled up so as to form waterway in each compartment of vessel, except in transverse bulkhead frames. Below bollards and fairleads plate frame $\frac{1}{8}$in. thick, to be fitted at top end, to be equal in width to gunwale stringer and fastened to deck beams; floors and frames, on the floors, to be of a width of about 3ft.

Floors.—To be in steel 8in. deep by 5 lb. to the square foot, one to each frame, to be in one piece. Waterway to be cut in all three compartments of vessels to suit joggling of frames.

Reverse frames and floor angles.—To be steel angles $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., and to be in one piece across vessel, every other reverse frame to run up to deck stringer and the remainder a sufficient height to make a secure attachment to frames. To be punched for flooring and ceiling.

Keelsons.—Main keelson to consist of two steel angles, $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., rivetted back to back and to a continuous steel plate, 10in. wide by 5 lb. to the square foot, rivetted to floor angles. Side keelsons to be intercostal, formed of steel angle frames, $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., and plating 5 lb. to the square foot, fitted between floors and below fore and aft angle on bottom of longitudinal bulkhead, to be made watertight, placed as shown in drawing.

Longitudinal bulkheads.—To be continuous and formed of steel plate, 5 lb. to the square foot, to be securely rivetted by a continuous steel angle, $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., to floor angles and angle frames of side keelsons. To have short steel angles between deck beams, $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., rivetted securely to deck ties. These angles to be doubled under feet of tube pillars for supporting hurricane deck. To have diagonal steel angles, as shown in drawing, $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., securely rivetted to same one on each side. To have double butt straps, treble rivetted, to be in one plate for depth.

Main deck beams.—Steel bulb angle, 3in. by 2in. by $\frac{1}{4}$in., firmly rivetted to frames of vessel by gusset plates 10in. by 10in. by $\frac{1}{4}$in. steel, and to deck stringers. In wake of hatchways the short beams are to be rivetted to a steel angle 2in. by 2in. by $\frac{1}{4}$in. attached to hatch coamings and by steel knees to carlins. Beams to be on alternate frames, and to have all holes punched for deck bolts.

Main deck stringers.—Gunwale stringer to be 27in. by $7\frac{1}{2}$ lb. to the square foot, securely rivetted to deck beams, and rivetted to steel angle $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., running right round vessel rivetted to top edge of sheer strake. All butt plates to be double and treble rivetted. Deck ties placed, as shown in drawing, over longitudinal bulkheads in steel 24in. wide and $7\frac{1}{2}$ lb. to the square foot, securely rivetted to gunwale stringer at each end and deck beams. The butt straps to be double and treble rivetted.

Main deck plating.—At forward and after ends of main deck to be plated over from ends to cargo hatches, and to extend in width to longitudinal bulkheads, to be 5 lb. per square foot, and securely rivetted to beams and stringers.

Hatchways to holds.—On main deck amidships, five in number, the coamings to be formed of steel plate $7\frac{1}{2}$ lb. to the square foot, to stand 7in. above deck, the carlins to be carried to lower edge of deck beams, and rivetted thereto by steel knees same depth as beams. To be fitted with the necessary angles for taking hatch covers. The upper edges to have a half round rivetted on outside. The hatchways at wings to be fitted, as shown in drawing, with cast iron rings and covers turned and faced so as to be made water-tight, the whole to be flush with deck.

Transverse bulkheads. — To be five in number, arranged in accordance with the drawing, to be water-tight throughout, 5 lb. per square foot in steel, to have steel stiffening bars $1\frac{3}{4}$in. by $1\frac{1}{4}$in. by $\frac{3}{16}$in., as shown in drawing.

Hurricane deck supports.—To consist of two fore and aft girders of I section rolled steel, the upper and lower flanges to be 4in. wide, the total depth about 5in.; web not less than $\frac{3}{8}$in. thick, to be formed as shown in drawing, the ends carried down and securely rivetted to beam tie and longitudinal bulkhead by steel forgings approved.

Pillars.—The hurricane deck to be supported by pillars formed of $2\frac{1}{2}$in. internal diameter steel tubing, screwed at ends into forged steel T ends 4in. wide and 12in. long, securely rivetted to girder iron at top and to deck tye and longitudinal bulkhead angles at bottom. Tules to be $\frac{3}{16}$in. thick. Where necessary the T ends to have provision forged on for transverse staying.

Hurricane deck beams.—To be in bulb steel angle iron, 3in. by 2in. by $\frac{1}{4}$in., attached by steel angles $2\frac{1}{2}$in. by $2\frac{1}{2}$in. by $\frac{1}{4}$in. by 4in. long, rivetted to girder. Length of beams to be as shown in drawing, to be placed 4ft. apart. On top edge of beam ends a steel angle stringer to be rivetted 2in. by 2in. by $\frac{1}{4}$in. to vertical stringer, to be rivetted 2in. by 2in. by $\frac{1}{4}$in. to vertical plate 5in. by $\frac{3}{16}$in., the whole length of hurricane deck. The vertical stringer to be attached to beam ends by steel angle knees, 2in. by 2in. by $\frac{1}{4}$in., the depth of deck beam. The beams to be punched for taking deck bolts.

Hatchways for hurricane deck.—Two hatchways, as shown in drawing, to be fitted, to have the necessary coamings and carlins in steel plate. Coamings to stand 6in. above deck beams, and to be fitted in same manner as main deck hatchways.

Accommodation ladders.—The ironwork for two approved accommodation ladders from main to hurricane deck, with the necessary hand rails in polished wood. Also the necessary uprights and hand rails round companions to be furnished in a similar style with the usual brass treads, and arranged as shown in drawing.

Centre supports for main deck beams.—Main deck to be supported at centre by stanchions, 2in. inside diameter, $\frac{1}{8}$in. thick, to have solid forged steel ends screwed on and rivetted to deck beams and main keelson, to be shouldered on to deck beams and main keelson, to be placed as may be pointed out.

Centre supports for hurricane deck.—To be steel tubes $2\frac{1}{2}$in. inside diameter, $\frac{3}{16}$in. thick, with screwed ends for taking forged steel ends rivetted to hurricane and main deck beams, to be shouldered at upper end, to be placed over main deck centre pillars.

Athwart ship, wind bracing below hurricane deck—To be fitted as shown in drawing, and as may be most conveniently arranged clear of cargo hatches, to be in Lowmoor iron $\frac{7}{8}$in. in diameter, with right and left-handed screws.

Awning stanchions on main deck.—To be placed as shown in drawing, to be bent over at top end and rivetted to vertical stringer at end of hurricane deck beams, to be $1\frac{3}{8}$in. diameter at lower end, and $1\frac{1}{8}$in. at top end, the lower ends to have a flat foot forged out of solid for bolting with through bolts through covering board and stringer plate not less than $4\frac{1}{2}$in. square. Fore and aft of hurricane deck stanchions to be provided for carrying an awning at level of hurricane deck.

Awning stanchions for hurricane deck.—The usual awning stanchions of the height shown in the drawing, $1\frac{3}{8}$in. diameter lower end, $1\frac{1}{8}$in. diameter at top end, placed 8ft. apart for the support of side rails and rafters for carrying canvas awning. Stanchions of similar size to run along centre of hurricane deck for carrying ridge poles for awning placed 8ft. apart.

Hand rail.—To be fastened to covering board in a similar manner to awning stanchions, to be $1\frac{1}{8}$in. diameter at bottom, and $\frac{7}{8}$in. at top end. Awning and hand rail stanchions are to have bosses forged in the solid for taking to $\frac{5}{8}$in. diameter hand rails, the holes through bosses to be drilled, and in height about 2ft. 9in., arranged as shown in drawing. Hand rail and stanchions in wake of cargo hatches to be made portable to serve the purposes of a gangway.

Rudders.—Two in number, arranged in position and mode of working as shown in drawing. The rudders to consist of an internal iron bar framing covered by steel plating 5 lb. per square foot, to be fitted up by cork in between, and to be water-tight. The spindle of rudder on upper and lower bearings is to be covered with a gun-metal covering $\frac{1}{4}$in. thick and to be turned; the carriage, which may be in cast iron, is to be arranged with two arms on upper end securely attached to deck plating, the lower end to skin plating, which is to be strengthened in wake of carriage by a stiffening steel ring for taking bolts with double nuts. The bearings are to be bushed with gun-metal bushes bored out to suit rudder head over gun-metal covering. The rudder head in lower bearing is not to be less in diameter than $3\frac{1}{2}$in. solid, the upper end not less than $3\frac{1}{4}$in. solid. To be fitted at top end under main deck with cast iron chain wheel with two gun-metal washers between chain and top of carriage, the carriage to be bored out and faced on top end, the chain wheel to be faced on both sides of boss, the rudder head in chain wheel to be made square and fitted with cotter and collar for taking weight of rudder. A design for this work to be submitted for approval previous to the work going in hand.

Trussing.—Truss rods and posts to be arranged as shown in drawing. The posts to consist of steel tubes 6in. in diameter inside, $\frac{3}{16}$in. thick, and in height as shown in drawing. The lower end to be fitted with a cast steel shoe bolted to deck ties immediately above the junctions of longitudinal transverse bulkheads. The upper ends to have a cast steel cap with lugs, the holes for pins of tie rods to be bored and fitted with turned pins. Both ends of truss posts to be faced in lathe, the caps and shoes to be correspondingly faced to give a true bearing. Tie rods to be made of Lowmoor iron fitted with right and left-handed screws, the lower ends of diagonal tie rods to be attached by turned pin joint to flat bars of Lowmoor iron, firmly rivetted to longitudinal bulkhead. The rods to be $1\frac{1}{4}$in. in solid and the screws to be enlarged to $1\frac{1}{2}$in. over thread. To have check nuts on both sides of screws. To have athwartship stays between caps of posts same diameter as the diagonals.

Steering gear.—To have an approved form of steering apparatus, with necessary chains, rods, pulleys, rollers, and carriages, tightening screws as may be pointed out; the steering chains to be connected to quadrants on hurricane deck, the spindles in steel not less than 3in. in diameter in bearing, to be carried down through main deck with chain wheel in cast iron, fitted on bottom end. A messenger chain to connect this chain wheel to chain wheel on rudder head, the whole in general conformity with the drawing. A handsome mahogany steering wheel not less than 5ft. in diameter to be fitted.

Capstan.—Two capstans, or windlasses, of approved design for working anchors, &c., with double-acting purchase, the spindle to be in forged steel, and stepped on main keelson, if capstans. The pawl plate to be seated on teak wood 3in. thick.

Chain stoppers.—To be fitted fore and aft of vessel suitable for size of chain, two forward and two aft.

Anchors and chain.—Three bower anchors, $4\frac{1}{4}$ cwt. each; two stream ditto, $1\frac{1}{4}$ cwt. each; two kedge ditto, $\frac{1}{2}$ cwt. each; 120 fathoms stud cable chain, $\frac{13}{16}$; 100 fathoms ditto, $\frac{8}{16}$.

Hawsers.—Ninety fathoms of hemp, 3in.; seventy-five ditto, $5\frac{1}{2}$in.

Mooring bitts—forward and aft.—As shown in drawing, two forward and two aft.

Bollards.—As shown in position, and number of approved size of cast steel.

Hawse pipes.—As shown in drawing, both forward and aft, with the necessary chocks in teak.

Fairleads for hawsers.—As shown in drawing of approved form and size.

Anchor davits.—Anchor davits placed as shown on drawing, fitted with blocks, falls, chains, pendants, and stoppers.

Gangway ladders.—Two in number, fitted as may be directed.

Life buoys.—Cork life buoys, four in number to be supplied.

Pumps.—One hand pump, with 6in. copper chamber, and $3\frac{1}{2}$in. lead suction pipe fitted to each compartment, complete with all gear, and galvanised iron rose boxes.

Stipulations as usual.

The thicknesses of woodwork to be allowed for in computing weights for draught are as follows:—Main deck, teak, 2in.; hurricane deck, teak, $1\frac{3}{4}$in.; awning covering, canvas, with pine side rails, rafters, and ridge pole, say 6ft. by 3ft. and 9ft. by 3ft.; flooring and ceiling of holds, pine, say $1\frac{1}{4}$in. thick.

Tenders, addressed to the Secretary of State for India in Council, endorsed "Tender for Cargo Boats," must be delivered at the India-office, Whitehall, London, S.W., before 2 p.m. on 24th inst.

The Sind-Sagar Railway Company require tenders for eight cargo flats or barges, built in steel, galvanised, to be arranged in general conformity with the drawing. To be spoon-shaped at bow and stern.

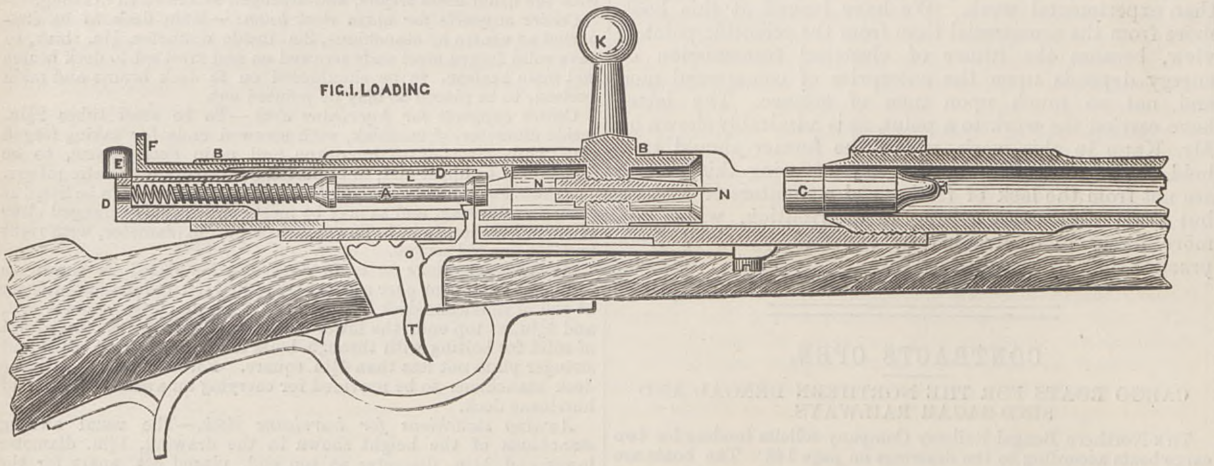
Dimensions.—Length on deck, 82ft.; beam moulded, 16ft.; depth at centre from top of beam to top of keel, 4ft.; draught of water, with all necessary equipment and twenty tons of cargo on board, 1ft. 4in.

The clauses in this specification are very similar to those in the specification for the larger boats, certain necessary modifications being made. The time and place for sending in tenders is the same.

OLD ENGLISH AND MODERN FOREIGN RIFLES.

The description of the Government works at Enfield, which we give on another page, may be supplemented with advantage by a glance at the history of the British rifle, and a short account of the rifles of the great military Powers. The idea of rifling a musket barrel to improve the accuracy of fire by giving the bullet a spin or rotation is no new one, although the first rifled barrels had straight grooves, with the supposed object of decreasing the bad effects of fouling, and causing the bullet to take a straight course down the barrel, instead of impinging from side to side, as in smooth bores. The invention has been attributed to Zoller of Vienna at the end of the fifteenth century, but Koster of Nuremberg is supposed to have adopted the spiral form about 1520. Rifles were not, however, used for military purposes until the next century, and then to a very limited extent. The fact is that the very imperfect state of mechanical science prevented the principle from being applied with advantage. The first instance of their employment in the British army we meet with was the issue in 1680 of eight rifled carbines to each troop of Life Guards, but it was not until 1800 that a whole regiment was armed with rifles, when "Baker's rifle" was supplied to the old 95th Regiment, now the Rifle Brigade. The details of this weapon are given in Table A; the bullet was spherical and wrapped in a grease patch, which caused the operation of loading to be so difficult that a wooden mallet was supplied to hammer down the ball. The rifle carried a sword-bayonet. In France, experiments were carried on continuously, with the object of discovering some mode of making the bullet take the rifling; a powder chamber with sharp edges, and also a "tige," or cylindrical pin of steel were tried, against which the leaden bullet was forced with a heavy rammer so as to expand it into the grooves. Although easy loading and very improved accuracy were the results, there were considerable defects in both these methods. About the year 1836 the Brunswick rifle, with two grooves and firing a belted ball, was introduced for rifle regiments; it was the first arm in our service fitted with a percussion lock, which was not applied to the smooth bore muskets until 1842. The ball was used with a grease patch, which added to the difficulty of placing the belt properly in the grooves, and caused much delay in loading; fouling was also very great, and the shooting bad beyond 400 yards. In 1851 the Minié rifle was introduced, and marked a great advance, being the first really practical application of the elongated bullet, the principle of which had been patented by Delvigne, ten years before. An iron cup fitting into

FIG.I. LOADING



PRUSSIAN NEEDLE GUN, 1848.

