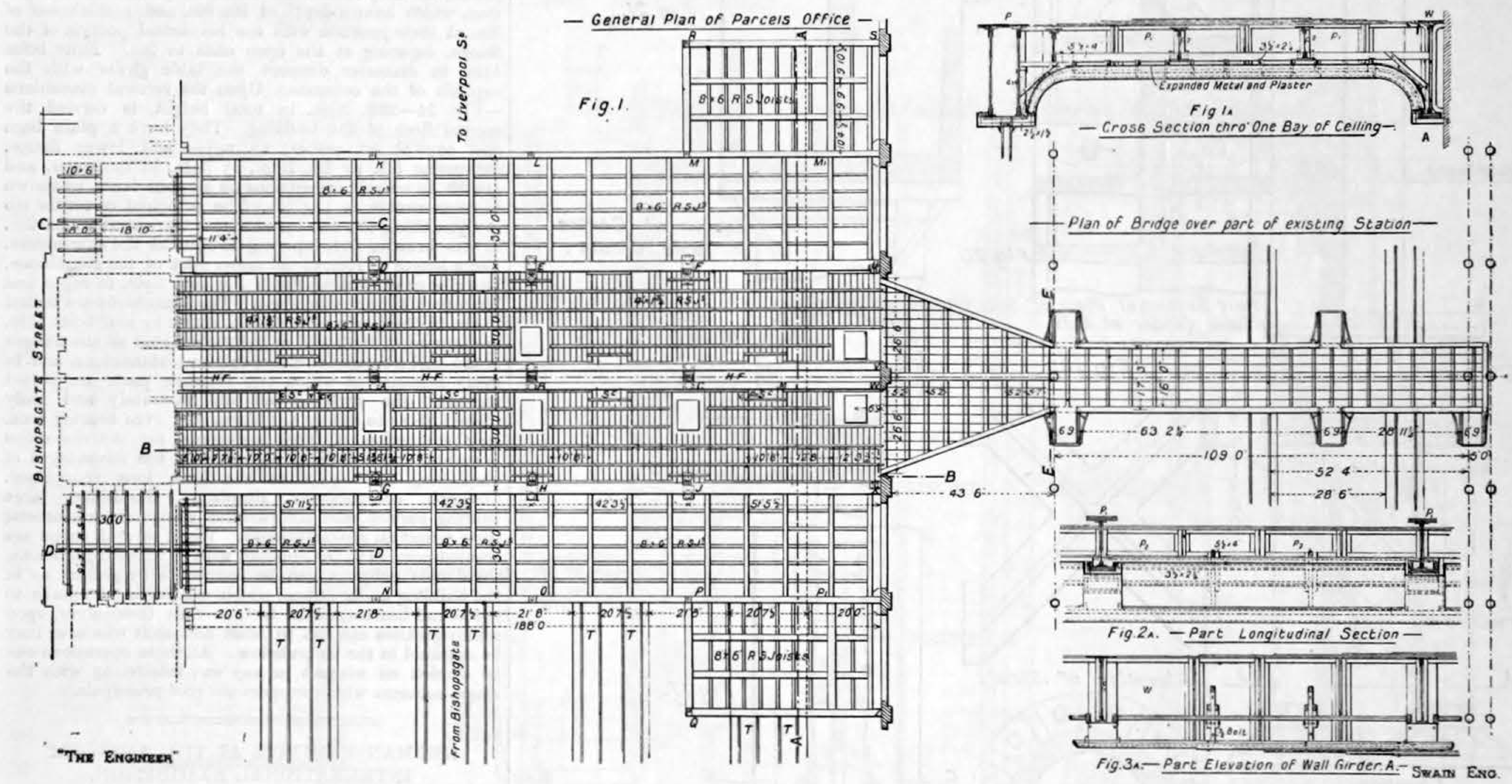
THE ENLARGEMENT OF LIVERPOOL STREET STATION, GREAT EASTERN RAILWAY.

No. IV.

Parcels Office.—It is due to the fact that the terminus of the Great Eastern Railway is on the low level that the "Parcels Office," which we now proceed to describe and illustrate, appears, when viewed from the platforms of the station, to be upstairs, or on the first floor, whereas the entrance to it from Bishopsgate-street is readily effected by means of a pair of inclines, one for ingress and the other for egress, of easy gradient, shown in the "General Plan of Parcels Office" in Fig. 1, at C C, D D, and in elevation in Figs. 4 and 5. There is an incline in Liverpool-street, near its junction with Bishopsgate-street down to the entrance gates of the terminus of the Great Eastern Railway.

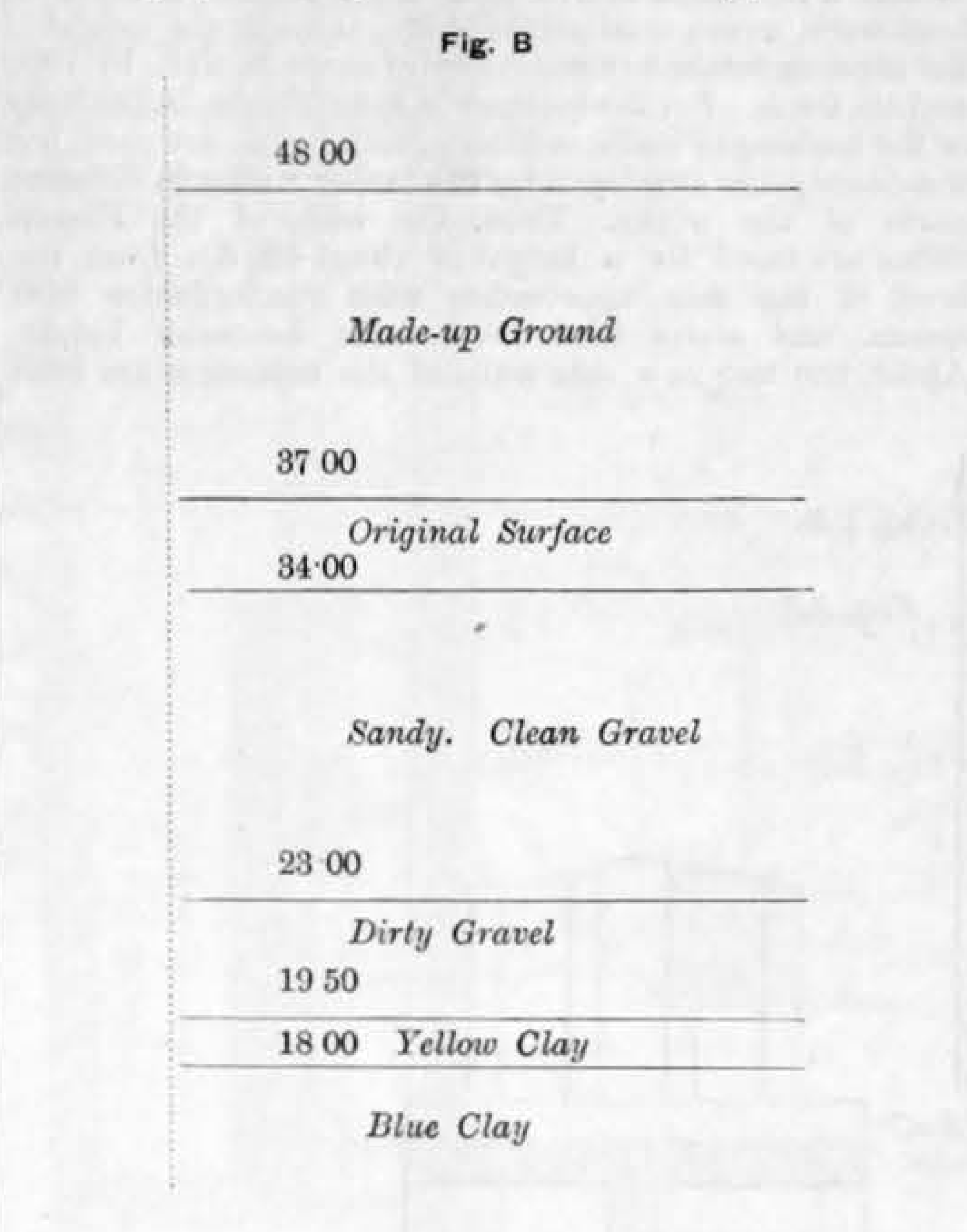
General plan.—The general plan in Fig. 1 represents, therefore, what may be called the ground floor of the Parcels Office, which consists of a pair of central spans of 30ft. each, a pair of covered approaches also of 30ft., situated on each side of the main portion of the building, and forming a continuation of the inclines from Bishopsgate-street, and a pair of wings or returns of the same span of 30ft. These dimensions are all measured in the direction of the lines of track—that is, in the direction of A A in Fig. 1. At the broad end of the office, the central spans are connected with the foot-bridge over part of the existing station by a fantail-shaped covered gallery. At the junction of the gallery or passage with the bridge at E E, there is another foot-bridge at right angles to the former, shown in section and elevation in Figs. 6 and 7. Longitudinally the bays or spans are situated between the cast iron columns, which form the two central spans, are double and spaced 5ft. apart from centres. These bays vary in width from 42ft. 3½in. to 51ft. 5½in. and 51ft. 11½in. at the respective ends of the building. The inclined approaches already referred to are carried under arches which pierce the wedge-shaped site of the shops on the level of the street, shown in the Key Plan in our columns for June last, and thus form two gaps or breaks in the long line of shop frontage, above which are the offices of the company, constituting the real façade of the extension in Bishopsgate-street.



General design.—From the general plan in Fig. 1, cross-section in Fig. 2, and longitudinal section in Fig. 3, the construction is as follows: Upon cast iron columns, double and single, are carried heavy wrought iron plate girders, unquestionably the best type to adopt for the support of a building, the maximum load upon which in actual practice is almost an unknown quantity, and one in which a very small crack or thread, in any of the arches or walls, might be a very serious matter. Anyone who has designed a warehouse for the storage of grain, especially if kept in a loose condition, that is, in bulk, has a very fair idea of the amount of the weight it is possible to pile up on the floor. Into the longitudinal plate girders are framed the cross girders, also of the plate type. Upon them rest rolled steel joists, 8in. by 5in., and weighing 31 lb. per foot run, and to them are riveted smaller steel joists or trimmers, 4in. by 1¾in., at 8½ lb. to the foot. We may now pass on to the details of the construction.

Foundations.—The strata passed through before arriving at the blue clay were composed first of made-up ground consisting of the usual miscellaneous description found under similar circumstances in similar localities, then a layer of earth, or the original surface of the ground. Underneath this there is a stratum of clean gravel, succeeded in downward progression by a bed of a somewhat dirtier description of the same material. A substratum of yellow clay underlies the gravel, and in its turn overlies the blue clay. In Fig. B the approximate respective depths and thicknesses of the different strata are shown, and are readily ascertainable from the levels given at each change in their composition. All the columns and heavier parts of the whole widening of the station were founded at the maximum depth, reaching down to the blue clay; but some of

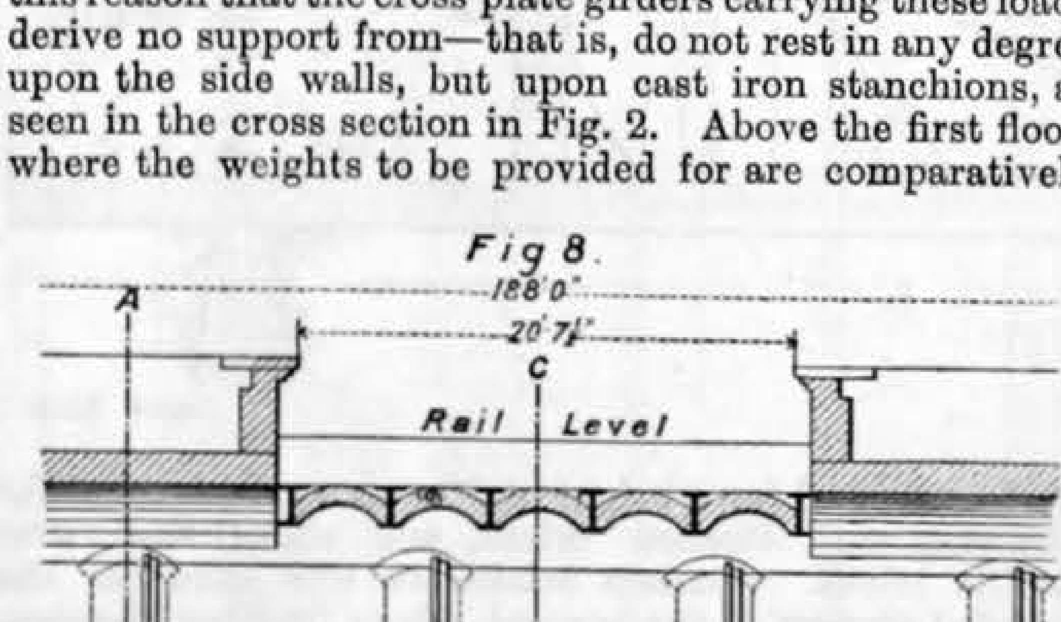
Fig. B



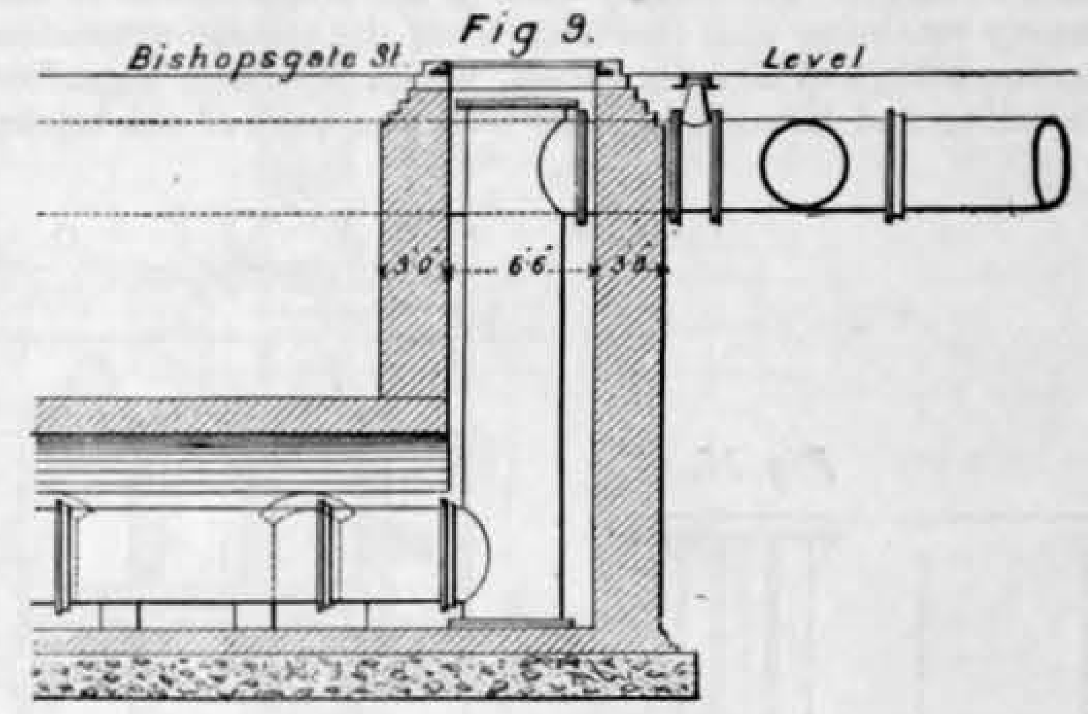
the walls and lighter portions of the buildings found a solid and secure resting place upon the gravel. Had this substratum been of a more rocky or harder character, and had it contained a smaller proportion of sand in it, a less depth might possibly have sufficed for some other parts of the structure.

Cross section.—A cross section of the Parcels Office along the line A A—in Fig. 1—is represented in Fig. 2, from which it will be perceived that the building itself consists of the two spans already mentioned, contained within its two side walls, and that both the ground and first-floor are intended to carry loads of the maximum amount. It is no doubt for this reason that the cross plate girders carrying these loads derive no support from—that is, do not rest in any degree upon the side walls, but upon cast iron stanchions, as seen in the cross section in Fig. 2. Above the first floor, where the weights to be provided for are comparatively

Fig 8.

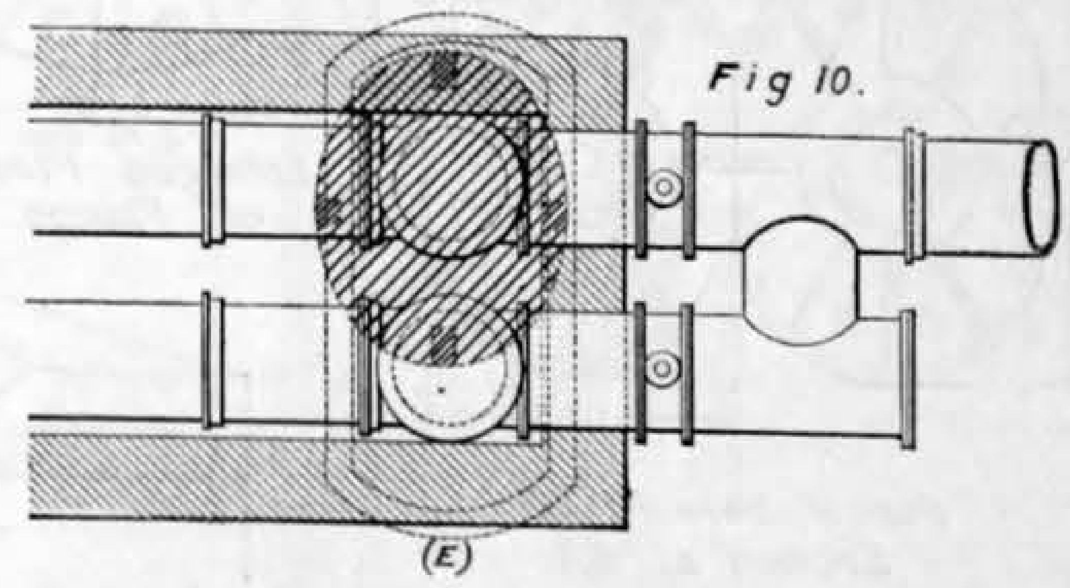


of a small amount, the floor girders and joists are supported in the usual manner by the walls of the building. Both the side approaches and wings or returns are roofed in and protected by a parapet plate girder, shown at P P, in Figs. 2, 4, and 5. In order to carry the mains of the Gas Lighting and Coke Company across the site of the widening, it was necessary to build a subway for them, shown under one of the approaches in Fig. 2, which ran from the existing station to Bishopsgate-street, at a depth of 6ft. below that of the foundations for the rest of the work. In Fig. 8 is a part longitudinal section of the subway under the track and the platforms respectively, and Figs. 11 and 12 show the corresponding cross sections at A B and C D. In Fig. 12, which is a cross section under the rail level, the arch of the subway, which

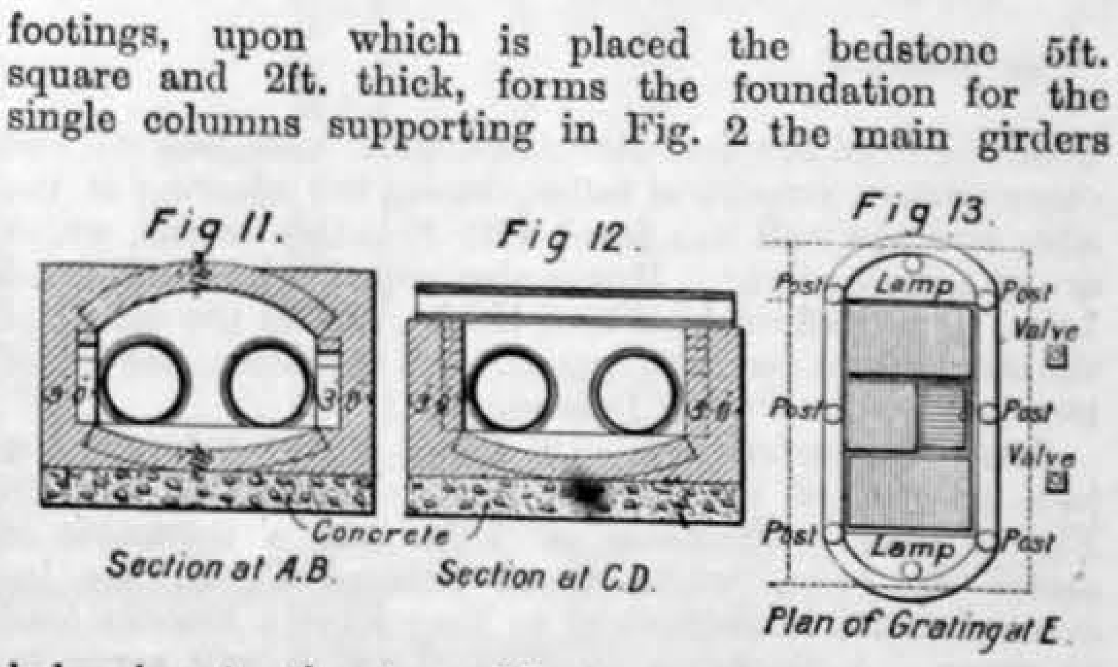


is 11½in. in thickness, when underneath the platforms, as in Fig. 11, is replaced by rolled joists 1ft. 6in. deep, and small jack arches 9in. in depth of brick, as shown also in Fig. 8. The invert has the same thickness as the arch, and is set on a bed of concrete 2ft. thick and 18ft. wide over all, including the side walls, which are each 3ft. in thickness. A vertical section in Fig. 9 shows the intake or connection between the subway and the gas mains, which are 4ft. in diameter, laid in duplicate, 18in. apart, and connected together as in Figs. 9 and 10. An enlarged plan of the iron grating, 12ft. by 6ft., is shown in Fig. 13.

Concrete, mortar, and bricks.—A bed of concrete 10ft. by 10ft. by 2ft., surmounted by four tiers of brick

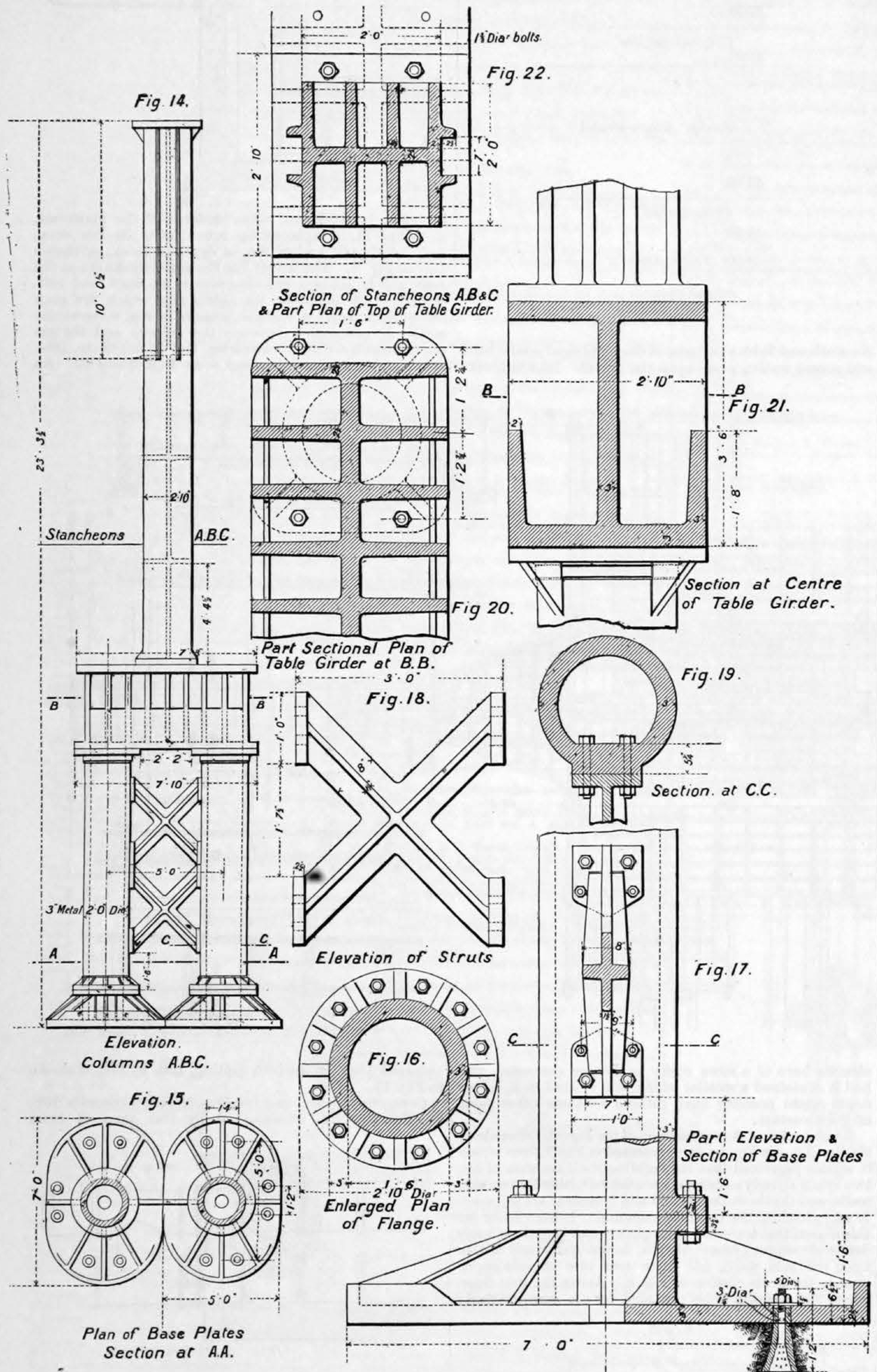


footings, upon which is placed the bedstone 5ft. square and 2ft. thick, forms the foundation for the single columns supporting in Fig. 2 the main girders



belonging to the two side approaches and their returns. According to the nature and situation of the work, so does the composition of the concrete slightly vary. In the foundations generally it consists of one part of Portland cement to six or seven parts of mixed gravel and sand, but in "bad spots" the proportion of cement is increased. Three descriptions of mortar have been used on the works:—(1) Lime mortar composed of one part of blue lias lime and two parts of sharp clean sand. (2) Cement mortar of the same proportions, substituting Portland cement for the blue lias lime. (3) Black mortar in which the ingredients are, one part of sand, one of ashes, and one of lime. This last description of mortar was largely used in the construction of the heavy retaining wall reaching from the station extension to the bridge at Skinner-street, which we shall hereafter describe and illustrate. The wall was built of old bricks obtained from the demolition of houses, walls, sewers, and other ancient structural relics, during the clearing of the site, and the wall was faced with Brindle's bricks, which are of a dark colour. It was also coped with bull-nosed 14in. B B Staffordshire blue bricks, and so the colour of the mortar was made to match. All the bedstones are of the well-known Darley Dale stone.

General construction.—Of these single columns the two exterior of the returns or wings marked C C in Fig. 2 have a diameter of 18in. and a thickness of metal of 1¼in., while those lettered C_1 C_1 are increased to 2ft. in diameter, as they have a heavier load to carry. A reference to Figs. 2 and 3 will serve to indicate the general construction of the Parcels Office, the first floor of which stands upon twin cast iron columns, and the second floor on vertical centre and side stanchions of a particular section. These double columns rest upon bedstones having a superficial area in feet of 12 by 10 and a thickness of 1ft. 9in. Five footing courses of brickwork, with a total height of 3ft., transfer the weight of the superstructure to a solid mass of concrete 21ft. by 19ft. and 3ft. thick. For the footings in foundations, in the body or the backing of walls, ordinary stock bricks are used, but the description employed for the facing varies in different parts of the works. Thus, the walls of the Parcels Office are faced for a height of about 4ft. 6in. from the level of the side approaches with Staffordshire blue bricks, and above that level with Leicester bricks. Again, the two new side walls of the extension are built of stocks, faced for a height of 7ft. above the level of the platform with Ruabon bricks, and above that with Suffolk bricks. Ruabon bricks are also used for the rounded corners in the general offices fronting Bishopsgate-street. Suffolk bricks form the facing of that portion of the new buildings, relieved by ornamental stone dressings from the quarries of Portland, Monkspark, and Bosgrove. While generally all the work above ground is set in lime mortar, the bedstones are laid in cement, and in all cases where new walls have been joined on to old ones, cement mortar is used to bond them together with.



"The Engineer" Swain Eng.

Double columns and stanchions.—An elevation of the double cast iron columns and vertical stanchions running down the centre of the building in Figs. 1, 2, and 3 is represented to a larger scale in Fig. 14. From base to capital the columns, which are 5ft. apart from centre to centre, are 9ft. 11½in. in length, or measured from top of the bedstone, 11ft. 5½in., have an external diameter of 2ft. and a thickness of metal of 3in. At the lower extremity each column is widened out so as to form a flange having a diameter of 2ft., and a thickness of 3¼in., and bolted down to the bed or base plate by twelve bolts spaced 12in. apart and of a diameter of 1⅝in.—Fig. 16. These base plates are of cast iron and oval in shape, with conjugate diameters of 7ft. and 5ft. respectively, as in Fig. 15. In Fig. 17 there is an enlarged plan and section of the base plates, which are 1ft. 6in. in total height, have a thickness of top flange of 3¼in., equal to that of the lower flange of the columns to which they are bolted, a thickness in the body of 3in., while in the lower flange the same dimension tapers from 3in. to 2½in. at the circumference, which has a rib or fillet 6½in. deep throughout. Six lewis bolts —Figs. 15 and 17—1¼in. in diameter and 1ft. 2in. long, hold down the base plate of each column to the concrete foundation, and are screwed home by a nut and washer 5in. in diameter and ⅝in. thick. Cast iron struts of the form and dimensions shown in Figs. 14—19 are used to brace the twin columns together in the figure of a couple of St. Andrew crosses, and are 8in. wide at the centre, 5½in. at the ends, and 1½in. in uniform thickness. These braces are bolted to the columns by two bolts 1⅝in. in diameter and two of 1in. in diameter, spaced 7in. and 9in. apart, and where the attachment occurs the columns are thickened out from 3in. to 5¼in.—Figs. 17—19. The capitals of the double columns, which have a space of 2ft. 2in. between them, are surmounted and connected by a "table girder" of cast iron 3ft. 6in. in total depth —shown in elevation on Fig. 14, and in plan and section in Figs. 20 and 21. It is 8ft. in total length, 2ft. 10in. in width, and 3in. in thickness in the centre rib or web, and in both the upper and lower flanges, which are of very different forms—Fig. 21. The former is a simple horizontal flange, but the latter is provided with two vertical or side plates, as they would be called in girders of wrought iron, which have a depth of 1ft. 8in. and a thickness of 3in. at their junction with the horizontal portion of the flange, tapering at the open ends to 2in. Four bolts 1½in. in diameter connect the table girder with the capitals of the columns. Upon the vertical stanchions —Fig. 14—23ft. 3½in. in total height, is carried the second floor of the building. They have a plain base and capital, or, rather, an upper and lower flange, measuring 3ft. by 2ft. 10in., by 3½in. in thickness, and are 2ft. in outside dimensions on all four faces, as shown in cross-section in Fig. 22. The principal or centre rib is 2½in. thick, the two interior and two exterior ribs 2in. at the broader end, tapering to 1¾in. at the extremities. For a length of 10ft. of the upper part of the stanchions, two ribs or projecting fillets are cast 2½in. in depth and 7in. apart from inside edges. The stanchions are bolted to the upper flange of the table girder by four bolts 1⅝in. in diameter. It should be mentioned that all the flanges of the cast iron girder work, columns, stanchions, and in every instance in which two separate parts are bolted together, the surfaces are all accurately and truly planed, so as to ensure a uniform and even bearing area. In the erection of large workshops for the numerous branches of mechanical engineering, the advantages of employing twin columns has been long recognised. Strength, compactness, simplicity, durability, large bearing surface, and comparative cheapness, are among their principal characteristics. When several shops are erected parallel to one another, with or without partitions, the double columns can be connected by girders, as in the building under notice, which can further be made to act as rail bearers, or, in fact, as rails themselves, upon which gantries can run to hoist and shift whatever may be required in the shops below. All these operations can be carried on without in any way interfering with the single columns which support the roof principals.

GERMAN EXHIBITS AT THE ANTWERP INTERNATIONAL EXHIBITION.

(*From our Special Commissioner.*)

Probably the largest makers of wire rope and electric cables on the Continent are Messrs. Felten and Guilleaume, of Mülheim. At Antwerp their exhibit of all classes of wire rope is not only larger than that of any other firm, but is one of the most important installations in the German section. Commencing with various gauges of iron and steel wire, plain and galvanised, they next show different sorts of copper and brass wire, including some specimens of high conductivity for telephones. Besides these, they exhibit two descriptions of a special make of wire. One of them, which they call "compound," consists of a core of steel and an outer covering of copper or brass. By this means a wire is obtained possessing the elasticity and tensile strength of steel with the conductivity of copper. The other special wire is made in the same manner, but of two different classes of bronze. The inner part consists of a wire capable of standing a great breaking strain, and this is covered with a metal of high conductivity. As there is very little difference in the composition of the metal in the two sorts of bronze, they are affected in the same manner by variations of temperature, and the result of this method of manufacture is a wire with qualities possessed by no homogenous wire of any description. The exhibitors say that it is more particularly noticeable for its extreme flexibility. Tests are given of the conductivity, elongation and breaking strain of the copper and brass wire which are exhibited. The breaking strain of the steel wires is also given; one of these, made of crucible steel, is stated to have supported a strain of 185 tons to the square inch. They also show some very fine brass and steel wire looking like silk. This is used chiefly for sewing silk neckties, and for making up fancy work.

As this firm started the manufacture of galvanised iron wire in 1853, and had then for many years been engaged in making wire rope, they are able—from their own products—to show the changes and developments which

THE ENLARGEMENT OF LIVERPOOL STREET STATION.—PARCELS OFFICE

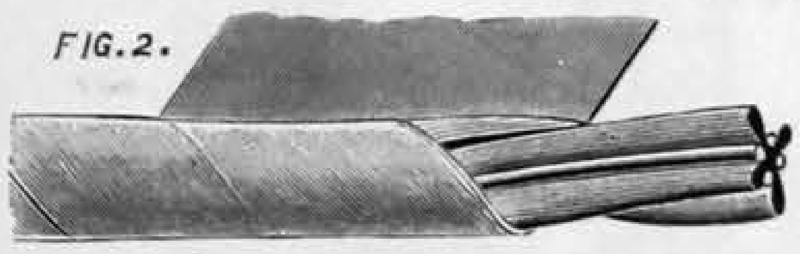
MR. JOHN WILSON, M. INST. C.E., ENGINEER

(For description see page 313)

have taken place in all classes of wire cables. In those made of galvanised wire for shipping, &c., very thick wire was used in the earlier ones, and gradually finer in cables of more recent date. The same may be said of mining cables, of which—both round and flat—a good historical collection is shown. But the most interesting part of Messrs. Felten and Guilleaume's exhibit consists in their electric appliances. Commencing with single wires coated with india-rubber or gutta-percha, and not otherwise protected, they show how wires have been grouped; how steel wire has succeeded iron for sheathing, and how special preparations of caoutchouc—such as okonite, kerite, &c.—have been introduced as insulators. Their latest improvements consist in insulating by means of prepared paper, and using wire of Z section for sheathing. Fig. 1 shows two wires with a flat strip of paper

FIG. 1.

FIG. 2.



between them, twisted together and then covered by a band of paper. In Fig. 2 the strip of paper is in the form of a cross; it serves to separate four wires, which are twisted and covered as in Fig. 1. These groups of wire are then made up into a cable, and covered with lead or other protecting material as may be desired. Besides lightness and cheapness, the use of paper has other advantages. The small quantity of air which is necessarily enclosed when the paper is twisted, helps to insulate and increases the conductivity of the wire; and by the use of different coloured paper, it is easier when making joints or repairs to distinguish to which circuit a wire belongs. Telephone cables of this description have recently been put down in Rome, Munich, and St. Petersburg. The Z-shaped wire was first introduced for wire rope tramways, but it is now used for other purposes. Figs. 3 and 4 show a submarine long-distance telephone cable. The group of four wires, insulated by paper, as described above, is enclosed in a leather sheath, and then covered with

FIG. 4.

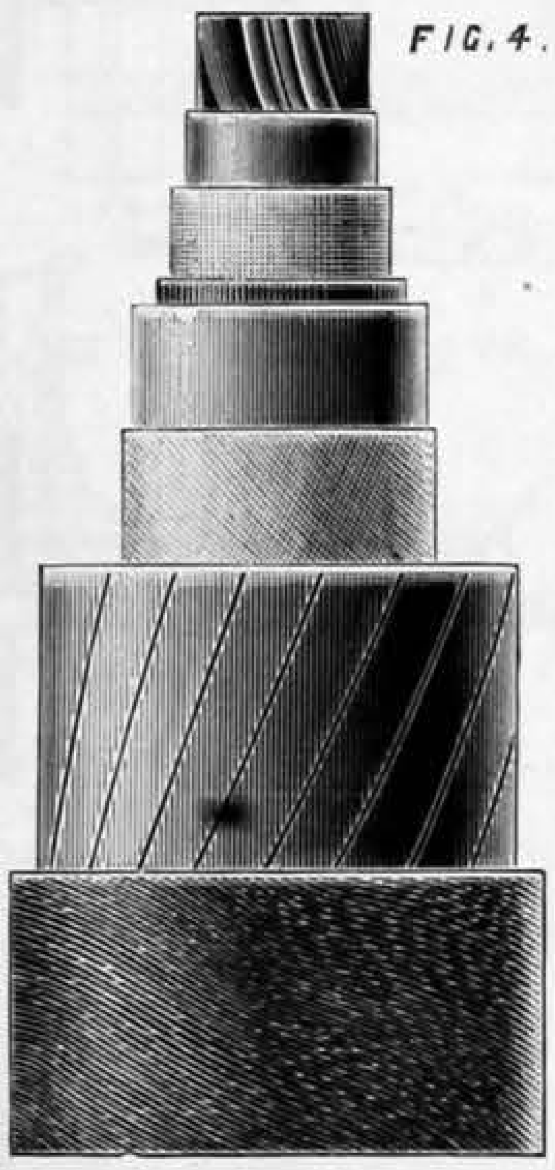
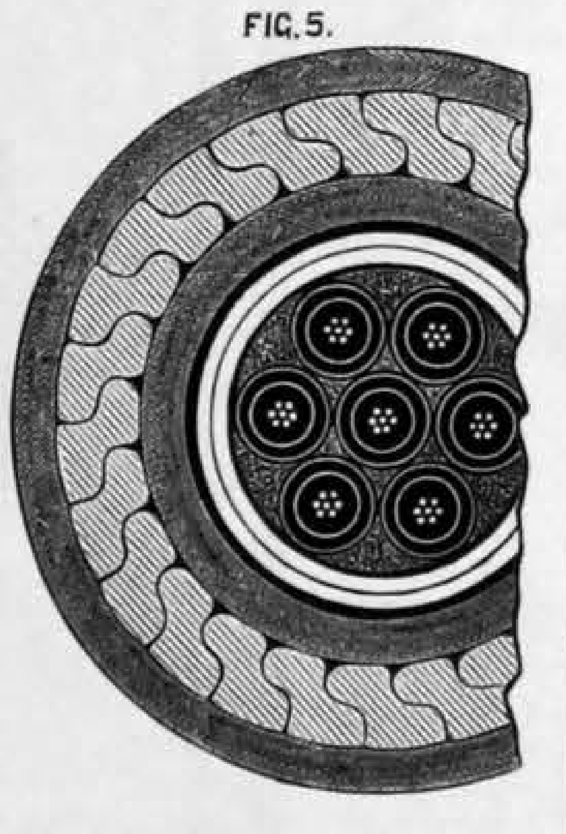


FIG. 3

two layers of gutta-percha. Round this an asphalted ribbon is wound, and then the Z-shaped wire. As in this, each strips interlocks with the next one, an incompressible and impenetrable covering is formed. Finally it is covered with a water-tight composition. When using cables made with this special form of wire for aërial tramways, it will be seen that more than half of the outer covering must be worn away before one strand of the wire can become displaced.

One of the latest cables made by this firm is shown on Fig. 5. It is for the telegraph from Goeschenen to Airolo, through the St. Gothard tunnel. It was put in place in October, 1893, to replace one by the same makers laid in 1882. As it has been found in the working of the tunnel that the sulphuretted hydrogen, sulphuric acid and ammonia, contained in the water which exudes from the walls of the tunnel, have affected the rails and sleepers, it was necessary to take special precautions. The cable is formed of seven groups of seven copper wires, each $\frac{1}{30}$in. in diameter, insulated by alternate layers of Chatterton's composition and gutta-percha till the diameter of the conductor was $\frac{1}{4}$in. Round this, impregnated ribbon was wound, and the seven conductors were then coiled, and covered with tarred ribbon. This was surrounded by a double sheath of lead, covered with an insulating composition, on which twenty-five strands of the special wire were wound, dovetailing into one another as shown on the drawing. A layer of a special composition outside this wire completed the cable, which when finished had a diameter of $2\frac{3}{64}$in. The total length was ten miles, and it was supplied in half-mile sections, each section weighing approximately fifteen tons.

FIG. 5.