FIG.I. LOADING

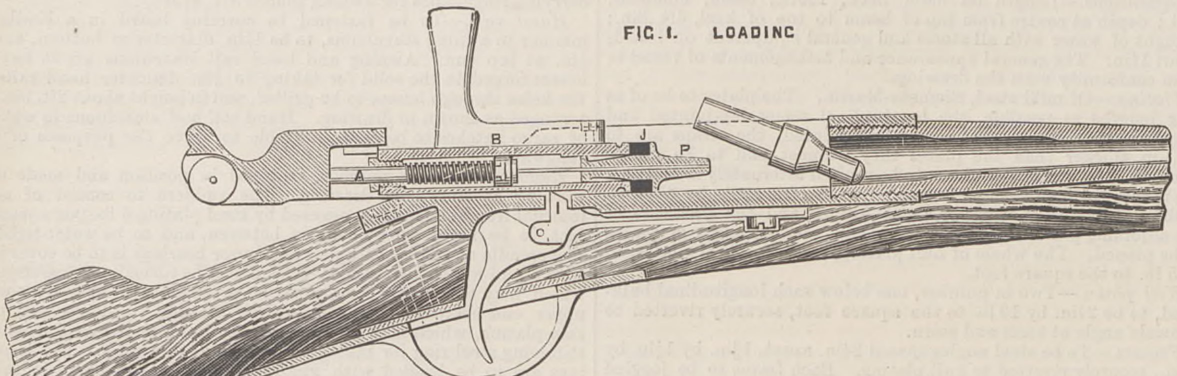
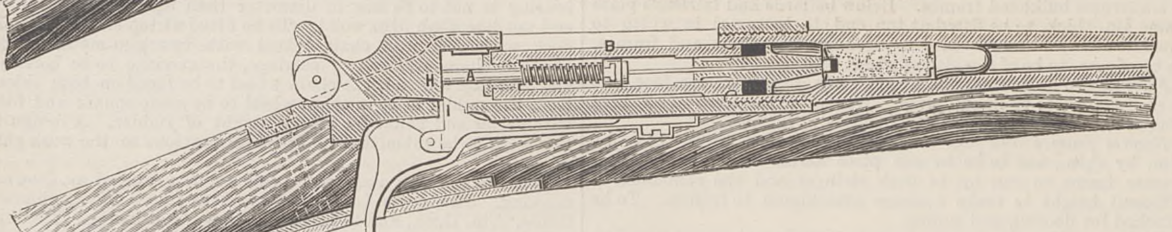


FIG.2. COCKED READY FOR FIRING



FRENCH CHASSEPOT, 1866.

FIG.I

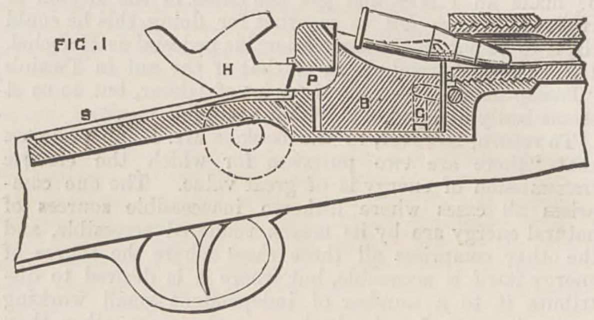
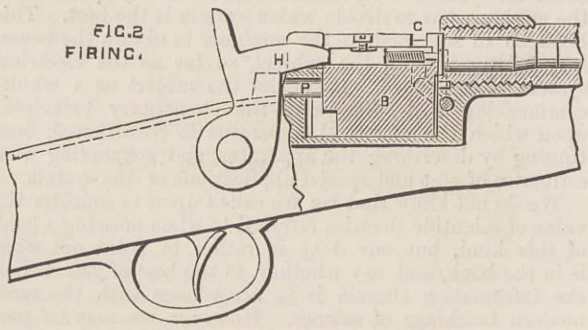
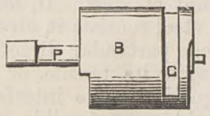


FIG.2 FIRING.



ELEVATION OF BREECH LOCK



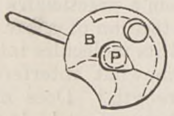
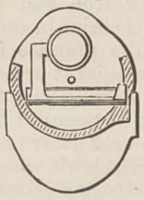
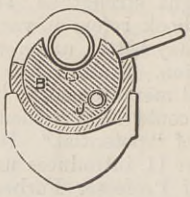


FIG.3 FIG 4

EXTRACTOR BREECH OPEN BREECH CLOSED





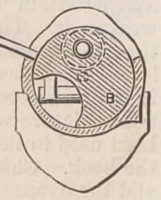
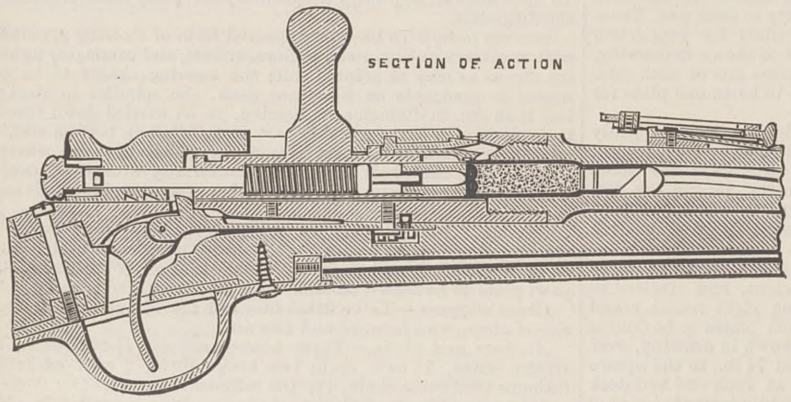


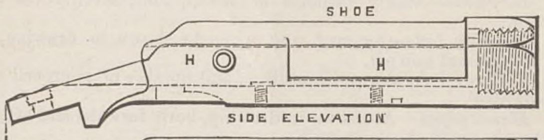
FIG.5 FIG.6 FIG.7

WERNDL—AUSTRIA.

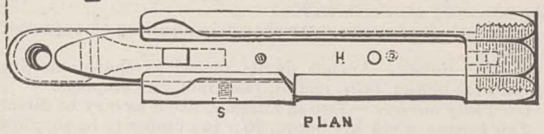
SECTION OF ACTION



SHOE

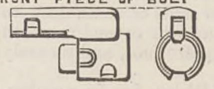


SIDE ELEVATION



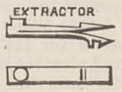
PLAN

FRONT PIECE OF BOLT



STOP SCREW OF BOLT

EXTRACTOR



FRENCH GRAS CHASSEPOT.

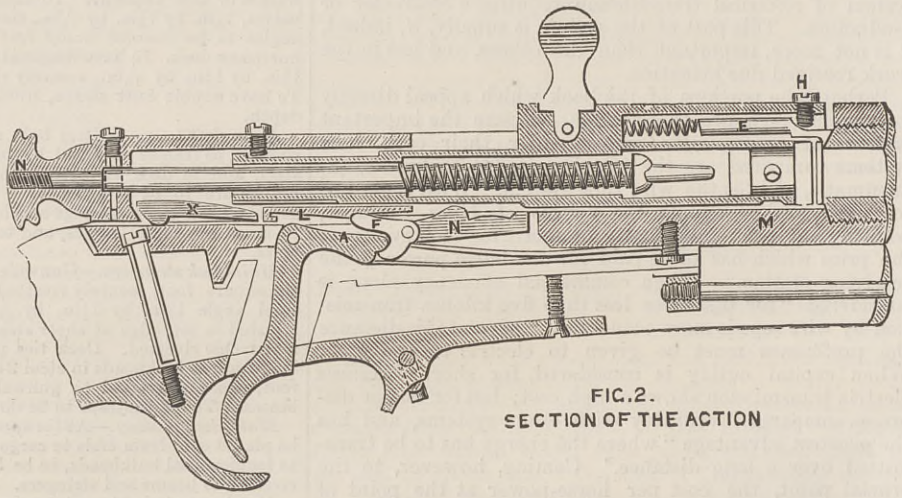
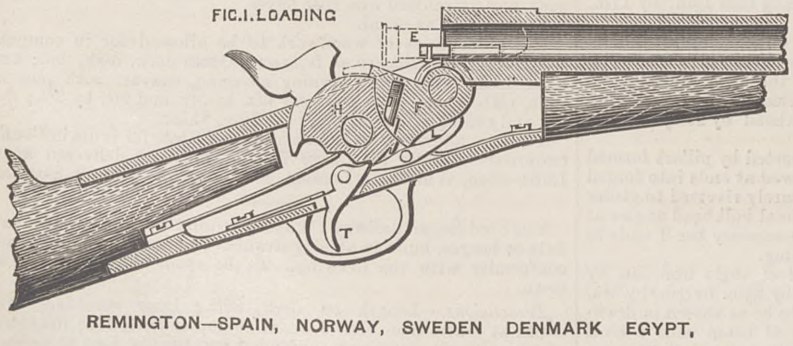


FIG.2. SECTION OF THE ACTION

RUSSIAN BERDAN.

FIG.I. LOADING



REMINGTON—SPAIN, NORWAY, SWEDEN DENMARK EGYPT.

FIG 2 FIRING

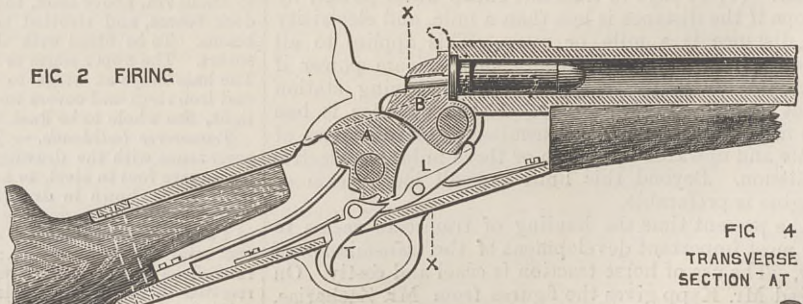


FIG 3 PLAN

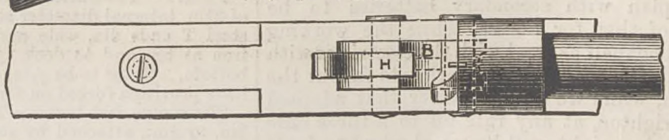
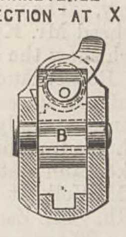
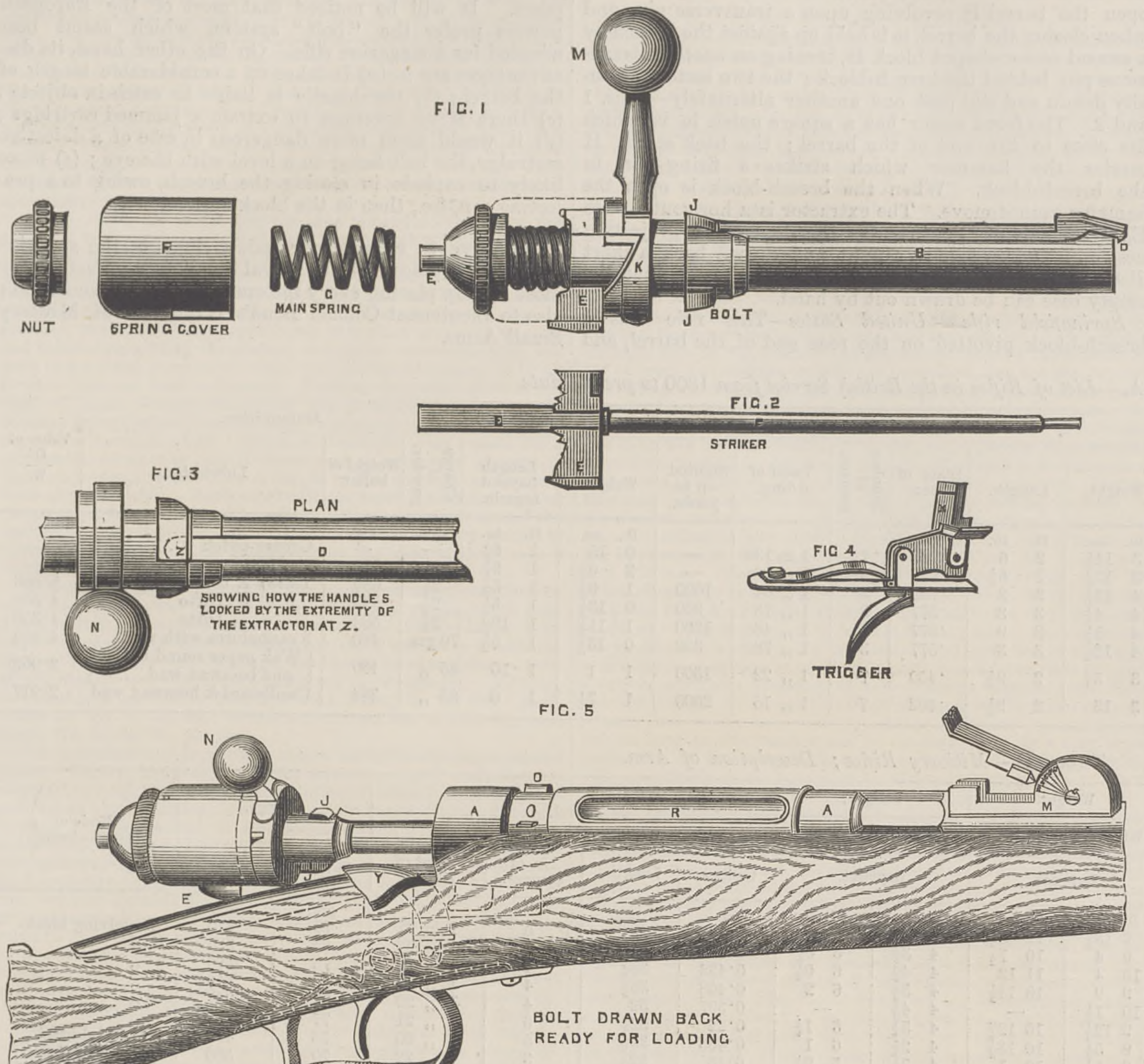


FIG 4 TRANSVERSE SECTION AT X X



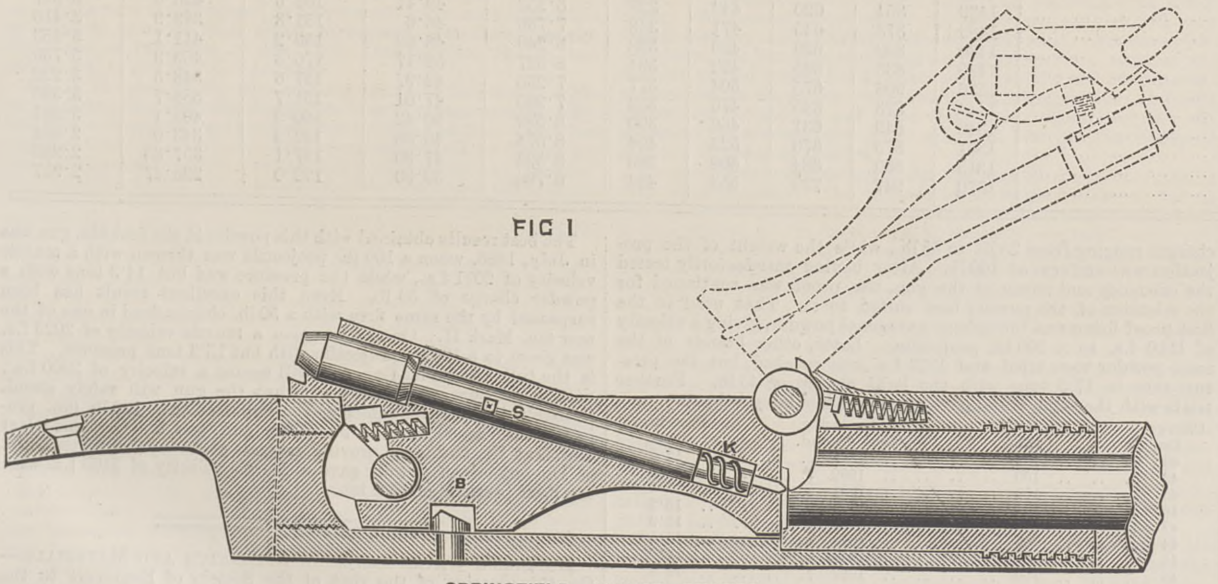
REMINGTON.

a hollow in the base of the bullet expanded the latter into the grooves; the grease patch was discontinued, and the bullet was wrapped in paper lubricated with a mixture of tallow and beeswax. As the Table A will



ITALIAN VETTERLI RIFLE.

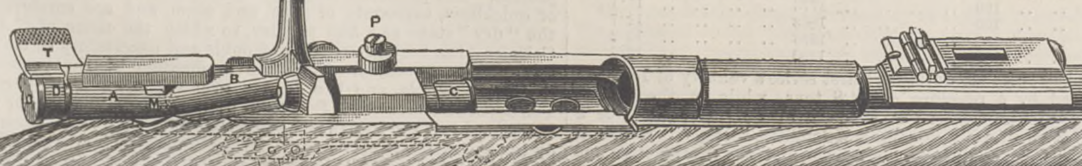
show, this arm, as also its ammunition, was very heavy, and the large bore—0·703in.—made the retardation very great, and experiments were soon instituted by the late Lord Harding, then Master-General of the Ordnance, which



SPRINGFIELD, UNITED STATES.

in 1853 resulted in the introduction of the first Enfield rifle. The bore was reduced to 0·577in., and the weight of the rifle was nearly 1 lb. less than that of the Minié, while the shooting was far more accurate; in fact, it was the most

BREECH OPEN

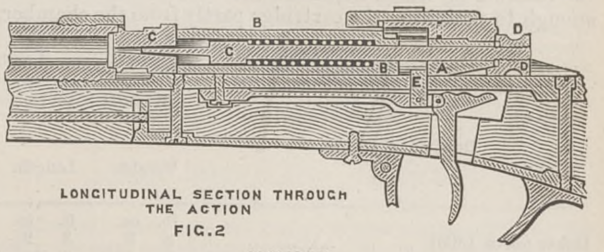


MAUSER, GERMANY.

efficient firearm ever put into the soldier's hands at the time of its issue to the army in 1855, when it was used in the Crimea, replacing both the Minié rifle and the old percussion musket of 1842. This position it maintained until the general introduction of breech-loading arms, when it was converted in 1864 into a breech-loader on the Snider principle, having a block hinged on the right side of the shoe. The cartridge, the determination of which gave great trouble, had the Boxer composite coiled case, with a percussion-cap fixed in its base, which was exploded by means of a pin or striker passing obliquely through the block, and actuated by an ordinary hammer and percussion lock; a light spiral spring drew back the striker after firing. The Snider was merely intended to utilise the large stock of Enfield muzzle-loading rifles, and also to provide a substitute until the best description of breech-loading rifle could be determined. Table A gives the particulars of the successive rifled firearms in use in our army and navy. The gradual development of power is very apparent.

Breech-loading rifles of foreign Powers, like all breech-loaders, may be arranged under two heads, according to the system of breech-closing mechanism adopted—(1) bolt; (2) block.

Prussian needle gun.—Of the first system, the original Prussian needle gun—see page 154—was the prototype. In it the breech was closed by a bolt resembling an ordinary door bolt, passing between guides, and containing within it the lock or striking arrangement to fire the cartridge. To open the breech, strike up the handle K to the left till rather past the vertical, and draw back the bolt B in a line with the barrel; to close the breech, reverse this process. The front end of the bolt forms a conical cup which fits on a corresponding cone at the end of the barrel, and closes the breech when pressed home by turning down the handle to the right into an inclined catch. The explosion of the cartridge C is effected by a steel needle N, which is driven forwards by a spiral spring, and—piercing the base of the paper cartridge—passes through the powder and



LONGITUDINAL SECTION THROUGH THE ACTION
FIG. 2
MAUSER.

strikes the fulminate inside a cap placed immediately behind the bullet. The base of the bullet is fitted into a sabot made of compressed paper, which is forced into the grooves of the rifle by the discharge, and causes the bullet to rotate with it. The spiral spring and needle-carrier A are contained in a tube D, which slides within another tube B, and this outer tube has also an independent longitudinal sliding movement, forming the bolt with knob handle K, as described above. The needle can be withdrawn from the barrel after firing by means of the thumb-piece E at rear of bolt, pressing down at the same time on the spring catch F, which requires releasing. The arm is cocked by pushing in this thumb-piece to its original position, where it is retained by the spring catch; this compresses the spiral spring as the shoulder of the needle-carrier A is caught and held fast by the trigger nose I, which allows it to pass backwards when the sliding bolt is withdrawn.

Chassepôt.—The French Chassepôt—used in the Franco-German war—was an improved needle gun; the action simpler and the bore smaller; the thumb-piece and the internal sliding tube are dispensed with, as the main spring is compressed by the first motion of pulling back the bolt. The breech is closed by a cylindrical plug P, with a packing-ring of india-rubber J, which is pushed into the barrel, and compressed and bulged out laterally by the back pressure of the explosion. It was found, however, that this elastic packing was liable to injury by use, and by the heat of long continued firing, and that it failed to prevent the escape of gas, which caused great inconvenience to the firer; this was also the case in the needle gun. The paper cartridge was supposed to be consumed, but a residue was often left which made loading difficult. The Gras, Mauser, and Beaumont—Holland—rifles have breech actions, which are modifications of the Chassepot, differing only from one another in minor details. In each the bolt is made up of three external pieces, viz., the rear piece, or hammer, the centre piece with lever or handle, and the front piece carrying the extractor, which consists of a spring capable of hooking and drawing out the empty cartridge case. The hammer and front piece can only move longitudinally; the centre piece can both move longitudinally and rotate a quarter circle. There is an arrangement consisting of a helix or curved inclined portion cut out of the centre-piece, into which a corresponding projection on the hammer fits; by this means, when the handle is turned vertical, the hammer and centre-piece are separated as far as is necessary and the main spring compressed. The entire bolt can then be drawn to the rear into the loading position, opening the breech, and at the same time extracting the empty cartridge case, which is removed by hand. When the fresh cartridge is inserted, and the bolt is being pushed forward, the hammer is caught and retained by the projecting trigger nose, thus cocking the rifle. Turning the handle to the right into the recess of the shoe has the effect of slightly moving forward the centre-piece as well as the front-piece, thus slowly pressing the cartridge into the chamber, and reducing the risk of premature explosion.

In the Berdan rifle—Russia—the principle is much the same, the bolt being in three pieces, but the main spring is compressed wholly by the operation of pushing forward the bolt after loading. The extractor E is peculiar; it is acted on by a small spiral spring which pushes it out, and by a screw H, which keeps it up to its work but allows it some play. Being attached to the centre piece of the bolt, it must rotate with it a quarter circle round the rim of the base of cartridge.

The Vetterli rifle—Italy—has a bolt B with projections J, which fit corresponding grooves cut on the inside of the shoe A—see Fig. 1. To load, raise the handle N vertical; this causes the striker E within the bolt to run up the inclined plane K, at the same time drawing the striker back and compressing the main spring G. The bolt can now be drawn back until the forward end of the extractor D strikes a small quoin at O—Fig. 5—which stops it. The rear end of the extractor as soon as it is free from the shoe being a spring, catches and locks the handle by entering a recess at Z—Fig. 3—and ensures the main spring being kept compressed. On pushing forward the bolt after loading, the rear end of the extractor comes against the quoin at O, which unlocks the handle N, and allows it to be turned down to the right, thus sending the bolt quite home. The projection on the striker E—Fig. 5—is at the same time caught by the trigger nose, which retains it and keeps the mainspring at tension; the arm is now ready for firing.

Block systems: Werndl rifle—Austria.—This arm has a rotating breech block, a horizontal cylinder B, which turns one quarter round upon a centre pin P, just below the axis of the barrel. A cylindrical groove is cut out along one side of the block, and when this groove is turned opposite the barrel the breech is open for loading; a reverse turn closes the breech. In either position the breech block is held by a spring S, which bears against the projecting end of its centre pin, which has two inclined flat sides for this purpose—Fig. 4. A striker J passes obliquely through the block, and is acted on by the hammer H of an ordinary percussion lock. The breech block has a slightly spiral face at the rear end—Fig. 3—by which it is driven home against the end of the barrel. The extractor is carried on a transverse pin just below the barrel, and on the other end of the pin is a horizontal arm which works in a groove G, cut with a slight spiral on the block—Fig. 3—the rotation of which depresses the arm of the extractor enough to withdraw the cartridge partly from the chamber, as shown in Fig. 1. The extractor is the weak part of this rifle.

Remington rifle—Spain, Denmark, Egypt; also Norway and Sweden.—The breech is closed by a block B shaped like the sector of a circle, which turns down backwards to open the barrel H revolving upon a transverse pin, and when closing the barrel, it is held up against the breech by a second sector-shaped block H, turning on another transverse pin behind the breech-block; the two sectors mutually detain and slip past one another alternately—Figs. 1 and 2. The front sector has a square notch in it which fits close to the end of the barrel; the back sector H carries the hammer which strikes a firing-pin in the breech-block. When the breech-block is open the hammer cannot move. The extractor is a horizontal slide E, laying hold of the cartridge base-flange. A projecting nose on its under side is caught and drawn back a short distance by the breech-block when opening, so that the empty case can be drawn out by hand.

Springfield rifle — United States—This rifle has a breech-block pivotted on the rear end of the barrel, and when closed is fastened down by a bolt and spring, worked by means of a projection on the right side of the action. The striker S is contained in the block, and is impelled by the hammer of an ordinary lock. The Tables B and C show the values of the foregoing arms for military purposes. It will be noticed that most of the European powers prefer the "bolt" system, which seems best adapted for a magazine rifle. On the other hand, its disadvantages are :—(*a*) It takes up a considerable length of the barrel; (*b*) the handle is liable to catch in objects; (*c*) there is no leverage to extract a jammed cartridge; (*d*) it would seem more dangerous in case of a defective cartridge, the bolt being on a level with the eye; (*e*) more likely to explode in closing the breech, owing to a projecting cap, &c., than in the block system.

We have to express our indebtedness to the superintendent and officers of the Royal Small Arms Factory for most readily placing every information at our command; also to Lieutenant-Colonel Bond's Handbook of Military Small Arms.

TABLE A.—*List of Rifles in the British Service from 1800 to present date.*

Description of arm.		Without bayonet. Weight.	Without bayonet. Length.	Barrel. Weight.	Barrel. Length.	Diam. of bore.	Number of grooves.	Twist of rifling.	Sighted up to yards.	Bayonet. Weight.	Bayonet. Length beyond muzzle.	Charge of powder.	Weight of bullet.	Lubricator.	Value of $\frac{D^2}{W}$
		lb. oz.	ft. in.	lb. oz.	ft. in.	in.				lb. oz.	ft. in.	drs.	grs.		
Baker (circa 1800)		8 9	3 9¾	3 14½	2 6	·705	7	1 in 136	—	0 15	1 6⅝	—	—	Grease patch	—
Brunswick...	Patt. 1836	9 6½	3 10	3 13¾	2 6¼	·620	2	1 ,, 28	—	2 0½	1 9¼	2½	557	Ditto	—
Minié	,, 1851	9 13	4 7	4 13¼	3 3	·703	3	1 ,, 64	1000	1 0¼	1 5⅝	2½	680	Tallow & beeswax on paper	5·886
Enfield long	,, 1853	8 14¼	4 6⅛	4 4¼	3 3	·577	3	1 ,, 78	900	0 13½	1 5½	2½	535	Ditto	4·356
,, short	,, 1860	8 11¾	4 0¾	4 1½	2 9	·577	5	1 ,, 48	1200	1 11½	1 10¾	2½	535	Ditto	4·356
Snider	,, 1864	9 5	4 7⅜	4 12½	3 3	·577	3	1 ,, 78	950	0 13½	1 5½	70 grs.	480	3 cannelures with wax ...	4·855
Martini-Henry, Mark III. ...	,, 1871	9 0	4 1⅜	3 5¾	2 9¼	·450	7	1 ,, 22	1300	1 1	1 10	85 ,,	480	Wax paper round bullet and beeswax wad ...	2·953
Enfield-Martini	,, 1886	9 3¾	4 1⅜	3 13	2 9¼	·402	7	1 ,, 15	2000	1 7¼	1 6	85 ,,	384	Cardboard & beeswax wad	2·917

TABLE B.—*Military Rifles; Description of Arm.*

Country.	System.	Weight. Without Bayonet.	Weight. With Bayonet.	Length. Without Bayonet.	Length. With Bayonet.	Barrel. Calibre.	Barrel. Length.	Barrel. No. of grooves.	Barrel. Twist of rifling.	Charge. Powder.	Charge. Bullet.	Mode of breech-closing.
		lb. oz.	lb. oz.	ft. in.	ft. in.	in.	in.			grs.	grs.	
Austria	Werndl	9 13½	11 8½	4 2	6 0⅝	0·433	33	6	1 in 28	77	370	Revolving block.
France	Gras	9 4	10 7½	4 3¼	6 0¾	0·433	32¼	4	1 ,, 22	80	386	Bolt.
Germany	Mauser	10 4	11 12	4 4¾	6 0½	0·433	33⅝	4	1 ,, 22	75	380	,,
Italy	Vetterli	9 9	10 14½	4 5½	6 2	0·408	33⅞	4	1 ,, 26	62	310	,,
Norway and Sweden*	Jarman (magazine)	10 1½	—	4 4½	—	0·397	32	4	1 ,, 22	77	337	,,
Russia	Berdan	9 12½	10 12¾	4 5¼	6 1¼	0·42	32¾	6	1 ,, 21	77	370	,,
Spain, Denmark, Egypt... ...	Remington	9 5½	10 13½	4 2¼	6 1	0·433	35⅜	5	1 ,, 20	75	400	Sectorial block.
United States	Springfield	9 5¼	10 1	4 3½	5 9½	0·45	32½	3	1 ,, 22	70	500	Turnover block.
England	Martini-Henry	9 0	10 0	4 1½	5 11½	0·45	33$\frac{3}{16}$	7	1 ,, 22	85	480	Falling hinged block.
	Enfield-Martini	9 6	10 4	4 1½	5 7½	0·402	33$\frac{3}{16}$	7	1 ,, 15	85	384	

* Norway and Sweden also have the Remington rifle.

TABLE C.—*Military Rifles—Velocities, Greatest Height of Trajectories, and Comparative Retardation.*

Country.	System.	Velocities at Muzzle.	Velocities at 500 yds.	Velocities at 1000 yds.	Velocities at 1500 yds.	Velocities at 2000 yds.	Height of trajectories. 500 yds.	Height of trajectories. 1000 yds.	Height of trajectories. 1500 yds.	Height of trajectories. 2000 yds.	Value of $\frac{D^2}{W}$
		f. s.	f. s.	f. s.	f. s.	f. s.	feet.	feet.	feet.	feet.	
Austria	Werndl...	1439	854	620	449	328	8·252	49·41	162·6	426·0	3·547
France	Gras	1489	878	643	471	348	7·769	46·6	151·8	389·9	3·416
Germany	Mauser...	1430	859	629	459	338	8·249	48·68	159·2	411·1	3·453
Italy	Vetterli	1430	835	595	422	304	8·527	52·17	176·3	469·9	3·759
Norway and Sweden	Jarman (Magazine)	1536	908	675	504	377	7·235	42·97	137·6	348·5	3·222
Russia	Berdan...	1444	873	645	476	353	7·995	47·01	151·7	388·7	3·336
Spain, Denmark, and Egypt	Remington	1340	849	631	468	350	8·539	50·42	160·3	403·1	3·281
United States	Springfield	1301	875	676	523	404	8·574	46·88	142·3	343·0	2·834
England...	Martini-Henry	1315	869	664	508	389	8·594	47·90	147·1	357·85	2·953
	Enfield-Martini	1570	947	719	553	424	6·704	39·00	122·0	298·47	2·917

UNITED STATES ORDNANCE.

So much has been said recently about the failure of English guns that it is not unpleasant to find that other nations have to do some experimental work, and this even when they profit by the results of our misfortunes. Our guns of certain natures are too weak forward of the trunnions, and it will be seen that just the same mistake has been made in America, and corrected by adding hoops. We have kept our readers informed about the new United States cruisers. These ships have to be supplied with guns, and we learn from American exchanges that the construction of new breech-loading steel guns has been continued under the direction of the Bureau of Ordnance, Navy Department, with but slight modifications of the original designs. The adoption of slower burning powders has carried the pressure still further forward in the bore, and has caused changes to be made in some of the minor details. The 8in. guns for the Atlanta will have two additional chase hoops, while those for the other ships will be hooped all the way to the muzzle. All the 6in. guns for the Chicago, Boston, and Atlanta, are built on a design known as Mark II. But one gun of Mark I. was built, which will be placed on board the Dolphin. The only difference in these two designs lies in the dimensions of the chamber, Mark I. having a chamber of 7in. diameter, and Mark II. 7½in. The length of the chamber in Mark II. is a trifle shorter than that of Mark I., so that the capacity of the chamber remains the same in each. Mark II. has also one more chase hoop. The proof of the Dolphin's gun was highly satisfactory. The main points proved by the trial are as follows:—(1) That the gun will stand successfully as heavy a strain as 21·9 tons per square inch. (2) That the Dupont brown powder is equal if not superior to any yet made, at home or abroad. (3) "The success of the gun—made of domestic steel—demonstrates," says our contemporary, "our ability to design and manufacture guns as powerful as any yet known, while the excellent quality of its metal is fully equal to that of foreign make."

After the proof of No. 1 6in. the star gauge indicated a slight enlargement of the chamber, the maximum being about ·014in., while the slope connecting the chamber and rifled portion of the bore was somewhat scored. This scoring has been removed by lengthening the chamber slightly, which has removed all the blemishes, and the gun is now regarded as in good condition for service, notwithstanding the excessive strains that it has passed through. As the service pressure for this design is not intended to exceed 15 tons per square inch, it will be seen that so great a pressure as 21·9 tons would naturally produce the effects noted, and the fact that it has stood so well the severe tests to which it has been subjected, reflects, it is claimed, the highest credit upon the Bureau of Ordnance, and affirms the practicability and propriety of building all guns necessary for the Navy under its direction.

The proof of No. 1—the Dolphin's—gun was commenced in February, 1884, and during the time it was upon the Ordnance proving grounds there were fired from it 271 rounds, with powder charges ranging from 25 lb. to 58 lb., while the weight of the projectiles was uniform at 100 lb. After having satisfactorily tested the efficiency and power of the gun, the proof was continued for the selection of the powder best suited to it. That used in the first proof firing was the sphero-hexagonal powder, giving a velocity of 1910 f.s. to a 100 lb. projectile. Later, other brands of the same powder were tried and 1927 f.s. was reached, but the pressure rose to 17·3 tons with the light charge of 45 lb. Further trials with the same brand gave results as tabulated below:—

Charge. lbs.	Projectile. lbs.	Muzzle velocity. Feet per second.	Pressure. Tons.
40	100	1825	12·8
43	100	1892	14·8
45	100	1951	15·4
46	100	1970	16·2
47	100	1978	15·9
44	100	1922	16·1
45	100	1948	17·2
46	100	1987	16·4
45	100	1948	21·9
48	100	2005	20·9

While none of these pressures reached the dangerous limits, they were still much too great for service, and the German cocoa or brown powder was tried, with the following results:—

Charge. lbs.	Projectile. lbs.	Muzzle velocity. Feet per second.	Pressure. Tons.
25	100	1277	5·2
30	100	1406	6·9
35	100	1555	8·7
38	100	1624	9·4
41	100	1705	10·4
43	100	1773	11·1
45	100	1808	11·7
47	100	1836	12·2
49	100	1890	12·8

It will be observed that during the first series a velocity of 1892 f.s. was obtained by a pressure of 14·8 tons, while in the second 1890 f.s. was obtained with a pressure of only 12·8 tons, or a decrease of 2 tons for almost the same muzzle velocity. A second brand of the German powder was tried, but the results were not quite as satisfactory. In October, 1884, the Dupont Powder Company entered the competition in the manufacture of slow-burning powder, and furnished the Bureau of Ordnance of the Navy Department with a sample lot, which was first tried on the 9th of October, 1884, and gave excellent results. Later, other samples, giving even more satisfactory results than those obtained from the first lot, were delivered, and this firm is now furnishing the Navy with a brown powder that is unexcelled. The grain is in the shape of a hexagonal prism with one perforation, the greatest diameter across the hexagonal face being 1¼in., while the length from end to end of the prism is 1in., and the diameter of the perforation is ⅜in. The grains are arranged in the cartridge in a symmetrical manner, so that the perforations form a continuous channel from end to end of the charge.