Another part of this exhibit consists of junction boxes. Small boxes are shown for the union of two or three cables, with joints made either by interlacing and soldering the wires, or by connecting them with two strips of copper held by set-screws. Besides these, there are two large distribution boxes, one for the three-wire, and the other for the two-wire system. They are in cast iron frames on brick foundations, and are provided with manholes and covers. The three-wire box is divided into eight chambers, for the reception of twenty-four cables, of which three are feeders, and twenty-one distributors.

There are several other exhibits at this stand showing different applications of wire, such as door-mats made of galvanised steel wire rolled spirally, and engine packing, formed of bundles of very fine iron or brass wire plaited together.

Another large German exhibit is that of the Phœnix Company of Laar. This firm show steel tram rails of every section used, as well as angle, T, Z, and many irregular sections of rolled steel. They also have bottles for containing liquid carbonic acid, and other liquefied gases, in all stages of manufacture. One steel bottle, which is intended for liquid hydrogen, is 8in. diameter, 4ft. 7in. long. It holds eight gallons, and has been tested to 4400 lb. on the square inch. Its weight empty, including valve and cover, is about a hundredweight. Besides these, they exhibit wheels, steel shells, and some hardened steel balls for mills.

The Mannesmann Tube Works of Düsseldorf have also a collection of steel bottles for liquid carbonic acid, oxygen, hydrogen, &c. The liquefied gas in these, exerts a pressure of about 1000 lb. to the square inch; but the bottles are all tested to 3700 lb., and are usually capable of standing a pressure of 7400 lb. before bursting. One of these bottles is exhibited which was filled with carbonic acid, and allowed to fall across a steel rail from the height of 23ft.: it is only slightly dented. Another speciality of this firm is the manufacture of drawn steel tube telegraph poles, One of those exhibited is 36ft. long, in one piece. Poles of this description are usually made with several offsets, and taper gradually to a point; for the sake of appearance the offsets are hidden by ornamental cast iron rings. Several special descriptions of steel tubes form part of this exhibit. Amongst them are boiler and refrigerator tubes, hardened tubes for soundings, and polished steel tubes for the frames of bicycles. They also show different sizes of steel shells.

A very fine display of copper pipes, bends, &c., is made by the Elmore's Metal Company, of Cologne. The largest piece is a pipe 17ft. long, 15in. external diameter, $\frac{1}{2}$in. metal. They also show examples of the application of the Elmore process in covering worn iron hydraulic press pistons, pump plungers, and other similar pieces with copper.

German machinery has mostly been kept in its proper place—the Machinery Hall; but there are two exhibits of machinery in the main building worth noticing. The first is that of Messrs Huck and Co., of Bielefeld. They manufacture various descriptions of lifting and traversing jacks, differential and other pulleys. One peculiarity in their lifting jacks is a safety brake, by which the pressure can be taken off immediately, or the object which has been lifted can be lowered at any desired speed. The lifting handle turns a small ratchet wheel on the outside of the machine; this wheel is hollow, and contains a strong spiral spring which presses against its inner circumference, whilst one end of it is solidly fixed to the main shaft. When the handle is turned, the pressure of the spring causes the ratchet wheel to revolve. On ceasing to turn the handle, the pawl prevents the ratchet wheel from going back, whilst the pressure of the spring is enough to keep the shaft from turning. A slight turn of the handle backwards lessens the pressure of the spring sufficiently to allow the weight to descend, but directly the handle is released, the spring tightens and the downward movement is arrested. In another form of jack, there are two tooth-wheels on the same shaft as the pinion which drives the rack. These tooth-wheels are turned by two four-toothed pinions on a counter-shaft, one set at 45 deg. to the other. By this means friction is lessened, the lifting is more regular, and jerks are avoided. The differential blocks shown by Messrs. Huck are powerful for their size. The gearing is of wrought iron, machine finished and case-hardened, and is all boxed in, the chain-wheel only being outside; the casing, however, is made to open for oiling or cleaning.

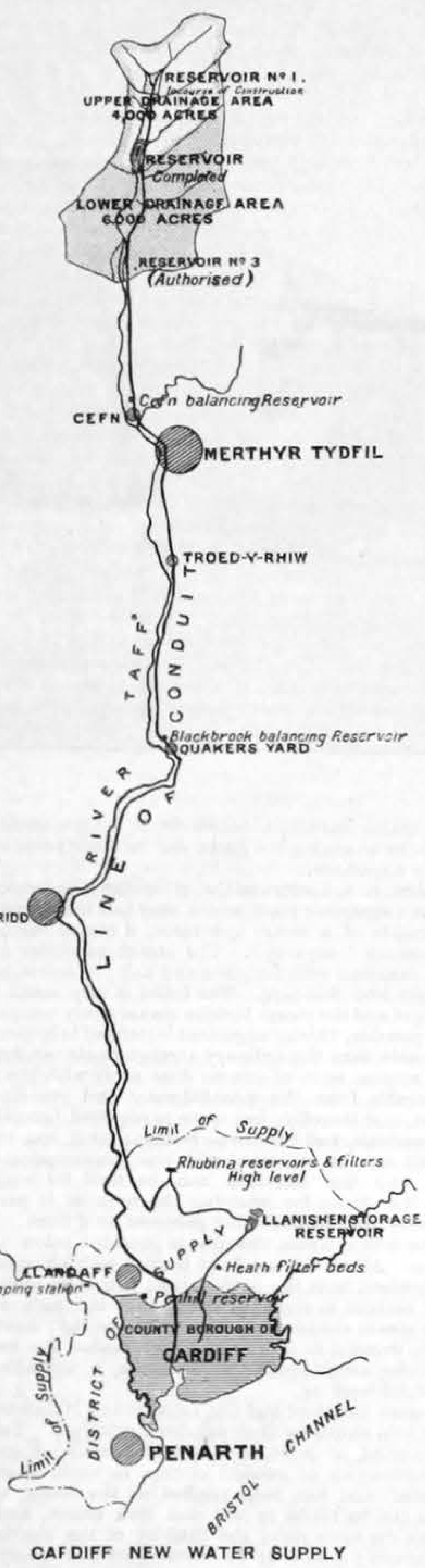
Another useful appliance in this section is a measuring machine exhibited by Mr. J. H. Ermbter, of Neuss. It is intended for measuring and marking all sorts of woven materials, felt, wall-paper, &c. The machine exhibited is constructed for metrical measurements, and will measure up to 1000 metres, showing also $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ metres, or 10, 20, 30, &c., centimetres. It resembles a small winch; the material to be measured is placed on a roll at one side, with one end passing over the main drum of the machine. A printing disc presses on this, and at each revolution stamps the number of metres. The colour, which dries immediately, can easily be removed, and will not injure silks and other thin textures of light shades. When marked, the material is rolled up at the other side of the machine. The marking disc can be put in and out of gear by a lever, or can in a few seconds be set back to recommence at No. 1. The motive power can be hand, foot, or steam. By employing this machine, the output of a cloth or linen factory can be measured by unskilled persons, and without fear of error; and it is especially useful as a check, for instance, in stock-taking.

A clever arrangement of sliding windows is shown by Mr. F. J. Schürmann, of Münster. On the Continent they usually object to sash windows, because they can only be opened half way, and also on account of the extra expense and trouble required for fitting sash lines, pulleys, and balance weights. But door windows have also their inconveniences. When they open inwards, a space must be kept clear for them; and they rarely shut tightly top and bottom. Besides this, they must either be wide open or entirely closed. An ordinary sliding window running in a groove would also have one of these defects; it would never shut tightly. The window exhibited is suspended; each leaf hangs from two pulleys, which run on a rail above. Either iron or wood can be used for the rail, and where there are shutters, as in the one shown, a bar of channel iron serves as a rail for both. Grooves are cut in the rail, and it is bent towards the casement, at the positions which the pulleys will assume, just before the window is closed. This causes the pulleys, and consequently the window, to make a three-fold motion; it drops the depth of the groove, moves laterally, and towards the frame. The edges of window and frame being cut on the level, this triple movement presses the window firmly against the frame, keeping out all rain or draught. When a strip of wood is used for the rail, the pulleys have india-rubber tires, to ensure their running noiselessly. To open the window, it is first lifted by a lever at the side, which moves the pulleys forward out of the groove; and there is then no trouble in sliding it. The exhibitor says that this window can be supplied cheaper than door or sash windows of the same size; and as it is easier to open, heavier glass can be used, thus keeping out the cold better. The same system can, of course, be adapted to warehouse doors, railway carriage windows, and tram car doors. It was originally devised for a wooden summer-house, but where used for a masonry building, a casing is required into which the panels can slide. This makes them more suitable for wooden buildings, such as are used in the United States, than for an average English or German brick-built house; though possibly some people may consider that they offer advantages which more than compensate for the disadvantage of having to provide a receptacle for the window, when open; and there are many buildings, such as stables and stores, where there is no occasion for the glazed panel to be concealed when the window is open.

Switzerland has only one exhibit of interest to engineers. It is an apparatus for the manufacture of condensed milk, shown by Messrs. Sulzer Brothers, of Winterthur, whose exhibits of brewery plant at other exhibitions have several times been described in The Engineer. The milk is first warmed in an open copper pan, and the requisite quantity of sugar is then added to it. The second operation takes place in a closed copper, into which the milk is drawn from the open pan at a temperature of about 120 deg. Fah. by means of a vacuum pump, which exhausts the air in the copper. This vessel is egg-shaped, and the sides are lagged with wood. It is heated by steam passing through two independent copper worms, and also underneath a false bottom. The level of the milk is seen on a gauge glass, and steam is only admitted to those parts which are covered with milk, so as to avoid over-heating and burning. There are also small cocks through which samples may be drawn, as well as thermometers at different levels, pressure gauges, &c. When the milk is sufficiently evaporated, which requires four or five hours, it is drawn out by the vacuum pump and passes to the coolers. These are forty circular vessels $11\frac{1}{2}$in. diameter, 26in. deep, in a wrought iron tank. Spur wheels at the bottom of the tank cause the milk pans to revolve, whilst fixed rousers —which are let down into them—stir up the contents and keep the milk from becoming lumpy. Water flows through the tank, and when the cooling—which takes about an hour and a-half—is complete, the milk is ready to pack.

THE CARDIFF NEW WATERWORKS.

The Cardiff Corporation, after some unfortunate experiences of the private contract system, resolved to take into their own hands the construction of the extensive chain of reservoirs which are now being rapidly proceeded with in the Breconshire mountains some forty miles northward of the town. A brief account of the opening of No. 2 reservoir was published in The Engineer two years ago; but the work then accomplished represented the least difficult part of the undertaking. A recent visit to the scene of operations shows that great progress has been made in the interval with reservoir No. 1, and reveals at the same time a remarkable transformation in the face of the romantic Taff Vawr valley. Whatever differences of opinion there may have been as to the relative merits of the site, only one view now prevails among engineers and all other visitors to the works, and they have come from the United States and many parts of the Continent. The gathering ground dips down from the crest of the Brecon Beacons to a natural basin at the head of the old river channel. The mean rainfall of the watershed is about 60in. per annum, as compared with 61in. at Vyrnwy, the Liverpool works; 62in. in the valley the Birmingham Corporation are at work in; at Thirlmere, $81\frac{1}{2}$in. in a dry season, 104in. in a wet year; and $53\frac{1}{2}$in. at Woodhead, until now the main source of the Manchester supply. The capacity of the three reservoirs is:—No. 1, 335 million gallons; No. 2, 322 million gallons, and No. 3, 670 million gallons. No. 1 is expected to be completed in three years, and it is calculated that with No. 2 it will supply the needs of Cardiff, rapidly as the town is increasing, for ten years. But meanwhile the excavation and embanking of the third reservoir will be commenced with more or less rapidity in proportion as the population of the borough approaches the standard of 280,000, the estimated number in fifteen years time. The vast scheme, it should be added, has almost paid its own way, and as the town, and consequently the number of consumers, becomes greater, it will do so to an even greater extent. According to the chairman of the Water Committee—Mr. Alderman David Jones—it was anticipated that the cost of the undertaking would be met by a rate of $2\frac{1}{2}$d. or $2\frac{3}{4}$d. in the pound, and although, through unforeseen circumstances, No. 2 reservoir involved a much larger expenditure than was estimated, the rate has not exceeded 3d., which may diminish as time goes on and an advancing community makes greater demands upon the water supply. The most noteworthy features —see map, next page—of the work executed since last autumn, entirely by Corporation employés, under the personal direction of Mr. J. A. B. Williams, C.E., the water engineer, and the author of the whole design, are the main trench and the discharge tunnel. The main trench, undoubtedly the most important achievement so far, runs across the valley 1060ft. in the open, and 1300ft., including the drivings, into the hillsides. The excavation in some places dips to 75ft., and is now finished, with a concrete bed resting on the solid water-tight rock. At its base the embankment is 400ft. wide, narrowing to 30ft. at the top, and the stone toes may also be said to be practically completed. So with the discharge tunnel, an admirable piece of work, which at present is used to carry off flood water, and will ultimately serve its purpose of draining the reservoir, when it is necessary to cleanse the bed. No inconsiderable amount of engineering skill and costly work, not obvious perhaps to those unfamiliar with the scene of old, were involved in the diversion of two highway roads, one to Brecon and the other to Hirwain, in order to raise their level and widen the limits of the lake. The Corporation possess

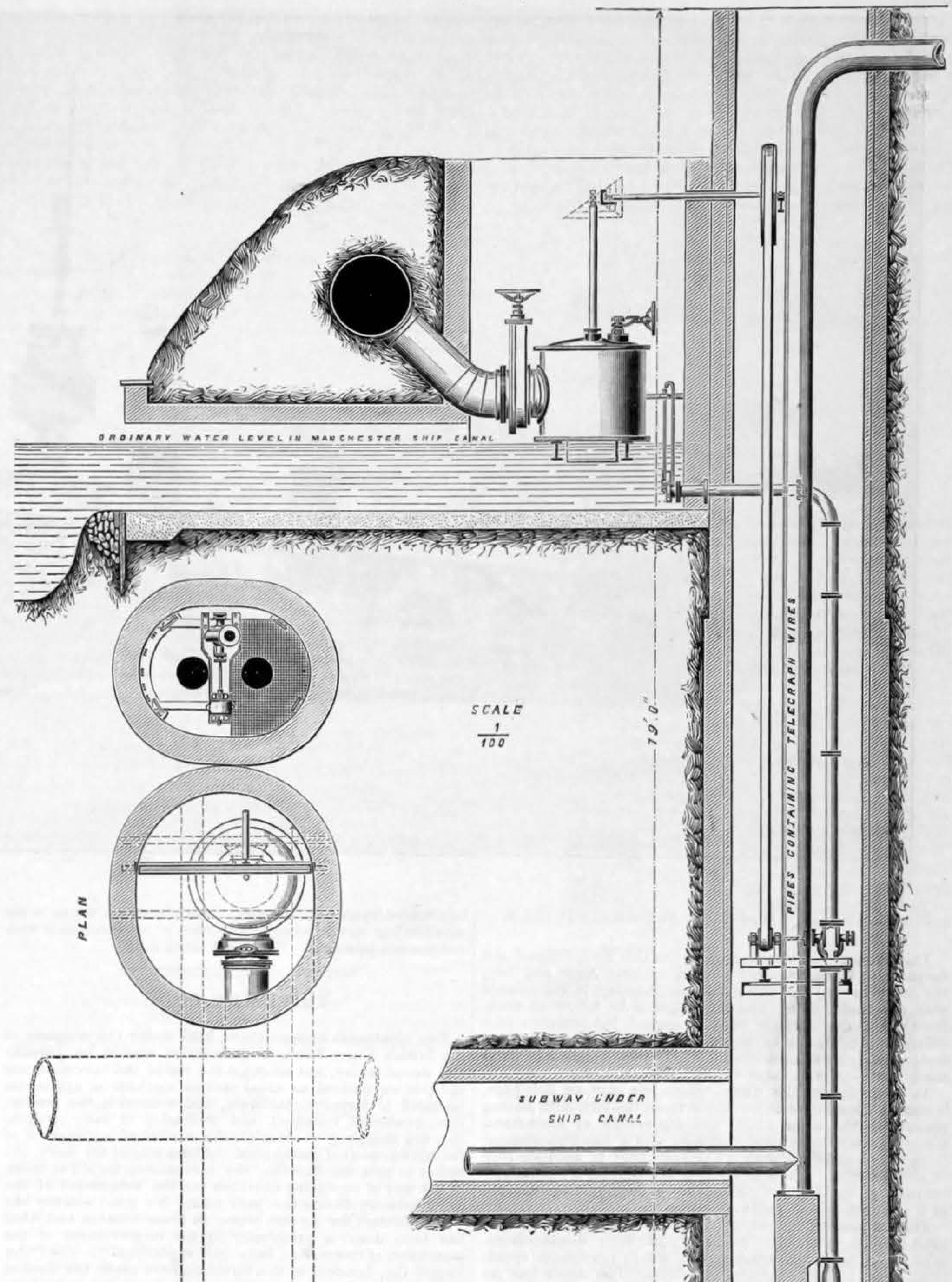


CAFDIFF NEW WATER SUPPLY

excellent limestone quarries close to the reservoirs, and the stone and gravel for the concrete is obtained from the old bed of the river and crushed on the spot. There is a complete establishment of engine repairing sheds, wagon-making shops, a fitting shop and smithy, and here all that is needed is done for the locomotives, the one hundred odd trucks, the eight portable engines, and sixteen cranes. Besides these are $7\frac{1}{2}$ miles of Corporation railway to the village of Cefn, where many of the workmen live. For the accommodation of the remainder of the men a little township of well-built houses has arisen by the side of No. 1 reservoir, with a large general store, a post-office, a public reading-room, a school-room, a chapel, together with a missioner, who acts as school-master on weekdays and a spiritual comforter on Sundays.

TURBINE AND PUMP, MANCHESTER SHIP CANAL

MR. C. L. HETT, BRIGG, ENGINEER



HARBOURS AND WATERWAYS.

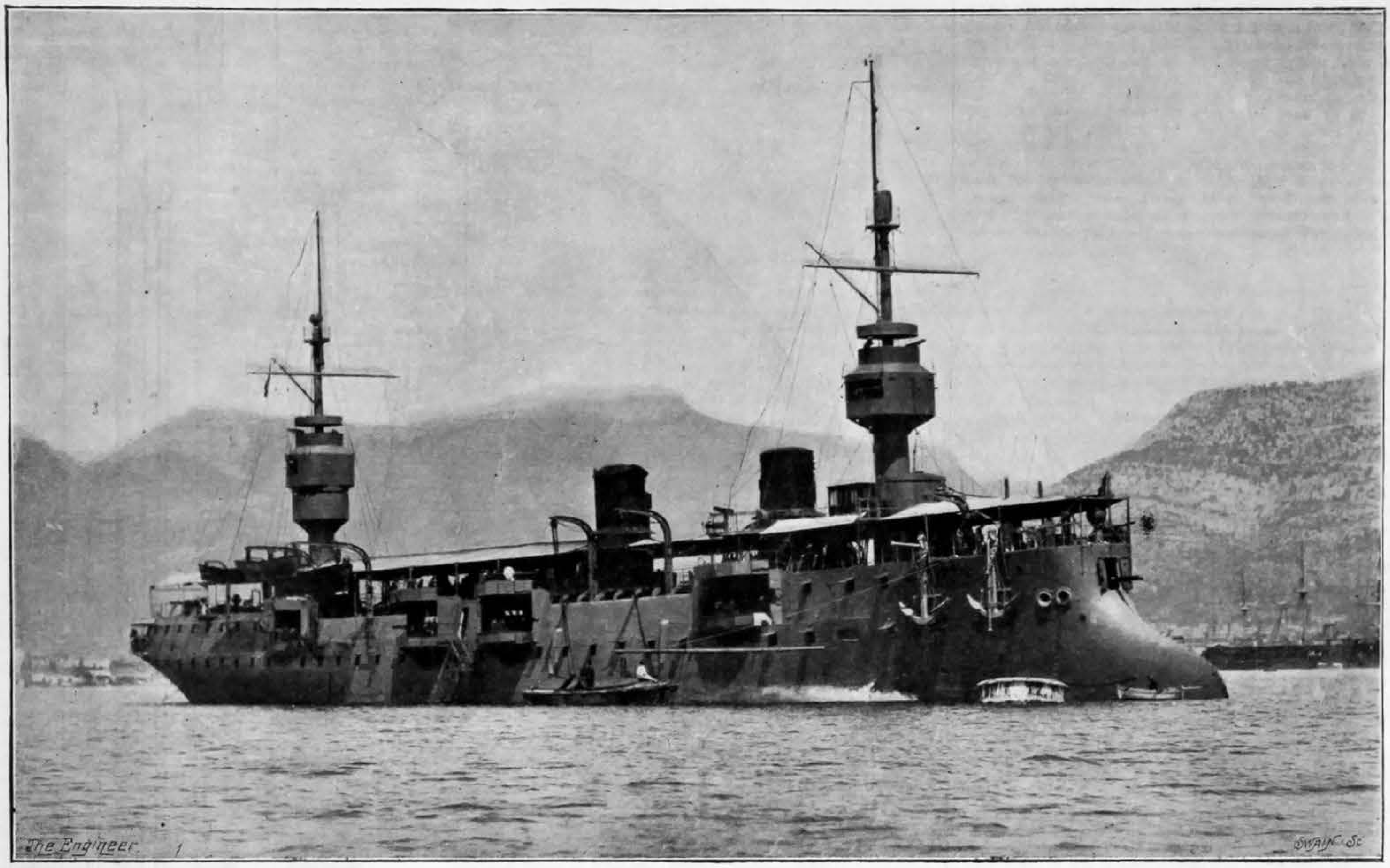
Grand Canal.—At the half-yearly meeting of this company, held at Dublin, the chairman reported that the net profits for the year amounted to £13,126, which allowed of the payment of a dividend of $3\frac{1}{4}$ per cent. The receipts from the carrying trade showed an increase of £765 over the previous year. During the year the Barrow Canal had been purchased at a cost of £30,000 for the navigation and £2500 for the plant and steamers. It is intended to build ten additional steamers for the Shannon, to accommodate new traffic, and to fit up more barges with steam power. A suggestion was brought forward at the meeting for an extension of the system in order to complete the 750 miles of the canal, which would connect the system with Belfast, Newry, Dublin, Waterford, and Limerick. It was thought that this scheme was beyond the means of the company.

The Danube.—Shortly before the close of the last session a report was presented to both Houses of Parliament on the further improvements made in the navigation of the Danube between 1878—1893. The report states that since the final completion of the piers at the Sulina mouth, the depth of $20\frac{1}{2}$ft. has been constantly maintained. At the close of last year it was determined to increase the depth to $23\frac{1}{2}$ft. by constructing parallel dams between the piers to increase the scour and by dredging; a new powerful hopper dredger being now under construction for the purpose. When this increased depth is obtained vessels which at the present time have to complete their cargoes in the roads will be able to carry out their operations in the port of Sulina, and so avoid the delay which occurs when rough weather prevails and prevents the barges lying alongside the vessels. The cutting of a new channel between the eighth and eighteenth miles commenced in 1890, which has suppressed three difficult bends and shortened the course by $4\frac{1}{2}$ miles, was completed last December at a cost under the original estimate of £152,000. It has now been decided to undertake another cutting $3\frac{1}{4}$ miles long between the thirty-first and thirty-seventh miles above Sulina, for the purpose of doing away with four bends and shortening the course of the river $1\frac{1}{4}$ miles, at an estimated cost of £96,000. When the works were first commenced it was intended to secure a depth at low-water of 13ft., and this was attained by training and regulating the channel by groynes. In 1880 a new series of works was commenced with a view of securing 15ft. and removing some of the worst bends. These works were completed in 1889, and the depth of 15ft. was secured, the channel being shortened about two miles. These works were carried out at a cost of £384,000, which was £96,000 below the original estimate, and the advantages secured were very much greater than promised. The works now in hand, it is expected, will give a depth of $20\frac{1}{2}$ft. along the whole of the Sulina branch when the river is at its medium height, and at a season when the shipping is busiest. All the loans effected by the Commission for carrying out the improvements have been paid off, the current income being sufficient to meet the expenses of the works now in hand in addition to the ordinary maintenance. The works have from the commencement been carried out under the direction of Sir Charles Hartley, Mr. Kuhl acting as resident engineer.

MANCHESTER SHIP CANAL.—TURBINE AND PUMP AT TWENTY STEPS BRIDGE.

As promised in our issue of the 3rd of August, we now give an illustration and description of the pumping installation recently put down for the Manchester Ship Canal Company by Mr. Chas. Louis Hett, of the Turbine Foundry, Brigg. The plant is intended to keep the subways—which were made for the purpose of conveying the telegraph and telephone wires under the canal—clear of water, to enable the authorities to inspect the lines at any time. The motive water is obtained from a 48in. main, which connects two streams in the vicinity, from the level of which to the ordinary level of the Ship Canal there is a fall of about 9ft. The turbine is one of Mr. Hett's Hercules type, €0 c.m. diameter, with vertical shaft enclosed in steel case, and fitted with sluice valve for shutting off the water for examination or repairs. The regulating gear of the turbine is mounted on the top of the case. The pump is driven by a belt from the turbine, and is a 6in. Accessible type, designed to lift 600 gallons per minute, with 45ft. lift, at a speed of 1220 revolutions per minute. The presence of the large pipes in the pump well necessitated making a special pump suitable for placing between the pipes, as shown in the illustration. The tail water flows into the Ship Canal through a culvert 3ft. wide, and the pump also discharges into this culvert, the discharge pipe being fitted with a penstock and air pipe to enable the pump to be examined when desirable. On these occasions the water is drawn from the delivery pipe through a cock fitted in the body of the pump. The whole of the work has been carried out under the supervision of the company's engineers, and has been found to fulfil its purpose admirably.

THE FRENCH CRUISER ALGER



THE FRENCH CRUISERS ALGER AND ISLY.

The French Minister of Marine has this week ordered the despatch to China of the first-class cruisers Alger and Isly, the latter having actually started on Tuesday, in compliance with the instructions, and the Alger is to follow at once. Both vessels are complete in every respect, but present a very different appearance to that anticipated in their original designs, which was somewhat similar to the Tage—a heavily-masted cruiser, with large sail surface.

An engraving of the Alger, which we give on this page, is equally illustrative of her sister vessel the Isly, both having practically the same class and disposition of armament, almost exactly the same dimensions, and a like arrangement of sponsons and deck plan. The Jean Bart is another ship of similar type. The engraving is taken from a photograph obtained of the Alger, whilst she lay off, completing afloat—as is the custom—at Toulon.

The dimensions, &c., of the Alger are as follows:—Length, 346ft.; beam, 45ft. 3in.; draught, 19ft. 6in.; displacement, 4122 tons; indicated horse-power, 8254; maximum speed, 19·61 knots; coal capacity, 860 tons. The Alger has no vertical armoured protection, but a curved steel armoured deck runs from stem to stern, and this is 3½in. thick—far stouter than as allowed in our cruisers of equivalent displacement, the Astræa type. The armament of the Alger is, moreover, immeasurably more powerful than that of the Fox or Astræa. She carries four 16 cm.—6¼in.—and six 14 cm. —5½in.—quick-firing guns as a main armament, against two 6in. and eight 4·7in. of similar type in the British vessels, and ten smaller quick-firers, with ten machine guns and four torpedo tubes. But what adds very considerably to the effective gun power of the Alger and Isly is the fact that all their eight heavy broadside guns are in protected sponsons, so that an overwhelming end-on power can be obtained when necessary. It has been recently advanced that an effective broadside fire is of greater value than end-on fire, and this must certainly be admitted as regards vessels which are designed for fighting in line of battle, as the effect produced by broadside firing from ships advancing in "line ahead," or "in column," as it would be expressed by landsmen, is absolutely crushing. We assume that the enemy is practically motionless, and "in line abreast." But a cruiser is a free lance, and expected to act, as a general rule, independently, so that her axially directed armament—after her speed—is her great feature.

The Alger and Isly have a high freeboard, in this respect resembling the four large cruisers which are doing such excellent work for the Japanese at this moment, and her coal bunker divisions are so arranged as to add immensely to the security afforded by the armoured deck. The conning towers are thickly armoured, and shelter decks are over all the upper deck gun positions. The fighting masts are of large size, with double staircases, and search lights in the upper tops, as may be seen in the engraving. The Isly attained a speed of 16·8 knots with natural, and 18·1 knots with forced draught, whilst her trials were being made in an exceptionally heavy sea; hence she must be a good seaboat. The Jean Bart has already displayed excellent properties in this respect.

It is clear, then, that France is despatching a very powerful reinforcement to her already strong China squadron, and that if her interests in the East demand such prompt and effective action, Great Britain ought not to be behindhand. The European community in Hong Kong, Shanghai, Hankow, and Tientsin, &c., consists practically of Englishmen, with a few Americans only, except at Tientsin, where they are numerous. The German and French merchants might be counted upon one's fingers. It is, therefore, for us to see whether our naval strength in China is commensurate with our present interests. We do not think it is.

THE DAIRY SHOW.

The nineteenth annual Show, held under the auspices of the British Dairy Farmers' Association, opened on Tuesday and closed to-day, and amongst the varied and miscellaneous exhibits we noticed as usual various mechanical appliances intended to improve, facilitate, and accelerate the production, treatment, transport, and utilisation of dairy produce. It is not necessary to chronicle the continued appearance of the time-honoured mechanical contrivances of the dairy, but rather to note the direction the mechanical mind has taken in the way of producing novelties for the betterment of the dairy industry during the past year. No great activity has been exhibited during this period in these matters, and what has been done is principally in the improvement of the separation of cream, &c., from milk, centrifugally. The Dairy Supply Co., London, in this direction have made the discs of their "Alpha" separator of a steeper angle, and claim thereby to increase the separating capacity without any increase in the power required for working; whilst to a small pattern of separator, the "Humming Bird," they have applied a strap and ratchet gear, the strap being alternately pulled and allowed to recoil as in some well-known toys, and a thorough separation of cream is rapidly effected with apparently a ridiculously small amount of exertion, the operator casually chatting and answering questions, while the stream of separated milk and cream run regularly from their respective spouts. The Dairy Outfit Co., London, now place within their separator a 1½in. thick metal cylinder or drum, for large sizes, made of aluminium. This cylinder is perforated with holes inclining upwards at an angle of 55 deg. in their passage from the outer to the inner surface of cylinder; the stream of milk directed in the usual way, passes up between the periphery of the revolving vessel and the cylinder, the cream passing through the perforations to the inner side of the cylinder, where four wings or blades, provided for the purpose, cause it to pass upwards to be discharged from the cream spout. The use of this honeycombed cylinder is stated to increase the efficiency to such an extent as to permit of seventy-five gallons per hour being separated by means of a small hand machine. This novelty is known as the "Empress" cream separator, and gained a silver medal. These and various modifications in centrifugal testing machines for stimating equality of milk, cream, and butter, are to be seen in number. In the latter graduated tubes containing the milk, cream, or melted butter are attached by their necks to a centrifugal machine, and are whirled round. When the separation is achieved the thickness of the various layers is measured, and the proportion of each constituent is determined. To avoid fracture of these tubes in some cases it is found advantageous to have them immersed in water when whirling. A churn, exhibited by S. Cheeld, of Chesham, consists of an open round vessel—a tub, in fact—which is made to revolve on a table whilst suspended in a socket in a cross piece. Resting on cast iron supports, is an iron rod which can be adjusted to any height and fixed by a screw. This rod at its lower end carries two or more vertical blades extending laterally so as to nearly reach the wall of the revolving vessel. The cream when run in is dashed against these blades, and is rapidly converted into butter or butter-milk. This is called the "E.C. churn." It makes butter with considerable rapidity and with a very small expenditure of power, and for this it gained an award in the butter-making contests. The same maker has also a butter dryer on the same principle, which, by changing the parts, can be readily converted into a testing apparatus.

Messrs. R. A. Lister and Co., of Dursley, Gloucester, exhibit a farmer's separator plant which they call the "Farmer's Rig." It consists of a steam generator, a steam turbine, and an "Alexandra" separator. The steam generator is an elaborated cauldron with fireplace and ash-pit below, and with a wrought iron flue-pipe. The boiler is very small and neatly arranged and the steam turbine makes a very compact arrangement possible. This arrangement is claimed to be more generally applicable than the ordinary arrangements involving the use of an engine, as it of course does away with the accessories inseparable from the establishment and sustaining of an engine, and therefore less space is required, less primary cost, less renewals, and besides no belting; by it, too, 1500 gallons of milk can be separated with the consumption of 28 lb. of coal; and the cauldron can be used for cooking cattle food, the steam for warming the milk as it passes to the separator, and sundry other purposes on a farm. For warming the milk a steam chamber is provided below the feeding cistern. Above this is a false bottom with an opening on the side farthest from the outflow tap; this false bottom rests on metal battens so arranged as to direct the milk over the top of the steam chamber on its way to the tap; hence the milk is only warmed as it flows to the separator, the mass of milk remaining unchanged in temperature, a desirable factor for successful working.

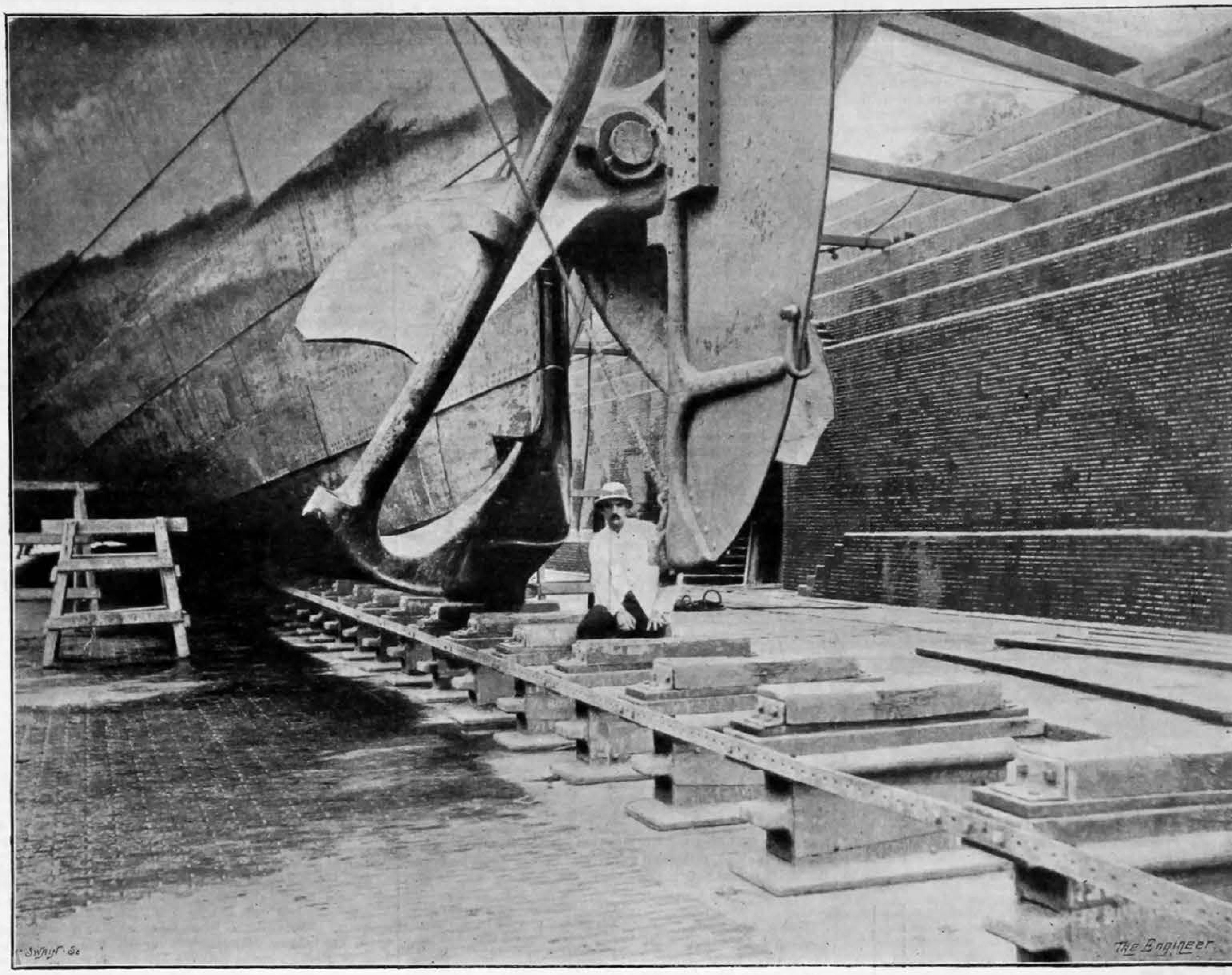
Thomas Bradford and Co., London and Manchester, exhibit a cast iron churn on their fish-back principle. This material was selected to overcome difficulties arising from expansion and contraction of wooden churns in warm climates, and it is stated, and has been verified at the Show, that perfect butter can be made in the cast iron churn, and curiously enough the more rusty the interior of the churn the more satisfactorily does it do its work, provided always that the rust is clean, the product of a good scalding rinse, with boiling water, after churning, with subsequent rusting, until the time for next churning, whether the interval be a day or a week. This exhibit obtained a silver medal.

Messrs. Pond and Son, London, obtained a bronze medal for a refrigerator, which consists of a series of superimposed horizontal tubes, so arranged that the cold water entering at the lowest traverses the whole length of each tube in succession until it leaves the apparatus at the end of the uppermost tube. The milk runs down the outside of these tubes, first encountering the upper ones, finally passing over the lowest and coolest tube before leaving the refrigerator.

There are various vehicles and other appliances that have received awards and attracted some attention, but for reasons already stated do not call for our special notice. The Disc Churn, for instance, is again somewhat prominent; is now mounted differently, and has obtained some successes in the butter-making contests.

We see that steam is making due progress in aiding dairy operations, and we are rather surprised not to see some exhibit illustrating the application of electricity in the dairy, more especially after the recent demonstration witnessed at Mr. James Blyth's dairy at Stansted, Essex. There the cream separator and various butter-making machines are driven by a shunt-wound 1-horse power motor, made by Messrs. F. H. Ruyer and Co., running at 1800 revolutions per minute; it is controlled by a multiple resistance switch. The shafting transmitting the power is coupled direct to the armature of the motor, is 1in. in diameter, and runs near the level of the floor. The power for driving the motor is derived from accumulator, which besides furnish light in various parts of the demesne; the accumulators are charged

THE BENT STEEL STERN FRAME OF THE S.S. LINLITHGOW



from an Edison-Hopkinson shunt-wound dynamo, driven by one of Marshall's semi-portable compound engines, 12 nominal horse-power. The whole was installed by Messrs. Pritchetts and Gold, of London, and gives great satisfaction. At the time of our visit it certainly was working well, and therefore we are surprised not to see any electrical aids for the dairy at the Show.

CAST STEEL STERN FRAMES.

THE above engraving is from a photograph of the stern of the s.s. Linlithgow, and affords a remarkable illustration of the value of cast steel stern frames. The s.s. Linlithgow, owned by Messrs. Raeburn and Verel, Glasgow, is a vessel of 3137 tons gross tonnage. She was built by Messrs. C. S. Swan and Hunter, Wallsend-on-Tyne, and was fitted with a cast steel stern frame made by John Spencer and Sons. The vessel left Messrs. Swan and Hunter's yard in the early part of this year. On her voyage she went ashore at Gocanada, Bay of Bengal, and twisted her stern frame as shown in the photograph, after which she was towed to Calcutta, put into dry dock, and the stern frame was bent back about 8ft. into position, and the vessel is now returning to London with full cargo.

PROGRESS OF BESSEMER STEEL.

CONSIDERING the general position of the trade of the country, it augurs well for the vitality of the Bessemer steel trade that the production during the first half of the current year should be about $3\frac{1}{4}$ per cent. larger than in corresponding period of 1893. It is true the increase is by no means large, but it is decidedly better than the decline that might reasonably have been expected. The 784,712 tons of the closing half of last year have become 810,392 tons, or an augmentation of 25,680 tons. The details given by the British Iron Trade Association in their official report issued a few days back on this subject are, when examined, both instructive and suggestive. In the first place, it is clear that the material is already being used for much more than rails. In 1882 practically the whole of the ingots produced were made into rails, whilst at the present time considerably more than one-half the ingots are rolled or hammered for other purposes. Another point to be observed about the statistics is the small proportion of available steel-producing plant that is being utilised.

Of the 104 Bessemer converters built in the kingdom, only 60 were at work at the end of June. The relative positions of the various districts with regard to ingot productions are as follows:—1, North-East Coast; 2, South Wales; 3, West Cumberland; 4, Sheffield; 5, Lancashire and Cheshire; 6, Staffordshire and Scotland. The proportion of basic to acid ingots in the Bessemer or pneumatic process, which in the first half of 1893 was 127,938 tons to 656,774 tons, has risen in the corresponding period of the present year to the following:—178,736 tons to 631,656 tons. This being so, we should expect that the acid process should be in vogue where good hematite pigs are near at hand, or easily obtainable, than elsewhere, and this is indeed what the statistics show, for Wales has made 181,839 tons; West Cumberland, 158,930 tons; and Lancashire and Cheshire, 104,532 tons—all of acid. The presence of and proximity to good pig iron in the southernmost portions of Yorkshire is also reflected in the 107,214 tons of acid Bessemer steel ingots made in Sheffield and its locality. On the other hand, in the North of Yorkshire, the presence and almost exclusive use of inexpensive phosphoric ores is shown by the North-East production being 129,142 tons of basic steel ingots, against only 73,141 tons of acid.

THE INSTITUTION OF CIVIL ENGINEERS.—The rebuilding of the Institution of Civil Engineers will not affect the place of meeting, as such arrangements have been made as will allow of the theatre and reception rooms under to be retained for use during the approaching session.

PORT MANCHESTER.—The result of a consideration of circulars issued by the Manchester Canal Company urging the advantages of chartering to and from Manchester has been to cause Baltic men, amongst others, to ask sundry questions, some of which are given in *Fair Play* as follows:—What advantage do merchants gain in sending consignments up the canal?—Was not the freight last year $\frac{1}{32}$d. per pound more than to Liverpool, although steamers paid no canal dues? Is not the carriage by rail from Liverpool to Manchester the same as this difference, *i.e.*, $\frac{1}{32}$d. per pound? (It was stated so some months ago.)—Does not an importer prefer to land at Liverpool and have the advantage of the market there if it cost him no more to send his goods on to Manchester eventually?—Does not the spinner prefer to buy in small lots in Liverpool?—What amount of combination is necessary to get such buying altered to induce people to import cotton they cannot see beforehand, and without the choice of an assortment, it may be?—If spinners buy in large bulks, where will they store them?—Can Manchester offer facilities with as low rates of insurance?—It must be remembered that an expensive equipment is necessary for storage warehouses to enable goods to be received in them and delivered out quickly.—What cargoes which usually come in bulk has Manchester a market for? Timber, grain, and cotton, perhaps.—Does she crush seed like Hull, refine sugar like the Clyde, or weave jute like Dundee?—Does she expect that general cargoes will be sent up to the canal and distributed thence when Liverpool has so many lines of steamers, railways, canals, &c., available, and does not need to send consignments for other ports up to Manchester and bring them down again?—As to outward business, has Manchester any bulk cargoes?—How many of coal has she shipped? Can she offer iron in the bottom of vessels loading general cargo, as many other ports do; or are her principal exports light rather than heavy cargo, which ought to go in last rather than first?—These are a sample of questions which Baltic men and others would like to have answered before they can estimate how many steamers can be chartered for Manchester—profitably, of course. The business might be done magnificently, like the Balaclava charge and the making of the Manchester Canal. But will it pay? That is the question.

WAVERLEY STATION, EDINBURGH.

THE completion of the tunnels under the Mound, in Edinburgh, which was recently accomplished, is another step towards the much-needed widening of the North British Railway Company's system in traversing the capital of Scotland. The opening of the Tay and Forth Bridges has led to great congestion of the traffic in Edinburgh, and the widening now in active progress is not being carried out a moment too soon. The piercing of the Mound has not been unattended with anxiety, for the material is "made" earth throughout, the Mound being an artificial bank connecting the northern and southern portions of the city, and carrying the valuable buildings of the Scottish Royal Academy, which had necessarily to be guarded from any possible damage from the excavations to be carried out beneath them. The widening has been accomplished by driving a single-line tunnel on each side of the existing double-line. Each new tunnel is lined throughout with cast iron segments having an external diameter of 18ft. 6in. The grouting has been performed with Arden lime, Greathead's patent grouting plant being employed for its injection.

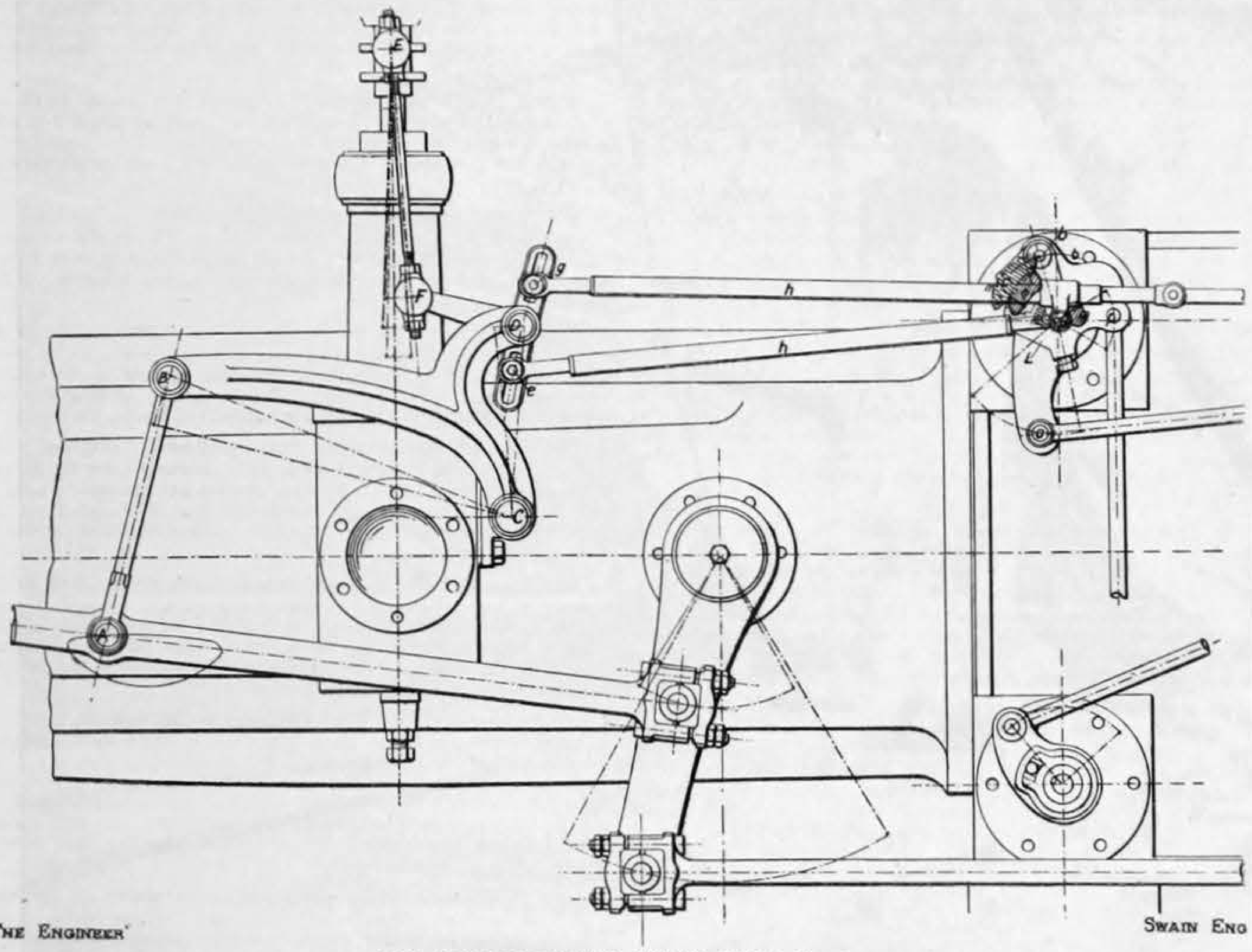
Compressed air has been employed throughout the work, which was commenced in August, 1893. The maximum air pressure attained was 20 lb. per square inch above atmosphere, and the average working pressure may be stated at about 15 lb. per square inch above atmosphere. Thirteen rams of 4in. diameter operated the shield with a pressure ranging about one ton per square inch. Hand pumps were provided for giving pressure. The excavation was carried on in lengths of 4ft. 6in.—the average number of men employed per shift being about twenty. The air-lock, which served both for the passage of men and spoil, was a wrought iron cylinder 12ft. long and 6ft. diameter. The segments were lifted into position by hand, no tackle being employed. Each ring is composed of thirteen segments and a 9in. key piece, the segments being 1ft. 6in. wide, and 7in. deep over the flange. Both back and flanges of the segments are $1\frac{3}{4}$in. in thickness, and are connected and stiffened by fourteen stout brackets or feathers in each casting. The number of bolt holes in the long and short sides is six and three respectively, and $1\frac{5}{8}$in. bolts are employed throughout. The brackets or feathers in the long and short sides are $1\frac{5}{8}$in. and $1\frac{1}{2}$in. thick respectively. A special feature to be noted in connection with these tunnels is that the segments are planed on every face, and that no recess is left on the inner edge for filling or packing. On completion the lower portion of the segments of each tunnel are filled with concrete flush to the full depth of the flanges. The faces of the tunnels are elliptical in form to correspond with those of the existing tunnel, and are built of handsome and substantial dressed freestone.

The work has long been looked for with interest by those who travel northward frequently, and especially since the accident which happened near the station about two years ago. It has been carried out by Mr. Geo. Talbot, under instructions from the engineers of the North British Railway Company.

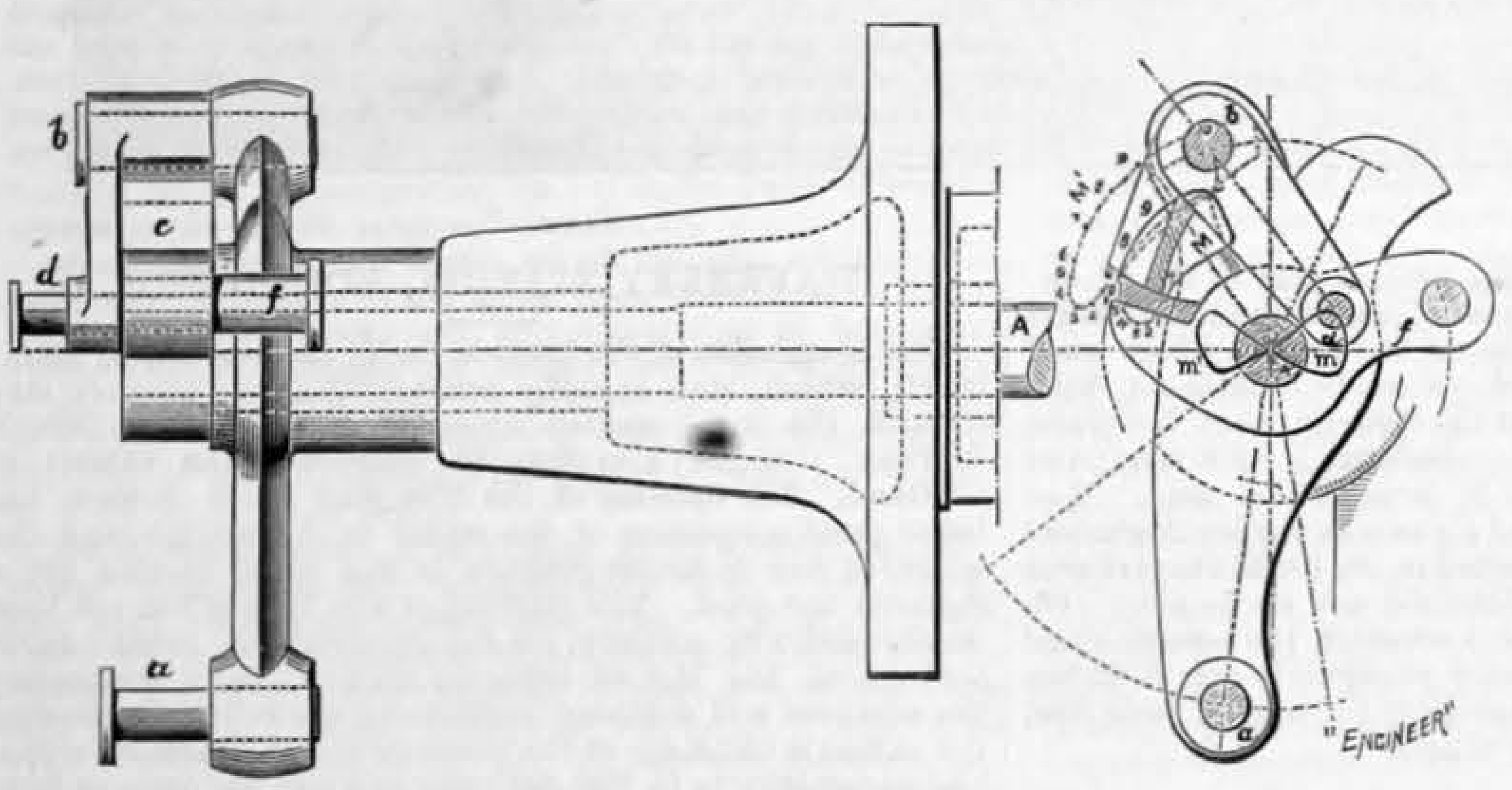
TRIPLE EXPANSION ENGINE—FRIKART'S SYSTEM.

WE illustrate on page 322 a triple expansion engine, which is now being shown by Messrs. John Cockerill and Co., at the Antwerp Exhibition. In no country has the rotary valve, which is the main feature of the Corliss system, found more favour than in Belgium. All the large horizontal engines exhibited at Antwerp have valves of the Corliss type, though each manufacturer has a different method for regulating the admission and cut-off which he considers superior to that adopted by rival makers. In Messrs. Cockerill's engines the system used is called the Frikart. They have for some time made single cylinder engines on this principle, and exhibit one of 100 indicated horse-power, with cylinder 1ft. 7⅜in. diameter, and 3ft. 5¼in. stroke. This machine is used to drive a dynamo, and works very steadily under a varying load. The application of the Frikart valve to triple expansion engines is quite new, and the one exhibited at Antwerp is the first that has been made. It works at a pressure of 150 lb., and its principal dimensions are:—Diameter of high-pressure cylinder, 1ft. 3¾in.; intermediate, 1ft. 11⅝in.; and low-pressure, 3ft. 1⅝in. The length of stroke is 3ft. 11¼in., and the number of revolutions is eighty.

The chief characteristic of the Frikart valve is that by it any degree of cut-off from 0 to 75 per cent., or even more if necessary, can be obtained with a single excentric, as the governor completely controls the admission. It is of the highest importance to be able to prolong the admission, as by this means the power of the machine to deal with extreme cases is greatly augmented. For instance, it may be required to exert increased power; or the pressure in the boiler may fall, either accidentally or because the fires are being allowed to burn down before stopping the works. If, as in many machines when the admission of steam extends over more than four-tenths of the stroke, the cut-off only takes place towards the end, this sudden increase in the admission will necessarily make a considerable, and possibly prejudicial, change in the speed. An arrangement by which the admission can be regulated so as to take place through any proportion of the entire length of the stroke, is especially advantageous for compound and triple expansion engines, where there may be a large amount of steam admitted into each cylinder.



THE FRIKART-CORLISS VALVE GEAR—Fig. 2


FRIKART-CORLISS VALVE GEAR—Fig. 3

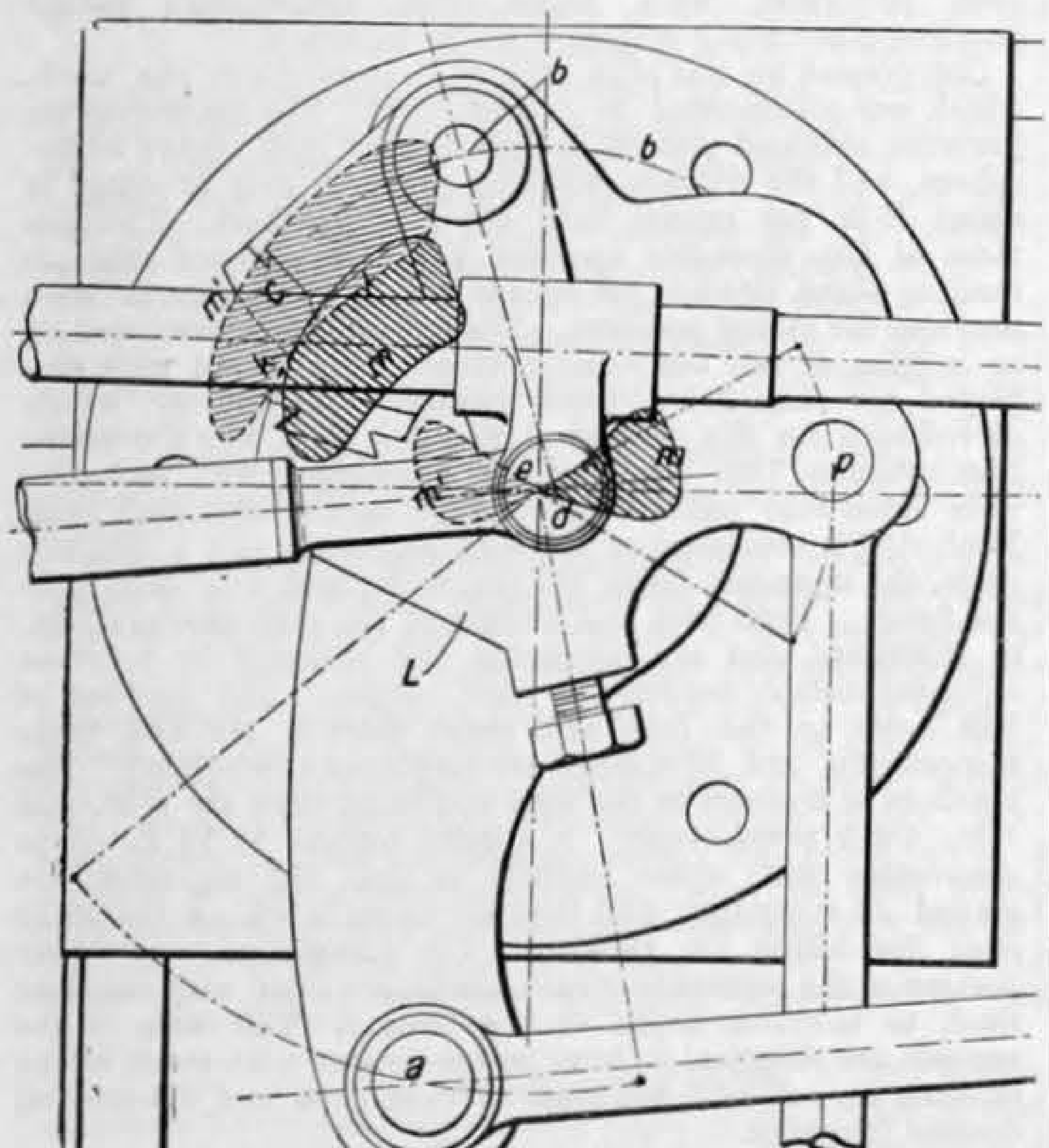


Fig. 4—ENLARGED VIEW OF PART OF Fig. 2

In the illustrations, Figs. 2, 3, and 4 show different parts of the back admission valve gear. The piston being at the back dead-point, the cast iron cut-off lever *a b* is in the position shown. This lever works freely on the axle of the admission valve, and carries the part of the trip gear which the makers call the "active." This is in steel, and consists of a finger *b c* and a lever *b d*. The "passive" part consists of a lever L, keyed to the end of the valve axle, and connected by a jointed rod to the piston of a dash-pot. The finger *b c* has a tempered steel trigger *c*, bearing on the trigger-plate *k*—also in tempered steel—of the lever L; the piston being always supposed at the back dead-point.

In this position the edges of the back admission valve, and of the orifice, are just touching. The radius to which the trigger-plate *k* is curved, being equal to the length of the finger *b c*, the lead is constant. On leaving the described position, the admission valve will commence to open, and the orifice will be more and more uncovered. But the finger *c* moves with the small lever *b d*; and during the oscillation of the point *b*, the point *d*, which is connected by levers with the excentric rod, will move also, and will follow the curve *m*; consequently the edge of the trigger *c* will describe the curve M. If therefore from the centre O we strike an arc, passing through the edge of the trigger-plate *k*, the point where this arc cuts the curve M will be that at which the release takes place. At this moment the air piston, connected with the valve gear at the point *p*, brings the whole apparatus back immediately into its original position.

The points 0 to 19 on the curves *m* and M, and on the arcs *a* and *b*, correspond to a complete revolution of the crankshaft; so that it will be seen that in its present position the release takes place at about 0 70 of the back stroke of the piston.

The manner in which the action of the excentric rod causes the point *d* to describe the curve *m* is as follows:—The point A of the excentric rod describes a sort of ellipse; its vertical movement is transmitted to the regulating lever B C D, oscillating at C; at the point D is connected a lever with three arms *e f g*, of which the arm *f* is joined by a small connecting-rod to the sleeve of the governor. Let us suppose for a moment that this sleeve is fixed, and in its lowest position; the point *f* will then describe a small arc round it, and the two extremities *e* and *g* will move in the same manner as the point D. It is this horizontal movement which, transmitted to the points *d* by the rods *h h*, and combined with the circular movement round the pivot *b*, causes the curve *m* to be described.

If the sleeve of the governor be raised to its highest position, the point *f* will be raised also, and the points *e* and *g* will undergo a corresponding angular movement round D, whilst continuing to follow the horizontal movements of the same point, the consequence being that the point *d* will now describe the dotted curve m^1, and the edge of the finger *c* will describe the dotted curve M^1. The point 10 of this latter curve is exactly at the extremity of the trigger plate. The trip would therefore take place at the dead point.

For an intermediate position of the sleeve, the point *d* will describe an intermediate curve between *m* and m^1, and the finger *c* will describe a curve between M and M^1; and thus, by the action of the governor, the admission will vary from 0 to 0·70. The admission of steam to the low-pressure cylinder is fixed and regulated by hand; the cut-off of the low-pressure is therefore constant.

Fig. 1 is from a photograph showing the high-pressure and intermediate cylinders, which are arranged as in a tandem engine. The low-pressure cylinder drives a crank on the opposite side of the fly-wheel from the other two. The condenser and air pump are behind the low-pressure cylinder, and in a line with it. All three cylinders are steam-jacketed; the steam for the jacket of the high-pressure cylinder is direct from the boiler, that for the intermediate from the reservoir or steam chest between it and the high-pressure, and that for the low-pressure cylinder from the other reservoir between the intermediate and low-pressure cylinders. These two steam reservoirs are under the floor, and the water which condenses in the jackets is drawn off by three separate pumps, and returned to the boiler. The engine has been designed for an effective horse-power of 600.

THE "SIMPLEX" EMERGENCY GRIP, FOR CRANES AND WINCHES.

THE engravings below illustrate a new form of self-sustaining device for application to cranes and winches to prevent the too-common accidents with the handles of these machines, or the unintentional and accidental running-down of the load. Fig. 2 of the engravings shows the grip as applied to a derrick or slate-quarry crane; and Fig. 1

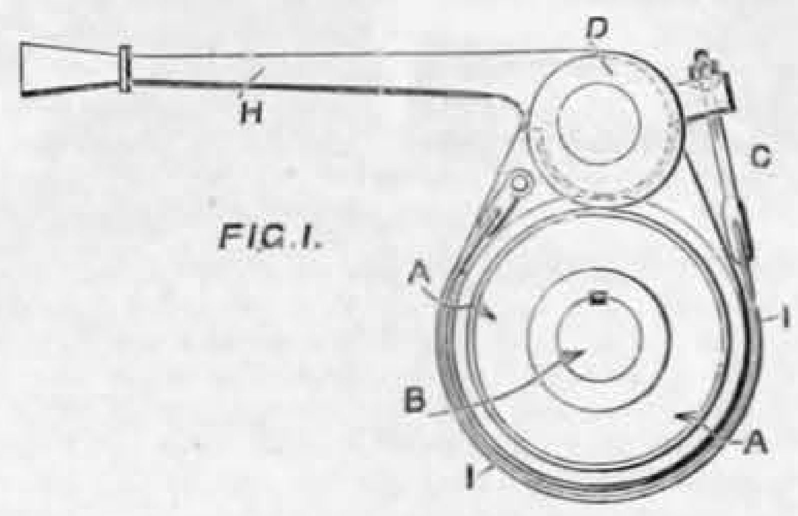
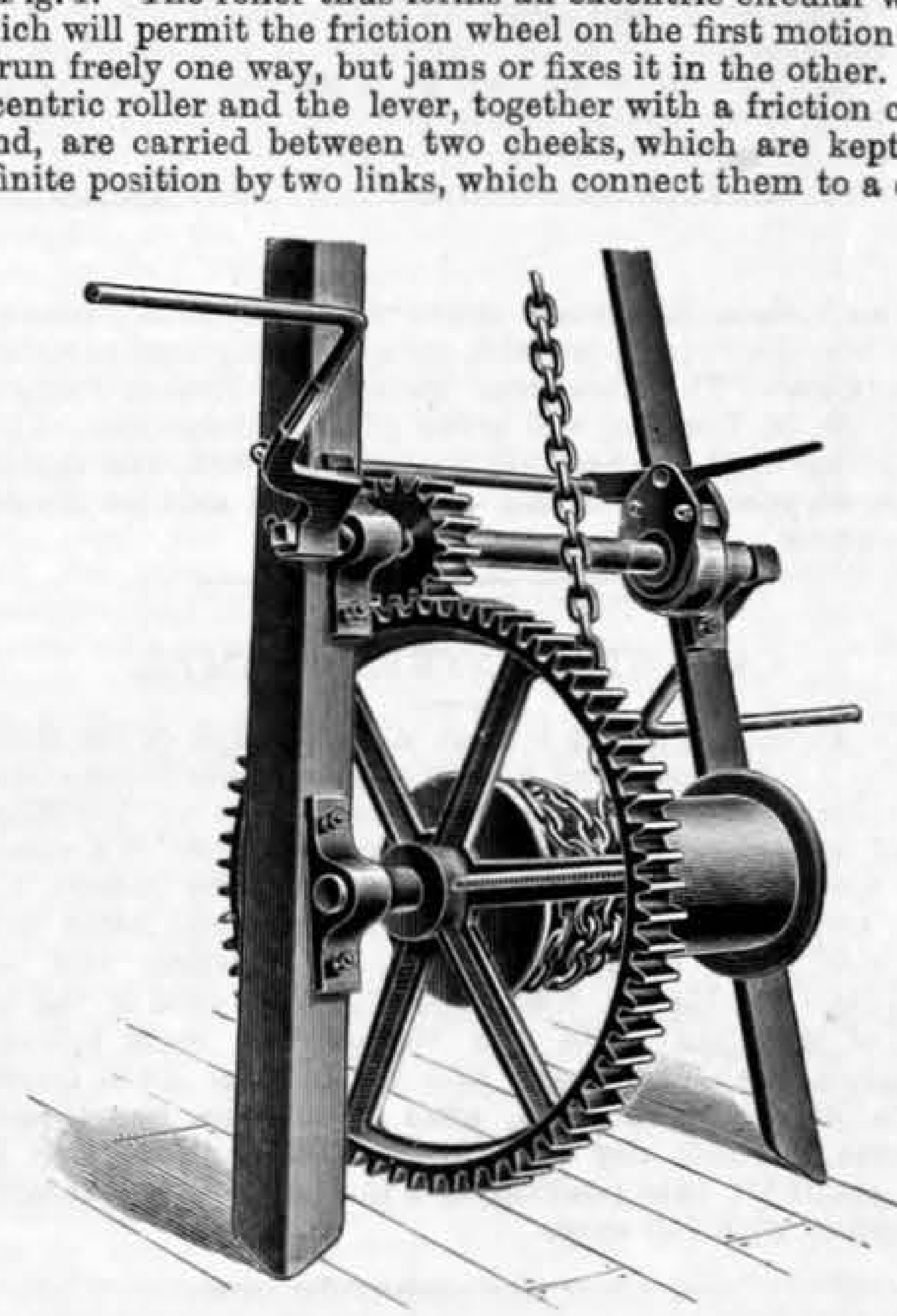


FIG. I.

shows the details of the grip. Upon the first motion spindle of the winch is fixed a friction wheel, into which gears an excentric friction roller or cam, carried by the handle shown in Fig. 1. The roller thus forms an excentric circular wedge, which will permit the friction wheel on the first motion shaft to run freely one way, but jams or fixes it in the other. The excentric roller and the lever, together with a friction clutch band, are carried between two cheeks, which are kept in a definite position by two links, which connect them to a cross-bar of the frame of the crane or winch. A—Fig. 1—is a cast iron sheave turned with friction grooves on the periphery. This is fixed to the first-motion or handle shaft, and into this friction sheave works the cam-shaped part of the friction lever H, which is held in position by side plates, see Fig. 2. By lifting the handle, the cam is taken out of gear, and the friction clutch band may be used for lowering the load. The "Simplex" grip is readily applied to existing winches, and is made, under the patent of Messrs. Beckett and Roberts, by Messrs. De Winton and Co., of the Union Ironworks, Carnarvon.


EMERGENCY GRIP APPLIED TO CRANE—Fig. 2

THE INCORPORATED ASSOCIATION OF MUNICIPAL AND COUNTY ENGINEERS.—The eighteenth voluntary pass examination of candidates for the offices of municipal engineer and surveyor to Local Board carried out by this Association was held at the Council House, Birmingham, on Friday and Saturday, the 5th and 6th of October. Eighteen candidates presented themselves for examination, the written portion of which was taken on the first day. The greater part of the second day was occupied with the *vivâ voce* portion of the examination. The examiners were:—(1) Engineering as applied to Municipal Work, Edward Pritchard, M. Inst. C.E., of Birmingham and London, past president. (2) Building Construction, W. George Laws, M. Inst. C.E., City Engineer, Newcastle-on-Tyne, past president. (3) Sanitary Science, A. M. Fowler, M. Inst. C.E., of Manchester, President. (4) Public Health Law, Joseph Lobley, M. Inst. C.E., Borough Engineer, Hanley, past president. The next examination will be held in London in April, 1895.

RAILWAY MATTERS.

RAILWAY construction in China is entirely suspended.

IT is proposed to construct a new line of railway between Windsor and Henley.

THE Philadelphia postal authorities are considering the question of operating postal cars on the electric railway lines in that city.

ALL of the bridges which were destroyed during the forest fires in Northern Wisconsin and Minnesota have been rebuilt, and traffic has been resumed on all the roads.

IT has been decided to use petroleum as locomotive fuel on the Baltic railroad, which is significant, because this line is almost the most distant of any in Russia from the oil wells. Great reservoirs are to be built in St. Petersburg and Reval and three other stations, which will hold in the aggregate about 5,000,000 gallons.

THE railway recently opened at Kiew, in Russia, is the first electric railway that has been constructed in that country. It is about two miles long, with grades as high as 9 per cent. The generators, which are two 30-kilowatt machines, are of German make, and are driven by Otto gas engines of 60-horse power. The track is laid with stringer rails.

THREE new mogul locomotives for the Erie and Wyoming Valley Railroad, with 56in. drivers, weighing about 56½ tons, have recently been delivered from the Baldwin Locomotive works. They have three 17in. by 24in. cylinders, set on an incline, so as to allow the middle one to drive the main axle just inside the right driver, all being connected at 120 deg., to give continuous effort on account of the heavy grades on the road.

THE Melbourne Tramways Company has been experimenting with tar as fuel. The tar is kept in a liquid condition by means of exhaust steam pipes, which are coiled in the tanks, and is pumped to the feed tanks, which are situated above the boilers. It is led from the tanks through a large strainer, before it is delivered to the furnaces through a 2in. pipe. The tar is mixed in the burner with steam, and both tar and steam pipes are provided with flexible joints at the furnace door-plate, so that they can be easily swung back as the furnace door is opened.

THE official statistics of the working of French tramways in 1893 give particulars of the operations of light railways and tramways worked either by steam, electricity, or animal power. Of light railways guaranteed by the State there are 645 kiloms. in operation. The light railways not guaranteed by the State comprise 288 kiloms. of line. Of tramways proper there are 100 kiloms. worked by steam, electricity, compressed air, or cable, and constructed at an aggregate cost of 16,469,500f. Tramways worked by horses represent a length of 635 kiloms.

IN a recent number of the *Revue Générale des Chemins de Fer*, the results of a number of tests to determine the steam consumption of locomotives per indicated horse-power per hour are given by M. Desdouits. In five trips the speed averaged from 37·2 to 40 3 miles per hour, and the average consumption of water 25·61 lb. per indicated horse-power per hour. M. Desdouits believes his experiments warrant him in concluding that in simple engines the best results are obtained with a working pressure of about 142 lb., with a cut-off at one-fifth the stroke, and with the valve given inside clearance.

INFORMATION from an American source reaches us of a novel method of removing rusty bolts from locomotive frames, viz., by gun fire. A special gun was made from an old crank pin 10in. long and 5in. diameter, bored with a 2in. hole about 8in. deep. The gun stood on the lower bar of the frame, being blocked up to bring it near enough to the bolt which was to be fired out. About 4in. from the muzzle, a ⅛in. vent hole was bored to relieve the internal pressure when the projectile, which was in the form of a ram 8in. long, turned to an easy working fit in the 2in. bore, has done its work. With less than ½ oz. of gunpowder, a 1⅛in. bolt was driven out with no more trouble than was entailed by the preliminary setting of the gun.

AN appropriation of £30,000 has been made by the United States Congress for the preliminary work on a ship railway to be constructed through the Dalles, on the Columbia River, in Oregon. The car that will be used will be 40ft. or 50ft. in breadth, and long enough to carry vessels that can steam up the river, which in the spring months, when the water is high, will allow a draught of about 14ft. The car will be sunk under water and the vessel floated over it; the car will then be raised by a hydraulic lift some 70ft. above the water level to the height of the land track and the car run upon it. The *American Engineer* says this land track will consist of four or five railway tracks of standard gauges, and there will be no curves sharper than 2 deg.

MR. EDMUND PEARSE BURD held inquiries at Nottingham and Leicester on Tuesday and Wednesday, on behalf of the Local Government Board, as to the demolition of houses by the Manchester, Sheffield, and Lincolnshire Railway Company in the construction of their line to London. At Nottingham Sir S. G. Johnson stated that some eight or ten years ago there arose an exceedingly wild building speculation in that town. Land went up in price, houses were placed upon it, and the town became so overbuilt that there were at one time fully 6000 empty houses. The line of railway, so far as it passed through the central parts of the town, would involve the destruction of a lot of insanitary property which had been condemned long ago. A large number of insanitary houses will also be demolished at Leicester.

THE Berlin local authorities have decided to call upon the Grand Berlin Horse Tramway Company to proceed at once with the work of laying a tramway from Reichenbergerstrasse to Treptow, as otherwise the project will be passed over to another company. The *Electrical Engineer* says a tramway is also to be constructed in Berlin from the Wienerstrasse *viâ* Wienerbrücke and Köpenicker Weg to Treptow. The Berlin municipality have also sent a deputation to Dresden to see Mr. Langen's electric tramway there. The Berliner Elektricitäts-Gesellschaft has formulated a scheme for the erection of an electrical station at Harburg for working an electric tramway, as well as for the supply of current for lighting and motors. The Elektricitäts-Gesellschaft "Union," of Berlin, have been negotiating with the Elbing Municipality to build an electric tramway in that town.

THE first town in Europe to substitute electricity completely for other methods of propulsion upon the tramways is Havre, where the new system of tramcars has lately been inaugurated. Three lines, of a total length of 14 kiloms., have already been constructed, and a fourth is now being laid down. The system employed is the overhead contact by copper wires carried at a height of 6 m. 50 cm. upon metallic posts placed at about 40 metres apart. There are 560 of these posts of tube steel, which are also utilised for carrying arc lamps, of which eighty-five have so far been erected. It is expected that lamps will be placed shortly over the whole length of the lines. This installation has been carried out by the Compagnie Thomson-Houston. The cars are forty in number, and are each capable of carrying fifty passengers. Some of the cars have two motors, while the majority have only one; these motors are geared directly on to the axle, and every care has been taken to protect them from the dust and damp. The power is supplied by the Société de l'Energie Electrique, whose station is situated in the centre of the town. Their plant includes at present three Thomson-Houston dynamos that are worked by a Farcot engine.

NOTES AND MEMORANDA.

THE mean density of the earth found by Professor Poynting is 5·49. Professor Boys' result is 5·53.

A RULE given by Mr. Preece for comparing the costs of gas and electricity for lighting is as follows: "Gas at three shillings per thousand cubic feet equals electricity at sixpence per kilowatt-hour," or in other words the factor is about six.

IN the city of Tokio and elsewhere in Japan wooden water-pipes have been in use for over 200 years. Pipes of 6in. internal diameter and less are made from tree trunks bored out; larger ones are usually square, and are formed of planks fitted together.

AN attempt made in Sweden to produce an extra strong cast iron, in order to reduce the thickness of shrapnel shells, so that the capacity of the chamber within them can be increased, produced a series of castings giving an average tensile strength of 19 5 long tons per square inch, with ·38 per cent. extension in 4in. The firm which makes the castings guarantees a strength of 17·8 long tons per square inch.

IN the return of the gas testings for the week ending 6th October, Mr. W. J. Dibdin, F.I.C., enters as the highest mean illuminating power that of the Tooley-street district supply, South Metropolitan Gas Company, which was 17 0 candles. The lowest being found at the Chelsea, Holloway, and Hampstead districts, Gas Light and Coke Company, and the Old Ford district, Commercial Gas Company, which were all 16·1.

POLISHED steel surfaces as saws, chisels, bits, &c., can be rendered rust-proof by making a preparation as follows: Take one-half ounce camphor, dissolved in one pound of melted lard, take off the scum, and mix in as much black lead—graphite—as will give it an iron colour. Clean the tools, and smear with this mixture. After twenty-four hours rub clean with a soft linen cloth. The tools will keep clean for months under ordinary circumstances.

A CHROMO-PHOTOGRAPHIC camera, by which a quick succession of photographs can be taken, suitable for combining in a zoetrope apparatus, so as to give an animated reproduction of a moving figure, has been invented by M. George Demeny. The problem to be solved is the same as that of Edison's kinetograph, but M. Demeny's apparatus is much simpler than Edison's, besides being portable. The instrument can be seen at the Anglo-American Import Office, 368, Rue Saint Honoré, Paris.

IN a paper recently read before the Paris Academy of Sciences M. Henri Moissan states that aluminium can be saturated with nitrogen by passing a current of the latter through a bath of the molten aluminium, and that such saturation has considerable effect upon the physical properties of the commercial metal, reducing the elastic limit from 4·76 tons—of 2240 lb.—per square inch to 4·13, and reducing the breaking stress from 6 98 to 6·10 tons per square inch. The elongation also drops from 9 per cent. to 6 per cent. The presence of more carbon than is ordinarily found in the commercial metal also reduced the tensile strength and the elongation.

M. FORSTER, of the Berlin Observatory, has communicated to the *Revue Scientifique* the result of a series of observations carried on simultaneously for twenty months past at Kasan in Russia, Marburg in Germany, and Bethlehem in Pennsylvania. The object was to study the question of the supposed oscillation of the axis of rotation of the earth. From about 10,000 observations it appears that the pole or end of the axis has an oscillation following a spiral traced from west to east. The rate of oscillation is variable; at the present time it is decreasing. It appears, however, that the actual extent of this movement is very small, not exceeding fifteen metres.

PROFESSOR KENNEDY recently stated that before the Edison and Swan lamp patent expired, and when current was sold at 8d. per unit, an 8-candle power glow lamp cost almost ½d. per hour of actual lighting, whereas at the present price of glow lamps, and taking current at 6d. per Board of Trade unit, the 8-candle power lamp costs ⅓d. per actual hour of lighting. Professor Kennedy estimates the average life of glow lamps at 500 to 600 hours of actual lighting. The earning capacity of lamps in private houses, hotels, and shops is, according to Professor Kennedy, inversely as the above order. The number of lamps of 8-candle power installed in London in 1893 was 9,666,000.

IN a recent paper in the *Comptes Rendus* on "Geodesy and its Relations with Geology," by M. H. Faye, the author says: —Gravity has a greater numerical value in islands than in the midst of continents, as the constant is determined by pendulum observations; this is probably due to the more rapid cooling of the crust of the earth beneath extensive seas, as evidenced by the low temperature of water—1 deg. or 2 deg.—at depths at which the temperature is about 133 deg. in land. The greater average density owing to the lower temperature accounts for the higher value of the constant at sea, notwithstanding the replacement of so much solid matter by the specifically lighter water. The author then draws attention to the need of aid from geologists in the further elucidation of the reasons for variations in the constant of gravity.

AN improvement in the manufacture of plumbago or graphite has been described in a recent patent specification. Graphite crushed and passed through a sieve of from 120 to 150 meshes per inch, is stirred into a saturated solution of alum or aluminium sulphate at 212 deg. Fah.; steatite is then added, and more water if required. After mixing, excess of water is evaporated until a consistency suited to grinding in a chilled steel or other mixer is obtained. More graphite may here be added; then, after thorough grinding, the material may be compressed into cakes for household use, or is ready for the manufacture of pencils or crucibles. The average formula for the mixture is: Graphite, 80; steatite, soapstone, or talc, 14; alum, 6; but this varies with the purpose to which the material is to be applied. When several different kinds of graphite have to be employed, the richest in carbon is first mixed into the alum solution. By this process graphites previously regarded as incapable of being compacted are utilisable, and are improved in polishing power; for pencils, the material may be hard without being brittle, and black without being soft; while crucibles made from the treated graphite are at once harder, more durable, and lighter.