The best results obtained with this powder in the first 6in. gun was in July, 1885, when a 100 lb. projectile was thrown with a muzzle velocity of 2011 f.s., while the pressure was but 14·3 tons with a powder charge of 50 lb. Even this excellent result has been surpassed by the same firm with a 50 lb. charge fired in one of the new 6in. Mark II. On this occasion a muzzle velocity of 2029 f.s. was given to a 100 lb. projectile with but 13·3 tons pressure. This is the full service loading and will secure a velocity of 2000 f.s., with a pressure well inside of what the gun will safely stand. Probably the highest velocity ever imparted to a 100 lb. 6in. projectile discharged from a 30-calibre gun was that obtained last March at the Ordnance proving grounds at Annapolis, when 54 lb. of Dupont brown powder gave a muzzle velocity of 2105 f.s. with the light pressure of 15·2 tons.

MAIGNEN'S WATER-SOFTENING APPARATUS AND MATERIALS.—On the occasion of the visit of the Society of Engineers to the Southwark and Vauxhall Water Company's works at Hampton, on the 10th inst., Maignen's "dry" water-softening process and "Filtre Rapide" was exhibited in operation. Some time since plant of this system was erected at the Battersea works of the Southwark and Vauxhall Water Company to soften the feed-water of the new Lancashire boiler which had just been set, and the new boilers since erected at the same pumping station are supplied with water softened in the same manner. It is, moreover, intended that all the water supply for the boilers at the Hampton works, referred to in our last impression, shall be softened by the same process. The patented reagents used consist of a special mixture of quicklime, carbonate of soda, and alum, and are employed in the "dry" state as a fine powder, to which the name of "Anti-Calcaire" has been given. The trouble and uncertainty of making solutions are avoided. Thus the application of the process is extremely simple, and the control over the proportions perfect. The apparatus erected at Battersea is a simple modification of that illustrated in THE ENGINEER some time ago. The space occupied by the apparatus is very small. An additional tank of 500 gallons, and a "Filtre Rapide" about 3ft. square, 4ft. high, constitute the whole plant required to soften 80,000 gallons per week. It is contemplated to transform one of the present Hampton sand filter beds into softening tanks and a huge "Filtre Rapide," to treat, in the first instance, 1,000,000 gallons of water per day. The sand will be cleared out, the bed roofed over, and 200 of Maigen's filter frames, covered with asbestos cloth, fixed perpendicularly at the bottom of the bed, the filtration taking place laterally, instead of downwards, and thus 2800 square feet of filtering surface will be obtained in the same space as is occupied now by 120 square feet of sand surface. We have received a sample of Mr. Maignen's anti-calcaire powder as made up in small packets for direct and easy use in the bedroom or kitchen, and have proved it to produce a beautifully soft water without the least trouble.

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

(*From our own Correspondent.*)

THE determination of the Cleveland ironmasters to adopt the restriction scheme is regarded by pig sellers here as most important. On 'Change in Wolverhampton yesterday, and in Birmingham to-day, this was the matter uppermost. In some circles the market may be said to be excited. Most animation was observed amongst the representatives of the pig makers of Derbyshire, Nottingham, Northampton, Leicestershire, Lincolnshire, and South Yorkshire, and of the hematite firms of Lancashire, Cumberland, and South Wales. These traders talked "loudly"—occasionally wildly—of the prospects of the market. They refused to book any more contracts at last week's rates, and asked for an advance whenever consumers pressed business.

A rise of 1s. or 1s. 6d. per ton was quoted to-day by a few sellers of Midland makes and of hematites. Such an advance, however, was wholly nominal. It at once stopped business and threw the brands affected temporarily out of the market. Consumers were not to be hurried into the belief that the market is suddenly going against them to this extent. They are mostly well bought forward, having made large purchases in the last couple of months, and before committing themselves to further operations they will wait to see what permanent effect the Cleveland scheme is likely to have upon our local exchanges. Nothing daunted, sellers of the class of pigs indicated talked of the possibility of even a 3s. advance being declared before long. Certain it is that present selling prices leave no profit. There is therefore every reason for a substantial advance in pigs if there were a legitimate increase in demand to support it. This week, however, demand may be said to be at a standstill. Purchasers will not enter the market against the stronger front exhibited by sellers. These point out that if the restrictive proposals are carried out in their entirety stocks in Cleveland should soon be decreasing at the rate of 3000 tons a week, instead of as now increasing at that rate.

Staffordshire pig makers proper are less expectant of establishing an advance in prices than are the salesmen of imported pigs. There is less briskness about the demand for Staffordshire than imported pigs, and this circumstance must act as a drawback. Our native make would be about the last to be advantaged. Still all pig makers and vendors are this week more hopeful. All-mine hot blast pigs are 50s. to 55s., and cold blast, 75s. to 80s. Part-mines are 35s. to 42s. 6d.; common foundry, 30s. to 32s. 6d.; and forge, 27s. 6d. to 30s. per ton.

The manufactured iron trade shows but little alteration on the week. Makers, however, are in an expectant mood, and are more disposed to hold their own in the matter of price. Lessened competition in plates, angles, tees, and other forms of iron for engineering purposes rolled in the Northern mills would probably ensue upon a sustained advance in the price of the raw material. Our makers regard such a probability with pleasure. A decrease in Lancashire competition through the same cause is also one of the welcome possibilities of the week. The improved prospects of business in iron with Spain, arising out of the new tariff that came in force on Sunday, is one of the most satisfactory features of the week. Manufacturers are hoping to do a considerably increased trade in hoops and other forms of rolled iron, and not only with Spain itself, but likewise with the Spanish Dependencies.

The intelligence of the receipt by other districts of further valuable orders for steel rails and other forms of steel for the United States market was quoted in Birmingham this afternoon with much satisfaction. All the evidences are in favour of a larger business with the United States this autumn than for a long time past. Hematite pig firms as well as steel and ironmasters proper are already doing a sensibly better business with America.

In the medium and common bar trade orders from abroad as well as from home are rather heavier, and specifications are obtained with greater freedom. Quotations are maintained at £7 for marked bars, and £6 for second marked sorts, and inferior qualities are changing hands at from £4 15s. to £5 5s. Tube, strip, and hoops, have larger buyers at, for the latter, £5 5s. to £5 10s. per ton. Sheets keep brisk at £6 for doubles, and £7 to £7 5s. for lattens.

The galvanised iron roofing manufacturers have more to do, and one of the new firms engaged in this branch have sufficient orders on hand to take all their make during the next three months. Prices are on the basis of £10 f.o.b. Liverpool for 24 w.g., and £10 2s. 6d. to £10 5s. f.o.b. London.

Mr. B. Hingley, M.P., who was appointed to arbitrate in the wages dispute between the Shropshire Iron Company and the Haybridge Iron Company, and the puddlers employed at their works, has awarded that the price to be paid for puddling shall be 6s. 3d. per ton. The payment of 6d. per ton, hitherto allowed as "bounty," is to be discontinued in consideration of the assistance given by the employers to the puddlers in taking the balls from the furnace to the hammer. 6s. 3d. per ton for puddling is 6d. per ton below the price paid in the Staffordshire works.

A few of the engineers and machinists report a slightly brisker business. Certain of the former who are engaged upon steam pumps are busier than they have been for a long time. The heavy ironfounders are doing a quiet trade, and complain of the unremunerative prices. There are some good bridgework and gasometer contracts receiving attention, and pulley blocks, hydraulic work, and electrical appliances are ordered on a fair scale from some of the makers. For railway fastenings there is a quiet demand, but a regular business is moving in agricultural fencing from numerous home districts.

The whole of the cable and small chain makers in the Cradley and Old Hill districts have struck work this week for an advance. They announce that the impression which has obtained in some quarters that they are striking against machinery is wholly false. The reason for the strike is that they are now determined to set their faces against any further reductions.

Endeavours are being made to revive the somewhat languishing organisation of operatives in the nut and bolt trade. A meeting for this object was held at Darlaston this week, when the value of the association was dilated upon, and it was contended that the large masters were favourable to the maintenance of the Union, because it prevented the keen competition which in depressed times was likely to bring masters and men to ruin.

The spike-nail makers of Sedgley have struck work against a reduction, the men contending that it is impossible to live at the present rate, and that a reduction means starvation.

The continued improvement in the Australian and New Zealand markets is matter for unalloyed gratification by the hardware manufacturers. Orders are likewise arriving with more vigour from several of the South American centres. The reported discoveries of gold in South America are leading to the expression of a hope that a revival in the position of the colony may before long occur.

An advance in the copper and tin markets would at the present time be heartily welcomed by hardware manufacturers, if it were to prove of an enduring character.

The arrangements for the forthcoming visit of the British Association to Birmingham are being rapidly and successfully pushed forward. There will be a good number of colonial and foreign visitors.

The present position of the municipality of Birmingham as regards the public introduction of electric lighting is sketched in the evidence of the Town Clerk of Birmingham, before the Earl of Camperdown's Select Committee upon the three bills introduced last session to amend the Electric Lighting Act of 1882. This official testifies that the Corporation made up their minds in 1882 that the electric light could not be advantageously supplied then. The subject had not been brought before them since that time. Provided intended undertakers waited a few years, until electricity was further developed, the Town Clerk thought it would be possible within thirty years—under the Government Bill—to raise money, not only to pay a fair return upon the outlay, but to provide a sinking fund to give 10 per cent.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—For the last week or two I have referred in my "Notes" to a growing conviction in this market that prices have at last touched their lowest point, and this has now gained such strength that it is making itself definitely felt in an increased disposition to buy. So far, however, as the weight of really new business coming into the hands of users of iron is concerned, it can scarcely be said that there is any perceptible improvement, and the requirements for actual consumption are still only very small; but buyers who have been holding back seem to have come to the conclusion that there is now nothing to lose, and possibly something to gain, by giving out their orders at current rates. Consumers who have requirements, and merchants who have sales still uncovered, are consequently showing some anxiety to place out orders, and there has been a considerable amount of inquiry during the past week, which has resulted in transactions representing a moderate weight of iron being passed through. The business has been chiefly in pig iron, and this has led to a decidedly stronger tone in the market, but any actual upward movement, so far as local and district brands are concerned, has not got beyond a levelling up of some of the very low cutting prices which have recently been taken for one or two brands of Lincolnshire iron. In Middlesbrough iron the proposed further restriction of the output has naturally had an effect upon prices, and sellers in this market have been quoting 1s. per ton above late rates, with a disinclination to commit themselves to anything like forward delivery. Hematites have also shared in the increased inquiry coming forward in the market, and some makers are asking more money, but there are still sellers at late rates. Manufactured iron participates in the improvement to the extent that there is a little more business stirring. Prices, however, show no improvement, and to effect sales quite as low figures as ever are being taken, showing that this branch of trade continues generally in a very depressed condition. The movement which has taken place in the market is unquestionably a change for the better, but there can be no really established improvement until the actual users of iron have secured a very considerable accession of new business beyond what they are now doing. Of course this may be very possible when once it is seen that prices have taken a really legitimate upward move, but so long as the market has to be backed up by a very large restriction of the output, there is an element of weakness which will necessarily cause buyers to be very cautious, if not to view with distrust merely artificial regulations of price.

The Manchester iron market on Tuesday presented a rather more animated tone than has characterised the 'Change meetings recently, and business was practicable at prices which buyers only a week or two back were not disposed to give. Lancashire makers of pig iron reported a very fair amount of inquiry during the last few days, which had resulted in sales of some weight being effected on the basis of 35s. 6d., less $2\frac{1}{2}$, delivered equal to Manchester, which although considerably below the nominal list rates, may be regarded as practically the current prices for local brands. In district brands the low sellers of Lincolnshire who have recently been quoting about 33s. 6d. to 34s., less $2\frac{1}{2}$, delivered here, have put up their prices about 1s. per ton, but 35s. 6d., less $2\frac{1}{2}$, delivered here, remains the top price that buyers are disposed to give even for the best brands. On the basis of this figure considerable sales could be made for forward delivery, but makers are very indifferent about committing themselves to any extended engagement at current prices. In anticipation of the proposed further restriction of the output in the North of England, users of Middlesbrough iron in this district have been covering such requirements as they have, and moderate sales have been made, which have been followed by makers asking an advance of 1s. per ton upon the late rates. For hematites there is more inquiry stirring, and in some instances makers are holding out for higher prices; there are, however, good foundry brands still to be got at about 51s. to 51s. 6d. per ton, less $2\frac{1}{2}$, delivered into this district.

In the manufactured iron trade makers report more business doing, and some of the sheet and hoop mills are being kept fairly busy. The general condition of the trade is, however, still very unsatisfactory, and no better prices are obtainable. For bars delivered into the Manchester district £4 17s. 6d. per ton remains the basis of quoted prices, but to effect sales 1s. 3d., and in some instances even 2s. 6d. per ton under this figure, is being taken; for hoops makers are not able to get more than about £5 5s. per ton, and sheets do not average more than about £6 10s. per ton delivered into the Manchester district.

As regards the engineering trades the general condition remains very unsatisfactory. The indications of improvement, so far as employment is concerned, which were apparent a month or so back in the reports of the trades union societies connected with this branch of industry, seem to have received a check, and although there is no actual increase in the number of men out of work, the returns have ceased to show any decrease in the number of unemployed members. The returns for the present month show the demand for labour has become stationary. In the Amalgamated Society of Engineers the number of men on the books in receipt of out-of-work support remains at about $8\frac{1}{2}$ to 9 per cent. of the total membership; and in the Steam Engine Makers' Society, which is a comparatively small organisation, at about 4 per cent., which are practically the same percentages as shown by the returns of last month. As to the condition of trade, the returns are also discouraging, bad, or only moderate, being the report from all the important industrial centres, and there is an absence of any indication of improvement which affords but a very unsatisfactory outlook for the ensuing winter.

For the fireproof construction of the buildings to be erected for the Manchester Jubilee Exhibition, it has been decided to use the patent wire lathing recently introduced by Messrs. Richard Johnson, Clapham, and Morris, of Manchester, of which an illustrated description was some time back given in the columns of THE ENGINEER. This material, which has successfully undergone the severest possible tests in withstanding the action of fire when used either in the form of a ceiling or a partition, is admirably adapted by its special form of construction for buildings which are intended to be of a temporary character, but which at the same time it is desirable should be as far as possible fireproof, and for the Manchester Exhibition building many thousands of square yards will be required, as I understand it is intended to employ it both for outside and for partitioning walls.

The remarkable statement made by one of the rescued men from the explosion at the Woodend Colliery, near Manchester, that he had really witnessed the actual origin of the explosion, and that it had been caused by the ignition of the gas in the mine through the medium of a so-called safety lamp, although it may be subject to some modification as further facts come to be elicited, cannot fail to draw attention to the over and over again proved insecurity of the ordinary Davy and Clanny type of lamps, even in air currents of not more than moderate velocity, and to the caution issued some time back by the Home Secretary against the further use of such lamps without additional protection. Notwithstanding this caution, the use of such lamps has been continued under dangerous conditions in many mines, and it is not improbable the question may now be raised as to whether there should not be some direct legislative interference in a matter so closely affecting the lives of large numbers of workmen.

In the coal trade there is still little or no change to notice; business still drags on very slowly at about the same low prices that have been quoted of late, and except where collieries are putting into stock, there are very few of them working much more than about half-time.

Barrow.—I have to report the continuance of what is regarded a lull in the demand for hematite qualities of pig iron, and the inquiry from all sources remains not only restricted, but the bulk of metal asked for is not considerable, and this is largely sold at present by holders of stock, who are disposing of their stocks of pig iron at prices which practically unsell makers. The latter are still quoting firmly 41s. 6d. to 42s. 6d. per ton for mixed parcels of Bessemer pig iron, net at makers' works, and they are all the better enabled to do this because of three circumstances—first, the output is confined as nearly as possible to the demand, and thus stocks, already large in many cases, are prevented from increasing; secondly, makers are fairly well sold forward at current prices, and all the iron they are delivering is in respect of forward sales; and thirdly, because the present rates are as low as is consistent with the price of labour and the cost of raw material, and on this ground there is an understanding that rather than submit to lower quotations the output must be reduced. Steel makers are fairly employed, but only in the rail department. There are numerous inquiries for terms on which makers can complete heavy deliveries of rails, but there is no disposition in the direction of a much needed increase in prices, and when makers ask for fuller rates orders are withheld. It is no secret, however, that there are in the market numerous orders for rails not only on home but on general foreign account. There is a perceptible falling off in the tin bar trade, an industry which for many months has been very briskly employed. Iron ore is in fuller demand, but the large stocks which have everywhere accumulated are sufficient to grasp with this. Prices remain at from 8s. to 9s. per ton at mines. There is nothing new to report in the shipbuilding trade, and orders are not coming in well in the engineering trade, although all marine shops are busy. Coal and coke steady. Shipping still fairly employed.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

SHEFFIELD trade with the United States has ceased to be the key to the steel and cutlery business of the town; but it is still, in spite of new markets, a most important factor. I have anticipated in my weekly reports a considerable increase in the two leading specialities of Sheffield for the midsummer quarter, and the figures which are now before me prove the accuracy of that anticipation. For the quarter ending June 30th, the results—for which I am indebted to the courtesy of Dr. C. B. Webster, the United States Consul here—show that steel and cutlery were exported from Sheffield to America to the value of £64,241 3s. 2d. and £45,279 2s. 7d. respectively. The values of the corresponding quarter of 1885 were—steel, £55,202 19s. 6d.; and cutlery, £27,691 7s. There is thus an increase in steel of £9038 3s. 8d., and in cutlery of £17,587 15s. 7d. In some other departments, however, there is a falling off, the totals for the quarter ending June 30th, 1885, and June 30th, 1886, being respectively £103,461 10s., and £129,443 18s. 3d. The net increase on the quarter in all goods sent from the Sheffield consular district is therefore only £15,982 8s. 3d.; but there are a great variety of articles included in our exports—the Sheffield district stretching as far as Lincoln—and the main cause for congratulation remains in the decided improvement in our two leading industries.

The United States rail mills are full of work, which probably accounts for some pretty extensive orders for steel rails coming to this country from that quarter. Another heavy order is expected to be placed in the Sheffield district shortly. Though the present accession of orders is no doubt stimulated by the activity in the American mills, there is also a further reason which is exceptionally gratifying—the preference of eminent railway contractors in America for English-made rails in consequence of their greater endurance on the track. The price at present is something abnormal, £3 12s. 6d. per ton.

The two armour-plate establishments have just received heavy orders for her Majesty's Government. I told you some time ago that the armour for the two new war ships, the Nile and the Trafalgar, was expected every day, but that some delay had takes place owing to the change in Government. This delay has not been prolonged. The orders have now been placed. The total weight of plates ordered for the two ships is 4908 tons, each ship having 2454 tons. Messrs. John Brown and Co., the Atlas Steel and Ironworks, have obtained the order for 2800 tons, and Messrs. Charles Cammell and Co., the Cyclops Steel and Ironworks, for 2100 tons. The bulk of the plates are 14in. tapering to 6in., up to 18in. tapering to 8in., and several of 18in. thickness throughout. There are also 1132 tons of 20in. plates, the greatest thickness in steel-faced armour ever ordered by the British Admiralty or any Naval Power. The nearest to these plates were those manufactured for the turrets of the Italia, which were $19\frac{7}{8}$in. The Government have not given a ship to each firm, as they have previously done, the result being that both vessels will be coated with "Ellis" and "Wilson" plates, the first, the invention of Mr. J. D. Ellis, the chairman of John Brown and Co.; and the second, of Mr. Alex. Wilson, of Charles Cammell and Co. The 20in. steel-faced armour is equal to 27in. in the old iron armour. Delivery is to begin almost immediately, and will continue to the end of the Admiralty financial year 1888.

In the coal trade there is rather more activity with a somewhat less desponding tone. The gas contracts have now been placed for the next twelve months, and though some of the colliery firms have been able to maintain prices, the gas companies have generally contracted for supplies at a lower rate than at the corresponding period of last year. House coal is firmer, owing to the winter stocking having commenced for the metropolitan and Eastern Counties markets. About three to five days a week are now being worked in the South Yorkshire district.

A Sheffield manufacturer, who has just returned from an extended tour in Canada and the United States, tells me that this country has not Germany to fear in competition, but America. He was surprised to find on every side the immense strides the Americans had made, readily adapting machinery to almost every article, and thus producing goods at prices at which the British manufacturer could not possibly place them before the trade.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE tendency towards an improved feeling in the Cleveland pig iron trade, reported last week, continues, and there is now much more cheerfulness apparent than there has been for a long time. Enquiries from the Continent are increasing, and as there is some probability that a restriction of output will be effected, consumers are not likely to withhold much longer their orders for autumn delivery. For prompt supply of No. 3 g.m.b., buyers are freely offering 29s. 3d. per ton, and for the last quarter of the year they are quite willing to pay 29s. 6d. per ton. Neither makers nor merchants are, however, inclined to commit themselves, and consequently the sales now made are mostly for prompt delivery and for small quantities. Few merchants will book orders at less than 29s. $4\frac{1}{2}$d. per ton, and no maker will take less than 29s. 6d.

Warrants are still difficult to sell, but holders hope to do better shortly, and in the meanwhile have advanced their price to 30s. per ton.

The quantity of iron sent into Messrs. Connal and Co.'s Middlesbrough store during the last few days has been less than usual. The increase last week was only about 2000 tons, as against 6000 tons during the previous week. The accumulated increase for this month, reckoning up to Saturday last, was about 8000 tons.

The exports of pig iron from the Tees are improving. They are much more than they were last month, and not far behind those of August, 1885. Up to Friday night 30,465 tons had left the river, as compared with 25,110 tons in the corresponding portions of July, and 33,228 tons during August, 1885.

It cannot be said that there are as yet any signs of revival in the finished iron trade. Most of the mills in the district are closed this week, owing to Stockton races. There is a fair demand for bar iron, but orders for plates are scarcer than ever. Prices remain unaltered.

Steel manufacturers have no reason to complain as regards the quantity of work they have in hand, but they are grievously dissatisfied at the exceedingly low prices they are compelled to take.

A sad accident, resulting in the loss of two lives, and very nearly of more, occurred at the Felling, near Newcastle-on-Tyne, on the 9th inst. Some boys were playing near an air shaft which ventilates a sewer connected with the chemical works of Messrs. Alhusen and Co. It appears they were able to get into the shaft, which is from 20ft. to 30ft. deep, and furnished with rough steps. One of them, named Lennon, was trying how far he dared to descend, when he was suddenly overcome by noxious gas and fell to the bottom on his face. The alarm being raised, a plumber named Swinburne and his apprentice, Quin, who were passing, hastened to the spot, and immediately attempted a rescue. Although a rope had been brought, Quin refused to have it attached to him. He descended without, and on reaching the level of the gas fell unconscious on to the boy. Swinburne then, without availing himself of the rope, went down the steps, was overcome like the others, and fell on to their bodies. A young man named Charlton, with the rope tied round him, next descended. He also succumbed, but was hauled up again, and in half an hour was restored to animation. The rope was then made into a loop at one end, and after many attempts this was put over Swinburne's head as he lay. The question now arose whether, if they hauled him up, they might not kill him by strangulation whilst saving him from suffocation. However, there was no time for discussion. Dr. Kelly, who, with his assistant, was now at the pit, took the responsibility of ordering the first alternative to be put in force. The man was hauled up, and after long-continued efforts restored to life. The other two were also eventually recovered, but, unfortunately, every attempt at resuscitation failed in their cases. The ideas which inevitably arise on hearing of such sad events, events which are but too common in our midst, are not a few. In the first place, one is struck by the latent heroism of our industrial population. One after another, just as they came up by chance, were ready to risk their own lives to save those of others, strangers to them, without a thought of payment. In the second place, we may well ask why such a dangerous air shaft was ever permitted by the owners, or by the public authorities, to be accessible to a boy nine years old. Why was it not planked over, or the parapet built up so as to be too high for any but authorised persons to get at? Lastly, why is not Fleuss' well-known apparatus, kept at all chemical works abounding in wells and sewers, and other places liable to be filled with noxious gases? If one of these had been at hand, the two lives which were lost could easily have been saved.

At a miners' demonstration which took place a few days since, some pertinent observations on the subject of mineral royalties, and the bearing they have on the depression of trade, were made by Mr. J. C. Swan, of Newcastle-on-Tyne. Mr. Swan is interested in lead mines, and says that British galena is subject to a royalty of 7s. per ton, whilst the freight from Spain to the Tyne on that which is imported from thence is at present only 5s. per ton. He and other gentlemen had not long since spent £13,600 in sinking a trial mine. Before going further, and having in view the ever increasing foreign competition, they determined to apply to the royalty owner, represented in this case by the agent of a certain duke, for an abatement of royalty. Eleven per cent. was what they were liable for, and, under the circumstances, they thought they ought to be let off with 5 per cent. The agent, however, would not listen to anything below 10 per cent. When reminded that the result might be the collapse of a great national industry, he replied that he could not take into consideration matters of that kind, nor any that were not compatible with "his Grace's interests." From that day to the present, an interval of about two years, nothing further had been done at the mine in question.

On the 12th inst. Messrs. Swan and Hunter, of Wallsend, shipbuilders, called a meeting of delegates representing the operatives employed in the various departments of their business. They informed them that they were very short of new orders, and that the work in hand was not immediately required. They proposed for the present to work only five days per week, but were willing to receive any suggestions from their workmen, if they thought a better means of overcoming the difficulty could be devised. The delegates promised to consult their constituents and report the result. The total number of men at present employed is about 600.

The Castle Eden colliers held a meeting on the 7th inst., and decided to resume work on the 9th. Meanwhile, the loss they have occasioned must be considerable, whilst the good they have accomplished is absolutely *nil*.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE advance of 6d. a ton which took place in Scotch warrants last Thursday, in anticipation of the movement for restricting the output of pig iron in Cleveland, was followed up by another increase of less extent when the principle of restriction was this week actually reported to have been agreed upon. But the good effect produced by the Middlesbrough resolution was partially neutralised by the comparatively poor return of Scotch shipments. These amounted for the past week to 7532 tons as compared with 9212 in the preceding week and 9839 in the corresponding week of 1885. Our principal customers at present are the United States, Canada, and Italy, other countries taking comparatively small quantities of Scotch pigs, and a large proportion of the exports to America is understood to be hematite iron. A very considerable quantity of warrants is understood to have changed hands in the course of the week. But the shipping demand keeps quiet, and pigs are being sent into Messrs. Connal and Co.'s stores at the rate of from 3000 to 4000 tons a week. Four blast furnaces have been put out for repairs at Carnbroe Ironworks, but it is expected that they will soon be again in operation. One furnace has also been extinguished at Dalmellington, and one at Glengarnock, and there are now seventy-nine blowing, as compared with ninety-two at this date last year.

Business was done in the warrant market on Friday at 39s. 7d. cash. Monday's market was rather quieter at 39s. 7½d. to 39s. 4d. On Tuesday forenoon the cash quotation advanced to 39s. 9d., but came back in the course of the day to 39s. 6d. On Wednesday transactions took place at 39s. 6d. to 39s. 4½d. cash. To-day—Thursday—the market was slightly firmer, at 39s. 6d. to 39s. 5d., closing with buyers at 39s. 6½d. cash.

The values of makers' iron are firm, but they have not as yet in any marked degree responded to the advance in the case of warrants. Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, is quoted at 43s.; No. 3, 40s.; Coltness, 46s. 6d. and 42s. 6d.; Langloan, 43s. and 41s.; Summerlee, 45s. and 41s.; Calder, 45s. 6d. and 40s. 6d.; Carnbroe, 40s. 6d. and 39s.; Clyde, 42s. 6d. and 39s. 6d.; Monkland, 40s. 6d. and 36s. 6d.; Govan, at Broomielaw, 40s. 6d. and 36s. 6d.; Shotts, at Leith, 44s. and 43s. 6d.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 42s. and 39s. 6d.; Eglinton, 39s. 6d. and 36s.; Dalmellington, 40s. 6d. and 38s.

The total shipments to date amount to 244,750, as compared with 283,791 tons in the same time last year; and there is a decrease of 33,483 tons in the arrivals of Cleveland pigs for the present year.

The Glasgow locomotive works are fairly busy at present, and have been turning out a good quantity of work both for home and Indian railways.

In the past week there was shipped from Glasgow three locomotives, worth £8250, for Calcutta; machinery, £4300, of which £2600 represented a sugar mill for Jamaica; sewing machines, £5688; steel goods, £6110; and general iron manufacture, £22,100.

At most of the ports the shipments of coals have been reduced in consequence of the restriction of output by the colliers, and the total shipments of coals in the past week are considerably smaller than they were in the corresponding week of 1885. At Glasgow, the quantity despatched was 21,666; Greenock, 909; Irvine, 1189; Troon, 4678; Leith, 2217; Grangemouth, 13,486; and Bo'ness, 6894 tons. For most qualities of coals about 6d. a ton more money is being paid than was current a few weeks ago; but on account of the increased cost of production and the smaller quantity dealt with, the actual return to the coalmaster is in many instances less than before.

Whether the colliers should be generally successful in obtaining more wages or not, the policy of restriction of output has become more general than it was ever known to be in Scotland at any former time. With the exception of Fife and Clackmannan, it may be said to be universal; and the miners appear to be fast adopting the opinion that no more than eight hours' work should be done in the pits under any circumstances.

In some districts the miners were idle on Monday, in addition to the weekly holiday adopted on Thursday.

The strike at the Blantyre pits of Messrs. William Dixon is now reported virtually at an end, after lasting six weeks. The cause of the dispute was the dismissal of certain men by the company, and the men took the view that they had been discharged on account of the leading part which they took in certain labour movements.

The miners of the Fife collieries continue to work full time, and they are thus reaping the advantage of the irregularities of their fellow-workmen in other districts. The shipments at Burntisland are not reported, but they are understood to be unusually heavy, and it is stated that in some cases the coals are being sold to the shippers at very low figures.

It is worthy of note that the students in the Glasgow College of Science and Arts, of which Andrew Jamieson, C.E., F.R.S.E., is the principal, have achieved a remarkable success this year in the examination for the Whitworth Scholarships. No fewer than six out of the twenty-five prizes awarded have been gained by them.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

UP to the last week or two the coal trade of the whole of the district has been one of steady depression. Last week I noticed that a slight reaction had set in, and this week another favourable sign of change is the fluctuation of trade. For a portion of the week it has been active, and then depression has followed. These are all characteristic signs to those who carefully note the changing conditions of the trade, and the result is to inspire confidence. The railways also share in the fluctuations. One day this week the Taff Vale went down to 214, the lowest point yet, but the next day it was quoted at 217 again. During the last week it was possible to buy good coal at Cardiff for a trifle over 7s. per ton. I need scarcely add that firms such as Nixon, Taylor, and Cary, or Harris's Navigation, would not entertain such a price for a moment. The leading firms quote a settled price, too low to admit of profit, and if they cannot get that they keep their coal. Taking a survey of the whole of the collieries, house and steam, they are working more regularly, and it may be expected that with the month of September this condition will advance. The autumnal and winter seasons are rarely depressed ones. Invariably the summer has its quiet phase in the best of times, but with these seasons the house trade begins its more active course. House coal prices are low enough now, and those who could put in a large order for forward delivery would be wise to do so. Prices cannot be lower. Small steam is the firmest in the market, 5s. being the lowest quotation. I should not be surprised at an advance, as the Russians are putting in large orders for patent fuel, and some good cargoes went off this week to Cronstadt.

Newport exports of coal last week were very good. Swansea was tolerable, sending off close upon 23,000 tons, while Cardiff coal shipments came up to 140,000 tons. Pitwood keeps low, the prevailing figure is 15s. 6d.

The steel rail trade keeps quiet; a small consignment for Port Nolloth left Swansea this week. India is fortunately going in for rails somewhat heavily, and if the consignments of last week can be kept up for a period our mills will be tolerably busy.

In tin-plate there has been a little lull as regards fresh business, and though makers are busy enough in completing orders, still the absence of fresh trade is a matter of some anxiety. Prices have fallen rather into a groove, and it is difficult to get buyers to give more than 13s. 3d. for ordinary cokes; 2500 tons left Swansea last week for America and some small quantities for Germany. Statistics for last month show that July indicated a falling off in business, France and America showing a marked decrease, but Australia and Canada indicated a slight increase. Two of the closed tin-plate works are rumoured to have been sold.

Several prominent subjects are under discussion in the tin-plate trade; one is the rivalry threatened by Germany, another the Randell Bill—the American Tariff Bill—and the third the coalition between buyers to keep prices down. With regard to the last, it is gravely suggested that makers should open agencies in New York as a beginning, and sell direct to consumers, thus doing away with the middlemen. I do not think this will do. The middlemen have frequently a direct and personal connection, and will be sure to turn the tables. Here is a case in point. A middleman brought a large buyer of coal into communication with a large coalowner, and a train of trucks was devoted to the trade that was thus inaugurated. After the first quarter the coalowner quoted direct to buyer, and the middleman was thrown out. Then followed some clever strategy; the middleman found a cheaper coal, and coalowner was left high and dry upon the sands.

A strike, possibly temporary, has taken place at one of the Ogmore collieries, in consequence of the manager having put an end to blasting without giving any equivalent to the men.

One of the five men injured by an explosion of coal gas on board a Norwegian vessel at Cardiff last week has died, and at the inquest a verdict in accordance was brought in. The vessel was laden with Dowlais coal. With one exception, of late Dowlais collieries have enjoyed a remarkable immunity from accident.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE Silesian coalmasters have recently signed contracts for deliveries of coal to the Danubian countries. Presumably this may be regarded as experimental, for owing to the enormous land carriage, the quality of the coals, and the fact that English coals as yet dominate the market in those regions, it is not apparent how the Silesian product is going to hold its own in competition against such odds and such sea freight. Nevertheless, it will only be common prudence if English shippers of coal keep a watchful eye upon what takes place in those localities. From September 1st the prices of coals are to be raised, 20, 40, and 60 pfg. p.t.

Of the iron trade there is little noteworthy to report. Sales drag their slow length along at the following prices:—Foundry pig, 50 to 53 M. p.t.; bars, 95; special qualities, 97·50; fancy sections, 10·50 to 11·50; common coke plates, 135 to 140; boiler plates, 150 to 155 M. p.t. at works.

The Reden Works are engaged on some exceptionally large petroleum tanks for abroad, weighing 50 tons each. The Rhenish-Westphalian iron trade is still in the same stagnant condition, and prices remain almost unchanged from those last reported. Bar iron, though, has been offered as low as M. 83 p.t.; also the price of rails has been reduced to M. 110 p.t. in face of the foreign competition. Native ores are in little request now, as foreign ones are cheaper. The plate convention comes to an end next month, and as a consequence prices are again weakening as compared to last report. This convention, as well as others, it seems, has not answered the desired end. The output of wire rods is still being reduced. There is no improvement to mark respecting the machine and wagon works. The Bochum Steel and Ironworks—the leading one in Westphalia—has had to decide between discharging a number of workmen or reducing the number of working days per week. The latter alternative has been elected. The remark is current that if the wealthiest company has come to this, what must be the situation of smaller and less favoured ones in the same line and district? There has been another slight explosion in a coal mine in the district, whereby nearly a dozen men were injured. From September 1st best coal is to be raised in price M. 1 p.t.

The Custom House officials in France are acting most vigorously, and actually refusing all German goods marked or labelled in French. It is to be hoped our laws would cover a similar proceeding on the part of our officials, and that they would act in the same spirit when they met with similar occasions, and so prevent these imitation goods entering our ports.