A SOLUTION of copper sulphate does not conform rigorously to the form in which Faraday's law of electrolysis is generally expressed. It has been shown by Gray that the metallic deposit is heavier the higher the current density and the lower the temperature, an explanation being given in the fact that copper dissolves to a very appreciable, although variable, amount in solutions of copper sulphate. According to Schuster, it is probably the atmospheric oxygen present in the solution that causes this chemical corrosion. In view of this, W. Gannon has sought to discover whether there is any difference between the weights of the two deposits in two copper voltameters, one of which is placed in a vacuum. Freshly made neutral copper sulphate solution was employed, and the electrolysis in one case was conducted first under reduced pressure, with the result that a heavier deposit was thrown down than was the case in a similar experiment, the pressure being that of the atmosphere; but the percentage difference was not constant. The *Electrical Review* says the addition of a little sulphuric acid to the voltameters caused this difference to be constant within experimental error. Under this condition, for current densities above 0 01 ampère per square centimetre of active cathode, there is no practical difference in weight between the two deposits, but for lower densities the "vacuum deposit" is very appreciably higher than the "air deposit.

MISCELLANEA.

A SURVEY of the Sea of Marmora has been undertaken by the Russian naval authorities in consequence of the submarine disturbances supposed to have been produced in that sea by the recent earthquakes.

THE first German ironclad built in the new Dantzic dockyards will be launched this month. It belongs to the Siegfried class, the armament consisting of three 36-ton guns. The indicated horse-power is 4800, and the displacement tonnage 3495.

EXPERIMENTS with the Sims-Edison steering torpedo are to be made in the Bosphorus. This weapon gave such good results when recently tried at Toulon, that the Ottoman Government are thinking of adopting it for the protection of their waterway.

A NEW twin-screw steamer, named the Alma, built for the London and South-Western Company's fast passenger and mail service between Southampton and Havre, has been launched at Glasgow. Her length is 270ft., breadth 34ft., and gross tonnage about 1100.

WE have received the second edition of Mr. L. B. Wells' canal map of England and Wales. The names of many junctions of canals owned by different companies have been added, and a few additional miles of waterways shown, bringing up the total to 3935 miles.

THE Admiralty have directed that trials are to be made on the new torpedo boats and torpedo destroyers on their delivery from the contractors, to test the flaming of the funnels when steaming. It is expected that with careful stoking this evil, which would render a night attack impossible, can be prevented.

THE French Government has decided to proceed with the construction of two great docks at Cherbourg—one for the use of those mail boats which will serve as auxiliary cruisers in time of war, and the other for the accommodation of ironclads of the largest size. The docks are to be built in the northern portion of the arsenal.

THE Local Government Board have given their sanction to a loan of £11,500 for the sewerage and sewage disposal of Bracknell. The sewage will be purified by irrigation, on 22½ acres of land. There are to be two small pumping stations, worked by oil engines. The engineer to the scheme is Mr. W. H. Radford, C.E., Nottingham.

A CURIOUS accident has happened at Boston, U.S.A. A man, while cleaning an arc lamp at the top of a high mast, received the full strength of the current and was killed instantaneously. His body was suspended from the wires for half an hour. When men were put to work to remove it one of them came in contact with it, and was thrown head foremost on the sidewalk. He was dashed with such violence against the kerbstone that he died shortly afterwards.

THE Halcyon torpedo gunboat, constructed at Devonport, and engined by Hawthorn, Leslie, and Co., has broken down seriously. A crack nearly a foot in length has been discovered in her high-pressure cylinder. The Admiralty had intended that she should represent her class in a series of experimental trials to ascertain the most suitable type of propeller for torpedo gunboats of the same tonnage. The vessel's machinery was only a few weeks ago accepted from the contractors.

A STATEMENT to be taken *cum grano* is to the effect that two Russian engineers contemplate making an attempt to raise the sunken battleship Victoria, owing to their recently achieved success in raising, by means of air balloons, a vessel sunk in 30ft. of water near Varsovie. In the case of the Victoria, it is said, ten air vessels will be used, each of a capacity of 60,000 cubic feet. The question which immediately occurs to us is, how are these vessels to be attached to the ship? 30ft. of water is one thing, and 450ft. is another.

MESSRS. JOHN AND HENRY GWYNNE, of Hammersmith, have entered upon a contract with the Mersey Docks and Harbour Board, Liverpool, to supply a set of their "Invincible" compound condensing pumping engines to raise the level of water in the Canada Huskisson dock system. This makes the fourth large installation fitted up by Messrs. J. and H. Gwynne for the same authority, which will have within the dock estate "Invincible" plant equal to a combined capacity of 4000 tons of water per minute when the new machines are at work.

A SERIES of experiments is being conducted on board the first-class battleship Revenge at Spithead, with a view to determine the precise advantage obtained by the new bilge keels which are being fitted to all the vessels of the Royal Sovereign class. At the first trial, the vessel was given a degree of stability and steadiness by her double bottom being filled with water, and her bunkers with coal. The four barbette guns, each weighing 67 tons, were then trained at right angles, which gave the vessel a list of twelve and a-half degrees, and this was increased to fifteen when the crew were assembled on the side to which the guns were trained. It has been decided to subject the ship to a far more severe test, by removing both the coal and the water, and adopting the same method of carrying out the test. At the conclusion of the trials the Revenge will be docked, and bilge keels affixed to her bottom, and she will then undergo the same experiments as before.

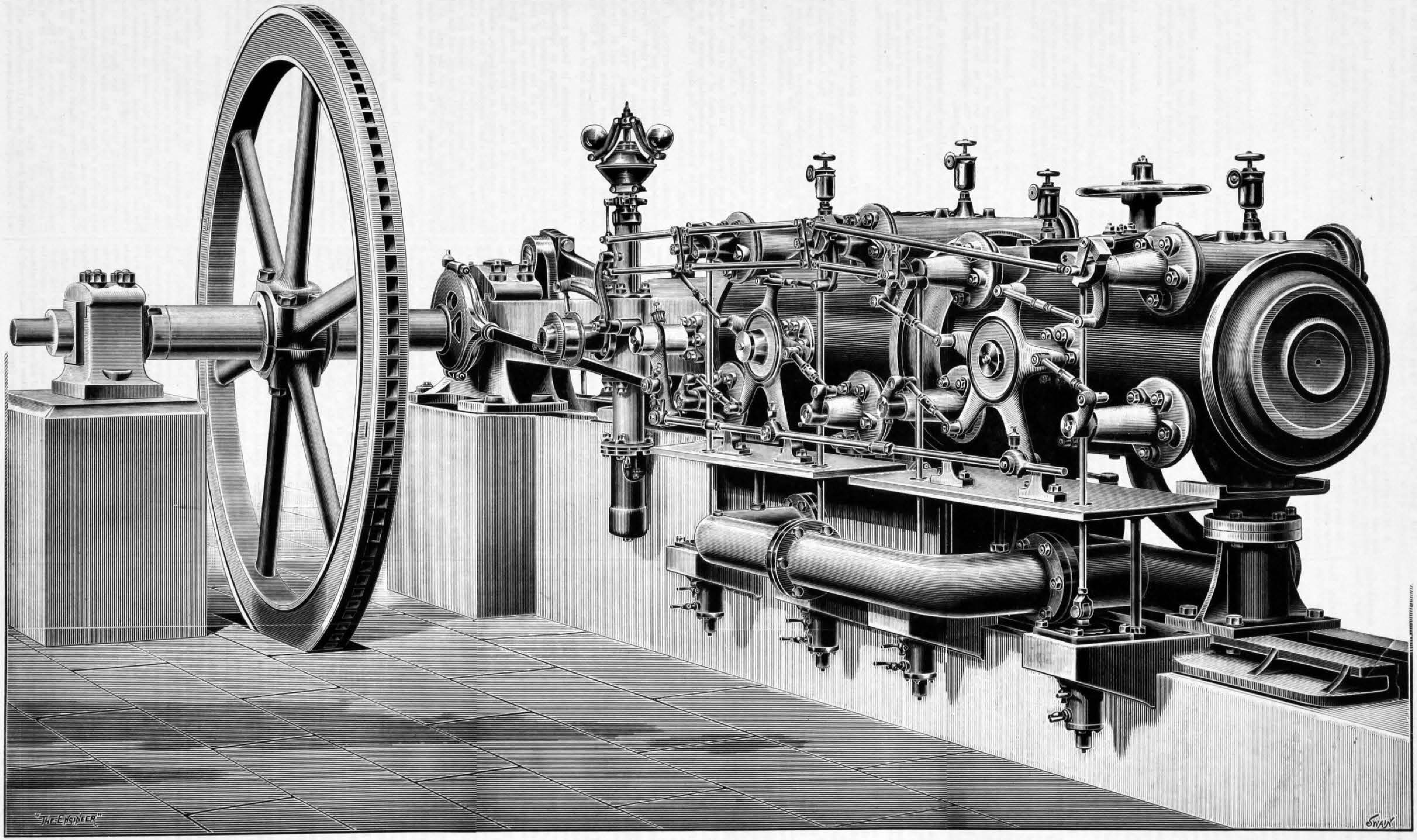
WE have received from Messrs. Edgar Allen and Co., Sheffield, a pamphlet containing particulars of, and reports upon, their dynamo magnet steel castings. The reports are by Mr. Gisbert Kapp, M. Inst. C.E., Professor Ewing, and Professor Jamieson. It has been for some time known that these steel castings were equal and now are superior to wrought iron forgings for dynamo construction. Mr. Kapp, very early in their history, tested their materials, and his great experience in dynamo design and construction enabled him to make use of this magnet steel, and to pronounce an authoritative opinion upon it. He found it better than wrought iron forgings in many cases, and some which he tested in April this year he speaks of as better than any magnet steel he had previously met with. The pamphlet we have received is accompanied by permeability curves by Mr. Kapp, and Professors Ewing and Jamieson, and will be found of considerable interest by those who are concerned with the construction of large magnets of any kind, and who are interested in the magnetic efficiency of materials to be employed.

THE new German third-class cruiser, provisionally known as "F," will be launched and named on the 15th inst. at Wilhelmshaven. She is, according to the *Times*, 246ft. long by 33ft. 6in. broad, and at a mean draught of 15ft. will displace 1640 tons. There are twin screws, and engines working up to 2800-horse power, which will give the vessel an extreme speed of 16 knots. The hull is of steel and wood. The armament will consist of eight 3·96in.—40-pounders—quick-firers, four machine guns, and two torpedo-launching tubes. A few days later at the same yard the keel plates will be laid of the new first-class battleship which is to take the place of the now almost obsolete Preussen, a vessel twenty-one years old. The new ironclad will be a reproduction of the Wörth, with, however, slight modifications, and will be constructed to carry four 11in. breech-loading guns of 40 calibres, two 11in breech-loading guns of 35 calibres, six 3·9in. quick-firing guns of 35 calibres, eight 3·4in. quick-firing guns of 30 calibres, two 2·3in. boat guns, and eight ·31in. machine guns. Her extreme speed, with forced draught and at 111 revolutions, will, it is anticipated, be 17·2 knots, 10,230 indicated horse-power being developed.

SIX HUNDRED HORSE-POWER TRIPLE-EXPANSION FRIKART-CORLISS ENGINE

MESSRS. JOHN COCKERILL AND CO., SERAING, ENGINEERS

(For description see page 320)



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THE ENGINEER, October 12th, 1894. PAGE

TO CORRESPONDENTS.

Registered Telegraphic Address, "ENGINEER NEWSPAPER LONDON."

*** *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 penny postage stamp, in order that answers received by us may be forwarded to their destination. No notice can be taken of communications which do not comply with these instructions.*

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

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

W. B. (Adelaide, S.A.) - *Consult the "Moulder and Founders' Pocket Guide," by F. Overman, published by Sampson, Low, and Company, London.*

A. E. (Stoke Newington).—*Make use of a little elementary geometry and wood splines to get parallel lines, project them upwards by means of plumb bobs hanging from the edge of a board or of a spline temporarily fixed overhead or from the piece of shafting to be set in position; use a spirit level, and with some practical experience and less reliance on cookery book engineering you will manage what you want.*

ALUMINIUM BRONZE PIPES.

(*To the Editor of The Engineer.*)

SIR,—I shall feel much obliged to any reader who will tell me where I can obtain aluminium bronze pipes which will be safe at 600 lb. pressure, the diameter of the pipes to be 10in. or 12in. AMERICUS.
October 6th.

MEETINGS NEXT WEEK.

NEWCASTLE-UPON-TYNE ASSOCIATION OF STUDENTS OF THE INSTITUTION OF CIVIL ENGINEERS.—Wednesday, October 17th. Visit to the Consett Iron Company's works at Blackhill, Co. Durham.

HULL AND DISTRICT INSTITUTION OF ENGINEERS AND NAVAL ARCHITECTS.—Monday, October 15th, at 8 p.m. Paper: "Hull Steam Shipping," by the President, F. H. Pearson.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Tuesday, October 16th, at 7.30 p.m. Minutes of closing business meeting for last session. Ballot for new members. Adoption of tenth annual report and financial statement. Inaugural address of President.

DEATH.

On August 31st, suddenly, at Buenos Ayres, S.A., W. H. MORROW, A.M.I.C.E., aged 50.

THE ENGINEER.

OCTOBER 12, 1894.

THE UNCERTAINTIES OF SCIENCE.

SOME months ago we reviewed an important book, "The Science of Mechanics," by Dr. Ernst Mach, professor of physics in the University of Prague. That book gave sufficient evidence that its author is a very advanced thinker—a man with small respect for authority in science. In the *Monist* for October we find a lengthy paper by Dr. Mach on "The Principle of the Conservation of Energy," which will supply food for thought to everyone interested in physics. This paper is remarkable in various ways. Thus, at the outset, we have actually an attempt at a definition of the word Energy. "The most multifarious physical changes, thermal, electrical, chemical, and so forth, may be brought about by mechanical work," says Dr. Mach. When such alterations are reversed they yield anew the mechanical work in exactly the quantity which was required for the production of the part reversed. *This is the principle of the conservation of energy;* "energy" being the term which has gradually come into use for that "indestructible something" of which the measure is mechanical work. Thus then we see that an advanced physicist can find no better definition for a word in everybody's mouth than that it is an "indestructible something." It is *not* work, but work is its measure. It is not, however, with Dr. Mach's definitions that we are concerned, but with his methods. These appear to us to be altogether admirable. He is not content to state ideas, or to give definitions; he goes much further. He asks where did the ideas—or as we prefer to call them, concepts—of physics come from? and the result of his investigations casts a curious light into very obscure regions. As to the doctrine or concept of the conservation of energy, he asks where did it come from? And he proceeds to show that the answer is by no means so simple as it appears, and that indeed it is in no way easy to prove that energy is really always and at all times conserved. It is not our purpose to follow him through his arguments: for the present we are considering only his conclusions. Page by page we find the words, "Not proven." He takes argument after argument, authority after authority, and shows that there is a reason why each and all break down somewhere or in some point. He shows that one of the strongest arguments in its favour is based on the assumed impossibility of producing "perpetual motion," which assumption is in turn based on another, that all forms of energy are modes of motion, concerning which he says, "Intelligible as it is, therefore, that the efforts of thinkers have always been bent upon the 'reduction of all physical processes to the motion of atoms,' it must yet be affirmed that this is a chimerical ideal. This ideal has often played an effective part in popular lectures, but in the workshop of the serious inquirer it has discharged scarcely the least function."

We have said enough, perhaps, on this point to show what manner of thought Dr. Mach puts before his readers on one question. But he is much more audacious in his method of dealing with thermodynamics, and to his views on the subject we direct particular attention. Dr. Mach gives a most simple and lucid exposition of what Carnot did and did not teach, and he explains very clearly the nature and truth of the work done by the Thomsons, Joule, Mayer, and others. It having been shown that heat was not a substance, the question was asked—What, then, is it? The answer, as is well known, is that it is a mode of motion that has been accepted implicitly for years by students as demonstrably true. Dr. Mach hastens to prove that it is not demonstrably true at all, and, *more suo*, he asks: Where did the concept originate? "The generally accepted notion of a caloric, or heat-stuff, was strongly shaken by the works of Mayer and Joule. If the quantity of heat can be increased and diminished, people said, heat cannot be a substance, but must be a motion. The subordinate part of this statement has become much more popular than all the rest of the doctrine of energy. But we may convince ourselves that the motional conception of heat is now as unessential as was formerly its conception as a substance. Both ideas were *favoured or impeded solely by accidental historical circumstances*. It does not follow that heat is not a substance from the fact that a mechanical equivalent exists for quantity of heat. We will make this clear by the following question which bright students have sometimes put to me:—Is there a mechanical equivalent of electricity, as there is a mechanical equivalent of heat? Yes, and no. There is no mechanical equivalent of quantity of electricity as there is an equivalent quantity of heat, because the same quantity of electricity has a very different capacity for work, according to the circumstances in which it is placed; but there is a mechanical equivalent of electrical energy. Let us ask another question. Is there a mechanical equivalent of water? No. There is no mechanical equivalent of water, but there is a mechanical equivalent of weight of water multiplied by its distance of descent."

Dr. Mach here explicitly states a circumstance which must be taken count with in all attempts to identify heat and electricity. That is to say, our existing concepts and definitions based upon those of heat and electricity are fundamentally different. Once more Dr. Mach asks why this difference in conception? and he answers, "The reason is purely historical, wholly conventional, and, what is still more important, is wholly indifferent." This, he proceeds to prove, and concludes his argument with the following pregnant statement: — "When we wonder, therefore, at the discovery that heat is motion, we wonder at something that was never discovered. It is perfectly indifferent, and possesses not the slightest scientific value, whether we think of heat as a substance or not. The fact is heat behaves in some connections like a substance, in others not. Heat is latent in steam as oxygen is latent in water." We have quoted at considerable length, because without quotation we have found it impossible to do full justice to Dr. Mach's views. Even now we have left essentials unnoticed. The broad fact, however, to which we would direct attention, is that a man of Dr. Mach's attainments should advance opinions which are so directly opposed to a great deal of the teaching of the present day. He brings fundamental modern conceptions of heat to the test and he finds them unsatisfactory. The very root of thermodynamics becomes under his hands one of the uncertainties of science. Our readers will find in the remarkable letter by Col. Basevi, which we print this week, another example of the uncertain foothold which men find in this path of science. It has often been stated that though men believe in the kinetic theory of gases, they know it is not true. Col. Basevi advances arguments which make it more difficult to believe in it than ever. On all sides we find men inquiring, thinking, revising, and on all sides upsetting received theories and notions concerning the nature of things and processes. Such inquiries are no doubt distasteful to many persons, but they mean progress so long as they are conducted in a proper spirit. Yet the student of science will do well to bear in mind the words of a very eminent lecturer of physiology. "The statements I have made to you, gentlemen, I have every reason to believe to be wholly untrue, but you must learn them, because if you do not you will not be able to pass your examinations."

CANALISATION OF RIVERS.

WHEN in classic days a river conducted itself in such a manner as to become a source of danger to the people and lands adjacent to its banks, its behaviour was attributed to the offended majesty of its tutelar divinity. The hydraulics of rivers are assumed to be under similar control in China even now. Although the French have a proverb, *Rien n'est sacré pour un sapeur*, and it must also be admitted that the modern engineer has no particular regard for ancient fluvial deities, yet he is not indisposed to try gentle measures when dealing with their wayward changes. As a proof that the belief in a presiding genius prevails among eastern people, may be mentioned the statement that when the first railway bridges threw their shadows over the sacred streams of Hindustan, bouquets and garlands of flowers were freely dropped from the locomotive, as an offering to the river god, into the waters below. Apart alike from ancient mythology and Hindoo superstition, there is one fact, which in connection with our subject cannot be overlooked. It is the universal consensus of hydraulic engineers that in projecting works for the improvement of rivers, the natural physical features of the watercourse should be interfered with as little as possible. It matters nothing for what especial purpose the particular works may be undertaken, whether for irrigation, drainage, prevention of floods, canalisation or water supply. That rivers resent—so to speak—the alteration or diversion of their natural beds, has been shown by more than one example in India. There are not wanting instances in which, after a new cut has been made, bridged over, and the water let in, the river in one night has returned to its former channel and breached the embankment, leaving the new waterway high and dry. It is clearly preferable —in popular language—to coax than to force a river.

While engineering works belonging and even essential to the canalisation of a river are frequently common to other improvements, the distinguishing characteristic of that operation is that it is undertaken, if not altogether, yet always in the interest of navigation. A river may be considered to be canalised when its normal condition at low water has been so altered by the carrying out of works in its channel as to permit of its navigation by boats which were previously unable to ascend it. This definition applies more particularly to the tidal compartment of a river, but if least depth be substituted for low water, it will be sufficiently correct for the upper, or river compartment proper. Some engineers regard the term canalisation as inappropriate to the improvement of rivers unless executed under certain conditions. They do not consider it applicable to the improvement of a navigable stream in which the works undertaken to guide and regulate the channel are solely of a character which will allow of its contours being preserved by the scouring action of the water. A curious example of the self-canalisation of a river was afforded some years ago through the agency of flood waters, which ultimately culminated in the establishment of a new outfall for the Vistula. An accumulation of ice, attended by a consequent damming back of the water, led to the blocking-up of the stream leading to the existing outlet. The obstruction continued to increase, until the pressure became so great as to break through a protecting embankment. The result of this "directing the great sources of power in Nature" was, contrary to what generally obtains, eminently satisfactory. It constituted a self-made "river navigation," and, as will be seen, was in every sense conducive to "the use and convenience of man." It appears that, previously to this fortuitously favourable incident, the engineers of the Government had repeatedly recommended the execution of works the very *raison d'être* of which was, with the addition of other artificial measures, to secure the accomplishment of what Nature had so beneficently effected. This felicitous though somewhat forcible method of forming a new outfall for the river enabled a long reach of it to be canalised to great advantage. Subsequently lock gates were constructed near the junction of the main stream and the self-created branch leading to the new outfall, which now fulfils the duty formerly devolving upon the old outlet—namely, that of affording a passage to the ice, which, brought down by the waters higher up stream, finds its way eventually to the sea. In a strategic point of view the works thus opportunely thrust upon the Government have been equally productive of good, as they very materially contribute to a successful defence of Dantzic in the event of its being invested by a hostile army.

The chief difference between a canal and the canalisation of a river is that whereas the former, in the strict sense of the term, is wholly artificial, the latter is not. It is, however, rare that a canal, during its entire course from one end to the other, comes under this definition. In some parts of its route it usually utilises the services of stretches of rivers canalised to render them equally navigable, and also freely avails itself of the extensive area of waterway afforded by the lakes which intersect its path. A familiar instance is afforded by the Caledonian Canal, very much out of date at the present time, which has thirty-eight miles of lake navigation. Most of the principal French canals are constructed in order to effect a junction of two separate river systems—such as the Rhône and Rhine, the Loire and the Saône, the Scheldt and the Somme, and the Seine and the Rhône. In Italy we have the Cavour Canal uniting the Po and the Tessin. In America there are canals forming a continuous waterway between individual rivers, between separate lakes, and also between lakes and rivers—as, for example, between the Potomac and the Ohio, the Delaware and the Hudson, Lake Erie and the same river, and Lake Michigan and the Illinois. Lake Ontario, in Canada, joins the St. Lawrence at Montreal; and that magnificent stream is, by similar means, placed in communication with the Ottawa. This compound system of navigation is not restricted solely to inland or fresh water canals, but extends as well to those of a maritime character. The Suez Canal has a portion of its course through the Bitter Lakes.

As a rule the chief point to be attained in the canalisation of a river is to increase the available draught of water, and in nine cases out of ten it becomes necessary to attack the bed of the stream. Something, no doubt, can be frequently accomplished by collateral operations, which consist in training, regulating, widening, and otherwise generally improving the course of the river, but it is rare that even a combination of these ameliorating measures will of themselves be effectual in producing the highest possible degree of navigability. Given a channel of a certain width, depth, and velocity of current as sufficient for the purposes of navigation required, the object, after having once constructed it, is to maintain it. In those cases in which "collateral operations," assisted solely by the natural scouring power of the stream, are sufficient to ensure the constancy of the necessary conditions, the river, although rendered navigable by these means, is not, as has been already stated, considered to be canalised in the full and distinct signification of the term. It is evident, therefore, that the canalisation of a river goes far beyond the mere control and regulation of its course and current, and simply furnishing facilities for navigation. The channel of a river, in which the bed is of rock, or of any material unattackable by erosion, or one in which all natural erosion has ceased, can be rendered navigable to a certain extent by the construction of the somewhat minor engineering works already instanced. It is true that even with these favourable conditions of a regular and normal volume of water, and with an assured stability of channel, both in dimensions and configuration, the question of floods arises, which has more immediate relation, not to the lowest, but to the highest level, at which navigation can be kept open. This constitutes one of the three vertical data to be observed by the engineer engaged in works of the description under notice. The other two are the highest flood and the lowest drought level. Unless the process of denudation, or natural erosion has ceased to take effect the bed of the river channel remains unstable, and may shift at any time in obedience to local action. Under these circumstances, it is not advisable to trust to minor works to ensure the regular navigation of the waterway, as although successful at first, they are extremely unlikely to prove of any permanent value. The only method by which the navigation of a river can be improved, under these conditions, in a substantial and durable manner, is by canalisation.

Experience has determined, although the conclusion appears a little irrational, that straight reaches, except of comparatively insignificant lengths, are not to be recommended. As a consequence, therefore, in those examples in which the original shore lines are rectilineal, or nearly so, it becomes necessary to alter them. But in adopting a different system of setting out, it is, in accordance with the principle laid down at the commencement of our article, incumbent upon the engineer to retain, as nearly as circumstances will permit, the existing conditions of the banks. The chief feature of one of the new systems introduced on the Continent consists in the abandonment of the arc of a circle and the employment of a curve increasing in curvature from the tangent points towards the middle, and increasing again from this point to the following tangent.

In addition to the construction of the locks, dams, and other necessary works, the canalisation proper of a river is always accompanied by dredging operations, frequently upon a scale of considerable magnitude. When the inequalities have been levelled and a new channel created, in order that its course should be accurately maintained, the trace of it should be set out, not by straight lines and arcs of circles, which always present more or less abrupt changes of direction, but by arcs of a curve termed by French engineers *sinusoïde*. The great extent in the variation of the radius of this curve, and the continuity which it presents in this variation, has been the cause of it having been very much adopted abroad in the canalisation of rivers, and in instances where the rectification of the normal configuration of the channels was concerned. It was so employed in connection with the works attending the improvement of the river Rhone. It may be noticed that this is also the curve which would graphically represent the variations in the currents, generated under certain conditions in a single coil.

It is unnecessary to mention examples of the canalisation of rivers. Our own Mersey, Weaver, and other streams were canalised, after a fashion, more than a century and a half ago. But there is one example which we shall quote, not merely on account of its importance and magnitude, but for the practical bearing it has upon the subject of our article, and the explicitness with which it corroborates the real meaning we have attached to the title. We refer to "The Danube Regulation Works," described and illustrated in The Engineer of June and July last. Without needlessly recapitulating, it may be stated that the twofold object in view was, first, to do away with the small depth at low water; and secondly, to check the high velocities, so as ultimately to ensure free navigation through the cataracts of the Lower Danube. To accomplish this result it is intended to deepen the navigation channel through the cataracts with a bottom width of 200ft. and a depth of nearly 7ft. below the lowest drought level. During the construction of the canal through the Iron Gate this depth was increased to 10ft. The manner in which the canalisation of this portion of the Lower Danube was effected, and the machines employed in executing the different works, point out unmistakeably that, both in extent and purpose, they far exceed those ordinarily applicable to the mere training or improvement of a river.

THE DROUGHT IN SCOTLAND.

The past month of September has been the driest experienced north of the Tweed for over a century, particularly in the West of Scotland, where the total rainfall for the month averaged only seventeen hundredths of an inch. Such abnormal dryness, in a district notorious for a too abundant rainfall at all seasons of the year, has naturally had a potent influence on the water supply. The wet weather generally prevailing during the summer has enabled the large towns to face the autumn scarcity with full reservoirs, and such places have not suffered appreciably, but smaller towns in many parts of the country have been put to considerable straits, while the numerous residential places on the Firth of Clyde were almost without exception left without potable water. From Gourock to Stranraer on the one shore, and Kilkriggan to Campbelton on the other, an acute water famine prevailed, necessitating the departure of visitors, and entailing great hardship on the natives, who were reduced to carting scanty supplies from distant lochs and streams. Nothing approaching such an universal scarcity has been experienced since these towns and villages came into existence, though in 1887, and also last year, there were periods of remarkable drought, which tested the resources of the great towns and cities severely. It appears, then, that the dry spell of last month possessed some unusual features, causing it to be specially felt by places depending on a direct hill supply for water. On turning to the records of the Ben Nevis summit observatory, we find that last month had the smallest rainfall of any month since the observatory was built in 1883. Under usual conditions the rainfall at the summit of the mountain greatly exceeds that at the sea level, but during the past month it was for the first time on record less on the summit than at the sea level. This very unusual occurrence explainable by the continuation of north and easterly winds during the whole month, at once explains the rapid failure of the water supplies of Clydeside towns. These places are usually situated at the base of a range of hills with an elevation of from fifteen hundred to two thousand feet. The waters of some streams are impounded by banking across the mouth of the glen through which it flows, a first-class water supply, equal to all ordinary requirements, being thus obtained at a very moderate expenditure. During seven months of the year the mountain stream could supply five times the water required, and even in dry weather copious and frequent showers condensed on the hill tops from the Atlantic breezes keep the supply abundant. When, however, a continuation of dry winds is experienced, so that even on the top of Ben Nevis no moisture is condensed for weeks at a time, it is evident that the system of water supply described is extremely liable to failure, unless the storage capacity is large. This, for the reasons mentioned, it seldom or never is, so that when the feeding stream dries up the stored supply is speedily exhausted. The remedy is obviously increased storage capacity, and though such a phenomenally dry September as the last is not likely to recur speedily, the absolute failure of water supply, or even its probability, is so serious a calamity that the authorities of the places which have suffered cannot afford to disregard its possibility. The case of Helensburgh, the only residential town on the Firth of Clyde which has not suffered from water famine during the recent drought, shows the advantage of sufficient storage capacity. During the remarkably dry summer of 1887, this town suffered unpleasantly from the long continued dry weather. The main feeding stream of the supply system, the Ballyvoulin Burn, dried up completely, and the one reservoir above the town, in spite of a very restricted supply to the inhabitants, threatened to give out altogether, a contingency which would have necessitated the carting of water a distance of six miles from Loch Lomond. The magnates took the lesson to heart, and on the advice of Mr. Wilson, of Greenock, trebled their reservoir capacity, with the result that at the end of last month the engineer was able to report a full three months' supply still in store.

BRITISH MACHINERY IN RUSSIA.

According to recent Foreign-office reports, the introduction of English cotton, spinning and weaving machinery into St. Petersburg in 1893 was considerably larger than during the previous year, and extensive orders for delivery during the present year were taken by English firms. It is generally supposed by those thoroughly competent to form an opinion on the subject, that the reduction of the duty on cotton machinery under the Russo-German Commercial Treaty is not likely to increase the demand for the same, the reduction being inconsiderable. As this kind of machinery is not made in Russia, it must be imported to the extent of local requirements. Owing to the comparative lightness, the duty does not bear very heavily on it, as in the case of boilers, paper-making machinery, steam engines, &c. Although all cotton spinning machinery came as formerly from England, the Mulhausen district of Germany secured orders for sundry dyeing, printing, and finishing machinery, which used formerly to go to England. One reason for this is the lower price of German machinery, but another and more important one is that German makers are ever ready to construct or alter their machinery to suit the convenience, and often merely the caprice, of the Russian buyer whenever they can possibly do so. Several new mills for spinning combed wool were built, but the machinery for them was ordered in Alsace instead of in England. The importation of paper-making machinery, now principally German, was somewhat checked last summer by the enormous increase in the duties levied differentially, when it was of German manufacture. The outlook for the present year under the reduced duties has stimulated the importation, and there is every appearance of a great increase in it. British threshing machines continue to be those most appreciated by the Russian farmers, and the demand for sets last year was so great and sudden, that intending buyers who came to Moscow, not only were unable to make any purchases, but could not get their orders executed in England. The general conclusions are that although British machinery makers fully sustain their reputation for high-class articles, Russia and Germany secure more business than they did previously. For mill engines, Switzerland, a new and dangerous rival, is coming to the front. Millowners who formerly bought exclusively in England, placed several orders with Swiss makers, and appear well pleased with the goods supplied. Prices, freight, and duty are about the same, whether the machinery comes from England or Switzerland, but Swiss makers guarantee the consumption of steam required by their engines for the work performed, which pleases Russian buyers.

SHIPBUILDING IN FRANCE.

The new law which increases the premium upon vessels constructed in France is said to have given a very great stimulus to the native shipbuilding industry. We referred lately to a new yard that had been established at Rouen, where enough contracts have been entered into to keep the hands employed for several months to come, and now a similar success has been achieved at Nantes, where the construction of a maritime canal, and the deepening of the port, have allowed of vessels drawing more than 6 metres of water ascending thereto. Last week the launching of the cruiser Descartes, the first war vessel constructed at Nantes, was made the occasion of a general holiday, and in the speeches which followed the ceremony the directors and other officials of the Société des Chantiers de la Loire spoke of the great possibilities that were now opened up to Nantes as a shipbuilding centre. The Descartes has a length, over all, of 96 metres, and a displacement of 4000 tons. It will be entirely completed at Nantes before proceeding to Brest, where it will receive a powerful armament. Besides this vessel the Société des Chantiers de la Loire have other vessels in hand for the marine, including the armoured coast defence vessel Valmy, the first-class battleship Massena and the cruiser d'Assas. They have also building four large sailing vessels, of which three of 4200 tons each are to be constructed for MM. Bordes, of Bordeaux. The company expects to enter into several other contracts shortly, so that the 3000 hands employed at Nantes, St. Nazaire, and St. Denis will be kept busily engaged for a long time to come. This result is considered to be all the more satisfactory in view of the exceedingly low freights, and it is thought that as these become more profitable a still further impulse will be given to the native shipbuilding industry. According to the builders this result could not possibly have been attained if foreign-made vessels continued to receive the half premium, but the owners themselves entertain the contrary opinion, as they consider that the premium hardly compensates them for the increased cost of the vessels.

LITERATURE.

Ueber Vorkommen und Gewinnung der nutzbaren Mineralien in der Südafrikanischen Republik — Transvaal — unter besonderer Berücksichtigung des Goldbergbaues. By Bergrath Schmeisser. Dietrich Reimer, Berlin. 1894.

The work now before us, which is practically an account of the gold mines and other mineral industries of the Transvaal, is certainly in many respects the most valuable contribution that has yet appeared to the already ample literature devoted to this subject. Besides the importance to which its intrinsic merits entitle it, it deserves special attention from Englishmen, seeing that it is fraught with a number of instructive and incisive lessons for us, which we should do well to take to heart.

It appears that the Prussian Government, having regard to the repeatedly expressed opinions of statisticians that the gold supply of the world is rapidly falling below its requirements, resolved to send a mining engineer to the Transvaal to investigate the position and probable development of the gold production of that country. Herr Schmeisser was accordingly sent out, and the book now before us is the result of his studies. Although British interests in the Transvaal are beyond comparison, more important than German, and the ties that bind us to South Africa are far stronger and further reaching than the somewhat indirect Prussian connections with that part of the world, yet we find the German Government freely taking upon itself the duty of studying this new goldfield, whilst our Government has never even thought of such a thing, and probably never will, all our knowledge of African gold mining being due to private initiative. It is evident that the German Government does not consider that it has done its whole duty to the mining industry of the country, when a local postmaster has been appointed inspector of mines; nor does it look upon a successful political canvasser as superior to a trained scientist for the carrying out of such duties. In England, however, we do things differently, and the attitude of our Government towards mining and manufacturing industries cannot but suggest the reflection that whilst party Government has its advantages, it has drawbacks that pretty well balance them.

Not only does Herr Schmeisser's book teach us a lesson in its mode of inception; it is equally instructive in its mode of execution, and is an admirable example of German thoroughness. The first chapter is of merely general interest, giving a brief account of the geography, history, and constitution of the Transvaal. With the second chapter, the geognosy and geological description of the country are commenced. The author gives a brief account of the various formations that occur in the Transvaal, and of their relations to each other. Although necessarily still very imperfect, this sketch gives an excellent outline of the broad geological features; and though errors of detail doubtless exist, the author's general conclusions will probably be found to be correct when fuller details are available for a systematic study of the subject. Herr Schmeisser has not only utilised the observations made by others, he has contributed largely to our knowledge of Transvaal geology by his own researches.

Commencing with the lowest sedimentary formation, the Swazischists, and the gold veins contained therein, it is worth while noting that he looks upon the Sheba reef as a true reef, whilst most previous writers on this subject seem rather to have held the view that it is an altered bed. His opinion on this reef may be gathered from the following quotations: "The footwall is sharply defined, the hanging wall less so, because the deposit is more or less united to the quartzite which forms the hanging wall. Midway between the two walls, a well marked fissure like a false hanging wall traverses the entire deposit. . . . . . Fragments of the country rock from the hanging wall side are of common occurrence in the body of the vein. . . . . The mode of occurrence of the Sheba deposit, its great width, and the presence of large horses of the hanging country rock, justify the inference that this is a composite vein, that is to say, a vein formed by the simultaneous opening of several fissures within narrow limits, and the destruction of a part of the rock-masses that separated them." The various other gold districts in which veins in the Swazischists are being worked, namely, Komati, Selati, Letaba, Molotsi, Houtboschberg, Marabastad, are all dismissed in a few words, commensurate with their present trifling importance, and then the gold districts of the Kaap series of rocks are approached, the first place in which is naturally taken by the Witwatersrand deposits. Herr Schmeisser is careful to point out that these are bedded deposits, although in describing each bed, he subjoins the name of the "reef" by which it is conventionally known. The entire "reef" series is fully described, and a capital table given of the various mining companies in the order in which they are situated along the main reef. For the first time we have a really exhaustive scientific description of the constitution of the famous Witwatersrand conglomerate. According to our author these are true quartz conglomerates, the pebbles being cemented by a mass of granules of the same quartz held together by a binding material of greyish-blue or green colour when undecomposed. The quartz pebbles consist but rarely of individual crystals; they are mostly rather coarsely crystalline, rarely microcrystalline aggregates, the granules showing no definite system of co-ordination. The quartz contains but few solid inclusions, but an extraordinary number of fluid ones, arranged in approximately parallel planes, so as to give sections of the quartz a streaked appearance. The microscopic structure of these pebbles, as well as their frequently flattened outlines, point to strong mechanical action, in all probability due to pressure, the effects of which are also seen in the cementing material. This latter contains, in addition to small grains of quartz, the following minerals:—Pyrites, magnetite, zircon, rutile, muscovite, chlorite, secondary quartz, and native gold. In one specimen tourmaline was found. The pyrites, the most abundant mineral next to the quartz, is a primary constituent of the conglomerate. The gold is a secondary component, and is not of alluvial origin, as is shown by its crystalline form, and the mode of its distribution in the conglomerates—it never occurs, properly speaking, enclosed in the quartz. When it is found in the pebbles it is always in a thin fissure or seam in them. It is evident from the above synopsis that the results of this research have given data of great value in determining the probable permanence in depth of the Witwatersrand auriferous conglomerate beds. Herr Schmeisser's calculations as to the probable duration of the working of, and the amount of gold available in the best known portions of the Witwatersrand goldfields were published in the German "Reichsanzeiger" for February, 1894, and were almost immediately translated into English. The results of these calculations will probably be fresh in the memory of our readers, and we need not therefore refer to them again.

The remaining goldfields of the Kaap formation, namely, those at Klerksdorp, Vryhied, and Lydenburg are briefly described; the latter perhaps not quite so fully as their geological, apart from their industrial, importance might seem to merit. There is also a brief account of the coal seams that are worked in certain of the Karroo formations, and a mention of other mineral occurrences—notably those of silver—closes this valuable chapter.

The third chapter comprises an account of the mode of extracting the various metals and minerals. It contains a short but fairly correct history of the rise and progress of mining in the Transvaal, and an excellent summary of previous legislation on the subject and of the existing gold law. The methods of mining are next described, and then the system of stamping and gold extraction. This is perhaps the weakest portion of the whole book, as many details of importance are omitted, and a few inaccuracies have crept in. It is interesting to note that the author estimates that during 1893 there were, on an average, 1955 heads of stamps at work in the Rand, and that their average crushing capacity was three tons per head per diem. He also refers briefly to other crushing machinery, concluding his paragraph on this subject with the pregnant remark that "the Huntington mill at the Wolverdon Gold Mines near Klerksdorp only ran for two days." A few pages are devoted to an account of chlorination and of the cyanide process. The description of the latter is good, but contains nothing novel. With regard to the machinery employed on these fields, our author states:—"The whole of the colossal requirements of the Transvaal as regards machinery is supplied by English and American manufacturers; but few German manufacturers or contractors are represented in Johannesburg. Hence, English and American makers are so busy *that they cannot themselves execute the orders, but are compelled to obtain assistance from Germany*. The Buckau Machine Works were lately building a 600-horse power driving engine to the order of Messrs. Fraser and Chalmers, of Chicago, for the stamp mill of the City and Suburban Gold Mines, near Johannesburg." The italics are our own.

The work concludes with a series of valuable tables, showing the output and financial position of the various Transvaal gold mines, and with a number of maps showing the general position and features of the various goldfields.

As we have already said, this is by far the best work on the subject we have yet seen, and perhaps the only one that can be considered as a serious scientific book. There are, nevertheless, one or two points on which we are not at one with the author. We cannot, for instance, admire his inclusion of all weathered rocks within the comprehensive term of Laterite, the same name being applied indiscriminately to weathered diorite and to weathered stratified rocks. It may be convenient to call the various deposits treated by hydraulicking at Spitz Kop, Rosshill, and Lisbon, Berlyn laterite, but it is certainly not scientific, and as regards the last-named property absolutely incorrect, even with the very elastic meaning here given to the word. Again, we cannot agree in the opinion here expressed that closer concentration by mechanical means —the German system of close dressing—is beyond doubt desirable. The author ascribes its absence to the influence of American mining engineers, who, he says, are not acquainted with such accurate dressing operations in their own country. We are not concerned in defending the American as against the German system of ore dressing; on the contrary, we hold the latter to be, generally speaking, the better. But in treating gold ores, too many dressing operations must be avoided if float gold is not to be lost, and we ourselves do not look for any improvement in the treatment of tailings in this direction. Nor do we agree with the condemnation of Frue Vanners, for the reason that they make only two classes and no middlings; this may not suit the ordinary concentrator, but it is, on the contrary, precisely what the gold miner wants. He only wants two classes—clean concentrates containing all the gold, and clean tailings containing none. Experience so far is against carrying dressing operations too far in the case of gold ore, although a certain degree of sizing would no doubt be found beneficial. We rather venture to think that the attention of gold-mining engineers will be directed in the near future to the question of treating all the tailings direct as they leave the plates by some chemical process that shall remove the gold left in them after amalgamation; and we believe that such a process is quite within the bounds of engineering science.

In conclusion, it remains only to say that all engineers are greatly indebted to Herr Schmeisser for having produced such an admirable work on a subject of general interest, as well as to the German Government for having given the incentive to it, and as we are not likely to get anything of the kind done for us in this country, we hope it will not be long before the work will appear in an English dress that will make it readily accessible to the mass of English engineers who would be glad of an opportunity of studying it. It is, however, to be hoped that any English translation will be furnished with a good alphabetical index; the absence of any index at all is a very serious blemish on the present work.

Continuous Current Dynamos and Motors. By Frank P. Cox. New York: The W. J. Johnston Co., Ld.
Electric Light Fitting. By John W. Urquhart. London: Crosby Lockwood and Son.
Electro-Magnetism and the Construction of Dynamos. Vol. I. By D. C. Jackson. New York and London: Macmillan and Co. 1894.

The work upon dynamos by Mr. Cox is intended as an elementary treatise for students, and is really a valuable book. It deals with no particular type of machine, but is a general consideration of the laws governing the design of direct-current dynamos and motors. The book is not burdened with cuts of the external appearance of machines, but discusses the principles which underlie the design of the separate parts. It is only assumed that the reader has a knowledge of algebra and of the elements of geometry. After describing the systems of measurement and the theory of the production of current, the author proceeds to calculations appertaining to the magnetic circuit, and deals first with the determination of the induction by the methods of Gisbert Kapp and of Drs. J. and E. Hopkinson, of which the author prefers the latter method. In the following chapter, the theory of winding, losses, &c., are discussed, and important use is made throughout of the system of plotting curves to represent results.

A good feature in the book is the practical application of the principles and formulæ which have been discussed to the actual design of dynamos and motors. The author supposes the case of a 200-light dynamo required to develope 110 volts at a speed of 1500 revolutions per minute, and very clearly explains his method of calculation. The last two chapters of the book are devoted to the action of steam in an engine, which is, of course, a subject which should be known for dynamo testing. In a table of belting, in the form of an appendix, we note that the author uses the word "strain" throughout where he means "stress." The book should be of considerable interest to young draughtsmen in the offices of dynamo builders.

Mr. Jackson is the professor of electrical engineering in the University of Wisconsin, so that we are able to compare two American methods of treatment with one another. This work has been developed from the lectures delivered by the author to his classes in dynamo construction. No special machines are described or illustrated, and only continuous current types are dealt with. Alternating work will be dealt with in a subsequent volume. A knowledge of the calculus and trigonometry is required to understand parts of this work.

In his description of experimental methods for the determination of the magnetic properties of iron the author alludes to a modification of the Hopkinson apparatus made by a Mr. Burton for the laboratory of the University of Wisconsin, the magnetising coil being placed upon the yoke instead of on the test piece.

Ewing's work is followed, and the results obtained are plotted. Both this work and that of Mr. Cox are very well printed. The author pays a great deal of attention to compensation for cross turns, and alludes to a number of different designs of winding. From the point of view of the Professor, he appears to desire to sort machines into families and species, and to fit each type with its special formulæ. Perhaps it is too much to say that some Professors are interested in the various types for the sake of the pleasure of producing formulæ, but the commercial aspect of the question is distinctly absent from the greater part of the work.

Mr. Urquhart has written several books upon electrical subjects; they are descriptive works, not dealing with formula or analysis at all. No mathematical knowledge is needed to read them, and the author writes for the intelligent workman engaged in electric lighting, or training for it; he claims the book to be the notes of a practical electrician. We see that the usual allowance of breadth of belt is said to be 1in. per horse-power, for belting moving at a speed of 1000ft. per minute. This is certainly on the safe side, as few belts come up to this requirement in practice. The rule is stated to apply to belts from 3in. to 12in. in width. The brush-moving device spoken of as suggested by a Mr. R. Tatham was patented some years ago by Mr. Druitt Halpin, and we believe was used in several cases. The practical directions concerning care of the dynamo and attention to the commutator, re-wiring, &c., are well written, and the notes as to attention to alternators are very valuable to dynamo tenders. In instructions for testing the insulation of electric wiring, the author alludes only to the Wheatstone bridge method, and describes in detail the method of using the Silvertown set. This is, of course, very useful for telegraph work and cases in which a low potential will eventually be used, but it is not nearly so satisfactory, in our opinion for circuits which will be supplied from the public mains, where a magneto machine and Evershed ohmmeter are distinctly preferable.

In his chapter upon the lighting of ships the author gives some useful hints, and recommends screw socket lamps. We have often thought it strange that in the United States the screw socket should be practically the only type in use, while here the pin socket is almost the only one employed. The explanation adduced by some electricians, that screw socket holders tend to slack back from vibration, can have little point if this pattern is considered best for steamships.

BOOKS RECEIVED.

Tramways, their Construction and Working. By D. Kinnear Clark. London: Crosby Lockwood and Son.

Recent Cotton Mill Construction and Engineering. By Joseph Nasmith. Manchester and London: John Heywood.

What is Heat? A Peep into Nature's most Hidden Secrets. By Frederick Hovenden, F.L.S., F.G.S., F.R.M.S. London: W. B. Whittingham and Company. 1894.

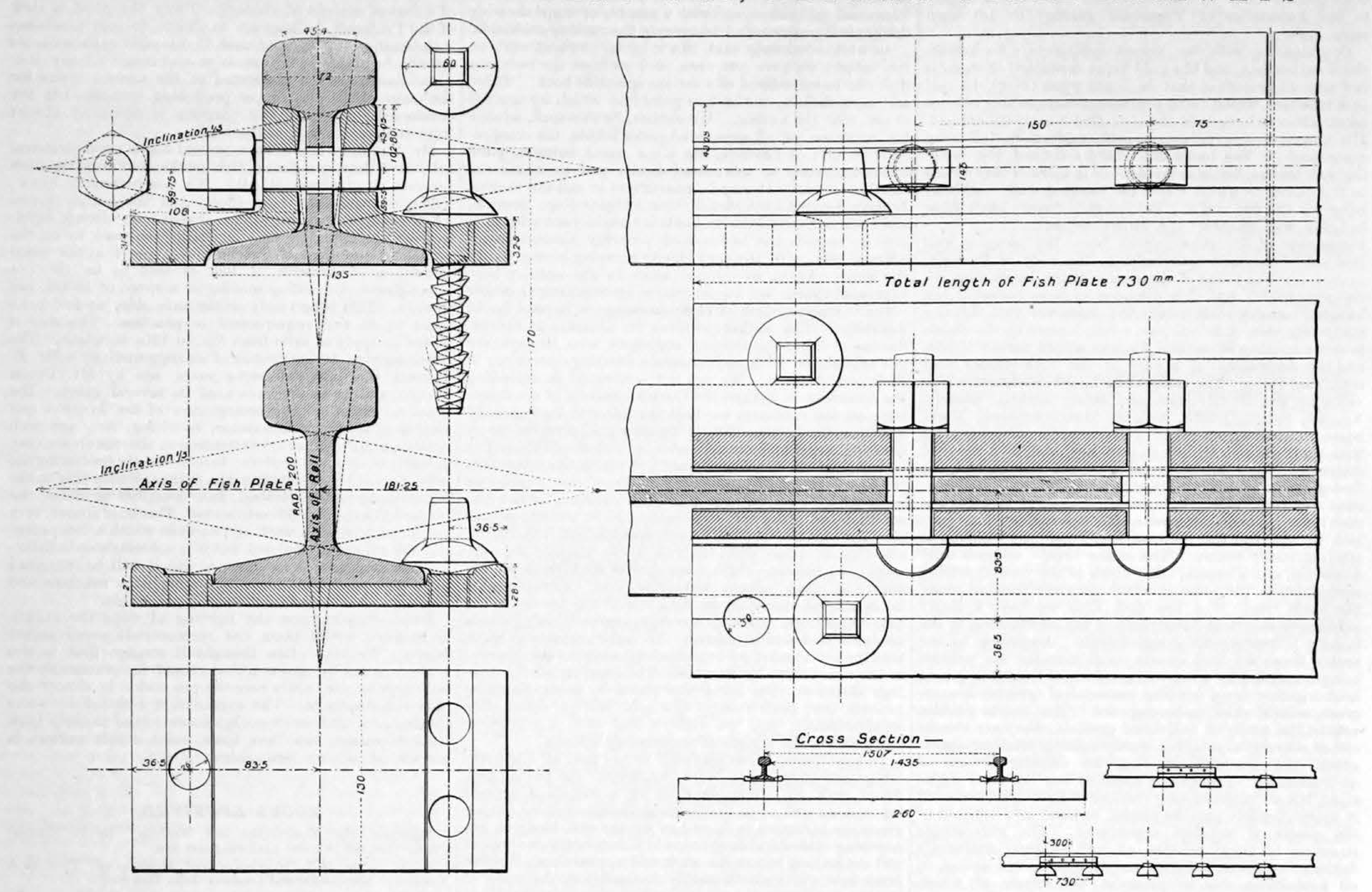
Electric Light and Power. Giving the result of practical experience in central station work. By Arthur F. Guy A.M.I.E.E. Illustrated. London: Biggs and Company.

Electric Transmission of Energy and its Transformation, Sub-division, and Distribution. A practical handbook. By Gisbert Kapp M. Inst. C.E. London: Whittaker and Company.

THE LATE MR. J. H. OSBORNE, C.E.

The death is announced at his residence, Summerseat, near Philadelphia, of Mr. John Humfrey Osborne, who has been a prominent civil engineer in the United States for over half a century. He was born in Dublin, September 30th, 1818, being the second son of R. D. B. Osborne, barrister-at-law, and Lucy Caulfeild, only daughter of John Humfrey, of "Killerig," co. Carlow, and was a direct descendant of Sir Edward Osborne, of Ashford, Kent, Lord Mayor of London, 1583, and of his grandson, Thomas, first Duke of Leeds. Mr. Osborne was educated at Mr. Richard's school, Bathampton, and on leaving school travelled widely, visiting Australia among other countries. In 1839 he went to the United States, and became confidential secretary to Mr. Wirt Robinson, chief engineer of the Philadelphia and Reading Railroad. From that time he threw himself ardently into the profession of engineering, and rose to be chief assistant in 1843. Three years later he was appointed chief engineer of the Philadelphia and Reading Railway, but resigned that position later on to join with his brother, Mr. R. B. Osborne, in the construction of the Waterford and Limerick Railway. Returning to the United States in 1850, he was appointed to the Ogdensburg and Lake Champlain Railway, and the next year took charge of a portion of the construction of the Southside Railway in Virginia. From 1852-3 he was superintendent of the Richmond and Danville Railway, and on resigning that post, to become associate chief engineer and superintendent of construction of the Camden and Atlantic Railway, was presented with a massive service of plate as a mark of the affection and esteem in which he was held. After the opening of the Camden and Atlantic Railway in 1854 Mr. Osborne became its general superintendent, but resigned four years later, to take charge of the construction of the most difficult section of the Lebanon Valley Railway through the counties of Berks and Lebanon, Pennsylvania. In spite of great difficulties Mr. Osborne completed this work to the day and publicly received the congratulations and thanks of the president and board of directors. In 1858 he also rebuilt the Quakake Railway, uniting the Lehigh Valley, Black Creek branch, with the Catawissa Railway above Tamaqua, and with his brother, Mr. R. B. Osborne, made a survey for the continuance of this line into the Mahanoy coal fields. In 1873 he also undertook with Mr. R. B. Osborne an extensive barometrical survey for the Shenandoah Valley and Ohio Railway from Harrisonburg, Va., over the Great Northern and intervening mountains, crossing the Alleghanies into the Valley at the head waters of the Greenbriar River. Mr. Osborne continued from time to time to take an active part in his profession to which he was most devoted, but for the past twenty years practically lived in retirement at his country place Summerseat, between Philadelphia and New York—one of the oldest and most interesting residences in the United States. The house, built over a century and a-half ago by an English gentleman, Captain Barclay, was the headquarters of Washington before the battle of Trenton, and the rooms he occupied and in which he wrote many of his despatches are often visited for their historical associations.

CROSS SLEEPER PERMANENT WAY, BELGIAN STATE RAILWAYS



PERMANENT WAY: BELGIAN STATE RAILWAYS.

Of the 2000 miles of line which form the system of the Belgian State Railways, 500 are called "International." There is probably no European country which has more through traffic than Belgium. Ostend has long been the rival of Calais for conveying English and American travellers to Germany and Austria; whilst Antwerp, as the chief commercial port of Central Europe, receives each year larger quantities of goods in transit for these countries. Traffic from Holland to France naturally passes through Belgium, and the railway through Luxemburg, which nearly served as as the pretext for a war between France and Prussia in 1868, has long been considered one of the main highways of Europe.

Before 1880, the rails used on all lines belonging to the Belgian Government weighed 76 lb. to the yard. The sleepers were of creosoted oak, half round, 10in. diameter, and 8ft. 6in. long, and there were ten of them to a 30ft. rail. Ordinary flat fish-plates were used, with four bolts. As the traffic became heavier, it was requisite to increase the strength of the permanent way. The section of rail was not changed, but in 1881 twelve sleepers were substituted for ten, and soon afterwards angle fish-plates, instead of flat. Meanwhile the weight of the locomotives necessary for express trains was continually augmented, till, in 1885, engines were being used in which the load on each pair of driving wheels was fifteen tons. It was then decided that the permanent way on the sections carrying international express trains would require to be completely reconstructed, and M. A. Flamache, Chief Engineer of the Belgian State Railways, was authorised to make an experiment, by re-laying two miles of the track between Antwerp and Brussels in whatever manner he thought best, using a rail which should weigh about 100 lb. per yard. He kept to the Vignolles section, but adopted a rail 5⅝in. high, 5⅜in. flange, with head 2⅞in. wide, and weighing 105 lb. per yard.

From experiments which he had been carrying on for some time, M. Flamache decided that screws were better than spikes, and that the form of screw shown in the drawing was the most suitable that he could adopt. It will be observed that the screw is cylindrical, not taper; that the pitch of the thread is ½in., which is unusually large for a screw whose diameter, measuring over the thread, is less than an inch; and that, instead of the upper and under surfaces of the thread tapering equally, the former is almost horizontal. M. Flamache's experiments led him to believe that this form of thread not only held better, but did less damage to the grain of the wood, than when both sides of the thread tapered equally. The conical shape given to the underside of the head, he also considered to be advantageous to the stability of the line. The diameter of the sleepers has been increased from 10in. to 11in., and their average distance apart is 2ft. 6in. centre to centre. This distance is diminished to 2ft. at the joints, whilst the fish-plates are 2ft. 5in. long. The rails are always vertical, and, except at the joints, there are plates between the rail and the sleeper.

Between Antwerp and Brussels the track is tolerably level; but on some parts of the system, and especially on the Brussels, Namur, Arlon, Sterpenich sections, there are inclines of 1 in 62, and even several of 1 in 55. On this branch, the weight of engine and tender is 83, and sometimes 88 tons; an increase of 40 per cent. over the weight of those formerly in use. It was calculated that a 95 lb. rail would be sufficient for these engines, but the 105 lb. was adopted to allow for rust, &c.

The first section of two miles was put down on the Brussels and Antwerp line in May, 1886. In 1888 another six miles was added to this, and as the new track was considered satisfactory, it has been substituted for the old, at the rate of 100 miles per annum. In the latter part of 1892 part of the permanent way laid down in 1886 was taken up and examined. Several of the sleepers which, as far as could be judged by external appearance, seemed the worst, were sawn through the screw hole. In all of them the thread was in a perfect condition, though it is calculated that 170,000 trains had passed over that section of the line since the new track had been laid, including fifteen express trains daily, and heavy goods trains, frequently with wheels on the brake-vans worn into flats. Altogether M. Flamache estimated that this test was equivalent to thirty years' work on any average continental line. M. Léon Bika, Chief Engineer of the Belgian State Railways, says that they continue to be thoroughly satisfied with the new road, and that the duration of the sleepers is much longer than they had expected.

ON THE HEATING POWER OF SMOKE.

By R. R. Tatlock, F.R.S.E., F.I.C., F.C.S.

It appears to be generally understood that a large percentage of fuel is lost in the smoke which issues so abundantly from most chimneys, and random statements have been made to the effect that the loss in heating power due to this passing away of combustible matters in smoky furnace gases may reach as high as 30 per cent. of the whole. A little consideration, however, will show that the loss of any large percentage of combustible matter, and consequently of heating power, is quite out of the question. This may be proved in two ways (1) by calculation of the two sources of heating power as shown by an analysis of coal or dross used for steam raising; and (2) by actual analysis of the furnace gases for combustible solids and gases. In the following paper are given the results of these two methods of observation, the same dross being analysed and also employed as fuel in a works furnace, from which smoky gases were given off which were tested for combustible matters.

(1) The following is the analysis of the dross employed:—

Gas, tar, &c.	37·63
Fixed carbon	49·97
Sulphur	·40
Ash	2·72
Water	9·28
	100·00
Heating power practical) due to gas, tar, &c.	1·16
" " " fixed carbon	6·49
	7·65

The points to be observed are the relative proportions of heating power—represented in the analysis by the number of pounds of water at 212 deg. Fah. capable of being evaporated to dryness by 1 lb. of the fuel—given out respectively by the combustion of gas, tar, &c., and by fixed carbon. These are calculated according to Playfair's well-known formula, which was practically tested on coals intended for the British Navy, and which shows that while 1 lb. of fixed carbon is capable, when burned, of evaporating 13 lb. of water at 212 deg. Fah. to dryness, 1 lb. of the gas, tar, &c., will only evaporate 3·1 lb. From these figures it appears that in this coal or dross the gas, tar, &c., only contributes 15 per cent. of the total heat given out during the combustion, and that the fixed carbon produces the remainder, or 85 per cent. In coals with less of the former ingredients and more of the latter, which is commonly the case, the proportion given out by the volatile constituents would be considerably reduced. It is thus perfectly clear that even though the whole of the volatile matters—which can alone be accountable for any loss of combustible material—escaped combustion, there could not possibly be a greater loss of heat than 15 per cent. of the whole, even in such an extreme case as this represents.

(2) An analysis was made of the furnace gases given off during the burning of the dross, of which the results are given above, with the following results:—

	Gas very smoky.	Gases almost free from smoke
	Per cent. by volume.	Per cent. by volume.
Carbonic acid	5·0	3·5
Carbonic oxide	None	None
Hydrocarbons	Trace	None
Nitrogen	79·9	79·9
Oxygen	15·1	16·6
	100·00	100·00

It has been asserted that carbonic oxide is given off in considerable quantity when much smoke is being produced, but it does not appear in this case; and Hempel in his work on "Gas Analysis" comes to the conclusion that little or no combustible gases are present in furnace gases. In the volume referred to—page 205—Hempel says, "Furnace gases usually contain only carbon dioxide, oxygen, and nitrogen. All other gases are present in but very small amounts. In oft-repeated analyses the author has always found only traces of carbon monoxide, methane, and the heavy hydrocarbons." This is in complete accord with the analyses given above, and it may be taken for granted that the presence of carbonic oxide or other combustible gases in furnace gases is a most unusual occurrence. This is quite conclusive evidence that no appreciable loss of heat, even when the furnace gases are smoky, can be attributed to the passing away of the products of imperfect combustion in the gaseous form at least.

That there is loss of combustible matter in the smoke is an undoubted fact, but the quantity seems also to be greatly magnified in certain random statements. In the experiment referred to above the soot was also collected during 1½ hours with the following results:—

	Grains per 100 cubic feet of furnace gases.
Carbonaceous matter	30·81
Ash or mineral matter	20·65
Total soot	51·46

It will be observed that the soot collected consisted largely of mineral or incombustible matter. In several experiments to estimate the soot in furnace gases, similar results to these were obtained, and the average would come very close to the quoted results of this special test. To find how much carbonaceous matter was actually lost as smoke it will be necessary to know the number of cubic feet of furnace gases given off by the combustion of, say, one ton of the dross. If the percentage of carbonic acid in the furnace gases is taken at 5 per cent., the total volume of these given off from one ton dross would be about 940,000 cubic feet measured at the ordinary temperature and pressure, and this would contain 41 lb. of carbonaceous matter and 27 lb. of mineral matter. This would represent 1·83 per cent. of the volatile matters—gas, tar, &c.—given in the analysis of the dross, and if from this is now calculated the heating power according to Playfair's formula, it will only come to 0·057. This figure, compared with the practical heating power—7·75—of the dross, goes to show that the solid combustible matter of the smoke can only account for the very small percentage of 0·74 of the total heating power which can be obtained from the coal.

From the results of these experiments it is evident that the loss of combustible matters in smoke is very small indeed, and that the belief in immense loss by this cause is simply a fallacy, and is decidedly not corroborated by experiment. In adopting methods of removing the smoke nuisance it must therefore be borne in mind that there is little or no gain in burning smoke, and that other methods of dealing with the problem, such as Dulier's Smok Absorption process, ought also to receive consideration.

The Birmingham Association of Mechanical Engineers.—The opening meeting of the session of the above Association was held on Saturday last at the Grand Hotel, Colmore-row, Birmingham. The chair was taken by the president, Mr. E. Hazel, and there was a large attendance of members.

LANCASHIRE AND YORKSHIRE RAILWAY WIDENING AT SALFORD.

To meet the demands of increased traffic, the Lancashire and Yorkshire Railway obtained parliamentary powers in 1890 for the widening of its line from Victoria Station, Manchester, to Hope-street, Salford, a distance of about a mile and a-half, and in April, 1893, a start was made with the demolition of existing house property which would require to be removed. As the route passes through a thickly-populated district, it has been found necessary to destroy about a hundred houses and shops, the old materials from which have been utilised in the foundations of the new viaducts. We give a plan showing the portions which are now being proceeded with, embracing about one-half of the projected undertaking. It will be seen that the Lancashire and Yorkshire Railway runs immediately alongside of the Manchester and Liverpool branch of the London and North-Western Railway, which latter has its terminus at the Exchange Station, while the Lancashire and Yorkshire principal station is at Victoria. Covering an area of 7½ acres, Victoria Station forms a busy nucleus of traffic; 1170 trains enter and leave it in one day, 350 of these by the lines which are now being widened. The original station of the Manchester and Leeds Railway, the forerunner of the Lancashire and Yorkshire, was at Oldham-road, the present site at Hunt's Bank being privately purchased by Mr. Sam Brooks, the vice-chairman of the company, and presented by him to the railway company in August, 1838. The station was opened on New Year's Day, 1844, and a junction with the Liverpool and Manchester line was soon effected. Between 1880 and 1884 various extensions were made, and there are now eight distinct platforms arranged in consecutive order from south to north, and dealing principally with traffic to and from the North of England and Scotland. The two chief arrival platforms are placed nearest the main approaches.

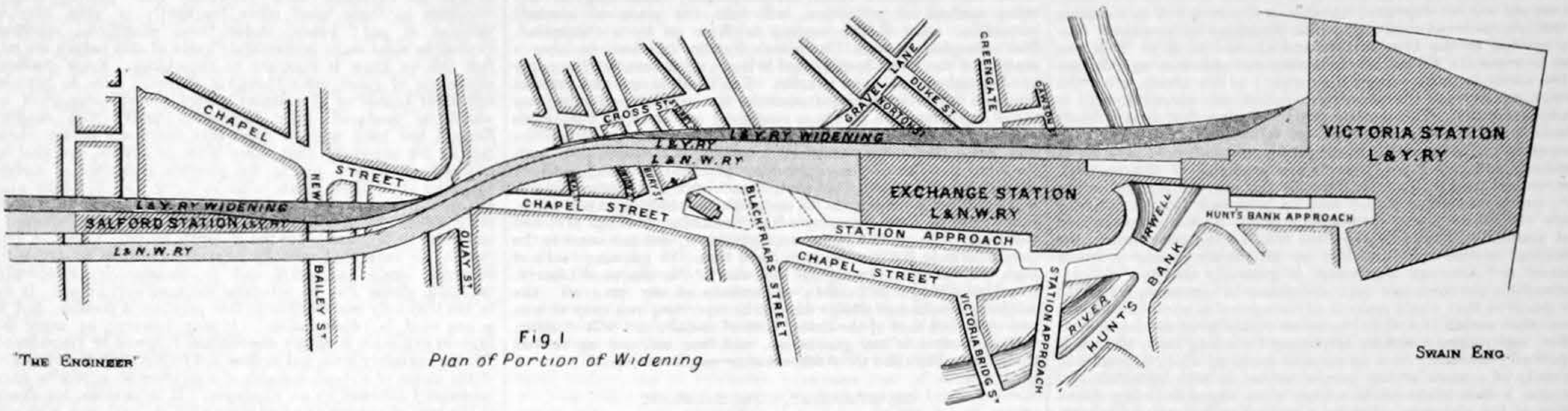


Fig 1
Plan of Portion of Widening

"THE ENGINEER" SWAIN ENG

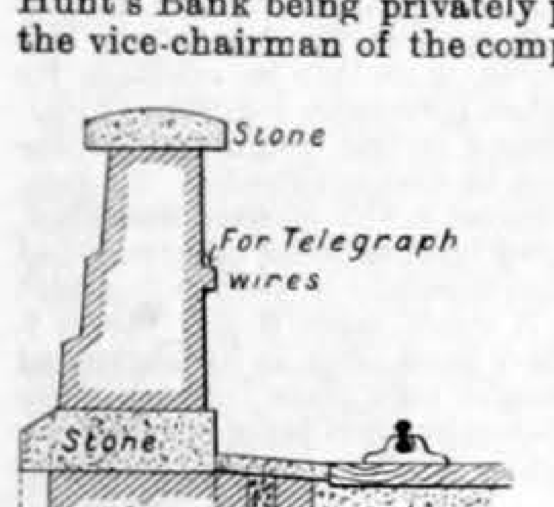


Fig. 2.
Section of Parapet

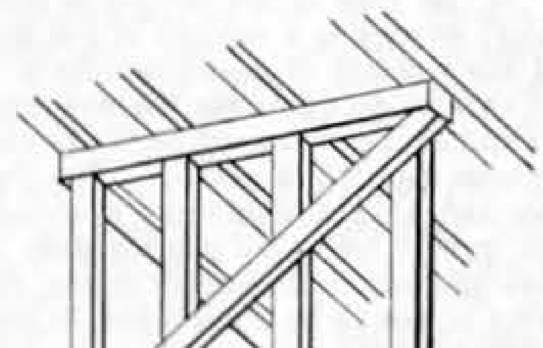


Fig. 4.
Shewing the Four Ribs of the Centre for Arch.

The present widening passes over a number of small streets, necessitating an expensive construction. Between Victoria Station and the crossing of Chapel-street, a distance of about half a mile, thirty-five brick arches have been built. They have generally a span of 28ft., with a rise of 10ft. The foundations are all carried down to the solid rock, which was found at depths varying from 20ft. to 4ft. below the surface. The piers are mostly lateral extensions of the old piers, and are built of common red bricks in lias lime mortar, or cement mortar, composed of one of cement to two of clean engine cinders. They are faced with blue bricks, and ashlar quoins are provided to the street abutments. The springers for the arches are specially made of blue brick, as recent experience has shown that in case of fire the blue brick is much less liable to damage than springers of stone, and, as most of the arches are closed in and glazed in the upper part to serve as stores, the danger of fire is one which it is necessary to guard against. The arches are constructed mostly in five half-brick rings, the two soffit rings being in blue brick, and the three outer rings in common brick. The spandrils are filled in with common brickwork, and the whole of the top surface is covered with 2in. of cement concrete and a layer of asphalte. A stone string course 24in. by 9in. runs the whole length of the face; above this the parapet wall is built, battered on the face, and having two plinth courses, as shown in Fig. 2. In order to prevent the brickwork from being damaged by drainage from the ballast of the line, a cavity is formed in the brickwork, as shown in the illustration, and run in with asphalte.

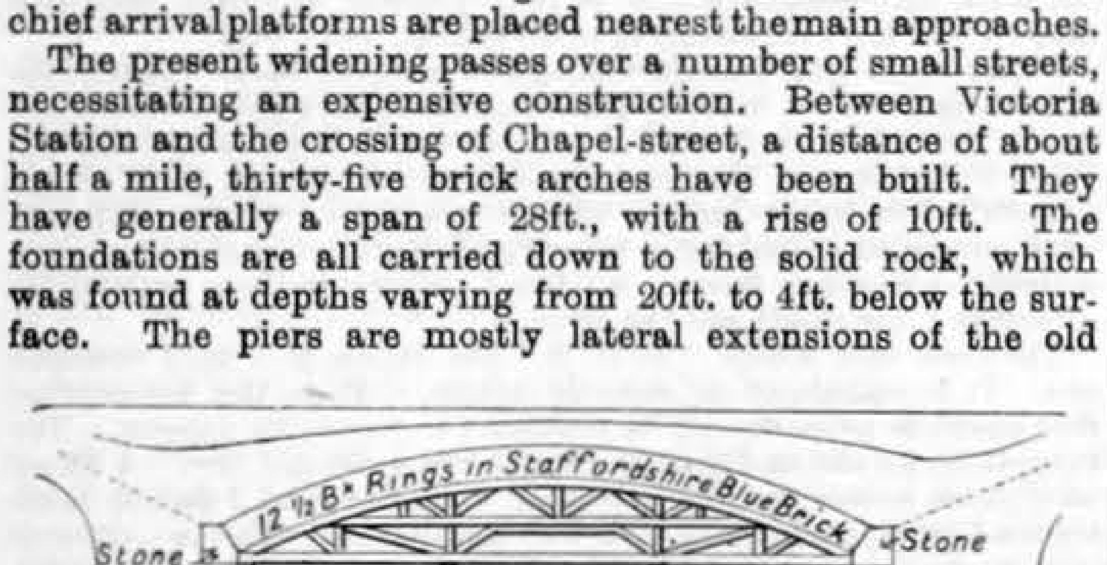


Fig. 3.
Centre for Brick Arch

There are several steel bridges included in the undertaking, the largest having a span of 63ft., and of the cantilever type. The others possess no features of special interest. One of the most interesting of the bridges is an unusually large segmental arch in brickwork carrying the railway across the river Irwell. It has a square span of 102ft., and a skew span of 105ft., with a rise in the centre of 13ft. 6in. The arch is composed of twelve half-brick rings of blue Staffordshire bricks, with springers of Derbyshire gritstone. The abutments are founded on the solid rock, which was dressed with the help of cofferdams. As the centreing alone for an arch of this size constitutes a work of some importance, it was determined to test its sufficiency by constructing a model of the centreing to scale, and applying various loads. A wooden model, one-twelfth natural size, was made, having four ribs, as shown in the Figs. 3 and 4. This was loaded with rings of blue bricks laid dry, with the interstices filled with sand; additional layers of bricks were added until thirteen rings were borne by the model without any excessive deformation, and no fears were felt that the actual centreing would not be strong enough for its work. This confidence was happily justified, and the bridge takes rank amongst the largest brick arches that have been constructed.

RUSTLESS COATINGS FOR IRON AND STEEL.*

By M. P. WOOD, New York City, Member of the Society.

(*Concluded from page* 308.)

ONE of the most trying situations for the protection of his work that the engineer has to deal with is in the exposure of wrought or cast iron water and gas pipes, through the cinder beds or fillings from blast furnaces, rolling mills, &c. Pitch compounds applied hot afford some measure of protection over that of the naked iron, but the creep of the pipes due to changes in the temperature of the fluids passing through them, and of the surrounding earth, the concentrated action due to the sulphur in the cinder or ashes, the porous nature of the covering over the pipe and in which it is embedded, allowing the ready access of air and moisture from the streets, ammonia, and other fumes and liquids due to the decomposition of a score or more of different bodies, all aided by the vibration caused by the passage of heavy trucks, railway trains, and kindred causes, combine to render the problem one not easy of solution. A thick puddle of good clay of a thickness all around of at least one-half the diameter of the pipe, and in case of pipes under 8in. or 10in. diameter, the thickness should be equal to the diameter of the pipe, if allowed to dry out well before covering in, gives a good protection and aids materially whatever compound is applied externally to the pipe. I do not know of any case where the pipes coated with magnetic oxide by the Bower-Barff or any other process has been tried, but it seems to the writer that if there was any situation in which the merit of the process could be demonstrated this is one, and it is not one of minor extent or importance. The rapid destruction of the wrought and cast iron mains, as well as the galvanised iron and lead service pipes of our water and gas distribution systems, by electrosis brought into action by the use of the system of pipes as a ready ground connection for our extended and fast multiplying lines of electrical service, is assuming so serious an aspect, particularly upon streets or locations where electrical railways are in use, as to call for serious consideration by all branches of the engineering fraternity for some method of protection other than now in use. So rapidly is the destruction progressing, that in many places the utter prostration of the water and gas systems may be looked for within the next decade. Pipes now affected, removed and replaced with new, but pass the corrosion further along to other and weaker points in the line, until the whole system is becoming honeycombed with points ready for failure on a little change in the ordinary working conditions. The return current from the single wire trolley system of electrical car lines appears to seek out and take for its passage back to the power house the pipe system contiguous to the line, instead of using the ground wire connections provided for it. The use of the electric motor now contributing so much to the comfort and conveniences of life in the form of electrically-driven ventilators, pumps, elevators, and other small powers, is rapidly extending the evil. The remedy, if not provided by the electric light, heat, and power companies in the form of taking better or sole care of their product from its generation to its extinguishment, will ere long be found in mulcting them for damages so heavy that the small margin now existing between the dividend point and a receiver will be wiped out.

Some experiments on a small scale of the Bower-Barff magnetic oxide application to pipes and iron exposed to electrosis action, appear to indicate its ample protective power. What it would develope upon an extended system of gas or water service remains to be tried. The iron pipes and connections, if protected by this process, would still leave the lead joints and lead service pipes exposed to attack. Cement joints might obviate part of the evil, but would render the main pipe line too rigid in withstanding changes of temperature, and expansion joints are not to be considered in pipe lines of hundreds of miles in extent. The electrical engineers as a body appear to have given this question only a sort of a happy-go-lucky, or after-me-the-deluge consideration; but the hour is not far distant when they will be walking the floor crying, "what shall we do?" instead of their water and gas brother who is now having his innings. The protective power of lime mortar and hydraulic cement to prevent corrosion in iron and steel under certain conditions has been demonstrated by centuries of actual use; yet the facts thus established are too often ignored by the engineer of to-day. We do not have to turn back many pages of the record book of success and failure to find a remarkable instance of the latter, in the utter collapse of the Bayliss patent wrought iron water pipe, that a few years ago was brought out as an indestructible, unperishable article with a hygienic annex, to take the place of cast iron pipe for water distribution. The pipe in question was made of wrought iron from $\frac{1}{16}$in. to $\frac{1}{8}$in. or more in thickness, according to the size and pressure to which it was to be subjected; formed and riveted together in the shop or worked to shape upon the ground from the sheets, by a portable lot of rolls, punches, and other tools needed, into sections about 5ft. or more in length; these sections being tapering, and if shipped were packed in nest form conveniently and cheaply so far as transportation was concerned. The tapering sections were laid in the pipe trench and lined *in situ* with hydraulic mortar, the large end of the section forming the bell for the small or spigot end, the joint being made with the cement, and the outside of the pipe was also covered with the cement mortar to the depth of an inch or more, all as far as possible at one operation, depending somewhat upon the size of the pipe, the location and the general conditions of the work, setting of the mortar, &c.

The advantages claimed were a continuous pipe from end to end, no matter what its size or length, of uniform strength, lined with a non-corrosive and protective, tasteless, and innoxious cement and guarded from external injury and corrosion from acids in the soil in which it was laid, and atmospheric influences by the same or a similar cement covering. The projectors wholly ignored the difference in the co-efficients of elasticity between the iron and cement, depending upon the integrity of the lining to protect the iron from the water; this lining once broken admitted the water pressure to the iron, the thin riveted joints of which it was impossible to caulk tight, the pressure thus reaching the external coating, which was unable to resist but a small head, cracked and flaked it off, and the destruction of the whole line of pipe followed rapidly, and as a matter of course after but a short period of service, most if not all of the lines being abandoned and relaid with cast iron pipes inside of ten years. In general no attempt was made to coat the iron with zinc or any coating, or to remove the scale of manufacture. When the pipe was thrown out of the trench finally and broken up, the outside coating came away, bringing with it the scale and oxidation under it as a porous plaster on removal takes away all over which it was spread. The connection of the house-service pipes with the main line gave no end of trouble to make and keep tight, and the whole system was a forcible illustration of the importance of those "next to nothings" that so often escape the attention of the best engineers, and bring no end of disappointment to those who are financially responsible for the introduction of the new idea.

Possibly the most extended application for a single purpose of the use of any process other than paint for the preservation of iron and steel exposed to atmospheric attack has been made at Philadelphia, Pa., in the construction of the iron work of the tower of the new City Hall, now under process of erection and nearly completed. I am indebted to Mr. F. Schumann, C.E., President of the Tacony Iron and Metal Co., Tacony, Pa., contractor for the work, for the following data. The *Scientific American* also describes and illustrates the process in the following issues, the data for which was also furnished by Mr. Schumann:—October 22nd, 1892, vol. lxvii., No. 17: "Aluminium Electro-Plating in Architecture." September 9th, 1893, vol. lxix., No. 11: "Electro-plating with Copper." This process is a double one. The first one is designed to protect the iron from rust by an electro-plating of copper of fourteen ounces per square foot of surface, and a finishing coat of an alloy of aluminium and tin of two and a-half ounces per square foot, for colour to harmonise with the stonework of the lower stories of the tower; also to prevent oxidation of the copper into a green coating of verdigris. The process was adopted as a substitute for paint, the periodical renewals of which would cost 10,000 dols. per annum, the primary coat of which was to be boiling linseed oil, in which all material was to be immersed until they had attained the temperature of the bath. The total weight of wrought and cast iron to be protected is about 500 tons, and comprises 100,000 square feet of surface, the largest single pieces being sixteen columns 27ft. long and 3ft. in diameter, weighing 10,000 lb. each. These columns received the copper coating inside as well as outside. The outside coating, being most exposed, is a double one, requiring two operations or baths, while the aluminium coat is given last as the protective coating to all beneath it. The cost of the whole process varies from forty cents per square foot to one dollar, depending upon the shape of the piece—simple plates, rods, angles, &c., costing the least, while curved pieces with large lugs, flanges with core holes, cost the most, the principal expense being the cleaning, the greatest care being necessary to ensure good work.

The capacity of the Tacony plant is about 250 square feet per twenty-four hours of from twelve to sixteen ounce per square foot coating; though some recent improvements by Mr. J. D. Darling, manager of the plating works, has nearly doubled the capacity of the plant, and avoids the trouble from "spit holes," blow holes and stodgy places, that give a great deal of trouble to search out and *solder up*. The electro-plating covering, in these cases, evidently follows the peculiarities of galvanising, where the smallest needle-hole will be coated, but will not fill up the crevice. The manipulation to apply the process necessarily varies with the shape and size of the piece. Suitable cranes, trolleys, hoisting gear, trucks, &c., being provided to handle one of the large columns referred to, the operation of coating it is as follows:—The column is first immersed in a tank containing a strong solution of caustic soda, heated by a steam coil, and is boiled a number of hours to remove all the grease and oil due to the machining process. It is then removed and thoroughly washed in water from a hose, then placed in a second tank and pickled with diluted sulphuric acid until all rust and scale are dissolved and loosened, then thoroughly cleaned with steel brushes and water and goes to the third tank containing the cyanide plating solution, and receives its first coating of copper. It is then removed from the bath and transferred to another tank and given a coating of paraffine wax *inside*, thence to the fourth tank containing an ordinary copper-plating solution, where it receives a heavy coating of copper, about sixteen ounces to the square foot of surface. The paraffin is then boiled off and the column enters the sixth or aluminium tank and receives a heavy deposit of aluminium, two to three ounces per square foot. It is then well washed with pure water and is ready for erection. The columns and other pieces are brought into the electric circuit by wires passing around them like slings, and attached to a conducting brass bar over the tank. In the cyanide tank a current density of 3 ampères per square foot is employed; in the acid tank, 10 ampères; and in the aluminium tank 8 ampères. Separate dynamos for the several tanks are necessary, the developments being 1000 ampères at 6 volts, 2000 ampères at 8 volts, and 4000 at 2½ volts.