It was mentioned in a former report that it was just possible the Darlington Company might, after all, not get the Altona order for rails. This has come to pass, for Krupp, on reducing his price to the same as the other, has received it. Such a proceeding should surely cause our Government to consider twice before it ordered goods from abroad to the amount of £1,180,170 in seven years, of which sum a considerable portion came to Germany, which could just as well have been executed in England. This reflection brings a subject to mind which is probably little known and might be interesting to some of your readers to learn, namely, the proof the sabres, which are now being or have been recently made in large numbers by the firm of Weyersberg and Kirschbaum, in Solingen, for the English Government, have to undergo before acceptance by the Government-Inspector: Firstly, the blade must bear a weight of 16 ko. laid on its point without bending in the slightest degree, then it must bear an increase of this weight until its length has been shortened by 16 cm., when it must spring back again and assume its original perfect straightness. After a cut has been made with it on an oak block by the full force of a man with the cutting edge, and then one with the back of the blade, comes the proof proper, but not until it has been laid in a countersunk template or gauge to ascertain that it has preserved its original curve and form in every respect. The bending proof consists in fixing the blade flat in a special apparatus, and then bending it to 90 deg., when it must spring back again and become as straight as before. Lastly, its weight and centre of gravity are ascertained, and then it is ready for the inspector to have his stamp of approval put upon it.

In considering the above, the question seems to arise whether it is the quality of the indigenous metal used for these weapons which is the reason why our Government would appear to give them the preference over the blades which could be made in England. It is recorded that Solingen enjoyed a great reputation in swords and other war-like implements at the time of the Roman occupation of the left bank of the Rhine, and that the Roman Legions were for the first time equipped here with steel—steely-iron?—weapons, and that the ores for this purpose were those dug out of the mountains of the Siegerland, where to this day the celebrated steel-stone is won. Those ores probably first produced the now well-known spiegeleisen, and for the last 200 years or more until quite lately, and perhaps here and there in isolated corners still, this and kindred sorts of charcoal pig iron have been reduced by means of charcoal and blast in small hearths to the once celebrated so-called German steel, which of all kinds seems best adapted to sword-blades, and such articles as require strength and elasticity. Besides that, it works and welds as easily as wrought iron. It was the judicious use of this steel as a mixture which first gave celebrity to Krupp, of Essen, through the good qualities of his cast steel tires for locomotives, and his rolls for laminating the finer kinds of metals. This natural steel possesses the inestimable qualities of extraordinary elasticity, of not warping when quenched in water at any degree of heat, and when only mixed with other sorts of steel in large masses—as metal rolls—of preventing their cracking whilst being hardened. When puddled steel came up, forty years ago, it cost only half the price of natural steel, and to a great extent was substituted for it; and when it is made from the same quality of pig iron as the natural steel it possesses nearly similar characteristics, and if this material, which is still made in Westphalia, were employed for these sabres, they could, of course, be produced very cheaply, and would possess the necessary qualities to stand the proof, which perhaps neither Bessemer nor Martin-Siemens steel would, but the raw material of the special kind could be easily and cheaply procured, to be subsequently worked up in England. The writer having had practical experience in these steels, sent working samples many years ago to Sheffield and Birmingham, but, as nothing came of it, he supposes it was not appreciated—perhaps not properly understood—or cheaper sorts were preferred, which is now to be regretted, if it should turn out that it is the peculiar quality of the metal which causes the foreigner to have the preference in an article of manufacture which should be one especially English, for no one can doubt that, in spite of lower day wages in Germany—which by no means always produces cheap and well-finished work—the English manufacturers could successfully compete with the Germans if it were worth their while to do so, which it is reasonable to suppose would be the case when £20,000 has been paid in the last seven years, according to a parliamentary return, by our Government to the Germans for swords alone.

MR. HAMILTON FULTON.—We regret to announce the death of Mr. Hamilton Fulton, M. Inst. C.E. Mr. Fulton was formerly a pupil of his father. The latter, after practising in Great Britain for many years with Messrs. Rennie and Telford, became chief engineer to the States of North Carolina and Georgia, U.S.A. At the death of his father, the late Mr. Hamilton H. Fulton became a pupil of the late Sir John Rennie, and was afterwards for years his principal assistant, and aided him in carrying out some of his numerous and most important undertakings, including the improvement of the river Nene navigation, and the river Ouse outfall navigation. Mr. Fulton was elected a member of the Institution of Civil Engineers in the year 1845. In the year 1853 an Act was obtained upon the plans designed by Mr. Fulton for the construction of the West London and Crystal Palace Railway, a line from the London and South-Western—Windsor and Richmond line—to the Crystal Palace Park, a distance of about 5¾ miles. The works with branch lines to the London and Brighton line at Norwood, and to the Chelsea suspension bridge, were subsequently carried out, from beginning to completion, by Mr. Fulton. In the year 1855 the Stokes Bay Railway and Pier Company obtained an Act to extend the London and South-Western Railway from Gosport to Stoke's Bay, with a pier to enable passengers to land at all times of the tide. The works were designed and carried out by Mr. Fulton. The Isle of Wight Railway Company obtained an Act of Parliament in the year 1860 to construct a line from Ryde to Ventnor, a distance of 12 miles, upon the plans designed by Mr. Fulton. The Salisbury and Dorset Junction Railway, being a line from Salisbury to West Pasley, near Wimborne, a distance of 18½ miles, was designed and carried out to completion by Mr. H. H. Fulton. Mr. Fulton was also engaged in connection with the Milford Docks, and with the Manchester and Milford Railway, for which an Act was obtained in the year 1860, to construct a line from Llanidloes to Peneader, being a length of 51½ miles. During the past sixteen years Mr. Fulton has been prominently before the public in connection with the Manchester Ship Canal project, of which he was the originator. In the year 1870 he made a preliminary survey and report upon the practicability of improving the rivers Mersey and Irwell, so that ocean-going steamers might reach Manchester. From the year 1870 Mr. Fulton has been untiring in his endeavours to keep the proposal before the public, and it was entirely due to his labours that the project was so warmly taken up and supported in the year 1882 and subsequently.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, Aug. 7th.

TRADE conditions continue favourable. Manufacturing activity is increasing. The volume of money is in excess of demand. Labour is everywhere profitably employed. There are no large strikes, but a large number of petty strikes throughout the country, growing out of the efforts of the working people to equalise the rates of wages on the higher basis secured last spring. Disputes are being quietly settled by voluntary arbitration entered upon for each particular case. Employers readily recognise the trade unions, and as a rule observe the agreement entered into. The weekly volume of business ranges from 750,000,000 dols. to 800,000,000 dols. A steady weekly increase is now probable. The reports from twenty-five railroad companies in the North-West show a slight gain for the past week over the same week last year. There is quite an active demand for ready money, and under it the rates of interest are firmer. Stock markets show very little vitality. The iron trade is only holding its own. The demand for all kinds of steel absorbs every ton produced, and the steel rail makers and wrought iron pipe makers are contracting for winter and spring deliveries. The daily sales of steel rails for the past week or ten days have been 5000 tons. Some mills are unable to accept any more orders excepting for delivery after January 1st. Two or three new oil wells have been struck in Washington, County Pa. One producer has been developed of 2000 barrels per day capacity. A new hoop iron mill is to be started at Milton, Pa. All the merchant bar mills throughout the State are on full time, but prices are weak. Eight thousand tons of pig iron have been sold this week at 16 dols. for forge and 18 dols. to 19 dols. for No. 1 foundry. Very little Scotch iron is selling, or English Bessemer. There is an active demand for old iron rails. Speigeleisen is arriving in small quantities. Steel wire rods are arriving in large quantities, and prices are weakening. To-day's quotations are 36 dols. The New England coal trade is absorbing larger quantities of coal during the past week. Winter contracts will shortly be made. Increasing activity is reported in several of the larger machinery manufacturing establishments. Reports from the interior show that an active fall trade is right at hand. Large manufacturers and merchants have made special contracts for freight delivery in the West and South. There will be no general cutting of prices on freights. The pooling system is being successfully extended throughout the 130 railroad companies centreing at Chicago, St. Louis, and one or two other far Western points.

NEW COMPANIES.

THE following companies have just been registered:—

Ackton Hall and Featherstone Manor Collieries Company, Limited.

This company proposes to acquire colliery works and property known as the Ackton Hall and Featherstone Manor Collieries, situate at Featherstone, York. It was registered on the 9th inst. with a capital of £200,000, in £100 shares. Power is taken to carry on the business of a gasworks company for supplying the townships of Featherstone and Ackton. The subscribers are:—

	Shares.
George Bradley, Castleford, York, colliery proprietor	10
J. Horne, Castleford, engineer and ironfounder	1
E. S. Peach, 4, Celia-road, Tufnell Park, N.	1
J. Simpson, Castleford, glass manufacturer	1
R. T. Worstenholme, Castleford, cashier	1
J. Skinner, Castleford, postmaster	1
F. W. Bradley, Gloucester-gate, Regent's Park, solicitor	1
J. Harling, Castleford, earthenware manufacturer	1

Registered without special articles.

British Empire Match Company, Limited.

This company proposes to purchase various letters patent granted to George Eastman Norris and William Elijah Hagan for improvement in machines for making match splints and matches. It was registered on the 10th inst. with a capital of £100,000, in £1 shares. An agreement, dated 26th ult., between John Fraser and Edward Nelson Hole is adopted, but as this document has not been filed, we are unable to state the amount of the purchase consideration, and the special arrangements made with the promoters of the company. The subscribers are:—

	Shares.
*James Inch, 126, Leadenhall-street, East India agent	1
*A. A. Ellis, 14 to 18, St. Mary-axe, match importer	1
J. Fraser, St. Aubyns, Hove, chartered accountant	1
E. Bigland, 7, East India-avenue, merchant	1
R. Deering, 75, Mark-lane, lighterman	1
E. N. Hole, 123, Bishopsgate-street, clerk	1
T. H. Tate Rogers, 3 and 4, Great Winchester-street, solicitor	1

The number of directors is not to be less than three nor more than seven; the first are Mr. R. S. Foreman and the first two subscribers. The directors are empowered to appoint additional directors, who need not hold any share qualification. Subsequent directors will be required to hold £500 in the capital of the company. The board will be entitled to 10 per cent. of the surplus profits remaining after payment of 10 per cent. dividend.

Francis and Co., Limited.

This company was constituted by deed of settlement on the 27th ult., and was registered as a limited company on the 7th inst. It proposes to take over and amalgamate on co-partnership businesses of Francis and Co., of Nine Elms Cement Works, Bridge-foot, Vauxhall, and of Cliffe, near Rochester, the whiting works at Cliffe known as Francis, Donald, and Johnson's Works, and of Empson, Holcombe, and Co., of the Pottery, Cliffe, cement, plaster of Paris, whiting, and cask manufacturers and merchants. The capital is £200,000, divided into 4500 preference shares of £10 each, and 15,500 ordinary shares of £10 each; 8265 ordinary shares have been taken up, and upon 4265 thereof the full amount has been paid, and £7 10s. per share has been paid upon the remainder. The members are:—

	Shares.
*C. Eastland de Michele, Nine Elms Cement Wharf, cement manufacturer	1673
*P. O. Francis, Nine Elms Cement Wharf, cement manufacturer	3324
*V. D. de Michele, Nine Elms Cement Wharf, cement manufacturer	433
*G. B. Francis, Nine Elms Cement Wharf, cement manufacturer	1226
*J. E. Johnston, Nine Elms Cement Wharf, cement manufacturer	863
G. J. Francis, 15, Cambridge-gardens, Notting-hill, commission agent	20
R. S. W. Donald, 39, Maxilla-gardens, North Kensington	120
R. E. Middleton, Cliffe, cement manufacturer	408
*W. H. Francis, Cliffe, cement manufacturer	198

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

Nevin United Granite Quarries (Carnarvonshire), Limited.

This company proposes to acquire and work certain quarries in the parishes of Pistyll and Nevin, Carnarvon. It was registered on the 11th inst. with a capital of £40,000, in £1 shares. The purchase consideration is £8750 in cash and 8750 fully-paid shares. The subscribers are:—

	Shares.
*R. Wood, Campion House, Sydenham	1
B. Hodge, 25, Davies-street, Berkeley-square	1
F. F. Goodliffe, 134, London-wall, merchant	1
W. J. Cordner, 40, Hilldrop-road, N., merchant	1
T. H. D. Berridge, 9 and 10, Pancras-lane, solicitor	1
P. R. Stamper, 49, Shardeloes-road, S.E., clerk	1
S. Innes, 1, St. Stephen's-road, Lewisham, clerk	1

The number of directors is not to be less than three nor more than seven; qualification, 250 shares; the first are Messrs. R. T. Hermon Hodge, M.P., R. Wood, J. F. M. Weston, and G. Rodger. The remuneration of the board is to be at the rate of £100 per annum for each director.

Swan's Chilian Manganese Company, Limited.

Upon terms of an agreement of the 4th inst., this company proposes to purchase from Wm. Creighton Tripler, of New York, and John Cameron Swan, of Newcastle-on-Tyne, certain manganese mines and other property at Coral Quemado, Fraguas, Loma, Negra, and Chanaral, in the Republic of Chili. It was registered on the 7th inst. with a capital of £150,000, in £1 shares. The considerations are: the taking over by the company of any balance, which may up to the time of taking over the business by the company, be due or owing from the vendors in account with the firm of J. Cameron Swan and Co., of Newcastle, in connection with the opening out and development of the said mines; also an allotment to the vendors or their nominees of 125,000 fully-paid shares. Should the company issue any further shares beyond the said 125,000, the vendors will be entitled to 50 per cent. of the total amount of every such issue.

	Shares.
W. C. Tripler, New York, mine owner	1
*J. C. Swan, Newcastle-on-Tyne, merchant	1
*C. H. Hills, Newcastle-on-Tyne, copper smelter	1
J. A. Tennant, Newcastle-on-Tyne, chemical manufacturer	1
*T. B. Barker, South Shields	1
R. H. Wilson, M.D., Gateshead	1
W. S. Burton, Newcastle, solicitor	1

The number of directors is not to be less than three nor more than ten; the first are the subscribers denoted by an asterisk, and Mr. J. A. Game; qualification, £100 in shares or stock; remuneration, £50 for the first year, and subsequently such sum as the company in general meeting may determine.

T. A. Whittle and Co., Limited.

This is the conversion to a company of the business of timber merchants, carried on at Faversham by the firm of T. A. Whittle and Co. It was registered on the 5th inst. with a capital of £30,000, in £15 shares, with the following as first subscribers:—

	Shares.
*Henry Richards, 39, Longridge-road, S.W., timber merchant	1
*E. Chambers, Faversham, timber merchant	1
*W. F. Richards, Birmingham, merchant	1
C. G. Beale, Birmingham, solicitor	1
Mary Anne Whittle, Faversham, widow	1
J. A. Ashworth, Southsea	1
F. Elkington, Wolverley, Worcester, manufacturer	1

The number of directors is not to be less than three nor more than five; qualification, five shares; the first are the subscribers denoted by an asterisk.

Sutton-on-Sea Gas Company, Limited.

This company was registered on the 5th inst. with a capital of £6000, in £10 shares, for the erection of gasworks at Sutton-on-Sea, Lincoln, according to the plans and specifications of Herbert Walker, Assoc. M. Inst. Civil Engineers. The subscribers are:—

	Shares.
Herbert Walker, C.E., Nottingham	1
G. T. Travell, Nottingham, solicitor	1
F. W. Brookbank, Nottingham, lace manufacturer	1
T. Sellars, Nottingham, estate agent	1
H. Vickers, Nottingham, builder	1
G. Wigley, Nottingham, silk merchant	1
W. Wright, Nottingham, commission agent	1

Registered without special articles.

A NEW METHOD OF DETERMINING THE SPECIFIC GRAVITY OF GASES.[1]

THE following is from a paper by F. Lux in the *Zeitschrift des Vereines deutscher Ingenieure.*

This method depends upon the well-known Archimedian principle, and is specially intended for use in gasworks, the apparatus being continuous in action, and giving the specific gravity by inspection. A cylindrical glass vessel, about 12 centimetres wide, and 70 centimetres high, closed at the top with a ground glass stopper, has two tubular apertures opposite to each other near the top, closing by cocks. These, when opened and connected with the source of supply, allow the vessel to fill with gas, but to ensure perfect distribution the tube on the admission side is prolonged downwards through about half the depth of vessel, or to the level of the water with which it is about half filled. The measuring instrument resembles an ordinary areometer or hydrometer, having a loaded spherical float with a divided vertical stem; but in addition it has a glass bulb at the top of the stem in the gas space. The stem joining the two bulbs is 4 millimetres broad and 1 millimetre thick, or has a section of 0·04 square centimetre; the capacity of the hollow glass bulb is about 300 square centimetres. As the weight of a litre of air is in round numbers 1·38 gramme, the difference in the weight of the bulb in air and in vacuo will be about 0·4 gramme, corresponding to 0·4 cubic centimetre of water. If the line of flotation in air is marked on the stem, and then the air in the upper space of the vessel is exhausted, the hydrostatic equilibrium will be disturbed, and the float will sink until 0·4 cubic centimetre of water is displaced by the immersion of the stem to a depth of 10 centimetres, which, when marked, gives the line of flotation for gas of specific gravity 0. The interval between the marks when divided into single millimetres gives a scale of 100 equal parts, whereby the specific gravity of any gas lighter than air is indicated to within ½ to 1 per cent. of the truth, which is sufficiently accurate for practical purposes. The actual determination of the zero point of the scale is made, not by flotation in a vacuum, but by filling the gas space with hydrogen—specific gravity 0·07—which can easily be obtained of sufficient purity for the purpose. The space between the two marks is then divided into ninety-three parts instead of one hundred, and the scale is prolonged by adding seven of these divisions at the top, and a similar continuation below the 100 millimetres level gives the scale for gases heavier than air. A thermometer passing through the stopper gives the temperature in the gas space, and another at the bottom that of the fluid, in order to admit of the necessary corrections for change of volume by irregular heating being made.

A further important application of the apparatus may, according to the author, be made in gas analysis, which, as at present conducted, consists essentially in alternate measurement of volume and removal of components by absorptive media; instead of which the composition of a gas mixture may be determined by taking the specific gravity of the individual components. For this purpose, supposing the mixture contains a gases, $a - 1$ specific gravity instruments will be required, which must be arranged in series alternately with the absorption vessels. From the observed specific gravity the composition of the gas may then be easily calculated. Supposing the specific gravity of a mixture of two gases to be indicated by s_3, that of one component (x) by s_1, and that of the other component $(1 - x)$ by s_2, the relation of these quantities will be—

$$s_3 = x . s_1 + (1 - x)\, s_2 \quad \text{or } x = \frac{s_3 - s_2}{s_1 - s_2}.$$

If the absorption vessels be made sufficiently large, and the absorbing media kept active by renewal from time to time, it will be possible to analyse a gas by a single series of simultaneous observations of the specific-gravity instruments.

[1] "Proceedings," Institution of Civil Engineers.

KRUPP'S SHAFTS IN THE UNITED STATES.—The Krupp steel shaft made in Germany, and which broke on board the steamer Boaz recently, had been in use three years. The shaft was 32ft. 7in. long, and 13⅜in. in diameter, near the centre, where it broke, and weighs 15,916 lb. It made 15 revolutions per minute by means of two engines with cylinders 26in. in diameter and 8ft. stroke. The largest of the Krupp shafts in use on the Mississippi river, is aboard the tow-boat Future City, and weighs a little above 11 tons. Several of these German steel shafts have broken, and many are of the opinion that they are not much safer than home-made wrought iron or steel.—*The Mechanical Engineer.*

NEW LABOUR LAWS IN MASSACHUSETTS.—Five new labour laws have been added to the public statutes of Massachusetts by the present Legislature. The first is the Weekly Payment Act, which came into effect on July 1st. It requires the payment in full of all wages earned to within six days of the date of payment, and applies to manufacturing, mining, quarrying, mercantile, railroad, street railroad, telegraph, telephone, and municipal corporations, and to incorporated express and water companies. Another Act limits the employment of women and minors in manufacturing establishments to ten hours a day, or sixty a week, by adding the requirements that the posted notice in the manufactory shall specify the time of commencing and stopping work, the time allowed for stopping and starting machinery, and the time to be taken for dinner, and that the form of the notice shall be approved by the Attorney-General. The next two Acts concern the safety of employés of manufacturing establishments and the reporting of accidents. The former, that in every manufactory where machinery is propelled by steam, communication by means of speaking tubes, electric bells, or other means satisfactory to the inspectors of factories, shall be established between each room and the engine-room. The other Act, to take effect July 1st, requires manufacturers and manufacturing corporations to report promptly to the district police any accident that results in death or injury sufficiently serious to prevent the injured person from returning to work within four days. The fifth Act enables corporations to issue special stock to their employés. The par value of the shares of such special issue is fixed at 10 dols., and the whole amount is not to exceed two-fifths of the actual capital of the corporation. These shares are not to be sold or transferred, except to an employé of the corporation or to the corporation itself. Of course, the practical value of this scheme, to identify the interests of employés with the interests of the corporation, can be determined only by experiment, but it promises well, since it provides a basis on which to accomplish many things that workmen of advanced views hope to achieve.

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.

9th August, 1886.

10,162. TAKING the GREASE off PLATES, H. E. Head, London.
10,163. MARKING BOTTLES, H. Codd, London.
10,164. TREATMENT of JERUSALEM ARTICHOKE, H. J. Haddan.—(*A. Z. Champy, A. N. Champy, and L. P. Champy, Belgium.*)
10,165. CYLINDER GLASS, L. de Dorlodot and I. Quinet, London.
10,166. LUBRICATING JOURNALS, C. Parmentier, London.
10,167. ARTIFICIAL ASPHALT, P. Jeserich, London.
10,168. DOOR and other HINGES, H. J. Haddan.—(*H. Schmidt, Prussia.*)
10,169. FURNACES, G. A. Hagemann, London.
10,170. RENNET, H. J. Haddan.—(*M. Blumenthal, Germany.*)
10,171. NAIL-CUTTING MACHINES, E. H. Bissett, London.
10,172. TRIMMING the CURLS of the BRIMS of HATS, G. H. Hooper, A. Campbell, and E. McLoughlin, jun., London.
10,173. CHECK VALVES, A. D. Glace, London.
10,174. UTILISING the FORCE of WAVES, J. Elias London.
10,175. LOCKING NUTS, H. W. Morrow, London.
10,176. TREATMENT of SILK COCOONS, &c., H. R. Randall, London.

10th August, 1886.

10,177. SELF-REVOLVING INSIDE DARKENING SLIDE for LANTERNS, T. Tongue, Handsworth.
10,178. MECHANICAL TOY, H. Stanning and W. Honeywood, London.
10,179. BUCKLES for HARNESS, H. Stanning and W. Honeywood, London.
10,180. CONSTRUCTION of GARNETT SAW TEETH, E. Sykes and E. Wilkinson, Huddersfield.
10,181. INDICATORS for TWISTING MACHINES, J. Jucker, Manchester.
10,182. MATERIAL for DECORATIVE PURPOSES, J. W. and T. Breakell, Manchester.
10,183. TOBACCO PIPE, C. Knott, Manchester.
10,184. FLEXIBLE SHAFT COUPLINGS, H. H. Lake.—(*T. J. Sloan, France.*)
10,185. ELECTRICITY for VENTILATION of SHIPS, J. Stephens and A. Smith, London.
10,186. ELECTRIC GENERATORS and MOTORS, C. W. Hill, Manchester.
10,187. MACHINERY for SPINNING, J. Buckley, Manchester.
10,188. REGULATING the DELIVERY of THREAD from REELS, M. Moore, London.
10,189. HANDLE for GLASS JUGS, P. Jones, Dublin.
10,190. MINERAL OIL LAMP for CYCLES, &c., J. Roots, London.
10,191. CAMERA SLIDES, W. Middlemiss, Bradford.
10,192. COCKING DROP-DOWN HAMMERLESS GUNS, R. Jackson and G. W. Toney, Birmingham.
10,193. AUTOMATIC PERFORATING ATTACHMENT for PRINTING PRESSES, G. Kennedy, London.
10,194. BUCKLES, W. P. Ward.—(*W. D. Stratton, United States.*)
10,195. WALKING STICKS, F. J. Biggs and H. A. Church, London.
10,196. UPRIGHT REVOLVING DRUM for ADVERTISING, R. Ashton and A. Macdonald, Southport.
10,197. PLATFORM TRUCKS, F. H. Baines, Halifax.
10,198. TURNING LATHES, R. Hyde, Sheffield.
10,199. FASTENING for DRAWERS, &c., S. Pratt, Birmingham.
10,200. CARPET SWEEPERS, B. H. Evers.—(*W. H. Castle, United States.*)
10,201. APPLIANCE for PERAMBULATORS, D. Weston, Blackpool.
10,202. WELDED IRON and STEEL TUBES for TELEGRAPH POLES, J. C. Johnson, London.
10,203. INDEX PLATES of SPIROMETERS, J. W. Waddington, Bradford.
10,204. RAILWAY ELECTRIC SAFETY SIGNALS, O. Hughes, Bangor.
10,205. TUBULAR DRUM for DRYING FILAMENTS, J. Bertrand, London.
10,206. ADJUSTING the ENDLESS APRONS of IRONING MACHINES, A. H. Reed.—(*H. E. Smith, United States.*)
10,207. EXCAVATORS, J. Garvie, jun., London.
10,208. METAL SHOE for POSTS, S. S. Bromhead.—(*J. Guérin, France.*)
10,209. MACHINERY for CUTTING TWIST DRILLS, J. Lee, London.
10,210. STEAM DRYING CYLINDERS, W. Atherton, London.
10,211. TYPE WRITER, E. Howard, London.
10,212. GRAIN BINDERS, W. P. Thomson.—(*C. H. McCormick, jun., United States.*)
10,213. INDEXES, A. J. Boult.—(*P. J. Schlicht, United States.*)
10,214. STEAM ENGINE LUBRICATORS, P. A. Bennett, London.
10,215. INDEXES, A. J. Boult.—(*P. J. Schlicht, United States.*)
10,216. PREPARING TRANSPARENCIES, W. Jones and R. C. Powell, London.
10,217. ELECTRIC TELEGRAPH KEYS, A. J. Boult.—(*R. A. Macready, United States.*)
10,218. INSTANTANEOUSLY HEATING WATER and other LIQUIDS, W. J. Righton, London.
10,219. FITTINGS for VENTILATING DRAINS, &c., P. R. Smyth, Glasgow.
10,220. BUTTON-HOLE SEWING ATTACHMENTS for SEWING MACHINES, F. W. Smith, jun., and S. S. Williamson, London.
10,221. COVERING STACKS of AGRICULTURAL PRODUCE, J. McDougall, London.
10,222. VOLTAIC BATTERIES, E. Andreoli.—(*J. V. Warnon, Paris.*)
10,223. BED REST, A. Simpson, London.
10,224. SEWING MACHINES, J. J. Robinson, London.
10,225. SEWING MACHINES, J. J. Robinson, London.
10,226. SOAP, H. H. Lake.—(*N. J. Clute, P. B. Rose, and J. M. Aubery, United States.*)
10,227. EXTRACTING METALS from ORES, H. R. Lewis, C. B. Phillips, and C. J. Sandahl, London.
10,228. PACKING COFFEE, &c., D. Pearman, London.
10,229. LASTS for BOOTS, &c., H. W. Mobbs and A. Lewis, London.
10,230. SEWING THIMBLE, J. W. Harding and T. W. Duffy, London.
10,231. MUSICAL INSTRUMENT, B. C. Gallico.—(*A. Antoldi, Italy.*)
10,232. GONGS for BICYCLES, &c., T. E. Ware, London.
10,233. ELEVATING WATER and LIQUIDS, B. Reymond, London.
10,234. SPRING SEATING for CHAIRS, &c., W. J. Bailey, London.
10,235. DRY GAS METERS, J. Hubbard and S. J. Whitbread, London.
10,236. GAME, known as PROGRESSIVE ANGLING, M. D. Bullock, United States.
10,237. RAG ENGINES for BEATING PAPER PULP, J. H. Horne, London.
10,238. BUTTON-HOLE SEWING MACHINES, F. H. Bennett and J. Dowling, London.
10,239. LIQUID METERS, J. Bowie, London.
10,240. BOTTLES for CONTAINING AERATED WATERS, &c., O. Gallafent, London.
10,241. WELDING METALS, H. H. Lake.—(*E. Thomson, United States.*)
10,242. ELECTRO-MAGNETIC LOCKS, H. H. Lake.—(*F. Sedgwick, United States.*)
10,243. STRETCHING and DRYING CLOTH, H. H. Lake.—(*J. H. Varney, United States.*)

11th August, 1886.

10,244. COAL CASKET, T. A. Moore, Norwich.
10,245. CORNISH or FLUE BOILERS, I. Morris, Bloxwich.

10,246. Noiseless Locomotive, &c., Wheel, D. Drysdale and B. A. Drysdale, Birmingham.
10,247. Checking the Receipt of Moneys, G. H. Gledhill, Halifax.
10,248. Repairing Fractured Crank-shafts at Sea, M. Anderson, North Shields.
10,249. Forming Felt Hats, G. Atherton and W. Carrick, jun., Manchester.
10,250. Testing the Purity of Raw Cotton, J. S. Farmer, Manchester.
10,251. Drawing Copies, G. J. Sershall, Birmingham.
10,252. Hair Curlers, J. Cadbury and J. G. Rollason, Birmingham.
10,253. Head Stalls, &c., for Horses, D. B. Harris and F. W. James, Birmingham.
10,254. Atmospheric Gas Burner, A. Hill, Birmingham.
10,255. Spinning Yarn, D. Maitland, Castleton.
10,256. Photographic Colour Printing, S. H. Crocker, London.
10,257. Lump Sugar, C. and J. Lyle, London.
10,258. Table Fork, F. E. Oliver, Sheffield.
10,259. Axles, Axle-boxes, &c., H. W. Robinson, Northampton.
10,260 Fastening for Carriage Sash Windows, &c., D. Allport, London.
10,261. Automatic Valves for Ventilating Pipes, J. Broadfoot, Glasgow.
10,262. High-pressure Flushing Tank, &c., J. Stapleton, London.
10,263. Mattresses, J. H. and W. H. Warren, London.
10,264. Door for Hansom Cabs, C. Groombridge, London.
10,265. Antiseptic Automatic Dry Closet, C. Webb, London.
10,266. Injector, F. F. Bourdil and P. H. Michaux, Liverpool.
10,267. Paper for Cigarettes, J. B. Scammell, London.
10,268. Propelling Ships and Boats, T. Newson and H. C. B. Shalders, West Ham.
10,269. Plug Taps or Cocks, W. W. Galloway, London.
10,270. Temples for Looms, W., H. E., and J. C. Lupton, London.
10,271. Coloured Glass, &c., Screens, E. Townshend and T. H. Thompson, Birmingham.
10,272. Apparatus for Condensing, &c., Liquids and Fluids, A. Rathbone, London.
10,273. Coffer Dams, C. J. Fox, Liverpool.
10,274. Portable Pocket Sewing Machine, T. S. James, London.
10,275. Track Buckles, V. A. Coleman, London.
10,276. Respirators for use in Smoky Atmospheres, C. Tighe, London.
10,277. Disintegrating Rock by Heat, H. E. Newton.—(*A. Nobel, France.*)
10,278. Polishing Machinery, S. Bellotti, London.
10,279. Gas Lamps, F. H. Wenham, London.
10,280. Oxychinoline Carbonates, J. Y. Johnson.—(*F. von Heyden, Germany.*)
10,281. Producing Ethers of Morphincarbonic Acid, A. Knoll, London.
10,282. Childrens' Cots or Cradles, G. H. Needham, R. Stapley, and W. Smith, London.
10,283. Damper Regulators for Steam Boiler Furnaces, P. M. Justice.—(*N. Curtis, United States.*)
10,284. Reflectors, J. C. Halliday, London.
10,285. Fire-extinguishing Apparatus, W. B. Dick, London.
10,286. Voltaic Batteries, F. H. W. Higgins, London.
10,287. Sawing Stone, &c., G. W. Handley and W. H. Burke, London.
10,288. Producing Four-thread Ornamental Stitches, C. O. Müller, London.
10,289. Joint for Connecting Pipes, H. Doulton, London.
10,290. Asbestos Board and like Fabrics, C. A. Faure, London.
10,291. Traction Engines, A. H. Wallis, London.
10,292. Lighting of Railway and other Carriages by Electricity, J. A. Fleming and C. H. Gimingham, London.
10,293. Rendering Paper Impervious, C. L. Lawrence, London.
10,294. Producing Sound Signals, E. L. Henry-Lepaute and P. J. Henry-Lepaute, London.
10,295. Securing Rails to Metallic Sleepers, J. T. Gardner, London.
10,296. Sewing of Hosiery, &c., H. H. Lake.—(*The Selvage Sewing Machine Company, United States.*)
10,297. Sewing Machines, F. N. Cookson, London.
10,298. White Pigment, F. M. Lyte, London.

12*th August*, 1886.

10,299. Tobacco Pipes, R. J. White, London.
10,300. Chandelier Globe Holders, J. Burn, Handsworth.
10,301. Spreading and Drying Machines, R. Eastman and J. Heald, Manchester.
10,302. Receiving the Thrust of Screw Propeller, E. D. Barnard, Gainsborough.
10,303. Breech-loading Small-arms, H. Tolley, Birmingham.
10,304. Locks and Keys, T. C. Dowd, Wednesfield.
10,305. Printing Consecutive Numbers, W. Jones, Newport, Mon.
10,306. Making Oval Shafts, J. Carter, Maryport.
10,307. Measuring Electric Currents, W. Greenhalgh, Leeds.
10,308. Brakes and Crank Arms employed in Looms, T. Singleton, Darwen.
10,309. Securing Hammer-heads to their Handles, J. Gibson, Liverpool.
10,310. Roasting Jacks, E. H. Chesterton, Birmingham.
10,311. Spring Curtain Barrel, H. Hordley, Birmingham.
10,312. New Letter, F. Howchin, Liverpool.
10,313. Ring Bearings, J. Platt, Stalybridge.
10,314. Uncapping the Cells of Honey Comb, J. Hooker, London.
10,315. Dyeing Hats, &c., H. Renold.—(*R. Hegnauer, Switzerland.*)
10,316. Bending Iron Bars, A. de L. Long, Stockton-on-Tees.
10,317. Double Lantern Slide Carrier, J. Place, Birmingham.
10,318. Moistening the Atmosphere in Mills, &c., A. M. Clark.—(*A. Koechlin, Alsace.*)
10,319. Secondary Batteries, W. Häberlein, Berlin.)
10,320. Lamp Bracket for Velocipedes, &c., C. Church, London.
10,321. Picking Apparatus, A. Whiteley, Halifax.
10,322. Keys or Wedges for Securing Rails of Railways or Tramways in their Chairs, T. Searls and J. Trippett, Sheffield.
10,323. Mechanically Splitting, &c., Stones for Building or Paving, F. Bosshardt.—(*F. J. Motte, France.*)
10,324. Forming the Outlet Passages for Blast in Hollow Fire-bars, T. Sellars, London.
10,325. Machine for Peeling Potatoes, E. de Pass.—(*L. J. P. Tardent, France.*)
10,326. Lock-nut, T. Humpage, G. J. Harcourt, and E. Shaw, London.
10,327. Lock-up Liquor Bottle Frames or Stands, J. B. Elkington, London.
10,328. Producing Fuel, W. Boggett, London.
10,329. Chambers for Drying Portland Cement, H. D. Cunningham, London.
10,330. Lucifer Matches, G. Beattie, Glasgow.
10,331. Regulators for Electric Arc Lights, A. J. Boult.—(*S. Doubrava, Austria.*)
10,332. Device for Reducing Noise of Escaping Gas, &c., C. V. Boys and H. H. Cunynghame, London.
10,333. Sewing Machines, J. Gilmore and W. R. Clark, London.
10,334. Dynamo Dermiques Plates for Nervous Affections, E. Mouron and E. Legras, London.
10,335. Gas Furnaces, W. P. Colchester, London.
10,336. Knitting Machines, H. J. Haddan.—(*F. Fichot, France.*)
10,337. Appliance for Packing Cigars, &c., E. G. Brewer.—(*Messieurs Tinchant Frères, Belgium.*)
10,338. Strengthening, &c., Paragon Umbrella Ribs, G. F. Redfern.—(*D. M. Redmond, United States.*)
10,339. Steam Boilers, &c., T. Lishman, London.
10,340. Regulating, &c., Lights in Railways, &c., J. St. Clair, London.
10,341. Coffee Roasting Machines, J. J. S. Heslop, London.
10,342. Sieves for Grading Barley, &c., C. Lampitt, London.
10,343. Alarm Bolts for Doors, &c., G. S. Brown and J. Gorman, London.
10,344. Raising Window Blinds, &c., G. S. Brown and J. Gorman, London.
10,345. Combinations of Gelatine with Chloride of Cobalt, &c., L. Brockmann, London.
10,346. Wire Ropes, D. H. and G. A. Haggie, London.
10,347. Mineral Gum and Glue, G. W. Bremner, London.
10,348. Automatic Shutting-off of Gas, J. Stott, London.
10,349. Screens for Screening Coal, T. J. Poupard, London.
10,350. Obtaining Motive Power, W. Potter and F. W. Frost, London.
10,351. Stoppering Bottles Externally, F. West and F. B. Armstrong, Surrey.
10,352. Files for Papers, J. F. Bennett, London.
10,353. Heating Air for Laundry Drying Rooms, H. Podger, Bromley.
10,354. Valves used on Board Ship, B. Haley, London.
10,355. Manufacture of Iron for Producing Steel, P. Barry, London.
10,356. Pulp and Half Stuff Machines, J. Brandt, London.
10,357. Combing Machines, A. M. Clark.—(*La Société Bourcart, fils et Cie., Germany.*)
10,358. Manufacture of Horseshoes, T. D. Richardson, London.