Mr. Darling's improvements in the acid solutions enable copper to be deposited at the rate of twenty to twenty-five ounces per square foot in twenty-four hours, that is as malleable and almost as smooth as rolled copper; and copper deposits one-eighth of an inch thick, or ten pounds per square foot, have been made

* Presented at the Montreal meeting, June, 1894, of the American Society of Mechanical Engineers.

in twenty-four hours. For rolled sheet iron and steel, and in rods and shapes where the surface is free from sand-holes, eight to ten ounces of copper per square foot of surface will be sufficient, while on rough cast iron or steel work fourteen to sixteen ounces will be required. These amounts are greatly in excess of those given in books treating on electro-plating, but practical experience shows that the above amounts are necessary to give a protection that will prevent any appearance of rust, and will last as long as the structure will stand. For inside work when the plating is used more for effect than as a protection, zinc, tin, or aluminium is added to the copper bath to give a bronze appearance, and a coat of two or three ounces to the square foot will suffice. The new Bourse building, to be erected in Philadelphia, will have examples of both kinds of plating. The outside ironwork, windows frames, &c., will have a heavy protective coat of copper, while the inside work will be electro-bronzed.

In France, when copper plating to protect iron was first used, the copper was not deposited directly on the iron, but on a coating of varnish, rendered conducting with plumbago or powdered copper, applied to the iron surface and allowed to dry. This was done to avoid the difficulties of cleaning the cast iron and the use of two solutions in depositing the copper; as the article, after the varnish was dry and the plumbago applied, was placed directly in the acid solution. This method gives a coating that is not firmly attached, and is liable to be torn off by mechanical injury. The lamp-posts of Paris and the beautiful fountains of the Place de la Concorde and the Place Louvois are examples of this method. The method used in America deposits the copper directly on the iron, and the article so plated may be bent and twisted into any shape without detaching the copper deposit. As it is often asserted that aluminium cannot be deposited from an aqueous solution, the following information, furnished by Mr. Darling, may prove of interest:—"Although aluminium is generally credited with indestructible qualities, and high resistance to corrosion, it has but few qualities that would make it advantageous as an electro deposit upon other metals; for while in a massive state it resists atmospheric action and retains a certain brightness for a long time, when it is deposited electrically from an aqueous solution, which deposit is of necessity of a more or less porous nature, it soon tarnishes and assumes a dull, bluish-white colour, when exposed to the direct action of the elements. But for a protective coat, say for copper, for which use it is used on the city hall tower, it answers very well, as the slight superficial oxidation that takes place protects the metal underneath from further attack, and the neutral colour that it assumes harmonises well with the stone work of the tower. Aluminium is no doubt more difficult to deposit than any other of the common metals. This is because of the high voltage necessary to decompose aqueous aluminium solutions, and the tendency to redissolve after being deposited. We have not got the thermal data required to calculate the potential difference or electro-motive force necessary to decompose the different aqueous solutions of aluminium, but reasoning from analogy, it must be several volts in each case, and as water requires only a minimum electro-motive force of 1·5 volts to decompose it, it would seem at first glance that a compound which requires over two volts for its decomposition in aqueous solution would involve the decomposition of the water, and therefore would be impossible. But in reality this is not so, as may be seen in the case of the caustic soda, which requires over two volts. Yet sodium may be obtained by its electrosis if mercury be present to absorb it and protect it from the water. The fact is, that when two substances are present requiring different electro-motive force to compose them, if the electro-motive force is high enough to decompose the higher compound, the current is divided between them in some ratio decomposing them both, and I find by using a solution of aluminium that has but a slight dissolving effect on aluminium, with a density of current of eight ampères to the square foot, with a sufficient high voltage—6½ to 7—aluminium can be deposited on the cathode at the rate of one gramme per hour per square foot, in a reguline state, and with higher currents it can be deposited much quicker, but it will be in a pulverulent state, which does not adhere."

Recent improvements in this process form the basis of a patent for a proposed use of electro-copper plating for the protection of ships' bottoms applied quickly and cheaply in sections, by means of movable and portable baths, the deposits overlapping each other, the entire hull being thus treated during construction, or it may be applied to vessels already built. How effectual this application, cation for the purpose named may prove is a matter of some doubt owing to the difficulty of thoroughly cleaning the surfaces to be coated, and which appears to be an indispensable condition for success. The irregular contour of the immersed parts of the ship being plated *in situ*, as well as the porous nature of the copper deposit requiring a heavier coating than is absolutely necessary for protection, and whether some insulating or protective compound interposed between the copper and the metal of the ship will be required to prevent electrical action, all are questions to be settled by the slow test of time, which does so much to upset the best laid plans of mice and men. If effectual, the cost of application at even the highest price named by the Tacony people, one dollar per square foot of surface, would be small hindrance to its general adoption, it requiring only about 80,000 dols. to coat our largest war vessel on its inside surfaces, as well as the outside surfaces, joints in the armour, and all places not of ready access for the application of paint compounds.

Japanese lacquer.—The adaptableness of this natural vegetable product to the preservation of metallic surfaces, as well as those of wood, paper, and other fibrous bodies, has never received the attention of engineers that the industrial importance of this method of coating and protecting surfaces demands. The general idea that its application is one of art, and is only adaptable to *bric-à-brac*, is wholly erroneous. The Japanese use it for an infinite variety of purposes—acid tanks, coating the keels of ships, highly finished coach and decorative panels, and articles for domestic use, resisting hot water, soap, and alkaline solutions. It may be truly said that were it not for the bamboo and lacquer trees, life for the Japanese would hardly be worth living. There is no reason why the lacquer tree should not thrive in this country. Its sap, which is used as the material for all lacquer work, is a natural essence, and vastly superior to any varnishes used here. Unlike even copal, which is an artificial mixture of resin, fatty oils and turpentine, Japanese lacquer is a ready-made product of nature that hardens into a mirror-like smoothness, never splits nor cracks, and is of great durability. The art lacquer work of Japan is essentially individual, and ought not to be treated as an undistinguishable whole. The superiority of the art work is due not only to the special merit of the material, but also to the care and skill shown by the Japanese in the manipulation of it. There is as wide a distinction between the ordinary lacquer tray, or cabinet of commerce, and the exquisite lacs of the great Japanese artists as between a theatrical poster and a canvas of Raphael. Each of the great masters of lacquer has created a style of his own, and has founded a school of which the traditions have been kept alive by his successors for centuries. At the Centennial Exhibition of 1876, in the Japanese department, there were exhibited plates, pans, &c., evidently of a common quality of lacquer used by sailors and others for domestic purposes; also some samples of a finer grade in trays and cabinet work that had been sunk in the sea over fifty years, and though covered with barnacles and other marine growths, were practically unharmed, so perfectly had they been protected by the lacquer. It seems almost incredible that so valuable an article that can be produced as cheaply as maple sap has remained comparatively unknown in this country and Europe, at least so far as applying it to the palpable protective purpose that nature evidently designed it to be used for.

In conclusion, the whole question of how best to protect iron and steel from corrosion in all the varying conditions that the wants and usages of to-day demand, seems to resolve itself into a category of Don'ts, as the best method of answering it, to wit:—

Don't use anything but common iron. Don't have any scale on that. Don't use anything but the best iron and steel. Don't polish those. Don't paint it with anything but pure linseed oil and oxide of lead or graphite paints. Don't let the air get to it if it is damp. Don't keep it from the air if the air is pure and dry. Don't let sea air, sea water, acidulated or sulphurous, ammonial or other fumes and liquids have access to it. Don't think it unnecessary to protect it in any case, because swords, armour, and other bright articles of iron and steel have been found uninjured by rust after an exposure of over 500 years with no other protection than that afforded by the closed room in which they were placed. Don't think your own product would not under the same conditions last as long as the piece of iron that was walled into one of the burial chambers of the Pyramid, 3000 years ago. Don't put it into any location where it cannot be inspected and its true condition ascertained at any time, by anybody, your successor in the trust not excepted. Don't think that magnetic oxide, electro-plating, enamelling, or any other method of protection, will take the place of constant inspection, even if the coating is fired on by a Columbiad. Don't imagine because Cleopatra's Needle has had to have a coating of wax to protect it, that it is not a good material to apply to other substances than granite. Don't let the cost and interest accounts be the governing factors in the case of protecting any metal superstructure on whose continuity and strength human life and safety depends. The old story of "for want of a nail the shoe was cast, the horse disabled, a battle and kingdom lost," finds too many parallels in the engineering practice of to-day, until in some cases we seem to need protection from the engineer quite as much as from the decay of the materials in which he experiments. Don't imagine that Macaulay's New Zealander, who has sketched the ruins of England's power and greatness, and has come to the New World to see how we have fared from the gnawing teeth of time, will not recognise amidst the ruins of Our Statue of Liberty, Brooklyn Bridge and other monuments of our progress; the ominous streaks and strains due to the corrosion, not only of iron and steel, but that of the better class of metals, and will exclaim, "We are wiser in our generation, and fear not, and can control these forces that like the Arch. slumber not, nor sleep."

LETTERS TO THE EDITOR.

(*We do not hold ourselves responsible for the opinions of our correspondents.*)

THE KINETIC THEORY OF GASES.—MAXIMUM MOLECULAR VELOCITY.

SIR,—According to the kinetic theory of gases, as at present understood, the velocities of the molecules of a gas vary from nothing to velocities inconceivably great. On this point, as least, all writers on the subject are unanimous. Maxwell's statement of the above theory is as follows ("Theory of Heat," page 316):—"It appears, then, that of the molecules composing the system some are moving very slowly, a very few are moving with enormous velocities, and the greater number with intermediate velocities." Two questions are naturally suggested by the foregoing statement, viz.:—(1) What is the meaning of the words "very few"; and (2) What is the limit, if any, to the velocity which may be acquired by a molecule?

Confining our attention in the first place to the latter question, imagine a cubic inch of gas at any given pressure and temperature to be isolated in a vessel of that capacity. Now, if all but one of the molecules contained in that cubic inch could by any possibility be brought to rest by their mutual collisions, then, by the law of conservation of energy, the total energy of all the molecules would be concentrated in this single one, and its velocity would become $\bar{v}\sqrt{n}$, in which expression $\bar{v}$ is the mean velocity of the molecules and n their number. Now a cubic inch of hydrogen at 0 deg. C. and at atmospheric pressure is supposed to contain something like three hundred million million millions of molecules (3×10^{20}) and the velocity of mean square is said to be about 6000ft., or rather more than a mile per second. From this it is easy to calculate that the velocity of this single molecule, if hydrogen is the gas selected, would be considerably more than seventeen thousand million miles a second, or more than eighty-five thousand times the velocity of light. If air instead of hydrogen had been selected for our illustration, the velocity of the single molecule would still have been, roughly speaking, twenty-one thousand times the velocity of light. Enormously great as is this velocity, yet according to the present theory, unless some qualification be introduced, it is not impossible, and indeed far higher velocities than this may very fairly be supposed to exist in an enormous body of gas like that of our atmosphere. Consider, for example, a thousand cubic yards of air, which is only a small volume when compared with the entire volume of the atmosphere. One thousand cubic yards contain 46,656,000 cubic inches. Hence in a volume of air of this magnitude, if only one molecule in every 46,656,000 lost all its velocity in the manner described, the mean velocity of all the others save one remaining unchanged, it would be quite possible, and in fact necessary, for that one molecule to have the enormous velocity above mentioned.

We will now pass on to consider these enormously high molecular velocities from another point of view, viz., that of the kinetic energy they represent. This is rendered necessary, since Lord Kelvin and others have demonstrated that molecules cannot be considered inconceivably small. A molecule moving with half or a quarter, or even with a much smaller fraction of the velocity given above must be considered as a missile having a measurable quantity of kinetic energy or stored-up work in it. The kinetic energy contained in a cubic inch of air at standard pressure and temperature, neglecting for the present the internal energy of the molecules, is, according to the usual estimate, about 1·8 foot-pounds. If the whole of this energy were to be concentrated in one molecule, as would happen if it were moving with the velocity above mentioned, it is curious to reflect on what the probable result of an impact from such a missile might be on the human frame, for example. Imagine the point to be broken off a needle and to be made to strike with the above-named energy. If the point weighed a quarter of a grain its velocity would be about 1800ft. a second. It is impossible to doubt that such a missile would penetrate a considerable distance into one's body, probably passing through the flesh and bone and whatever else came in its way. But a molecule of gas is far better adapted for penetration than even the point of a needle. For it is the concentration of energy on a very small surface, combined with hardness, that causes a needle point to penetrate with such facility. But the diameter of a molecule is quite insignificant when compared with that of the finest pointed needle; and hardness is one of the predicated characteristics of gaseous molecules. Can it be, as Sir Lucius O'Trigger is made to remark in "The Rivals," that "a ball or two may pass clean through your body and never do any harm at all"? Is it possible that one of these rapid-moving molecules may pierce through and through the whole length of a nerve without causing one the least inconvenience, even without our being aware that anything had happened, although the slightest touch of the same nerve by anything else would cause acute pain? If these questions can be answered in the affirmative, what are we to think of the effect of impact from such missiles on inanimate objects—the glass windows of our houses, for example, or the pictures on our walls? The mere framing of such questions, arising as they do of necessity from the kinetic theory of gases, should be sufficient to make one hesitate to admit its truth without some modification of a nature to render the existence of these high velocities either impossible or, at the very least, extremely improbable.

So far only the translational energy of the molecules has been considered. When, however, the vibratory energy of the molecules is also taken into account, the result is still more unfavourable to the theory. Clausius supposes that the vibratory energy of a molecule is proportional to its energy of translation. In the case of air the ratio is said to be 0·634—Maxwell's "Heat," page 327. But as I have already pointed out in a former letter—June 22nd, 1894, page 542—the vibratory energy of a molecule can be nothing else but its sensible heat or temperature. Hence molecules moving with the enormous velocity we have been considering must have a temperature many million times that of one standard temperature. Now it is well known that a mere spark will cause an explosion in a mixture of hydrogen and oxygen. The absolute temperature of such a spark, say, at red heat, or about 1100 deg. C., would be rather less than five times that of standard temperature. Now a molecule moving with rather more than double the mean velocity to a temperature of 0 deg. C., and atmospheric pressure, would have a temperature of about 1100 deg. C., and consequently whenever a molecule attained this velocity in a mixture of hydrogen and oxygen an explosion must inevitably take place. But such velocities as these must occur frequently in even very small volumes of gas; hence, under these conditions, spontaneous explosions must occur immediately gases of this nature are mixed. But this we know is contrary to experience. From considering explosions of gases, one's thoughts naturally turn to gunpowder and other explosives of a similar nature, the safe storage of which would be rendered quite impossible under such conditions. Enough has been said to show that there are strong chemical reasons for supposing that there must be a limit, and that by no means an extensive one, to the possible variations of molecular velocities above their mean value at 0 deg. C. But here at once we are confronted with a fresh difficulty: for if any variation at all is possible, that is, if on a collision occurring between two molecules, it is possible for the molecule moving with the greater velocity to have that velocity increased, what is to prevent this occurring again and again and so occasionally, comparatively speaking, giving rise to velocities inconceivably great? It seems to me that only one solution to this problem is possible, and that, in one word, is "dissociation." It may, however, be urged that a gaseous explosion is simply dissociation followed by recombination. That is certainly true, but it does not follow that the dissociation of the atoms of *a single molecule* of a mixture of explosive gases is necessarily followed by an explosion. It is obvious, for example, in the case of oxygen and hydrogen that at least one molecule of each gas in proximity to each other must have its atoms separated before two atoms of hydrogen can combine with one of oxygen.

If we suppose an explosion in a mixture of gases to spread from the atoms of dissociated molecules impinging against other molecules, causing these to be dissociated in their turn and so on, then it is evident that to start the explosion the dissociated atoms must have a sufficiently high velocity given to them in some way or other for the purpose, and this necessary velocity may be considerably higher than that caused by what may be termed the ordinary velocity of dissociation due to molecular collisions at ordinary temperatures. Considering this latter kind only, as no loss of energy admissible, the transational energy of dissociated atoms must be equal to the combined kinetic and vibratory energies of the molecule immediately before dissociation takes place. But this will be modified by the mutual attraction of the atoms tending to convert the translatory into potential energy, which will, of course, in its turn be available for reconversion into kinetic energy when favourable conditions occur.

If this view of the subject is correct a certain percentage of the total energy in a volume of gas must be always potential. Again, if the velocity of gas molecules is limited in the manner described, it at once accounts for the well-known fact that air or other so-called permanent gas cannot be made experimentally to radiate any light whatsoever when heated. Finally it would seem, if this theory is correct, that in a mixture of explosive gases, such as hydrogen and oxygen, a very slow combination might take place between them without any explosion occurring, the combination being so extremely slow as not to be observable, except in trials extending over long periods of time.

C. E. BASEVI.

8, Norfolk-square, W.,
October 6th.

LABOUR AND LUXURIES.

SIR,—Your correspondent "R. G. B." has yet to learn the very elements of political economy. In his letter of the 2nd instant he puts words into my mouth which I have not used, and mixes up ethics and morals with political economy. Now political economy knows nothing of morals. It takes no account of them in any way. Whether a Government clerk or any one else is morally right or morally wrong in spending a sovereign on a bouquet is a question which I have no desire to discuss; whether a man who does not work ought to have any money, or be left to starve, is also a question that is totally outside my contention. What remains, if we eliminate such considerations is pure political economy, and with that only in the first instance, at all events, will I deal.

I have never said that the wearer of a bouquet was a "benefactor to a whole army of bricklayers, carpenters, glaziers, flower girls, &c." There is no such word as "benefactor" in political economy. What I did say was, that so long as a sovereign was spent, it was a matter of no importance on what it was spent; whether the men were employed in making a sovereign's worth of cartridges, or a sovereign's worth of flowers, mattered nothing to those getting the sovereign; the result was the same.

The error into which "R. G. B." has fallen is a very common one. It is embalmed in socialist ethics. It is the assumption that absolute property can be possessed in money by anyone. The exceptions to the fact that it cannot are extremly few. A miser who buries sovereigns in a hole is an exception, but I do not think we need trouble ourselves with this gentleman. In the matter of money we are all distributors, and the most that can be said is that whoever holds money has, for the time being, the power of saying into what channels it shall flow. Thus, for example, our typical Government clerk, possessed of a sovereign, may decide to distribute it among gardeners; or he may prefer to distribute it among wine growers; or he may devote it to the farmers by buying meat and bread, or to the miners by buying coal. In any or either case the result is the same; the money has been distributed, and has to use words in a well-understood sense, given employment.

Let us take two men—one of these has one hundred pounds a-year, the other has one hundred thousand. The first distributes his money wholly among farmers, bricklayers, carpenters, tailors, &c. The second has a larger range, and distributes his money besides among coachbuilders, horse-breeders, florists, &c. The result to the community in the end is better than it would have been if the £100,000 had been spent by 1000 individuals with £100 each, because employment is given over a much wider range. I do not think it is necessary to dwell on this point at all. If "R. G. B." were right, luxuries so called should not be produced under any circumstances. I suppose he will not go so far as to say this, but if he once admits that a luxury may be produced and paid for then he concedes my whole case, which is, that so far as the worker is concerned it matters nothing what he produces. The result to him is gold in some form or other. Whether the world at large would or would not be better without certain so-called luxuries is a very wide question; that I am not called upon to discuss. I have heard it said that enormous sums are wasted on growing tea, and on silk. To the political economist, however, there is really no such thing as waste in the expenditure of gold. The spender may not get an adequate return for it, but the gold will do its work in the world, no matter by whom it is spent.

Your correspondent writes, "For the sake of our argument, let us assume a more extreme case, namely, that of a millionaire who has got his money by cornering pork, wheat, or cotton, and who gives a smart function at his West End house, in which in the course of an evening flowers are consumed to the extent of £1500. Let this sum be taken as representing the labour of thirty men—in the shape of the aforesaid bricklayers, carpenters, glaziers, &c. —for one year at 20s. per week. Then what really happens is that these thirty men have to do a year's work in order to get back from your millionaire the £1500 which he took out of the pockets of the public when he cornered his pork and raised the price on them, and to obtain which he not only did nothing in return towards assisting in the production of the commodities of which he is a general consumer, but actually taxed the public."

I have ventured to quote him at length, because it would not be easy to select a better example of the confusion of mind which exists among many worthy and excellent people on the subject of value. In the first place, I may point out that your correspondent scarcely knows what "making a corner in pork" is. He is evidently unaware of the fact that, generally speaking, the pork cornered never had any existence at all. This cornering business, as practised in Chicago, for instance, is purely gambling. It means nothing more than bulling and bearing the market; practically, it is betting that pork will be such and such a price on such and such a day, and settling means paying differences. But, for the sake of argument, I will admit that a man attempts to make a real corner in pork. To do this he must buy pigs, and to get all the pigs into his own hands he must pay more for them than his neighbours. The result is, of course, that he distributes more gold among the farmers than they would otherwise have got, and the most that can be said is that he has benefited the farmer at the expense of "the public," whatever that may mean. But this only for the moment. The farmer now having more money than he had before, proceeds at once to buy extra boots, or hats, or ploughs. In the end the result is just the same as though no corner had been made. In fact, all political economists know that it would pass the wit of man to devise a scheme by which one section or individual of a community is benefited without other sections sharing in the good. Surely, for instance, "R. G. B." will admit that cheap coal is a good thing. The miner suffers on the one hand, but on the other he is a direct gainer. His wages may be less, but the necessaries of life are all cheapened and made more plentiful, and the whole community is better off.

Let me quote one passage more:—"There is no escaping from the fact that since commodities, be they flowers, carriages, dress, or what not, are only produced by labour, those who consume them without assisting in the production—directly or indirectly—do so entirely at the expense in labour of those who produce them; and, in proportion as our social system permits of wealth being accumulated without equivalent labour, in precisely the same proportion is the labour of the working classes increased beyond what is requisite to produce the commodities they themselves consume, the balance between what they consume and what they produce going to the idle; this being the reason why idleness and luxury are invariably found side by side with poverty and overwork."

We have here something so vague and intangible that it is difficult quite to understand what "R. G. B." means. I do not quite know whether it is ethics or political economy. If it is the latter the deductions drawn are entirely wrong. No man works for another, that is one fallacy. He always works for himself, unless indeed he is a slave. The miner does not hew coal for me, he hews it that he may get gold to spend on himself and his family. The second fallacy is that every man who spends should give in labour the precise equivalent of what he spends. This fallacy comes of overlooking the part played as distributor by so many. Let us return to our bouquet, and ask ourselves two questions. First, is it right or wrong in a politico-economical way to grow flowers? Secondly, suppose that our Government clerk made for himself in his leisure hours a greenhouse, did all the bricklaying, painting, &c., and grew his own flowers, would he have done better to the community at large than he did by buying the flowers?

In this case he would have a sovereign in his pocket. If he buried it then it is clear that the growing of the flowers by himself would be a distinct injury to a number of his fellow-men. If he did not bury it, but spent it, say, on a pair of boots, would the community really be better off than it actually was when the money was spent on flowers?

Possibly it may be comforting to your correspondent to know that I am myself not a millionaire; on the contrary, I have to work in order that I and my family may live. Should he take up his pen again, is it too much to expect that he will so place his ideas on paper that we may know precisely what he wants to convey? I am still terribly puzzled to know what he means by the "public out of whose pockets, &c." Again, will he explain how the labour of the very few rich men who do no work would improve the lot of those who do work? Would the match girls at the East End of London be better off if all the girls at the West End spent their days in making matches?

Shall I be considered rude if I recommend "R. G. B." a severe course of Smith, Ricardo, and Mill before he writes again?

October 8th. Y. X.

SIR,—Will "R. G. B." explain what he means by labour? If he had had any experience of life in Chicago he would not talk so glibly about cornering pork. The mental and bodily work done by the man—or, rather, by the men—who make, or attempt to make, a corner in anything is incredible. The anxiety, the excitement, the wear and tear are so tremendous that if labour deserves payment under any circumstances, the pork man ought to win a fortune. AMERICUS.

The Langham, October 8th.

GOVERNING ELECTRIC LIGHT ENGINES.

SIR,—Is it not the case that where high-speed direct coupled engines have been adopted, that the space occupied is of paramount importance, and quite apart from other considerations would determine the use of that type? No doubt high rotative speed conduces to good governing, but there are other types which find a large use, and in which first-class governing is equally essential.

In suggesting the use of the "hit-and-miss" type of governor, I think that both yourself and Mr. Robinson have overlooked some essential features of "alternator" driving, especially when the machine is one of high periodicity. In such cases to secure good parallel running, it is essential that the speed of all the alternators having the same number of field poles should be identical, and that the similar poles should occupy the same position with reference to the armature coils in each machine. Should one alternator's phase lag or advance with reference to the others, then a synchronising current will pass tending to quicken or slow the particular machine. A heavy fly-wheel, whilst tending to prevent changes of speed, would increase the difficulty of parallel running, because it would introduce a larger moment of inertia that the synchronising currents will have to overcome; unless, of course, the fly-wheel is of such enormous size and weight that the effect of variations of crank effort on speed is entirely nullified. If it is not, then although the two machines may give the same mean volts, unless the engines as well as the alternators are in phase, a larger or smaller synchronising current will pass between them at different points on the crank path.

Does not this point to two systems of governing each the best for an alternating station?

1. In a station having its units all of the same size. The governors on each unit to be as sensitive as practicable, and to be of sufficient power to control the steam on all the units in a group, and the other governors being disconnected thus one unit would be the "master" unit, the cranks being brought into unison and the loads adjusted by hand.

2. In a station having units of varying size, all the governors to be of the greatest sensitiveness possible, so as to control the speed closely when running separately, but having means by which they can be at will rendered sluggish. Then one governor, preferably on the largest unit, would be left sensitive, and the control of the fine adjustment of the station would be by the largest unit.

Of course I am assuming in case 2 that the rotative speed varies with the size of each unit, but from this point of view does it not appear that in any alternating station the speed of each unit should be the same irrespective of its capacity?

In short, I think that the governing arrangements of any particular station, especially if alternating, should be considered with reference to the whole plant as far as and including the switchboard arrangements.

Perfect governing of an alternating station would consist then not merely in the maintenance of constant or similar speed of each unit, but also in the maintenance of simultaneous and equal impulses on each alternator. Would not the system of group control by one central governor enable alternators to be driven in parallel by gas engines? G. T. P.

October 8th.

SIR,—We have read with considerable interest your article upon "Governing Electric Light Engines," and agree in the main with the conclusions you have arrived at, especially your statement that "what appears to be needed is a governor which the moment the speed drops or rises—say 1 per cent.—will open the throttle valve full or shut it absolutely, and will then by a series of very rapid alterations or oscillations, open and close it through smaller and smaller arcs, until the new position suited to the load has been attained."

We beg to state that these conditions are perfectly fulfilled by the "Richardson Electric Regulator," which has been used for some years, and that it will fully open the valve, or entirely close it, before there has been any change in speed of the engine, as it acts simultaneously with the turning on or shutting off of the lamps. These advantages cannot be obtained with any kind of mechanical governor, which must act after the change in speed has taken place. With the electric governor, it is also quite easy to run the engine faster with a heavy load than with a light one, its speed changing directly with the load, as it is increased or decreased. It can equally well, however, be used for maintaining a constant speed, if a constant speed is required by the dynamo, in order to maintain a constant current, or constant electro-motive force. This electrical governor is applicable to throttle valves for small engines, and to automatic expansion gear of large engines working with a current not exceeding that required for a 20-candle power lamp. Your suggestion of a piston driven by an engine producing hydraulic pressure, and working a throttle valve or automatic gear, was tried by us many years ago; but though it acted fairly well with slight changes of load, and could produce a constant speed of engine, it was much too slow in its action for great changes. ROBEY AND CO., LIMITED.

Lincoln, October 5th.

COLONIAL LOCOMOTIVES.

SIR,—As a locomotive contractor I have read with interest the leading article in your issue of September 28th on "Colonial Locomotives," the general tendency of which appears to be to show that the American knows better what class of engine to supply to Colonial roads than the English contractor. But, Sir, is it not the case that American contractors are allowed a very much freer hand in this matter than Englishmen?

Speaking from my own somewhat large experience, I can say that a Colonial road of any magnitude almost invariably retains a consulting engineer, who issues the detail specification and very generally the drawings of the engines which he may require, and in any case certainly retains the entire control of testing the material, passing the drawings, &c. In other words, the contractor has to do as he is told, and if the latter does venture to point out that in his opinion some modification should be made, he is apt to be told, of course in a most polite manner, to "mind his own business, and not pretend to know better than the consulting engineer." For example, you call special attention to the flexibility of the bearing springs which the Americans use suspended on compensating levers. It is absolutely useless to put in flexible springs and compensating beams when the play of the axle-box in the guides is limited and rigidly laid down, as it generally is by the specification. It is well known that the vertical play of the axle-boxes allowed by American builders is very much in excess of usual English practice; yet it is very rarely indeed that I have ever been permitted to alter a specification in this respect, though I know perfectly well that with a small amount of play, and therefore stiff springs, the engine is sure to ride rough on a bad road.

I believe that were the average English locomotive contractor allowed as free a hand as his American cousin, our Colonies would get engines very much better adapted to their wants. I do not mean to insinuate that consulting engineers do not know their business, but I think that locomotive builders are likely to know at least as much, considering the years of experience they have had solely devoted to this one particular class of engineering. Moreover, were they allowed a freer hand, so as to be able to utilise as far as possible their existing patterns and drawings, engines might be turned out of equally good design at a much lower cost and in much less time. So far as I have been able to find out, when a Colonial road buys American engines it buys the American builders' standard; whereas, as I have already pointed out, when it buys English-built engines it employs a consulting engineer, who issues elaborate specifications and drawings which must not be modified in any way.

There would be no difficulty in giving endless examples of the above, but I will content myself with one which occurred in my own works a short while back. I had in hand, at the same time, three different orders for locomotives, all the same type, size and gauge, but the cylinders were of the following sizes:—14in. by 18in., 14in. by 19in., 14in. by 20in. There was also a few inches difference in the wheel base, and a fraction of a square foot difference in the area of the fire grate. No deviations were permitted from any of the three specifications, which therefore necessitated preparing three complete sets of patterns, drawings, gauges, templates, &c., where one ought to have sufficed. You must therefore admit that the two opposing builders are not comparable one with another, and it is scarcely fair on your part to saddle the English contractor with faults of design with which probably he had little or nothing to do. I enclose my card, but for obvious reasons prefer to sign myself KAY-FIST.

October 4th.

ALUMINIUM TORPEDO BOAT.

SIR,—The accounts of this speedy little vessel have been most interesting. It will be noticed that an additional speed of 3½ knots is claimed from the use of the new metal, and it is further stated that the speed of a similar boat in steel would be 17 knots only. But in your issue of December 11th, 1891, an account appears of an apparently precisely similar craft, namely, 60ft. long by 9ft. beam, and having a water-tube boiler, with triple expansion engines developing 300 indicated horse-power, also built by Messrs. Yarrow and Co., the mean speed of which, taken from six runs, is there said to have been 20·03 knots—the highest single run being given as 20 57; the difference in speed, therefore, between this craft and the new one of aluminium appears to be 0 528 only, or roughly speaking, ½ knot, and not 3½ knots.

Admitting that the figures 20 558 are obtained from two hours' continuous steaming, and 20·03 from the mean of six mile runs only, calculations based on the trials of a number of fast torpedo boats and "Destroyers" give us the difference between the average of the mile runs, and three hours' continuous steaming, and this difference reduced to 20·558 knots gives an increase of ·36 of a knot as the highest average mile speed above the longer time trial. It is, therefore, to be presumed that the new boat could have developed at the most an additional ½ knot if mile runs had been adopted. So that, assuming the most favourable possible terms, the total gain in speed works out at slightly over ⅞ of a knot, instead of 3½ knots.

Whatever, then, the advantages of aluminium may be, and doubtless it has some—when its price ceases to be practically prohibitive—a great increase in speed does not appear to be amongst them, assuming the above data to be correct, and a 40-knot aluminium Havock, as suggested in this week's daily press, is at present, at all events, quite chimerical.

It would be interesting to know what is the highest speed Messrs. Yarrow consider this little boat could develope, in light trim, and on a mile. PERPLEXED.

October 8th.

SIR,—As some of the statements that have been published in connection with the above subject are not quite accurate, and may, therefore, be misleading, I shall esteem it a favour if you will kindly give publication to this letter in your next issue.

The price of 3s. to 5s. per lb. does not represent the price of the metal itself, but that of angle irons, bars, castings, &c., of the suitable aluminium alloy used, which is quite a different matter. Aluminium in ingots is now sold in the market at 1s. 9d. per lb., and taking into consideration that the weight of this metal is one-third of that of the other metals commonly used in shipbuilding, this price really represents only 7d. per lb. if compared with them.

It is quite true that the prime cost of this torpedo boat, or of any other ship made of aluminium, will be somewhat greater than that of the same sized ship built of steel, but the former with engines of the same horse-power will attain much greater speed. With regard to the boat in question, a speed of 20½ knots was obtained in place of 17 knots, this being the rate of the ordinary steel boats. It is therefore evident that an aluminium boat, for the same rate of speed, will require less horse-power, which means considerable economy in the consumption of fuel, and this in a short time would fully compensate for the extra first cost. This is quite irrespective of the other advantages of aluminium for shipbuilding purposes, which are fully explained in your interesting article.

It has been stated that we are not equal to other countries in the production of aluminium, and that this is due to natural causes. It is quite true that none of this metal is now made in the United Kingdom, but there is absolutely no natural cause why it should not be produced here as cheaply as in other countries. In fact, the British Aluminium Company has been formed for this purpose, and is now completing arrangements for starting a large factory for the production of aluminium in this country by electricity. The raw material is to be found in Ireland in large quantities, and of good quality; water power for generating electricity can be obtained quite as cheaply and conveniently as abroad; and by using the same patented processes for the production of aluminium by electricity which have been so successfully used in France, Switzerland, and the United States of America, this company will be able to produce the metal as cheaply in this country as elsewhere.

For THE BRITISH ALUMINIUM COMPANY, Limited.
(CHARLES F. JONES, Secretary.)

9, Victoria-street, London, S.W.,
October 9th.

ELECTROLYTIC SANITATION.

SIR,—In your issue of September 28th we notice an article headed "Electrolytic Sanitation," in which you comment on the Hermite process of disinfection. We must request you to allow us a little of your valuable space for a few remarks upon this article. The commencement of the article promised an impartial review of the subject, and we regret that this was not adhered to in your subsequent remarks. We fear to take up too much space in mentioning all the points which might be brought forward, and will therefore point out only one or two of the most striking statements with which we do not agree.

The article says, "Seawater is a wasteful material to choose in the preparation of a bleaching and sterilising liquid," &c. We venture to suggest that it is not proved that the organic matter in the salt water is the cause of the reduction in strength of the electrolysed salt water when diluted. It is sufficient to our mind that seawater can be run up from no chlorine strength to ·7 grammes of chlorine per litre, with an average yield of 1 gramme per ampère hour, which, as you will see, is fairly good approximation of a theoretical yield.

We think the reference to "magical compounds" and "wand of the patentee" is not consistent either with proper treatment of this subject or of the absolutely public way in which everything connected with this process has been carried on. Mr. Hermite or ourselves have never made any claim for any magical compound, nor in fact have ever encouraged any mystery. Our simple statement is that we can produce a disinfecting liquid of sufficient strength to sterilise sewage absolutely by electrolysing sea water with a yield of one gramme of chlorine per ampère per hour, and that in our apparatus the necessary electro-motive force does not exceed 6 volts. Therefore with 1000 ampères × 6 volts, we produce 1000 grammes of chlorine per hour.

Anyone caring to work out the cost can do so from this data. The suggestion that a solution of bleaching powder could be distributed in the way that we propose to distribute our disinfectant is rather startling, and we do not think would be seriously considered by any engineer. We think it unnecessary to do more than point out that practically one-third of bleaching powder is all that is useful, the remaining two-thirds, consisting of lime, would have to be got rid of. Anyone familiar with the working of paper mills and bleach works will appreciate the difficulty of getting rid of the refuse. Imagine a large town supplied in this way, and using many tons of bleaching powder per day, two-thirds of which they would have to dispose of otherwise than in the sewers. No suggestion is made as to how this difficulty is to be overcome, nor indeed is any practicable method proposed as to either mixing and using this powder, nor of carrying on the proposed dioxydising process.

There is no possible comparison between the Hermite process and such a suggestion, because the one is workable and the other is not. What can be simpler than sea water flowing continuously through an electrolyser and into the sewers? Again, those connected with the chemical trade might ask, where would bleaching powder be found if such a demand were to arise?

PATERSON AND COOPER.

3, Princes-mansions, 68, Victoria-street,
Westminster, London, S.W.
October 10th.

CONDITION OF THE THAMES.

SIR,—I am pleased to see that you have brought to the notice of your readers the condition of the river Thames at low water near Kew Bridge, which bridge will no doubt be removed shortly. The new bridge having fewer buttresses, will enable the water to flow out quicker than now.

In the year 1885 I was one of the competitors for the disposal of the London sewage; my scheme removed the sewage out of the way from London, and improved the Thames from Teddington to Coal House Point. Your illustration called to my memory a paragraph in my scheme. It runs as follows:—Residential property adjoining the Thames at Teddington, Twickenham, Richmond, Isleworth, Kew, Mortlake, and Putney are not healthy, owing to the river being nearly dry several hours each day in the summer time, the tide being much more swifter than of old. The first impediment to the tide flowing out was the removal of old London Bridge. At this old structure there was a fall of 5ft. from the upper side to the lower side, five arches being blocked up for the London Bridge Waterworks. The river on the upper side of the bridge presented the appearance of a lake—*vide* old prints. The next impediment to the flowing out of the Thames was the removal of old Westminster Bridge with its numerous arches. The next was the shoals at Waterloo Bridge. I have walked nearly across the river near the bridge many times when a boy. The paragraph goes on to say, now for the final, you have only to remove Old Battersea, Putney, and Kew Bridges, and the flats or shoals at Hammersmith, and you have done it. There will not be much water left in the river at the places indicated for several hours per day. This was written over nine years ago, and now it is a reality. If you lock the river at Putney, you will still have trouble lower down. HENRY SPORTON.

The Glen, Chase Side, Enfield,
Middlesex, October 9th.

MIDLAND RAILWAY CARRIAGE STEPS AND FITTINGS.

SIR,—The Midland Railway Company is now running, on its express trains between Edinburgh and London, some carriages which would be a disgrace to even a small railway company. The steps are a positive source of danger to the public, being of thin iron barely the width of the carriage doors, so that should anyone slip between the carriage and the platform their legs must inevitably be cut off by these knife-like appendages. These small iron steps are slippery, and a continuous wooden footboard should be insisted on by the Board of Trade. The standard door handle adopted by the Midland Company is also about the worst that could possibly be designed, and appears to have been handed down from the old coaching days; it requires two forces to be expended in its use, one to lift up and keep steady the movable ring and another to turn it. This form of handle must cost more to make, and is not nearly so convenient as the cross handle in general use by other companies. It is strange that the Midland Company should have gone out of their way to adopt as their standard handle one so hideous in design and so inconvenient in use, and one which, moreover, is not even automatic in its action, and therefore dangerous, more especially when most other companies, even small ones, have adopted door locks which are both convenient and automatic in their action, so that when pushed to they automatically lock themselves.

Of the different kinds in use, Wethered's patent is perhaps the simplest and best. It is used on the Metropolitan Railway and also the new West Highland Railway, and I would suggest to the Midland Company that they adopt either this or some other automatic door lock as their standard pattern. One would not expect so influential and go-ahead a company as the Midland to be so far behind the times in the matter of carriage fittings.

Constitutional Club, London, PERCY CALDECOTT.
October 8th.

THE THEORY OF THE STEAM ENGINE.

SIR,—Mr. Maurice Cross's letter in your last issue appears more explicit than his previous communications. In reply, first, as I have already stated, Rankine refers to experiments made by Mr. C. W. Siemens as the basis of his statement that steam freely expanded becomes superheated. Secondly, Mr. Cross seems to object to wire-drawing being employed in investigating the results of free expansion. At the same time he lauds Joule and Thompson's experiments on free expansion. This is highly inconsistent, since Joule and Thompson arrived at their conclusions by wire-drawing apparatus. Thirdly, he appears to regard steam, *i.e.*, the gaseous form of water, as not a "permanent" gas, whereas it is quite as much a "permanent" gas as air or carbonic anhydride or other such gaseous body.

I have my own opinions as to the manner in which the "efficiency" of a steam or other heat engine is most justly to be calculated. This part of the correspondence or controversy I have no wish to deal with, and will refrain from saying further than that I totally disagree with Mr. Cross's views in so far as I understand them. HENRY CHERRY.

21, Festing-road, Putney, S.W.,
October 10th.

AMERICAN ENGINEERING NEWS.

(*From our own Correspondent.*)

New passenger station.—A handsome station is now being built by the New York Central Railroad at Syracuse, to replace the old station. As this is a through station the main building will be at the side of the tracks. This building will be 122ft. by 94ft. in plan, three storeys high, with a steep pitched roof, and the tower will be 20ft. square and 80ft. high, surmounted by a pyramidal roof. The exterior will be of dark red sandstone, quarry faced, with dressed stone facing, and the roof will be of Spanish tile. The main waiting-room will be 90ft. square; women's waiting-room and men's smoking-room 24ft. square, each with a toilet-room 12ft. by 14ft.; parcel-room, 15ft. by 20ft.; ticket office, 18ft. by 24ft., with one end partitioned off for ticket offices for the sleeping car companies; baggage-room, 57ft. by 50ft.; trainmaster's office, 14ft. by 18ft.; and a restaurant, 128ft. by 28ft. in the basement. From the main hall a subway passes under the tracks, with steps to the main platforms. The upper floors of the building will be occupied by railway offices. The building will be heated by fifty steam radiators, and lighted by 500 incandescent lamps, the light, heat, and power plant being located in a separate building. The train shed will cover seven tracks, four of which are through main tracks, and the three main platforms will be 25ft. to 36ft. wide, 1ft. above the rails. There will be ticket inspectors' offices at each end of the platform at the head of the stairways from the subway. The train shed will be 480ft. long and 128ft. wide, with main roof trusses 110ft. long, and a cantilever roof on the outer side opposite the station building. The interior decoration and fittings will be very complete and elaborate.

Railway statistics (*Chicago, Milwaukee, and St. Paul Railway*).—In former letters I have given details of the operating statistics of some of the important railways, and below are given similar details respecting the results of operation of the Chicago, Milwaukee, and St. Paul Railway—a system comprising 6147 miles—during the year ending June 30th, 1894. The dividends for that year aggregated 7 per cent. on the preference stock, and 4 per cent. on the common stock. The freight and passenger traffic and the total earnings were less than for 1893, but the freight and passenger revenue increased:—

Gross earnings, dols.	31,327,951
Total operating expenses, dols.	20,114,333
Net earnings, dols.	11,213,618
Miles operated	6,147
Miles run by passenger trains	7,848 438
" " freight trains	12,869,482
" " mixed trains	987,704
" " revenue trains	21,705,624
" " switching trains	4,411,146
" " construction trains	575,700
Total train mileage	26,692,470
Passengers carried	7,921,882
Passengers carried one mile	337,133,338
Average journey per passenger, miles	42 56
Revenue per passenger per mile, cents	2 169
Revenue per passenger per train mile, cents	90 320
Tons of freight carried	10,794,058
Tons carried one mile	2,077,869,479
Tons per loaded car	9 93
Average haul per ton, miles	192 50
Revenue per ton per mile, cents	1 037
Revenue from freight per train mile, dols.	1·5834
Expenses per revenue train mile:—	
For repairs of engines, cents	5·05
For repairs of cars, cents	7 05
For station service, cents	12·82
For train service, cents	7·34
For locomotive service, cents	8 87
For train and station supplies, cents	2 44
For fuel, cents	10·49
For oil and waste, cents	0·63
For all other expenses, cents	37 98
Total operating expenses, cents	92·67
Percentage of operating expenses to earnings	64 21 per cent.

Railway statistics (*Walash Railroad*).—The following detailed operating statistics are from the report for the year ending June 30th, 1894:—

Miles per day per freight train	85
Freight train miles per day	17,170
No. of passenger trains per year	46,092
Miles per day per passenger train	112
Passenger train miles run per day	14,112
Cost of locomotives per 100 miles run:—	
Repairs (dols.)	3·34
Stores (dols.)	0·29
Fuel (dols.)	4·75
Enginemen and firemen (dols.)	6·06
Wiping and dispatching (dols.)	0·89
Total cost per 100 miles run (dols.)	15·33
Average mileage per engine per year	43,116
Average mileage per month per engine	3,593
Cost per ton of coal on tender (dols.)	1·13
Miles per ton of coal	23·80
Average number of loaded cars per freight train	14·69
Average number of cars per freight train	21·57
Average load per freight train (tons)	175·39
Average earnings per freight car (cents)	8·33
Average expenses per freight car (cents)	7·24
Average number of cars per passenger train	4·79
Average number of passengers per train	40·96
Expenses per passenger car per mile (cents)	19·34
Earnings per passenger car per mile (cents)	12·91
Miles operated	1936
Earnings per mile (dols.)	6485
Operating expenses per mile (dols.)	5079
Net earnings per mile (dols.)	1406
Tons of freight carried	5,414,994
Tons carried one mile	1,097,585,279
Rate per ton per mile (cents)	0·698
Expenses per ton per mile (cents)	0·607
Net earnings per ton per mile (cents)	0·091
Freight train mileage	6,258,093
Freight train earnings per mile (cents)	122·35
Freight train expenses per mile (cents)	106·40
Freight train net earnings per mile (cents)	15·95
Average load per car (tons)	11·94
Average freight train load (tons)	175 39
Number of passengers carried	3,724,674
Number of passengers carried one mile	210,281,487
Rate per passenger per mile (cents)	1·877
Expenses per passenger per mile (cents)	1·508
Net earnings per passenger per mile (cents)	0·369
Passenger train mileage	5,133,272
Passenger train earnings per mile (cents)	92·61
Passenger train expenses per mile (cents)	61·79
Passenger train net earnings per mile (cents)	30·82
Number of paying passengers per car	11·49
Number of paying passengers per train	40·96

Electricity for handling heavy guns.—Successful experiments as to the use of electricity for moving heavy guns and revolving turrets on warships have been carried out by the Ordnance Bureau. Tests have been made on the double-turret monitor Montauk in turning the turrets and training the 10in. guns. A device has been perfected by Captain Sampson, of the Bureau, by means of which one movement of a lever enables the rotary motion of the turret and the vertical motion of the gun to be done at the same time, thus facilitating the work of training the gun, and the rapidity of action is quicker than where steam power is used. In the experiments on the Montauk, the old-fashioned turrets were moved easily and rapidly, and the guns were lowered or raised and turned in the direction of the target at the expense of little energy and without appreciable loss of time. The movements were more rapid than when steam is employed, and the accuracy was greater. The advantages noted for the proposed new system were many. Chief among them were the ease and economy of the plan. Wires can readily be attached to the dynamos of the main electric plant, and the power be thus transmitted to turrets and guns. Should a wire be shot away, it can be quickly spliced or a new one laid, and the firing go on without long interruption. There are no valves and other delicate gearing to get out of order and destroy the efficiency of the battery at a critical time. The present plan is to install the new system on the Iowa and Brooklyn. It is not intended to remove the steam motors on the vessels now in commission, or which have advanced in construction to such a stage as to make the change an expensive one.

Automatic block signals.—Automatic block signals showing "danger" as the normal position, which is a new feature in automatic signals, are now in operation on about eighty miles of double track road. The signals are on the Hall system, with a circular box or case having an 18in. circular opening, behind which appears a red disc for the "danger" signal. Over this large opening is a smaller one for the night signal. The electrical appliances are enclosed in the case, which is mounted on a post or upon an overbridge. A track circuit is used, and switches are interlocked with the block signals. The blocks are from a quarter of a mile to one mile long. There are no distant signals, but a train passing one signal sets it at "danger," but the signal behind does not show "safety" until the train has gone 1500ft. further.

Swaging machines.—Machines for cold swaging metal articles are being quite extensively used in the production of small pieces of which large quantities are required, the work being done by pressure between revolving dies, the outer ends of which touch intermittently the faces of a floating ring of rollers in a circular frame concentric with the dies. The stock does not revolve, but the dies revolve around the stock. One of its most extensive uses is in the manufacture of sewing-machine needles, which are swaged down to shape from blanks the diameter of the shank of the needle, the machine requiring only to be supplied with blanks. Tubes can be swaged without the use of any mandril. Amongst the smallest and most delicate work done are tubes for hypodermic syringes, which are of steel with a hole through them 0 015in. diameter when finished. Another example of small work is in making "rolled plate" wire for manufacturing jewellers. A cylindrical piece of base metal about $1\frac{1}{4}$in. diameter is covered by a case of gold, which is drawn in a drawing press from a flat blank the same as cartridge shells are drawn. The gold case is soldered to the core, and the whole is then reduced by these swaging machines to such diameters as are suitable for eye-glass chains, &c., some of it being swaged down to 0·015in. diameter. The applicability of the process to tubing for bicycle frames, &c., is shown by the fact that steel tubing $\frac{3}{32}$in. thick, 1in. diameter, is reduced to $\frac{5}{8}$in. diameter, and when the straight reduced portion of the tube is 6in. to 10in. long, about five pieces per minute can be done. Tubes for bicycle frames are sometimes reinforced at certain points requiring extra strength, and this is done by simply inserting a short piece of smaller tubing at the desired point and swaging the outer tube down upon it. In the manufacture of bicycle spokes, the wire is taken from a coil, straightened, passed through the hollow spindle of a swaging machine and reduced to a proper diameter by swaging, but leaving unswaged sections at proper intervals, which, when sheared in two at the middle, leaves the spokes large at each end for heading, bending, and threading. All this is done continuously and automatically. Three tensile tests of swaged and unswaged wire—0·072in. and 0·092in., 0·083in. and 0·115in., 0·08in. and 0·105in. diameter—from the same coils, showed an increase for the former of 9, 14, and $15\frac{1}{2}$ per cent. respectively, the two first being for crucible steel wire and the third for Bessemer steel wire.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Engineers: W. R. Lawton, to the Hebe, and Reginald W. Parry, to the Pembroke.

THE HERMITE ELECTRICAL SANITATION PROCESS.—The Ipswich Town Council decided at their meeting on Wednesday, the 10th inst., to adopt the Hermite process. This decision was unanimous, and resulted from the exceedingly favourable report submitted by the sewerage committee on the trials which have been made on the main sewers of the town during the last three months. We understand the permanent installation is to be proceeded with as rapidly as possible. We hope in our next issue to give further details.

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

(*From our own Correspondent.*)

THE quarterly meetings of the iron trade have been held this week in Wolverhampton on Wednesday and in Birmingham to-day—Thursday. Taken altogether they have been fairly prolific of business, though many sellers would have liked to do more. A healthy demand was present for iron and steel of most descriptions, and improved prices were here and there secured. A good sign of the times is the accentuated demand for bar iron, and it is gratifying to hear makers declare that they have lately obtained larger orders. Marked bars were re-declared on the basis of £7 10s. for ordinary branded qualities, and £8 2s. 6d. for the L.W.R.O. production of the Round Oak Iron and Steel Company. Merchant bars were £6 10s., and common bars £5 10s. to £5 15s. The official prices of marked iron have not remained unaltered since January, 1893. Common bars as compared with a year ago are cheaper to the extent of 5s. to 7s. 6d. per ton, but this is explained by the circumstance that the coal strike of last autumn was the means of advancing prices of all iron. A more justified comparison is that with three months back, when common bars were quoted £5 10s.

An animated trade is being done in sheets, and it is not unlikely that before long prices will further rise. Galvanised corrugated qualities of 24 w.g. were to-day £9 15s. to £9 17s. 6d., but several makers would not entertain business at less than £10 for delivery Liverpool f.o.b., or £10 2s. 6d. delivery London. Galvanising sheets were strong at £6 12s. 6d. to £6 15s., doubles, and £7 5s. to £7 10s. trebles.

Sellers quoted cold rolled and close annealed sheets for japanners, £8 to £8 5s. doubles, and £8 15s. to £9 lattens, while the same sheets in steel were £8 5s. doubles, and £9 to £9 5s. lattens. Iron hoops were rather active at £6 10s., though makers stated that as yet no large orders had been received from the United States, as a result of the passing of the American Tariff Bill. Gas strip was rather slow at £5 15s., thin strip £6 10s., and locomotive boiler strip, either in iron or steel, £5 15s. A large demand was recorded for steel strip for bedstead tubes.

Pig iron sellers recorded a steady business, and in many instances contracts were concluded for delivery to the end of the year. Native all-mine hot-blast pigs were 55s. to 60s. per ton, medium qualities 42s., and common cinder 38s. upwards. Outside irons were in prominent request, and agents quoted the following prices: Derbyshires, 42s. 6d. to 43s.; Northamptons, 41s. 6d. to 42s., and Lincolns, 43s., the two former being delivered here less $2\frac{1}{2}$ per cent. and the latter net. North Staffordshire grey forge of good make was 43s. 6d. delivered here, while foundry qualities were 50s. for No. 1; 47s., No. 2, and 46s. No. 3.

Official statistics issued this week show that the number of blast furnaces now blowing in the Midland and Staffordshire district is as follows:—Derbyshire, 26 out of 52 built; South Staffordshire, 22 out of 76 built; North Staffordshire, 13 out of 38; Leicestershire, 3 out of 4 built; Northampton, 12 out of 28; Lincolnshire, 14 out of 21; Nottingham, 3 out of 4; and Shropshire, 4 out of 10. These returns do not evidence much change on three months ago, but taking the entire furnaces of the United Kingdom, the returns are a decline of no fewer than 52 furnaces on three months back, the result mainly of the Scotch strike.

A spirited inquiry was noted for steel, and it is significant from the increasing number of orders that a larger consumption is at present taking place of this material than perhaps at any previous date. Bessemer blooms and billets were quoted this week £4 4s. net; Siemens qualities, £4 6s. 6d.; soft steel plates, suitable for bridge and other engineering purposes, £6; and boiler plates, £7. Steel bars, flats, strips, &c., used for stamping and pressing purposes, and rolled down in this district, were generally 10s. per ton above the price of iron.

The steps which mining engineers will have to adopt to maintain the prosperity of the collieries under a system of eight hours for miners were suggested by Mr. Alexander Smith, the new president of the South Staffordshire Institute of Engineers, in his inaugural address on Monday. More coal would have to be turned out for the same capital outlay, so as to spread the interest on fixed capital and standing charges over a larger tonnage. This could be done in one or two ways, such as working two shifts and improvements in machinery and other arrangements. Prominent among the possible improvements were the introduction of mechanical coal-cutting, more rapid haulage and drawing, and the provision of coal-washing and coal-picking apparatus, for making the best market possible of the coal raised. Whenever the eight hours system came into force greater pressure and responsibility would be thrown upon mining engineers, and prompt thought should be exercised by the profession as to how these new conditions were to be met.

The wages dispute in the wrought nail trade is likely to be settled by the masters paying the 1890 list, for which the men have been agitating. At least, the operatives believe that at the adjourned joint conference which is to be held the employers will be willing to concede these terms, and upon this understanding it has this week been resolved to resume work at once.

A company with a nominal capital of £75,000 has just been formed locally to take over the business of the Eagle Range and Foundry Company, Aston, near Birmingham, cooking range and heating apparatus engineers. The object of the new limited concern is to develope the present business, and it is said that the average profit for the last five years has been considerably in advance of any previous period.

The goodwill, registered trade marks, brands, &c., of the New British Iron Company, in liquidation, have been purchased by the well-known firm of Messrs. N. Hingley and Sons, Netherton Iron Works, near Dudley. Messrs. Hingleys' mines adjoin those of the North British Iron Company, and are situated in the same beds of coal and ironstone. It is their intention to continue the manufacture of "Lion" iron exactly as heretofore produced under that celebrated mark. "Lion" pig iron will also be made at Corngreaves' furnaces, and used in making bar and plate iron of the "Lion" brand.

The rating of machinery assessment appeals by the Wolverhampton manufacturers, and which were to have come before Quarter Sessions, have mostly been settled out of Court. Originally fifteen appeals were down for hearing, but only one of these, and that not relating to a manufacturing business, has actually come for trial. In the other cases arrangements agreeable to the appellants have been consented to by the Union authorities. It is stated that the actual result of the re-assessment of the borough will be a very large increase in the rateable value, and that although reductions have in numerous instances been allowed on the original re-assessments, the net results will be most satisfactory from a ratepayer's point of view.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—The tone throughout the engineering and iron industries of this district continues one rather of depression than otherwise, and a very emphatic proof of the generally unsatisfactory condition of trade is the fact that notwithstanding the excessively restricted production of pig iron, as shown by the recent returns of the number of furnaces in blast and the almost complete absence of stocks of any weight, business seems to be impracticable on anything like a remunerative basis. If there were any confidence whatever with regard to a revival of trade, the present position of stocks and the large number of furnaces out of blast could not help but give a stimulus to some substantial advance; but there seems to be no confidence in buying, and business is again dragging on in the merest hand-to-mouth fashion, with prices tending in a downward direction. So far as the engineering industries are concerned, there is still no indication of any real improvement; here and there, of course, business fluctuates, and in isolated cases more activity is reported, but generally establishments continue but very indifferently employed, and new work generally is not coming forward in any increasing weight.

The Manchester Iron Exchange on Tuesday was but thinly attended, and only a very slow business was reported either in raw or manufactured material. For pig iron only the most restricted inquiry is coming upon the market, and merchants and consumers are in many cases only taking partial deliveries of the iron that was purchased during the rush of buying a few weeks back, with the result that makers, although well sold, are here and there having iron thrown on their hands, which they are showing rather more anxiety to sell, even where they have to take something under recent quoted rates. For Lancashire pig iron quotations remain nominally on the basis of 40s. for forge to 42s. foundry, less 2½ at the works, but at these figures there is practically little or nothing doing of any moment in local brands. For district brands prices are easier if anything, one or two of the Lincolnshire makers especially showing more disposition to entertain offers, and forge qualities could be bought readily at 39s., with foundry numbers scarcely averaging more than 40s. 6d., and quotations for foundry Derbyshire remaining nominally at 45s. up to 46s. net cash, delivered Manchester. With regard to outside brands offering here, the continued scarcity of Scotch iron keeps up fully late prices, Eglinton not being quoted under 49s. to 49s. 6d., and Glengarnock 51s. net prompt cash, delivered at the Lancashire ports; but Middlesbrough could be bought at lower figures, makers who still hold to 45s. 4d. net cash for good-named foundry brands, delivered equal to Manchester, finding these prices practically out of the market, as there are ready sellers at quite 6d. under this figure.

In finished iron new business still comes forward very indifferently, and it is exceptional where manufacturers are able to keep their forges running more than four days per week. Quoted prices remain unchanged, but the tendency is towards less firmness. Delivered Manchester or Liverpool, Lancashire and North Staffordshire bars remain at £5 7s. 6d. to £5 10s.; Lancashire and Staffordshire sheets, £7 to £7 5s.; and Lancashire hoops, £5 17s. 6d. for random, to £6 2s. 6d. for special cut lengths. Nut and bolt makers report only a slow demand, the large users, such as bridge builders and boiler makers, being only quiet, and very low prices have to be taken to secure orders. With regard to bridge work, I may, however, mention that contracts have recently been secured by local firms, but these, I understand, have been taken at excessively low figures.

The steel trade continues very quiet, with ordinary foundry hematites not averaging more than 53s., less 2½; ordinary Bessemer basic billets, £4 net cash; and steel boiler plates £6 5s. per ton, delivered in this district.

In the metal market there is no change in quoted list rates for manufactured goods, but buying goes on very slowly from hand to mouth.

The Ashbury Railway Carriage Company, Manchester, have just secured orders for twenty-four complete bogie carriages of various classes for the Ceylon Government Railways, and they are just now busily employed upon another important order for ninety-two underframes, together with the ironwork and fittings, for various classes of carriages, for the Indian State Railways.

The Vaughan Pulley Company, of West Gorton, have just completed extensive additions to their works, and have laid down special machine tools for the manufacture of their wrought iron pulleys with steel rims, which will about treble their capacity for turning out their special class of work. I may add that the firm are very busy with orders, both on home account and for shipment to all quarters of the globe, the exceptional lightness, which is one of the special features of the Vaughan pulleys, rendering them particularly adaptable for export.

The fifty-sixth annual meeting of the Manchester Geological Society was held on Tuesday, Mr. W. Saint, Inspector of Mines, the president, occupying the chair. The report presented showed a continued increase of membership, and improvement as regards the financial position of the Society, the total membership being now 230, as against 222 last year. The report, in reviewing the work of the session, made reference to several important contributions on mining and geological subjects. The President had opened the session with a very practical address on "Recent Improvements in Mining Machinery and Appliances," this being followed by papers on ventilating and coal-cutting machinery, in which the desirability was set forth of a more extended adoption of mechanical appliances for the getting of coal, which so far had made very little progress in this country. On geological subjects, Professor Boyd Dawkins had contributed an important paper on the "South-Eastern Coalfield at Dover," and Mr. De Rance had given an interesting paper, with detailed sections, of a boring for coal on the Freeholders' Estate, at Hazel Grove, which had resulted in the finding of valuable seams of coal and proved the extension of the coalfield beyond the boundary previously assumed. A matter of some importance which had engaged the attention of the Council during the session had been the desirability or otherwise of the association joining the Federated Institution of Mining Engineers, but with regard to this, nothing had so far been definitely settled. Mr. W. Watts was elected President, and Messrs. G. Pearce, John Gerrard, H. Speakman, Mark Stirrup, vice-presidents; Messrs. R. Clay, S. Garside, George Wild, W. N. Atkinson, C. Cockson, R. Winstanley, S. Platt, J. Ridyard, H. H. Bolton, G. B. Harrison, D. H. F. Matthews, and G. C. Greenwell, junior members of Council; Mr. Clegg Livesey, hon. treasurer; Messrs. J. Tonge and Joseph Crankshaw, hon. secretaries; and Messrs. G. H. Hollingworth and H. A. Woodward, hon. auditors for the ensuing year.

No really material improvement can be reported in the position generally as regards the coal trade. In the better qualities of round coals, suitable for house-fire requirements, an increasing business is being put through, and pits have in isolated cases been able to run about full time, but in other descriptions of fuel, only a very indifferent demand is reported to be coming forward, and four days per week continues the general average that the pits are working, with supplies ample for requirements, even with this limited production. With regard to house coals, prices average about 11s. to 11s. 6d. for best qualities, 10s. to 10s. 6d. for seconds, and 8s. to 8s. 6d. for common house fire coals at the pit mouth, but the top figures still represent exceptional prices, although they are more readily obtainable, in some instances, than they have been recently. Only a very slow inquiry is coming forward for steam and forge coals, which are readily obtainable at 7s., although 7s. 6d. is quoted for some of the better qualities at the pit mouth.

Engine fuel continues more or less of a drug in the market, and in some cases extremely low prices are taken to effect clearance sales; common slack averages about 3s. 6d. to 4s., good medium sorts 4s. 6d. to 5s., and best qualities 5s. 6d. to 6s. per ton at the pit mouth.

During the past week there has been a falling-off in the weight of business put through for shipment, this being chiefly due to the cessation of inquiries for Scotland, and there is a slight giving way in prices, which do not average more than 8s. 6d. to 9s. per ton for ordinary qualities of common round coal, delivered at the Mersey ports.

Barrow.—There is still less activity to report in the hematite pig iron trade this week, and a distinct tone of depression has set in. Orders are very few, especially for forward deliveries, and prompt sales are from hand to mouth. There has been a further decrease in stocks this week amounting to 417 tons, and stocks now stand at 158,490 tons, or 63,867 tons more than in the beginning of the year. Prices are depressed at 44s. 6d. to 45s. for mixed Bessemer Nos., net f.o.b., with warrant iron at 43s. 6½d. cash sellers, buyers at 43s. 6d. Thirty-three furnaces are still in blast.

Iron ore is in slow demand, but Scotch smelters are again wanting deliveries, and some improvement in shipments may be expected. There is a quiet local demand. Late prices are maintained.

The steel trade is still very quiet, except in three departments. Some new orders are to hand for steel ship plates, and for heavy steel castings, and it is expected there will be a fair trade during the winter months in tin-plate bars, but rails, heavy as well as light, are in quiet demand, and there is but little doing in billets and hoops, while the trade is almost absolutely nil in blooms, slabs, and wire rods. The Bessemer departments generally are inactive.

The shipbuilding and engineering trades are fairly well employed, and much progress is being made with the Admiralty work in hand. The Naval Construction and Armaments Company have booked an order from the London and North-Western and the Lancashire and Yorkshire Railway companies for the building of a high-speed twin-screw passenger steamer for the Fleetwood and Belfast service. Recent additions to this fleet have been made by Laird's, of Birkenhead, and by Denny, of Dumbarton. In years gone by the Barrow Company built three vessels for the Fleetwood service, but they were of the now discarded paddle type. Greater economy in working is secured by the twin-screw steamers, and higher speeds are obtained.

Shipping returns show an improvement this week. The exports of pig iron from West Coast ports during the week amount to 6793 tons, and of steel 6599 tons, compared with 4080 tons of pig iron and 4781 tons of steel in the corresponding week of last year, an increase of 2713 tons of pig iron and of 1818 tons of steel. The aggregate shipments this year amount to 277,654 tons of pig iron and 313,183 tons of steel, compared with 208,663 and 383,950 tons respectively in the corresponding period of last year, an increase of 68,991 tons of pig iron and a decrease of 70,767 tons of steel.

The demand for coal and coke is quiet, and prices are, generally speaking, easy.

Throughout the district generally there is scarcity of employment, and many men coming into the district for work have to go elsewhere disappointed.

It is reported that a new company is about to be formed to produce, at a Barrow works, a new material to take the place of silk.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THIS has been a very dull week in the steel and iron trades. There has been practically no movement reported. In all the works visited during the last ten days the reply to inquiries has been one continuous note of depression. No signs whatever are perceptible of any improvement in the demand either for railway material or for shipbuilding. Shipowners are discouraged at the lowness of freights, which makes their business altogether unprofitable. As long as ship-carriage is thus so unsatisfactory it would be unreasonable to expect any new orders of consequence to be placed. Hematites run from 51s. to 52s. 6d. per ton, delivered in Sheffield; common forge iron, 38s. to 38s. 6d. per ton, but there is literally no business doing. Consumers have quite sufficient supplies for their requirements, and the absence of new work causes them to hold their hands and keep back orders. The position of affairs is exceedingly unsatisfactory and disappointing, as a decided change for the better, which was stimulated by the revival of a month ago, was expected. The quotations for hematites, already given, show a reduction of from 1s. to 1s. 6d. per ton, and in forge iron of about 6d. per ton. Derbyshire irons are also slightly reduced. Bessemer billets are at £5 10s., bar iron is quoted at a similar figure where the requirements reach any amount.

In the manufacture of locomotives and other engines, English makers, both in this and other districts, are finding German and Belgian competition get increasingly keen. Much of the work which used to be done in this country is now also turned out by native engineers in foreign markets. In several of our large railway material establishments orders are daily expected for material from India. Extensions of railways in that great Dependency are now contemplated, which will involve an outlay of over thirty millions sterling. Of this work a considerable share is certain to come to Sheffield. At the same time the prices of finished material have got to so low a point that it is doubtful whether in home industry they cover the cost. In general cases orders are said to be taken for no other object than to keep the machinery employed against better times, and to keep their men at work. The war between China and Japan has had the effect of suspending nearly all deliveries to these countries. Some pressing orders for buffers for the Japanese Government are now in course of execution in Sheffield, and when the war is over it is expected that both combatants will place heavy requirements not only in military, but in marine and railway material. The revival anticipated in the South American markets has not yet commenced, and the general opinion amongst our principal houses is that the season is too late now for the foreign markets to afford any great improvement this year.

In the coal trade 6d. to 1s. per ton advance has now been pretty generally obtained in household sorts. The long-continued mild weather led to the belief that no advance would be made this month, and merchants even yet are not buying to any extent, but owners are stubbornly requiring more money, and as the season advances they are certain to get it. Silkstone is now at 10s. to 12s. per ton; Barnsley House, 9s. to 9s. 6d. per ton; second qualities, from 8s. to 8s. 6d. per ton. In steam coal a full average tonnage is still being sent to the Humber ports, and the railway companies are taking good deliveries on account of contracts. Barnsley hards, 7s. 9d. to 8s. 3d. per ton; Parkgate and other qualities from 7s. per ton. Gas coal seems to be rather lower and in less demand. Manufacturing fuel continues very quiet, screened slack being quoted at 4s. 6d. to 5s. 6d. per ton; pit slack from 3s. 6d. per ton. Coke is in rather better demand at from 9s. to 11s. per ton.

Colliery extensions are proceeding briskly in South Yorkshire. On Monday last Mr. George H. Turner, general manager of the Midland Railway, cut the first sod of a new colliery at Griemthorpe, belonging to the Mitchell Main Colliery Company. The undertaking is on the property of Mr. F. J. Saville Foljambe, of Osberton Hall, who has granted a lease of about 3000 acres of coal, lying in such a direction that it will be connected with the workings of the Mitchell Main Colliery, Wombwell. It is expected to find the Barnsley thick seam at a depth of about 500 yards. The sinkings are to consist of two shafts, each of a clear diameter of 19ft. inside the tubbing. The coal is expected to be reached in about two years. With the two large pits already worked by the company, and the fresh enterprise in full operation, the output will be about one million tons per annum. The new colliery is connected with both the Midland and the Manchester, Sheffield, and Lincolnshire Railways. The sinking operations are in the hands of Mr. Charles Walker, of Darfield, under the supervision of Mr. Mitchell, the engineer.

On Wednesday, 10th inst., deputations of engine and boilermen from South and West Yorkshire had an interview with the executive of the South Yorkshire Coalowners' Association, the object being to require their wages to be restored to 30 per cent. above 1888 standard and to have the reductions returned. The men decline to submit to the reduction of one-fourth under the decree of the Conciliation Board, on the ground that not being represented on the Board they are not bound by its decisions. The executive are to report the result to a full meeting of coalowners to be held next week.

The return of coal sent to Hull from the Yorkshire collieries during September, issued by the Hull Chamber of Commerce and Shipping, shows that trade has been in a fairly good condition, with business as well up to what it usually is at this time of the year. The tonnage forwarded to that port last month amounted in the aggregate to 263,000 tons, as compared with 42,992 tons for the corresponding period of 1893, and 171,816 tons for September of 1892. The reason of course for the return for September, 1893, being so small was on account of the great coal strike, when practically no business was done with the Humber ports. Out of the 42,992 tons then sent, 39,552 tons came from Durham, and twenty-five Yorkshire collieries only sent 3440 tons. For the completed three-quarters of the year the tonnage forwarded to Hull was 1,591,800 tons, as compared with 1,049,480 tons for the same period of 1893, and 1,695,408 tons for the three-quarters of 1892. These figures, compared with those of 1893, exhibit an increase of half a million tons, but contrasted with those of 1892, a decrease of 103,000 tons is shown. The export trade has considerably advanced. Last month the figures were: coastwise, 19,945 tons; and to foreign countries, 147,838 tons; as against 75,607 tons in the same month of 1892. In September of 1893 no coal was exported coastwise, and only 624 tons sent away in all. The exports for the nine months of the year were:—1894, 665,462 tons; 1893, 349,807 tons; 1892, 635,089 tons. For the month of September the country which took the largest weight was Germany, with 45,458 tons. In the corresponding month of last year there was no coal sent to any foreign port except North Russia, and Sweden and Norway. Last month Sweden and Norway took 37,674 tons; North Russia, 29,680; Denmark, 12,411; and Holland, 6551 tons. For the nine months the largest weight was taken by Sweden and Norway with 215,644 tons, North Russia occupying second place with 140,158 tons, Germany being third with 117,872 tons, and Holland fourth with 37,105 tons. The highest individual tonnage sent by a single colliery was, as usual, from Denaby Main, with 23,456 tons. Peckfield, after sending moderate contributions, has sprung into second place with 16,472 tons. The third place is occupied by Manvers Main with 10,888 tons. Two collieries in West Yorkshire take fourth and sixth place, and the fifth is occupied by a South Yorkshire colliery.

During the month of September there has been the serious decrease of £20,298 in hardware and cutlery. The increasing countries for that month are Belgium, from £5937 to £8103; United States, from £12,987 to £25,314. This latter increase is due to the settlement of the tariff question. The markets which show a decrease include Russia, Sweden and Norway, Germany, Holland, France—from £8256 to £4606; Spain and Canaries, Foreign West Indies—from £3306 to £2509; Chili, from £3063 to £1291; Argentine Republic, from £3306 to £2825; British Possessions in South Africa, £12,736 to £11,577; Australasia, £24,027 to £18,868, and British Possessions in East Indies from £19,307 to £12,493. There is also a decrease reported on the exports for the nine months of £208,682. The only increasing markets are Russia—from £31,756 to £42,734; Sweden and Norway, from £28,181 to £30,477; Germany, from £82,426 to £82,905; Holland, from £56,642 to £69,336; Belgium, from £45,673 to £69,999. The decreasing countries are again very numerous, including France, from £71,008 to £55,862; Spain and Canaries, from £29,660 to £23,937; United States, £169,237 to £99,461; Foreign West Indies, from £37,706 to £28,704; Chili, from £35,134 to £14,053; Argentine Republic, from £45,866 to £35,215; British Possessions in South Africa, from £108,504 to £99,131; British Possessions in East Indies, from £167,300 to £123,842; Australasia, from £200,093 to £177,643; and British North America, from £75,295 to £52,225.

In steel unwrought there is a considerable improvement reported on the month's business. The increasing markets are Russia, from £17,660 to £39,115; Germany, from £17,334 to £30,158; France, from £6243 to £12,036; United States, from £11,704 to £32,361. Decreases are shown by the following countries:—Sweden and Norway, from £3112 to £2498; Denmark, from £3684 to £3645; Holland, from £12,815 to £7684; British East Indies, from £6394 to £3300; Australasia, from £4796 to £4593; and British North America, from £13,843 to £5995. An advance is reported on the nine months' working, the reviving markets including all except Holland, United States, and British North America.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THOUGH it is generally held that the trade of the country has entered upon a revival, and that prospects are more favourable to producers, yet in this district at present the tendency is rather the other way, and what little improvement has been gained is disappearing. Certainly the pig iron market has become very flat, and buyers are few, while plenty of sellers are coming forward, though it is but right to say that these latter are not the producers themselves, but are people who have been speculating and bought heavily when prices were advancing, in the expectation that the value of iron was going up still further. When, however, prices took a turn downward, there was the usual rush to sell out, and this prevented any recovery in prices, but rather helped them down until now they are at least 6d. per ton below the best price that has generally been realised. The unsettled state of foreign political affairs has made the speculators timid, and there is not nearly so much confidence in the market that there was a fortnight ago. Business in this district also is quieter, because less pig iron is required to be sent to Scotland, the miners' strike there having almost ended, seeing that forty thousand miners have gone back on the masters' terms out of the seventy thousand who came out more than three months ago, and coal being more plentiful the other nine of the blast furnaces have been relighted, making twelve at work altogether. There were nearly seventy in blast before the strike commenced. A good deal of capital has been made in commercial reports of the fact that between sixty and seventy furnaces could cease operations without causing any marked improvement in the demand for and prices of pig iron in other districts; but it ought to be taken into account that the consumption of pig iron fell off likewise, seeing that nearly all the finished iron and steel works in Scotland were stopped, and did not require the pig iron. If cheap and adequate supplies of fuel had been forthcoming so that they could have been kept going, a much greater improvement in the demand for and prices of pig iron in other districts would have resulted.

Cleveland pig iron makers have had to reduce their quotations, owing to the action of speculators, who have forced prices down in their anxiety to realise, and this though foundry qualities are admittedly scarce, so much so that only small lots can be furnished by the speculators themselves, and makers have little of which they can dispose for prompt delivery. Most of the business in No. 3 this week has been done at 36s. per ton for prompt f.o.b. delivery, but less than that will be accepted now—35s. 9d., and even 35s. 6d. was taken on Wednesday—as warrants all round have became so very weak, and this rules the general market, now that warrants are again coming more in competition with makers' iron. Not long ago Cleveland warrants could not be had under 36s. 6d., and at the close of last week were not below 36s., but on Tuesday they dropped to 35s. 8d., and on Wednesday to 35s. 6d. In the face of this and of as large a fall in Scotch and hematite warrants, it could hardly be expected that prices of makers' iron could be kept up. Very little iron is being taken out of the public stores, whereas a large quantity might have been expected, seeing that No. 3 is so scarce, and that large shipments are being made. The exports have considerably improved to the Continent, but as this is the last month of the northern navigation season, the despatch of the iron cannot be delayed, and those who need to get a stock in for the winter have to import it now. The pig iron exports from the Tees this month to Wednesday night were 30,035 tons, as compared with 21,[illegible]50 tons last month, and 34,333 tons in the corresponding month of last year, all to 11th. No. 4 Cleveland foundry pig iron has declined to 35s., and grey forge—which has once more become almost a drug on the market, there being so much more offered for sale than is required—can be bought at 33s. 9d., a price which will not pay the producers. If the old differences in prices were maintained, grey forge should be only 1s. cheaper than No. 3, whereas it is 2s. 3d. cheaper; the expense of producing it is the same. East Coast hematite pig iron is also in better supply than demand, yet there are no signs of the output being reduced, though makers' stocks must be increasing considerably, and the cost of production increases. Mixed numbers can readily be bought at 43s. for prompt delivery, and even 42s. 9d. is said to have been accepted, Middlesbrough hematite warrants having fallen to 42s. 3d. buyers. Foreign ore is dearer, some sellers asking 12s. 3d. per ton for good Rubio delivered on the Tees. Messrs. Cochrane and Co. are dismantling a furnace at their Ormesby Ironworks, Middlesbrough, and they will have four built, of which three are now in blast.

The accountants certify that the average realised price of No. 3 Cleveland pig iron during the quarter ended September 30th was 35s. 1·96d. per ton, or 3·65d. decrease upon the previous quarter, a result which is disappointing, as most people had looked for an increase, seeing that the market quotations have been higher, being 35s. 6d. in July, 35s. 10d. in August, and 36s. 4d. in September, the average for the quarter being close upon 35s. 11d. It is evident that the makers must have had on hand a lot of low-priced contracts. Wages of blast furnacemen for the current quarter have been reduced half of 1 per cent. They looked for an advance, and thus they some time ago asked that the sliding scale, which would according to their notice have terminated at the end of September, should be prolonged to the end of the year.

Very little improvement can be reported in the finished iron and steel trades, but the prospects for rail makers are somewhat more promising, as orders are likely soon to be given out for India, as well as for railways at home. There seems also to be a brightening up in some of the markets abroad to which we have in past years sent large quantities of railway materials. The quotation for heavy steel rails is £3 12s. 6d. net at works. Steel billets are in good request, and several cargoes have been sent to the Manchester district by sea, it being cheaper to do that than to forward by train. The railway companies, however, rather than lose the traffic, have considerably reduced their rates, so that little more is likely to be sent by way of the Ship Canal. The chief market for steel billets is South Wales. The Darlington Steel and Ironworks have now been entirely closed, and 800 men thrown out of employment. Steel ship plates are quoted £4 17s. 6d.; steel boiler plates, £5 17s. 6d.; steel ship angles, £4 15s.; iron ship plates, £4 15s.; iron angles, £4 12s. 6d.; common iron bars, £4 17s. 6d.; and best bars, £5 7s. 6d.; all less 2½ per cent. and f.o.t.

A Staffordshire firm has been making inquiries about the Bowesfield Ironworks, Stockton. These were formerly well-known iron-plate mills, but have been idle for several years. The situation of the establishment is good, being on the left bank of the Tees, and close to blast furnaces, with shipyards not far away.

Messrs. Ropner and Sons, whose shipyard has been closed for three months, have this week recommenced operations, but have not yet found work for more than half the number they usually employ.

Mr. J. W. Willans, of Dolforgan Hall, Kerry, electrical engineer, has been accepted as the Liberal candidate for the Montgomery Boroughs. Mr. Willans was for many years engineering manager at the Tees-side Iron and Engine Works, Middlesbrough, and since then has had a good deal to do with the construction of the Liverpool Overhead Railway. The Skerne Steel and Wire Company, Darlington, is about to be reconstructed. It is being wound up voluntarily, so that the share capital may be reduced. The depression of trade and the moulders' strike in particular led the directors to consider the course now adopted to be desirable.

A meeting of promoters held at Manchester has decided that the Bill for the new through line between Manchester, Newcastle, and Glasgow shall be proceeded with in the parliamentary session of 1895, and Newcastle was chosen as the headquarters of the provisional committee. A very favourable report on the proposed line of route has been received from several engineers in the country. It is stated that the North-Eastern Railway Company is contemplating the extension of the Richmond branch up the Swaledale Valley as far as Muker.

The strike of patternmakers in the North of England—which has been in progress since April 5th—is not yet settled, and the men seem to be as loth as ever to recede from their demands. They decline to follow the example of the moulders, and allow their dispute with the employers to be adjudged by arbitration or conciliation; and nothing will content them but the full advance which they demanded half a year ago. Some of the masters have obtained men from Scotland, but the strikers have induced them to return. The district is suffering greatly yet from the effects of the late moulders' and engineers' strikes, and some steamers which might have been completed four or five months ago are still waiting for their engines.

The newly added south and west wings of the Durham College of Science at Newcastle were opened on Tuesday by the Mayor of Newcastle. It is twenty-three years since the College was opened. It was in 1887 that the first wing of the present building was erected, and the building will be complete when the north wing is opened, on which occasion the King of the Belgians is to be invited to perform the ceremony. On Tuesday an experimental engine of 200-horse power was presented to the College on behalf of the Worshipful Company of Drapers, by Mr. Robert Thompson, past-president of the North-East Coast Institution of Engineers and Shipbuilders.