13*th August*, 1886.

10,359. Scraping Potatoes, A. T. Chippendale, Blackpool.
10,360. Moving Obstructions in Pipes of Drains, &c., J. L. Cartwright, Birmingham.
10,361. Safety Automatic Swing for Adults or Children, J. Hodgkins, Warwick.
10,362. Fastener for Gloves, &c., J. Cadbury and J. G. Rollason, Birmingham.
10,363. Metallic Knobs or Nails, A. H. Adams, Birmingham.
10,364. Rollers employed in Washing, &c., Fabrics, J. Summerscales and H. C. Longsdon, Halifax.
10,365. Oil Cans, T. Lees, Manchester.
10,366. Double-acting Check Till, W. H. B. Wood, Birmingham.
10,367. Bottling Liquids, S. Bunting, Dublin.
10,368. Loading Cartridges, J. T. King.—(*E. A. Franklin, United States.*)
10,369. Removing Desks, &c., in Schools, J. Cumpstey, Blackburn.
10,370. Filtering Liquids, S. Vickers, Liverpool.—[8*th July*, 1886.]
10,371. Automatic Coupling for Tram-cars, &c., H. East, Birmingham.
10,372. Bottles, &c., for Holding Liquids, G. Francis, Leeds.
10,373. Lock and Safety Brakes for Tricycles, J. P. Taylor, Leeds.
10,374. Window Sashes for Railway, &c., Carriages, G. A. Nussbaum, London.
10,375. Lock-stitch Sewing Machines, D. Jones, London.
10,376. Brewers' Coppers, D. W. Hamper and J. H. Howell, London.
10,377. Locking Nuts on Bolts and Screws, A. Barraclough, London.
10,378. Forcing Draught in Boiler Furnaces, C. J. Croft and F. Dowling, Hertfordshire.
10,379. Milk and Cream Separators, J. T. Brickwell, Coleraine.
10,380. Construction of Zithers, G. Winkelmann, London.
10,381. Fire-grate for Furnaces, E. Edwards.—(*K. Wehse, Germany.*)—[22nd May, 1886.]
10,382. Fittings for Violins, &c., A. N. Mezzetti, London.
10,383. Weighing Machines, G. Reimann, London.
10,384. Door-locks, G. Nobes, London.
10,385. Tennis Poles, J. Malings and W. Muckle, London.
10,386. Extinguishing Fire in Chimneys, E. Abate, London.
10,387. Producing Methyl-morphin (Codein), &c., A. Knoll, London.
10,388. Carding Woollen and Cotton Flocks, &c., C. Gauntlett, London.
10,389. Valve Screw Stoppers for Bottles, H. Barrett, London.
10,390. Breaking and Scalping Grain for Flour Mills, J. H. Carter and G. F. Zimmer, London.
10,391. Instrument for Finding Altitudes and Zenith Distances, G. P. Evelyn, London.
10,392. Apparatus for Collecting the Fee for Closets, &c., J. Gozney, London.
10,393. Conduits, &c., for Electrical Conductors, T. C. Callender and C. E. Webber, London.
10,394. Operating on Animal and Mineral Material for Paint, G. W. Bremner, London.
10,395. Treating Materials for Washing Liquids and Cleansing Powders, G. W. Bremner, London.
10,396. Locking Nuts on Bolts, S. de la G. Williams, London.
10,397. Tobacco Pouches, J. G. Ingram and E. W. Dickins, London.
10,398. Steam Boiler Furnaces, J. S. White and G. E. Bellis, London.
10,399. Teapots, &c., H. Clive, London.
10,400. Tobacco Pipe Joints, C. Ellenberger, London.
10,401. Winding Thread, A. M. Clark.—(*E. Defaÿ, France.*)
10,402. Fastenings for Railway Rails, A. B. Ibbotsen, London.
10,403. Production of Motive-power, J. J. Couchemann, London.
10,404. Telephonic Systems, J. Y. Johnson.—(*A. M. Rosebrugh, Canada.*)
10,405. Water Motive-power Engines, C. W. Thompson, London.

14*th August*, 1886.

10,406. Ships' Rudders, W. H. Wilson and W. J. Pirrie, Belfast.
10,407. Harness for Horses, J. F. Weidner, Newcastle-on-Tyne.
10,408. Ventilation of Rooms, J. Wilson, Bradford.
10,409. Inflated Cycle Saddle Cover, R. U. Martyn, St. Austell.
10,410. Portable Balcony for Use in Cleaning Windows, J. Sneddon, Glasgow.
10,411. Dissolving Apparatus for Optical Lanterns, F. Barber.—(*G. R. Prowse, Canada.*)
10,412. Fastener for Cuffs, &c., F. R. Baker, Birmingham.
10,413. Keyless Mechanism for Fusee Watches, I. Herrmann, Dulwich.
10,414. Stay Busk Fasteners, F. R. Baker, Birmingham.
10,415. Perfect Measure for Tea, &c., Testing, G. Seddon, Lewisham.
10,416. Couplings for Railway Wagons, &c., J. W. Hancock and W. B. Maxfield, Leicester.
10,417. Single Belt Direct-action Controllable Power Transmitter, C. Dickens and H. Imrie, Dublin.
10,418. Silos for enabling Grain to be Drawn-off Uniform, G. Henderson, Liverpool.
10,419. Separating Ammonium Chloride from Liquors obtained in the Manufacture of Soda, G. Jarmay, Liverpool.
10,420. Movable Mantlets for Sationary Target Marking, A. L. Winser, Brighton.
10,421. Setting Potatoes, &c., E. Buckle, Prestwich.
10,422. Rotary Motion, S. Savery, Chipping Detbury.
10,423. Wash or Dip for Sheep, &c., A. MacArthur, Glasgow.
10,424. Attaching Handles to Drawers, J. Gordon, Birmingham.
10,425. Combination Snap Hooks and Whistle for Dog Whips, C. Brown, Birmingham.
10,426. Bedsteads and their Fastenings, T. E. Wale, Birmingham.
10,427. Cutting-off Blank Edges of Wall Paper, J. and J. Eccles, Preston.
10,428. Preventing Overflow of Streams, &c., J. Lanyon, London.
10,429. Expansion Gear of Steam Engines, H. Kühne.—(*W. R. Proell, Germany.*)
10,430. Band Saw, J. and H. J. Anthon, London.
10,431. Knitting Machines, J. H. Cooper and W. J. Ford, Leicester.
10,432. Knitting Machines, J. H. Cooper and W. J. Ford, Leicester.
10,433. Mechanical Rests for Rifles, J. V. Marmery, Brighton.
10,434. Coupling and Uncoupling Railway Wagons, G. McPherson, Glasgow.
10,435. Ambulance Wheel Barrow, F. F. Lee, Salisbury.
10,436. Combination Chair and Fish Plates, A. T. Allen and H. Cavill, Sheffield.
10,437. Percussion Fuses for Projectiles, C. D. Abel.—(*W. Lorenz, Germany.*)
10,438. Enabling Persons to Breathe Pure Air in a Vitiated Atmosphere, G. Runge and A. Stude, London.
10,439. Obtaining Photographic Negatives Formes for Lithographic Printing, J. H. Buxton, H. H. Shanks, and C. H. Evans, London.
10,440. Indicating the Depth of Water on Board Ship, H. A. B. Cole, London.
10,441. Gas Pipe Connections, J. Surl, Tewkesbury.
10,442. Washing and Drying Grain, F. Brandstaetter, London.
10,443. Fixing Candles in Holders, C. L. Wright, London.
10,444. Rotary Engines, P. M. Justice.—(*R. Isbell, United States.*)
10,445. Nose Bags for Horses, R. Cornut, London.
10,446. Opening Envelopes, M. R. and R. V. Carden, London.
10,447. Cylindrical Paper Boxes, F. Hahnlein, London.
10,448. Toasting Forks, C. Halsey and C. F. Arnold, London.
10,449. Gauging Cartridge Cases for Small Arms, F. Bisson and C. Bernard, London.
10,450. Weighing Machines, A. Warner, London.
10,451. Multiple Telegraphy, W. R. Lake.—(*A. M. A. Beale, United States.*)
10,452. Manufacture of Rolled Metal Articles, E. S. Higgins, London.
10,453. Flushing Cisterns, R. B. Evered and N. Coleman, London.

16*th August*, 1886.

10,454. Lifting Water, M. H. Tilley, Dorchester.
10,455. Sand, &c., Paper or Cloth, S. Midgley, Skipton-in-Craven.
10,456. Purses or Portmonnaies with Pocket-books, F. Haas, Dresden, Germany.
10,457. Box-iron, R. Hofér, Dresden, Germany.
10,458. Securing and Removing Frost Calks for Horseshoes, G. H. Wells, London.
10,459. Bottle Cork Extractors, &c., W. Vaughan, Birmingham.
10,460. Bevelling Band Sawing Machines, J. Anderson, Newcastle-upon-Tyne.
10,461. Ships and Vessels for Carrying Fluid and other Cargoes, J. J. F. Andrews, London.
10,462. Tobacco Pipes, S. McLardy, Manchester.
10,463. Detachable Cuff for Shirts, G. Benson, Dublin.
10,464. Fastening Window Sashes, C. Thornett, London.
10,465. Perambulators, &c., T. Thorp, T. W. Thorp, and T. Dineen, Leeds.
10,466. Ships' Winches, T. Thompson, Newcastle-on-Tyne.
10,467. Combination Mackintoshes and other Garments, R. F. Hird, West Butterwick.
10,468. Surgical Truss, R. Harrison, Dublin.
10,469. Smoke consuming Apparatus, S. S. Bromhead.—(*F. J. Anbialet, France.*)
10,470. Boiler for Heating Purposes, G. E. Killick, Crosby.
10,471. Pipe Cleaner, J. F. Mayne, Dublin.
10,472. Bottle-washing Machine, G. Rae, Glasgow.
10,473. Filling and Corking Bottles, G. Rae, Glasgow.
10,474. Self-acting Mules, W. Royle, London.
10,475. Making Two or more Screws or Nuts at One Operation, J. P. Tournier, Enfield.
10,476. Shuttle Spindle, T. Sutcliffe and J. Marshall, London.
10,477. Deposition of Platinum by Electricity, W. A. Thoms, London.
10,478. Guiding the Trawl Rope from Capstan to Trawl Beam for Fishing Smacks, W. F. Crabtree, London.
10,479. Rug and Tidy Machine, J. Garner, Farmworth, near Bolton.
10,480. Petroleum Motors or Engines worked with Liquid Fuel, M. V. Schiltz, London.
10,481. Artificial Gum, M. Strasser, London.
10,482. Decoration of China, &c., N. Kiessling, London.
10,483. Photographic process for Printing in Colours, J. C. Hösch, London.
10,484. Shutter, G. Hudson, London.
10,485. Pneumatic Discharge of Cartridges, &c., O. P. H. A. Straube, London.
10,486. Adjustable Ships' Berths, &c., W. R. Lake.—(*J. Goodwin, United States.*)
10,487. Spittoons for Railway, &c., Carriages, G. J. L. Lang and C. Duckering, London.
10,488. Absorbent Tissue for Surgical and Medical Dressings, S. Gamgee, London.
10,489. Cutting and Gumming Paper for Cigarettes, J. J. G. Aubert, London.
10,490. Bottle for containing Two Different Liquids, H. E. C. Way, London.
10,491. Alkali, J. Barrow, London.
10,492. Reversing Gear for Steam and other Engines, E. D. Barker, London.
10,493. Disinfecting Urinals, R. Brett, London.
10,494. Steam Boilers in which Ebullition of Liquids has to be effected, J. Gamgee, London.
10,495. Regulating the Discharge of Water from Mills, &c., J. C. Mewburn.—(*G. Rostosky, Germany.*)
10,496. Steam Traps, J. Hendry, Glasgow.
10,497. Receiving and Conveying Messages, T. J. Hewson, London.
10,498. Counter Show Heater, T. Mitchell, London.
10,499. Telegraph Keys, J. M. Biggs, London.
10,500. Producing Optical Illusions, G. W. Jones, London.
10,501. Moulding the Beading of Button Boots and Shoes, A. Keats, London.
10,502. Electrical Storage Batteries, E. Frankland, London.
10,503. Wood Doors and other Framing with Zinc, &c., Frames, E. G. Law, London.

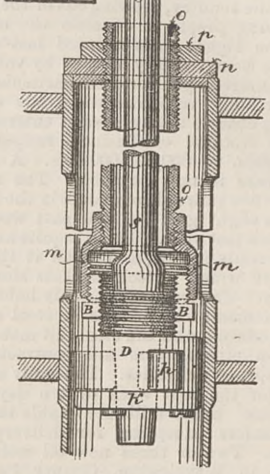
SELECTED AMERICAN PATENTS.

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

343,730. Tube Expander, *George A. Rowell, Brooklyn, N.Y.—Filed November 6th*, 1885.

Claim.—(1) A tube expander consisting of a revolving expanding head constructed with concentric circumferential grooves, and a stationary adjustable collar to engage with said grooves and bear against the end of the tube to be expanded, substantially as described. (2) A tube expander consisting of a revolving expanding head, and an adjustable collar to bear against the end of the tube to be expanded, said collar being

343,730

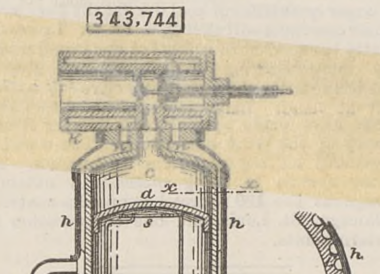


made in sections and held in adjustment by a removable ring or its equivalent, as described.

343,744. Gas Engine, *Stephen Wilcox, Brooklyn, N.Y.—Filed October 12th*, 1885.

Claim.—(1) A cylinder of a gas engine provided with a close fitting continuous wrought iron jacket for strengthening the same, and to allow by its elasticity for the expansion and contraction of the cylinder. (2) A cylinder of a gas engine provided with ribs or projections upon its external surface, and a close-fitting continuous wrought iron jacket, whereby the range of elasticity of the latter is increased and an

343,744

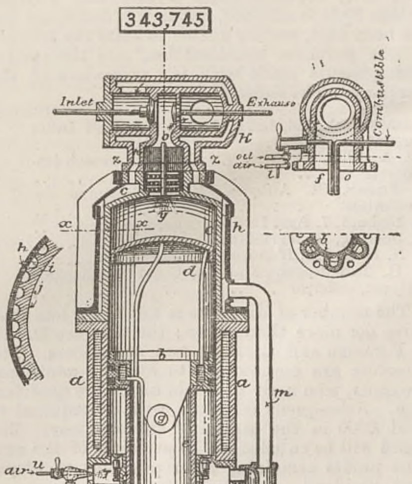


intermediate space provided, through which the compressed air passes on its way to the cylinder. (3) In a gas engine, substantially as described, a water circulating pipe or coil arranged within and adjacent to or in contact with the piston plunger. (4) A cylinder of a gas engine having its extended portion constructed with a grooved external surface and provided with a close fitting wrought iron jacket to form a passage for the compressed air flowing to the cylinder, and having that portion of its surface adjacent to the piston provided with a water jacket.

343,745. Gas Engine, *Stephen Wilcox, Brooklyn N.Y.—Filed November 14th*, 1885.

Claim.—(1) In a gas engine a regenerating device arranged between the point of combustion, the air jacket, and the exhaust passage whereby a portion of the heat of the escaping products of combustion is intercepted and returned to the combustion chamber with the entering air. (2) A gas engine provided with a jacket forming a passage to the entering air, and a connected water jet for supplying moisture to the air, whereby the temperature of the jacket and cylinder is regulated. (3) An igniting device having an oil and air supply, the latter being provided with an auxiliary valve operated by the engine mechanism, so as to

343,745



allow a small current of air to flow past the igniting device and convey the flame to the combustion chamber. (4) In a gas engine, an igniting device in constant communication with the combustion chamber, and located at such distance therefrom as to prevent the cushion or other pressure from forcing back the burned gases and extinguishing the flame. (5) An air pump of a gas engine, provided with a water jet for moistening the air, and a track for collecting and removing condensation or an excess of water contained in the air.