On Tuesday, at the invitation of the Bishop of Durham, a number of gentlemen representing labour and capital met at Auckland Castle to talk over the limitation of competition with regard to the "living wage" and cognate subjects. The conference was private, but it is stated that Professor Marshall, who takes a great interest in these subjects, gave those present the benefit of his advice.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THERE has been a fair business in pig iron warrants, but the tone of the market has been easier, and the tendency of prices downward. As the miners' strike has now practically collapsed, there is no chance of the prices current of late for pig iron being maintained, and holders are understood to have been selling. Scotch warrants have further declined about 6d. per ton. The price of Cleveland iron is also down 5d. per ton, and Cumberland hematite has fallen in proportion. Only a small business has been done in hematite, although it is certain that the consumption will henceforth increase.

Since last report three furnaces have been put in blast at Gartsherrie Ironworks, and the prospect is, that in a short time a further considerable increase will be made.

The prices of makers' pig iron are as follows:—G.M.B. f.o.b. at Glasgow, No. 1, 44s.; No. 3, 42s. 6d.; Monkland, No. 1, 48s.; No. 3, 42s. 6d.; Carnbroe, No. 3, 46s.; Summerlee, No. 1, 59s.; No. 3, 52s.; Coltness, No. 1, 59s.; No. 3, 51s. 6d.; Calder, No. 1, 58s.; No. 3, 50s. 6d.; Glengarnock at Ardrossan, No. 1, 54s.; No. 3, 49s. 6d.; Eglinton, No. 3, 43s.; Shotts at Leith, No. 1, 58s.; No. 3, 52s.

The shipments of pig iron from Scottish ports in the past week amounted to 2236 tons, compared with 5035 in the corresponding week of last year. India took 25 tons, South America 50, Australia 15, Italy 150, France 15, Germany 220, Holland 216, Spain 65, other countries 20, the coastwise shipments being 1460, against 1105 tons in the same week of 1893.

The stocks of Scotch pig iron are reduced to very small proportions at the ironworks, and those in the warrant stores show a decrease for the week of about 1000 tons.

Work is now being gradually resumed at the malleable iron and steel works, the managers proceeding with caution, as they are obliged to have cheap fuel. The prices obtainable will not afford anything else. It is a matter of uncertainty as to the amount of employment to be immediately available in finished iron and steel. The interruption to shipbuilding during the strike has been only partial, because supplies of steel were always to be had from the North of England, and merchants were thus able, wherever it was absolutely necessary, to carry out their engagements. Prices are not very regular, but they may be expected to equalise themselves in the course of the next two or three weeks.

The shipments of iron and steel manufactured goods from Glasgow in the past week embraced sewing machines to the value of no less than £10,825, of which the greater proportion went to the Continent; other machinery, £7743; steel goods, £2456; and miscellaneous iron goods, £11,792.

The coal market is now assuming something like its usual appearance, although a few weeks must still elapse before the full supply of coal will be attainable. Orders for cargoes from the North of England are now no longer given. On the other hand, the shipments of Scotch coals are on the increase, and the prices are receding. In the Glasgow district the best all-round coal is quoted at 9s., second quality 8s., and dross 5s. per ton.

The colliers' strike has quite collapsed in Lanark and Ayr. Fife and a part of Stirling and the Lothians still hold out, but the men must now be fully aware that their cause is utterly hopeless.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE colliers, having given in their notice, have now put aside, apparently, all discussion for a time, and continue working very regularly, with the exception of a few partial strikes. The General Federationists are, however, not inclined to let the opportunity slip by, and it may be taken for granted that the coming winter will see a lot of platform work, the agents of the English organisation making every effort to annex the Welsh colliers. I have spoken to influential men amongst the local colliers, and though they cannot guarantee the action of the hauliers, they think the middle-aged and common-sense colliers will strongly oppose any union with England.

The coal trade has entered upon the fourth quarter in a way to arouse very satisfactory comments. It is evident that war rumours, and the necessity of keeping the British fleet on the alert and ready to protect our interests abroad, tells favourably on the steam coal trade, and coaling stations are being well supplied. Some large tonnages went out this week. The total last week from Cardiff ports, notwithstanding the monthly holiday, was 280,000 tons. I note that the great steamship and other companies are beginning to make their arrangements for next year's contracts. The P. and O., as usual, are moving, and invite tenders for 120,000 tons.

On 'Change Cardiff the prominent topic of conversation of late has been the prominent figure at which contracts will be entered into, and from all I can glean, seeing what prices are had, and the firmness of the market, and noting also the prospects and the possibilities of the future, a likely price will be from 11s. to 11s. 6d. A good authority on 'Change agrees with this, though if the Foreign-office became actively disturbed during the next week or two, the higher figure might be exceeded.

The latest quotations this week, Cardiff, are as follows:—Best steam, 11s. 9d. to 12s., demand good; seconds, 11s. to 11s. 6d.; best Monmouthshire, 10s. 6d. to 11s.; dry coal, from 10s. f.o.b. House coal continues in a vigorous condition, and home and outside demand is good. Best continues at 11s.; No. 3, Rhondda, 10s. 3d. to 10s. 6d.; No. 2, Rhondda, 8s. 9d.; through, 6s. 9d. to 7s.; small, 4s. 9d.

Newport and Swansea coal exports remain good, and prices firm. Swansea quotes best steam at 11s., and anthracite from 8s. 9d. to 12s. 6d., according to quality. For this class of coal, and for the kind which yields a useful blending of bituminous and anthracite, the inquiry is good, and I hear, in respect of the latter, that developments are likely at Hirwain on a large scale.

Coke remains tolerably firm, and I note that the closed steel works of Tredegar and Rhymney are busy in that direction. Cyfarthfa in the fulness of its requirements lending a helping hand. Present quotations, Cardiff, are:—Furnace, 15s. to 16s.; foundry, 17s. to 18s.; special foundry, 20s. to 20s. 6d. Patent fuel is on steady demand at last prices, 11s. to 11s. 6d. Swansea price, 10s. 6d. to 11s. Pitwood, 15s. 6d. Cardiff; 17s. Swansea.

There has been little change from the ordinary rut in the iron and steel trades, and the activity one meets with here and there is more of the nature of preparing for briskness than meeting increased demands. The quantity of ore coming in and stocked at the principal works continues very large. So also in the make of tin bar, which has been heavy, particularly at Cyfarthfa. On two occasions this week the despatch sent, principally to the Great Western sidings, has been unusually large. On one day 50 wagons, principally ten tons each, were sent away.

I note that at these works the storing of pig iron has been immense of late, and every available corner utilised. Several hundred tons of refinery iron, which had been stocked for years, have also come under the Cyfarthfa tactics of putting everything to good purpose. This iron was of excellent brand, and to bring it to account a short railway was put down, and the whole rapidly cleared.

Pig iron continues to come in from Middlesbrough and Millom. Only two cargoes of rails have been despatched this week—one of 750 tons to Spain, and another, Great Western rails, to Highbridge, 110 tons.

Market quotations, Iron and Steel Exchange, Swansea, were as follows, midweek:—Glasgow warrants, 42s. 6½d.; hematite, Middlesbrough, 42s. 7½d.; Welsh bars, £5 to £5 2s. 6d.; steel rails, heavy, £3 15s. to £3 17s. 6d.; quotation at Cardiff, £3 12s. 6d. to £3 15s.; light, Swansea, £4 10s. to £4 15s.; steel sheets, £6 5s. to £6 7s. 6d.; sheet iron, £6 to £6 10s.; Bessemer steel tin-plate bars, £4 to £4 2s. 6d.; Siemens best, £4 to £4 2s. 6d. Tin-plates: Bessemer cokes, 10s. 3d. to 10s. 6d.; Siemens, 10s. 6d. to 10s. 9d.; ternes, per double box, 28 by 20, 20s., 21s., 22s., 24s.; best charcoal, 12s. to 12s. 6d., according to finish of brand; wasters, 6d. to 1s. less than primes.

Block tin is down to £69 5s. There have been large clearances of tin-plates against Swansea; but tonnage has not come in as expected, or they would have been heavier. The total received from works last week amounted to 66,167 boxes; total shipped, 57,766 boxes, leaving stocks at 235,712 boxes.

The shipments of September were very satisfactory, 13,882 tons to the United States and 4374 tons to Russia, as against 9906 tons to the States and 3817 to Batoum for September, 1893.

A good deal of satisfaction is felt at the healthy state of the Swansea harbour trade. September beat the record. In imports there was an increase of 23,408 tons, and in exports 35,216 tons. During the month, in iron ore and in iron and steel, the increase in imports was large. Last week Swansea imported 1516 tons pig and 290 scrap steel, and a large quantity of tin-plate from the Monmouthshire district. In patent fuel there would have been a large clearance had tonnage come in. As it was exports were confined to 2470 tons to France, 1200 to Roumania, and 1000 tons to Algeria.

The great question now "on" at Cardiff is, Shall the Corporation acquire the Bute Docks and Penarth, possibly Barry, and form a harbour much the same as Swansea; but it would seem likely that while the Council are discussing payment to experts, and ways and means generally, the opposition will grow stronger. Some of the moderate men hold, that with a costly waterworks scheme, carrying out electric lighting, and acquiring tramways, they have enough on their hands at present. On Wednesday it was stated on good authority, that the Taff Vale Railway Company has decided to withdraw from the scheme, and up to the date of my despatch this has not been corrected. The impression in Cardiff is, that if the statement is right—and it seems reasonable, as without Penarth the Taff would have no sea outlet—the Corporation will retire from the undertaking.

In Swansea a water action, for which a claim of £60,000 was made, has been settled for £10,833 by arbitration in London.

The first main line train was run by the Rhondda and Swansea Railway directors over the new extension into Swansea on Tuesday, they having first inspected the whole work of the railway, including the swing bridge over the Neath river. The connection from the Rhondda is now unbroken with the exception of a few yards at Briton Ferry.

The Llanelly Harbour Commissioners held an important meeting this week, and comments were passed on the dilatory character of the Board of Trade in not sanctioning the improvements desired. Doubtless this will take a practical form next week.

A conference of collier delegates is to be called to enter into the question of the use of carbonite instead of compressed gunpowder in blasting operations. It is contended that though the use of carbonite is safer than powder, the miners are not able to earn so much, and that in consequence they should have compensation.

The formation of a transport company for the Severn Navigation is proceeding vigorously, and Sir W. T. Lewis has announced to the promoter that the Bute Docks Board are prepared to support, financially and otherwise, the scheme of a water transport company. In this, traders at Cardiff and Worcester are benefited, and the building of suitable steamers will be one of the earliest efforts.

NOTES FROM GERMANY.

(From our own Correspondent.)

THE position of the iron and steel trade over here has in no wise altered since last week, a limited business being done in most departments, while quotations are rather fluctuating, and certainly anything but satisfactory. Quietness still prevails in most branches of the Silesian iron trade. Pig iron is in particularly weak request, and the blast furnace works justly complain of the decreasing tendency in prices, which has been very keenly felt in some instances. In malleable iron very little is done just at present, and for the few orders that are being secured here and there extremely low quotations have to be accepted.

With reference to the Austro-Hungarian iron trade, nothing of interest can be reported to have occurred since last week. Makers and manufacturers, on the whole, are well employed, though here and there a slackening off in demand has been noted lately. Pig iron continues to be scarce, and there is generally much firmness exhibited in prices. Few orders are coming in for bars, which may be accounted for by the exceptionally brisk demand that was coming forward for that article in last quarter, when dealers as well as consumers were anxious to profit from the low prices then ruling; for the present there is little chance for an improvement in demand, unless stocks should begin to decline. The steel trade is altogether in a poor condition, owing to the scarcity of orders for rails and railway rolling stock. The machine and wagon shops are in comparatively fair employment, twenty express locomotives having been ordered by the Austrian State Railways.

In France a rising demand can be noticed for almost all sorts of iron, though orders of weight are, as yet, rather scarce, but downward movements have not been reported for some time past. On the contrary, there is a very firm tone perceptible in most departments. A hopeful feeling generally prevails, and in many quarters the belief is entertained that a fairly good winter's business will be done.

The Belgian iron trade begins to show slight signs of a revival, and a firm tendency is generally reported. For the present, however, makers "live in hope," the business actually done being of small weight, but the more sanguine persons are of opinion that the worst is past, and that a general and lasting improvement is about to take place. Up to date both the raw and the finished ironworks are but moderately engaged; export trade continues uncommonly weak, and there are very few works that can boast of any forward orders. The Company Cockerill has been fortunate in securing a pretty fair order for fish-plates for the Roumanian Government at 147·50f. p.t. at works.

There is nothing new to note with regard to the Rhenish-Westphalian iron and steel industry. Some branches are tolerably well employed, and the fact that prices are rather firmly maintained is generally considered as a symptom of lasting improvement. The quietness in the iron trade cannot fail to have a strong influence on the iron ore market, and there is but little activity to be noted at the iron ore mines. Since previous letters no alteration in quotations can be reported to have taken place, nor is it at all likely that there will be any material change so long as the weakness in the pig iron department continues. From the malleable iron market tolerably good accounts have been coming in upon the week, though little actual business is done in most branches; but a good number of inquiries have come in for bars as well as for hoops, and buyers appear to be just a little less reserved than formerly. In girders not much has been done lately. A good activity continues at the plate and sheet mills, but makers find it impossible to carry an advance in quotations. Foreign inquiry is dull, sheets only meeting with a pretty strong request. Drawn wire and wire nails still show no sign of improvement, either in price or demand; and there is likewise a very weak tone to be noticed in the rivet business. The ironfoundries and machine factories are only poorly employed, while a good activity continues at the wagon shops.

A concession for the building of a locomotive wagon and rail shop in Russia has been granted by the Russian Government to an American syndicate, under condition that twenty-four foreigners, at the most, are to be employed, and that only Russian raw material is to be consumed.

The following figures, showing the average prices of pig iron in the different countries, may perhaps be of some interest. The highest prices for raw iron are quoted in Italy, where 161f. p.t. is paid for common foundry pig. In Russia 104f. p.t. is quoted; in Austria, foundry pig is paid with 92f.; in Hungary, 90f. p.t. In Japan, 84f. p.t. is quoted; in Spain, 69f. p.t.; in Norway, 69f. p.t. In Luxemburg, 45f. p.t. is the price quoted; in Belgium, 51f.; and in Bavaria, 57f. p.t. is paid. In the United States 71f. p.t. is the average price for foundry pig, Prussia and France each quoting 61f. p.t.

STATUE TO SIR WILLIAM PEARCE.—A memorial statue of the late Sir William Pearce, Bart., the eminent shipbuilder, who died in London, December 18th, 1888, was unveiled at Govan, Glasgow, on Saturday, the 6th inst., by Lord Kelvin. The event took place in presence of a large concourse of spectators for most part composed of the trades' societies belonging to Govan, and of employés in the shipbuilding works. Besides Lord Kelvin, there were present, Lady Kelvin, Lady Pearce, Sir Wm. George Pearce, Lady Roberton, Sir James Bain, the Provost and Council of Govan, and Rev. Dr. John MacLeod. The statue, which has been erected at a cost of some £2000, defrayed by public subscription, occupies a commanding and central position near the cross of Govan, the site having been given by Lady Pearce. The statue proper is from the design of Mr. Onslow Ford, of London, while the massive and lofty pedestal on which it stands is of polished Peterhead granite, supplied by an Aberdeen firm. The pedestal alone weighs about 25 tons, and is 12ft. 6in. high. On the upper base dado are four sunk moulded panels for inscriptions and memorial tablets. The statue represents the late baronet examining the plan of a ship, and the likeness fully maintains the reputation of the sculptor. A glass vase deposited inside the base of the pedestal contains drawings of some of the famous steamships built under the deceased baronet's management, including the Arizona and Alaska, together with a full list of the vessels built during his time; a pamphlet entitled "The Building of a Ship;" a map of the borough of Govan, photographed by the late baronet; current coins of the realm, copies of newspapers, &c. In unveiling the statue, Lord Kelvin gave a lengthy biographical statement regarding the late baronet, and said that by the statue now unveiled they would be kept in remembrance of what Sir William Pearce had done for Govan, for the Clyde, and for the world. Sir W. G. Pearce followed Lord Kelvin, and formally handed over—on behalf of his mother—the title deeds of the ground on which the monument had been erected.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, October 5th.

The expectation of the early placing of large orders for billets, pig iron, bridge plate, steel rails, and cast pipe has had a favourable effect on the pig market. Pig iron production is increasing at the South, and large sales were made this week of mill irons at Ohio River points. Specifications for considerable bridge workers expected in a few days. The anxiety for winter orders is leading to the shading of prices. Wire rods and barb wire are in good demand. The rush for nail orders led to another cut of 5 cents. Sheet iron and boiler plates are doing better than for two months. Work will be hurried through on projected tin-plate mills, and despite the refusal of the workmen to accept a 25 per cent. drop, a sufficient cut will be made to protect the bulk of the home trade, especially in ternes. Several large users of billets made offers this week for three months' supplies, but acceptances have not been announced. Girder rails are active. The railroad demand for structural material will soon improve. The money markets are easy. For shop and factory work there is a gradual increase of orders, but no great expansion of trade is probable until the opening of spring.

LAUNCHES AND TRIAL TRIPS.

The s.s. Turret Bell, turret deck steamer, was taken on her official trial on Thursday, the 4th inst., when a mean speed of 11¼ knots was registered, her total deadweight capacity being 3800 tons on 19½ft. draught. She has been built by Messrs. William Doxford and Sons, of Sunderland, to the order of the Turret Steam Shipping Company, Newcastle—Messrs. Petersen, Tate and Co., managers—and has received the highest class in both British Corporation and Bureau-Veritas Registries.

EXPERIMENTS ON THE DISINFECTION OF TOWN SEWAGE WITH SULPHURIC ACID.*

By Dr. M. Ivanoff.

The fact that the cholera-bacillus displays an intense susceptibility to the action of acids was known to its discoverer, for Dr. Koch pointed out that in the acid secretions of the stomach these bacilli speedily lose their vitality. The subsequent experiments of Kitasato have shown that very minute additions of sulphuric and hydrochloric acids to bouillon cultures destroy cholera germs in the course of a few hours; and, lastly, Messrs. Stutzer and Burri have studied exhaustively the effect upon these organisms of very dilute solutions of sulphuric acid. At the suggestion of Professor Pfuhl, the author undertook to investigate the action of dilute sulphuric acid upon cholera-bacteria when present in sewage water. From the inception of his experiments he surmised that under these conditions the acid must be used in a more concentrated form than in the above cases, because the sewage water invariably contains substances which would combine with the acid, and would thus, to some extent, neutralise its effects. It was, however, ascertained that the additional amount of acid rendered necessary on this account was but trifling. The samples of sewage water were derived both from the Berlin and the Potsdam sewers, and were infected alternately with pure cultures of the cholera-bacillus and with the fresh dejections of a cholera patient. The acid in the case of the Berlin sewage water was used in three degrees of strength: (1) as a 0·02 per cent. solution; (2) as a 0·04 per cent. solution; and (3) as a 0·1 per cent. solution. The conditions under which the analyses were made are fully described, and the author availed himself of microscopic observations, as well as bacteriological tests. Four parallel series of experiments were carried out, and the results were in every case identical. The Potsdam sewage, which is three times as concentrated as that of Berlin, was treated with stronger acid, viz., with 0·04, 0·06, 0·08, and 0·12 per cent. solutions. It was found that in the case of the Berlin sewage the 0·04 per cent. solution of acid was fatal to the cholera-bacilli, but that with the stronger sewage water of Potsdam the amount of acid needed was that present in the 0·08 per cent. solution. It is pointed out that, whereas previous to treatment the sewage water was faintly alkaline, the sample to which 0·08 per cent. of acid had been added had a strongly acid reaction on being tested with litmus paper, and that such reaction may be regarded as an indication that the necessary dose of acid has been employed. This treatment is, with the exception of the use of lime, the cheapest system that can be adopted.

Siemens Brothers' Electrical Works. — The last vacation visit of the Society of Engineers for the present year was made on Tuesday, when the president, Mr. G. A. Goodwin, and about 70 members, inspected the electrical engineering and submarine cable works of Messrs. Siemens Brothers and Co., at Charlton. The first department visited was the new dynamo shop, which is fitted up with all the latest appliances for turning out this class of work. Much interest was shown in the cable shop where deep sea and electric lighting cables are made. Some of the cables for the latter purpose are very heavily armoured for laying in the ground in Edinburgh without pipes or protecting channels. The central power and lighting station attracted considerable attention, as nearly the whole of the works are now being driven by motors instead of scattered engines, and the engines have been taken out. The station contains engines and dynamos for producing the current for driving machinery and lighting the works. The driving is done by 54 electric motors distributed through the works. We shall refer more at length to this in another impression.

* "Proceedings," Institution of Civil Engineers, vol. cxv., 1893-94.

THE PATENT JOURNAL.

Condensed from "The Illustrated Official Journal of Patents."

Application for Letters Patent.

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

26th September, 1894.

18,259. Producing Printing Surfaces, H. Dade, London.
18,260. Full-sized Body Baths, A. Boots, Eastbourne.
18,261. Boot, &c., Lace Fasteners, A. E. Muller, Germany.
18,262. Improving the Colour of Raw Skins, J. Baird, London.
18,263. Warp Flushing Threads, A. F. Craig and R. Millar, Glasgow.
18,264. Treatment of Scrap Iron, W. R. Renshaw, London.
18,265. Whisks, E. Goodwin, Glasgow.
18,266. Spring Mattresses, O. Ransford, Glasgow.
18,267. Scissors Sharpener, W. S. Freeman and J. Turvey, Kent.
18,268. Gas Engines, J. W. Hartley and J. Kerr, London.
18,269. Substitute for Caoutchouc, J. Schmid, London.
18,270. Paint Brushes, J. L. Thomasson, Worcester.
18,271. Reading Desks, J. Ballinger and J. Henshaw, Cardiff.
18,272. Obtaining Pure Phenols from Mixtures, L. Lederer, London.
18,273. Electric Motors, J. Imray.—(*La Société Anonyme pour la Transmission de la Force par l'Electricité, France.*)
18,274. Arc Lamps, J. Brockie, London.
18,275. Vessel for Travelling on Ice or Water, E. E. Dulier, London.
18,276. Brake, A. Bucsanszky, London.
18,277. Machines for Kneading Dough, T. Kade, London.
18,278. Typewriters, G. Royle, London.
18,279. Extracting Metals from Ores, A. E. Morgans, London.
18,280. Check Tills, R. Zabel, London.
18,281. Automatic Fire-arms, F. R. von Mannlicher, London.
18,282. Sensitising Photographic Paper, C. Beadle, London.
18,283. Fastener for Ladies' Dresses, G. McDonald, London.
18,284. Valves for Pumps, A. W. and Z. W. Daw, London.
18,285. Process for Treatment of Milk, G. Gaertner, London.
18,286. Disc Engines, W. G. Kent, London.
18,287. Safety Stirrup, J. Cope and H. Taylor, London.
18,288. Secondary or Storage Batteries, C. Riordon, London.
18,289. Electric Motors, J. H. K. McCollum, London.
18,290. View Finder for Photographic Cameras, H. Ransom and A. D. Thornton, London.
18,291. An Improved Tooth Brush, C. Feldman, London.
18,292. Advertising on Bicycles, &c., G. G. White, London.
18,293. Typewriting Machines, N. W. Hartwell, London.
18,294. Mariners' Compasses, J. Morton, London.
18,295. Decorated Looking Glasses, E. M. Philz, London.
18,296. Improved Truss, C. Lange, London.

27th September, 1894.

18,297. Apparatus for Striking Bells, D. Mathieu, London.
18,298. Inking Ribbons for Typewriters, L. H. Vaughan, London.
18,299. Disinfecting Ventilators, F. Park, London.
18,300. A Vermin Trap, G. F. Griffin, London.
18,301. Kettles, A. King and A. C. Oakes, Nottingham.
18,302. Rotary Swings, C. Merington, London.
18,303. Apparatus for Swing Exercise, C. Merington, London.
18,304. Toy, T. F. Edgeworth and J. F. Parsons, Bristol.
18,305. Billiard Table Adjuster, G. C. Waterfield, Aldershot.
18,306. Tapestry Carpets, W. Wallace and R. Barclay, jun., Glasgow.
18,307. Detachable Lids of Jugs, A. Martin, Staffordshire.
18,308. Range and Position Finders, W. M. Huskisson, London.
18,309. Mantles for Incandescent Gas Lights, H. Blücher, Manchester.
18,310. Weaving Apparatus, W. Simpson and the Duplex Weaving Appliance Company, Manchester.
18,311. Machine for Extracting Vegetable Fibres, N. Ismaljee, Manchester.
18,312. Cutting Wood, W. Whitley, Keighley.
18,313. Marine Signalling, J. Wall, Liverpool.
18,314. Casks, J. W. Mellor, Oldham.
18,315. Storage Buildings for Coal, T. Wrigley and T. Taylor, Manchester.
18,316. Cotton Reels for Holding Needles, G. Grigioni, Liverpool.
18,317. Art Decoration, M. English, near Clevedon.
18,318. Reciprocating Motions, J. Sturrock, Dundee.
18,319. Passenger Guard for Omnibus, E. Pink, London.
18,320. Machines for Digging Potatoes, J. Holt, Cheshire.
18,321. Apparatus for Tilting Casks, P. S. Lawless, Dublin.
18,322. Separating Cream from Milk, J. V. Geary, Dublin.
18,323. Close-jointing Chair Frames, J. Gaymond, Manchester.
18,324. A Pneumatic Billiard-table Cushion, J. C. Murray and W. McI. Valentine, Brechin.
18,325. Hydraulic Cranes, J. A. Saner, Liverpool.
18,326. Hydrocarbon Lamps, B. Cars, London.
18,327. Steam-generators, J. J., T. F. and J. W. Meldrum, Liverpool.
18,328. Duplex Telegraphy, G. E. Fletcher, Stockport.
18,329. Domestic Filters, W. H. Barr, Manchester.
18,330. Reversible Cloth, W. Buchanan, Glasgow.
18,331. Rotary Water Meters, H. J. Rohlf, Glasgow.
18,332. Attaching Inflators to Cycles, J. Stradling, Newbury.
18,333. Driving Gear of Rear-driving Cycles, W. J., E. Freeman and R. Thompson, London.
18,334. Window Lock, J. Wharfe, London.
18,335. Boots and Shoes, F. Kennel, London.
18,336. Utilising Tidal Power, W. J. Roberts and J. R. Jones, Liverpool.
18,337. Frozen Meat, J. Atherton, Liverpool.
18,338. Soldering Irons, J. R. Cooper, Birmingham.
18,339. Carbons for Electric Lamps, E. G. Acheson, London.
18,340. Trousers, J. M. Forster, London.
18,341. Soles of Boots, F. Leigh and G. Padmore, jun., London.
18,342. Saddles, P. Taaffe, London.
18,343. Bridles, P. Taaffe, London.
18,344. Horse-collars, E. E. Kelsey, London.
18,345. Filling Stoppered Bottles, E. Butes, London.
18,346. Apparatus for Supplying Fluid, O. Beck, London.
18,347. Hinge Folding Splashboard, C. Irvine and G. Dyer, Belfast.
18,348. Spring Bottoms for Beds, &c., T. A. Stoll, London.
18,349. Felt Handles for Cycles, F. G. Bensly, Birmingham.
18,350. Trays of Wardrobes, G. W. Raikes, Birmingham.
18,351. Starting Gear for Vehicles, J. B. Lee, London.
18,352. Indicating the Names of Stations, G. P. and E. A. Wadsworth, and H. I. Hankin, London.
18,353. Focussing Images in Cameras, L. H. Chase, London.
18,354. Motive-power Engines, E. Edwards.—(*O. Pick, Belgium.*)
18,355. Cycles, W. E. Corrigall, London.
18,356. Station Indicators for Waiting-rooms, A. A. Jeenel, London.
18,357. Pneumatic Cushion in Boot Soles, J. H. Betteley and F. W. Phillips, London.
18,358. Treatment of Starch, H. C. E. Wilmot, London.
18,359. Elevating Mechanism, B. Wilcox.—(*The Eisenwerk, Germany.*)
18,360. Blocking and Cutting Presses, N. J. Hill, jun., London.
18,361. Plates for Printing, G. Isaac, London.

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18,362. Spur Protector, D. J. Coyne and T. Christian, London.
18,363. Earthenware, R. Jackson and J. H. Carter, Sheffield.
18,364. Hinge for Doors of Cesspits, &c., G. Waller, London.
18,365. Boilers, L. P. Perkins and G. F. Buck, Manchester.
18,366. Machinery for Making Felt, C. Aris, London.
18,367. Box with Powder Puff, A. W. Shirley, London.
18,368. Envelope Book, E. H. Wilson.—(*J. H. Hunter, Argentine Republic.*)
18,369. Gas Producer, G. Threlfall and R. J. Hodges, London.
18,370. Buttons for Gloves and Dresses, J. Paterson, London.
18,371. Mechanical Counter or Indicator, C. Jost, Manchester.
18,372. Minimising the Effect of Shots, W. Powell, London.
18,373. Buckle for Animal Harness, E. Roberts, Longport.
18,374. Tacking Machines for Boots, W. H. Dorman, Stafford.
18,375. Internal Combustion Engines, W. J. Crossley, Manchester.
18,376. Rotary Pumps, G. Marty, Manchester.
18,377. Nut Locking Plate, H. J. Fuller, Dublin.
18,378. Safety Watch-holding Glove, H. Robinson, Bradford.
18,379. Cooking and other Ovens, H. J. B. Holland, Blackburn.
18,380. Wind and Rain Excluder, W. Walks, Bradford.
18,381. Boot Protectors and the like, A. Smith, Glasgow.
18,382. Gas Fires, J. J. Wilson, Glasgow.
18,383. Couplings for Railway Wagons, A. and H. Ingram, Liverpool.
18,384. Ventilating Apparatus, W. J. Thomas, London.
18,385. Brake for Vehicles, J. R. Kyme.—(*G. Kyme and P. G. Williams, Australia.*)
18,386. Velocipedes, H. W. D. Ingram, Birmingham.
18,387. Ladies' Hair Dressing Pin, G. A. Morgan, Cardiff.
18,388. Railway Carriage Seats, J. J. Duffy, Dublin.
18,389. Wheels for Vehicles, S. T. Richardson, A. Smallwood, and R. Price, Birmingham.
18,390. Chain Wheels for Cycles, J. Appleby London.
18,391. Feeding Bottles, H. Hermann, Liverpool.
18,392. Controlling Water Supply, A. Campbell and W. C. Sim, Bristol.
18,393. Grates of Looms for Weaving, J. W. Banister, Halifax.
18,394. Disinfecting Cisterns, C. O. Williams and J. Stotter, London.
18,395. Vehicle Wheels, W. Pain and L. Sargent, London.
18,396. An Improved Dress Holder, E. S. Collins, London.
18,397. Fictile-ware, The Worcester Royal Porcelain Company, Ld., W. M. Binns, and G. H. Hancock, London.
18,398. Classifying Ores, J. Hosking, London.
18,399. Elastic Wheels, R. Thom and J. Watt, Aberdeen.
18,400. Chairs, A. E. Carrie, London.
18,401. Gas Pliers, J. R. Cooper, Birmingham.
18,402. Fly-wheel, G. Sharman, Birmingham.
18,403. Clutch Pulleys, W. P. Chapman, Birmingham.
18,404. Chimney Cowls, T. Schröder, London.
18,405. Frizzling Hair, H. T. Turner, London.
18,406. Weighing Apparatus, E. Maibaum, London.
18,407. Preventing Ladders Slipping, J. Arnott and J. Skirrow, London.
18,408. Tobacco Pipes, R. V. Burt, London.
18,409. A New Game, M. L. Dorrington and J. S. Trott, London.
18,410. A New Cartridge Belt, A. M. E. Summer, London.
18,411. Dress Fasteners, A. Turner, London.
18,412. Cigar Tray, H. Ost, London.
18,413. Rope Horseshoes, M. Müller, London.
18,414. Locomotive Gear, J. F. Toomer and G. C. Morton, London.
18,415. Car Couplings, J. Shearn, London.
18,416. Drawing Off Beverages, A. Soames, London.
18,417. Gasholder Guide Carriages, S. Cutler, London.
18,418. Automatic Self-opening Umbrellas, G. Ross, London.
18,419. Tires, W. Dodd, London.
18,420. Securing or Holding Persons, J. J. Wilson, Birmingham.
18,421. Drying and Airing Clothes, C. Holmström, London.
18,422. Washing Powder, S. Rasenblum and F. Bartelt, London.
18,423. Ledger Markers, G. C. Marks and E. Ellisden, London.
18,424. Washing Machines, W. Gibbins, Leytonstone.
18,425. Extracting Metals from Ores, J. Mactear, London.
18,426. Lamp Shade and other Wire, J. Wright, London.
18,427. Electric Traction, M. Hutin and M. Leblanc, London.
18,428. Cans for Conveyance of Milk, W. Cooper, London.
18,429. Preparing Diazo Salts for Dyeing, A. Feer, London.
18,430. Bobbins and Reels for Weaving, W. Webster, London.
18,431. Lock-nut, J. Newns, London.
18,432. Pocket Calendar or Indicator, E. S. Cadman, London.
18,433. Tackle Blocks, A. J. Boult.—(*F. X. Rousseau, United States.*)
18,434. Disinfectors, A. B. Reck, Liverpool.
18,435. Purification of Beer, A. J. Boult.—(*A. Delhaise, Belgium.*)
18,436. Lighters, W. J. Chambers and R. Williamson, Liverpool.
18,437. Weaving Shuttles, A. J. Boult.—(*W. Wagenknecht, Germany.*)
18,438. Stirrups, W. E. Schenk, London.
18,439. Signalling Apparatus, L. B. Stevens, London.
18,440. Gas Washing Apparatus, S. Hersey and Kirkham, Hulett, and Chandler, Ld., London.
18,441. Gas Washing Apparatus, Kirkham, Hulett, and Chandler, Ld.—(*F. D. Marshall, Denmark.*)
18,442. Colour Printing Apparatus, J. Bachelerie, London.
18,443. Apparatus for Using Liquid Fuel, S. H. Terry, London.
18,444. Safety Mechanism for Lifts, J. S. H. Drew, London.

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18,445. Gas Generating Plant, B. H. Thwaite, London.
18,446. Rope Grip, J. W. and J. J. Taylor and F. Broadbent, Oldham.
18,447. Extinguishing Lamps, W. Pearce and A. J. Mason, Birmingham.
18,448. Washing Bottle Stoppers, F. A. Bird, Birmingham.
18,449. Braces Attachments, T. Walker and J. J. Glasgow, Birmingham.
18,450. Cycle Brake Attachments, A. Blackwell, Birmingham.
18,451. Funnel, G. F. Fitter and J. Burley, Birmingham.
18,452. Oil Engines, P. P. Bedson and J. C. Hamilton, Glasgow.
18,453. Arm Chairs and Appliances therefor, A. Plant, Glasgow.
18,454. Manifold Books for Use as Post Cards, A. H. Megson, Manchester.
18,455. Preventing Scratching of Polished Surfaces, F. Smith and H. T. Heath, Bristol.
18,456. Window Blind Furniture, W. Lowe and C. Britton, Birmingham.
18,457. Coupling, &c., Railway Vehicles, C. Wright, London.
18,458. Door Lock, W. Anderson and S. Stott, West Hartlepool.
18,459. Appliances for Curling Hair, G. H. Twigg, Birmingham.
18,460. Refrigerators, T. Sharratt, Derby.
18,461. Valve, W. E. Bryan, Lyndhurst.
18,462. Taps for Chemical Fluids, T. W. F. Cherry, North Shields.
18,463. Method of Advertising, H. R. Dixon, Manchester.
18,464. Cycle Lamps, F. Powell and F. Hanmer, Birmingham.
18,465. Pneumatic Tire Covers, R. W. Edlin and R. Green, Birmingham.
18,466. Bamboo Bicycle Frames, R. W. Smith, Birmingham.
18,467. Bicycles, J. Talbot, Wellington, Salop.
18,468. Making Felt Forms for Toys, T. M. Cockcroft, Leeds.
18,469. Manufacture of Linoleum, &c., J. Igleby, Leeds.
18,470. Soles of Boots, Shoes, and Slippers, W. L. Dash, London.
18,471. Flushing Water-closets, D. Mitchell, Dundee.
18,472. Damping Appliances for Letter Copying, M. S. Stevenson, Glasgow.
18,473. Lamps, M. S. Stevenson, Glasgow.
18,474. Nose-bags for Horses, R. Wright, Glasgow.
18,475. Chip Cutting Machinery, R. T. Heselwood, London.
18,476. Opening Window Sashes Inwards, T. Black, Glasgow.
18,477. Automatic Delivery Machines, E. P. Wicke, London.
18,478. Casements, W. Youlton, London.
18,479. Fixing Castors to Chair Legs, W. G. Tubb, London.
18,480. Electric Gaslighters, W. N. Jaskey and E. S. Else, London.
18,481. Motors Driven by Compressed Air, C. Bone, London.
18,482. Steam Pressure Indicators, J. Beswick, London.
18,483. Boot, Shoe, and Corset Laces, D. G. Lewis, London.
18,484. Apparatus for Unloading Ships, W. Parr, London.
18,485. Watering Cans, E. T. Gamble, London.
18,486. Door Bolts or Fastenings, O. H. Steed, jun, London.
18,487. Teat, H. Carter, Horwich.
18,488. Pneumatic Swing Razor Strop, T. Reynor, Dublin.
18,489. New Fire Escape, S. Simpson, Blackburn.
18,490. Underground Railway Construction, H. Grauel, London.
18,491. Book Protector, G. Barnes, Birmingham.
18,492. Horse Shoes, A. S. Walker, London.
18,493. Flower Trays, T. M. Ellis, London.
18,494. Surface Exhibitors, V. P. de Knight, London.
18,495. Picture Frames, G. M. Dodshon, London.
18,496. Explosive, F. W. Bawden, London.
18,497. Polishing Tools, A. J. Boult.—(*C. Bruart and L. Lombot, Belgium.*)
18,498. Protector for Pins, C. J. Gerry, Liverpool.
18,499. Chain for Cycles, M. Boudard and H. A. Shelton, London.
18,500. Movable Partitions, G. Thornborough and J. Wilks, Manchester.
18,501. Incandescent, Electric Lamps, W. T. Kerr, London.
18,502. Crutches, B. B. Moss, Liverpool.
18,503. Lantern Slide Carriers, F. Bartlett, London.
18,504. Enemas, E. J. Lambert, London.
18,505. Revolving Chair-actions, E. Warren, London.
18,506. Advertising on Cycles, C. L. Lamare, London.
18,507. Electric Lampholder, C. O. Duetschmann, London.
18,508. Band Saws, A. J. Boult.—(*J. Leclerq, Belgium.*)
18,509. Manufacture of Ethers, M. Otto and A. Verley, London.
18,510. Apparatus for Enriching Gas, W. Kemp, London.
18,511. Fruit Presses, E. Edwards.—(*C. Heinle, Germany.*)
18,512. Knife Cleaner, L. A. Fidge, Gravesend.
18,513. Anchors, F. Grosvenor, London.
18,514. Oil and Gas Engines, J. N. Aronson, London.
18,515. Coating Creams with Chocolate, D. M. Holmes, London.
18,516. Manufacture of Alkylrhodonates, A. M. Clarke.—(*A. Edinger and A. Müller, Germany.*)
18,517. Ink Reservoir for Pens, C. Smith.—(*J. F. S. Wallace, China.*)
18,518. Knitted Fabrics, T. Hill and A. D. Whitehead, London.
18,519. Manufacture of Cyanides, J. Pfleger, London.
18,520. Manufacture of Alkaline Metals, J. Pfleger, London.
18,521. Churns, T. Bradford, London.
18,522. Electric Arc Lamps, W. S. Pendleton, London.
18,523. Vehicle Wheels, H. H. Lake.—(*F. Myers, United States.*)

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18,524. Soil-pipes for Water-closets, F. Walsh, Halifax.
18,525. Celestial Globe, R. Huntley, South Shields.
18,526. Sodium Chlorates, J. Hargreaves and T. Bird, Farnworth-in-Widnes.
18,527. Toilet Apparatus, A. M. Cadell and Z. E. Gardiner, Dublin.
18,528. Pneumatic Pads for Cricketers, G. Hodson, Dublin.
18,529. Ships' Water Draught Indicator, A. Corner, South Shields.
18,530. Carrying and Stacking Bottles, H. Slingsby, Bradford.

18,531. Emptying Bottoms of Bottles, H. C. Slingsby, Bradford.
18,532. Adjusting Beer Barrels, &c., H. C. Slingsby, Bradford.
18,533. Carriage for Beer Barrels, H. C. Slingsby, Bradford.
18,534. Curtain Poles, W. G. McMaster and J. Sinclair, London.
18,535. Furnaces for Destroying Refuse, J. Gill, Bradford.
18,536. Springs for Weighing Machines, W. H. Penning, Henfield.
18,537. Liquid Drawing-off Apparatus, J. J. Clark, Cardiff.
18,538. Fire Doors for Furnaces, D. B. Morison, Hartlepool.
18,539. Toy, J. W. Wood, Nottingham.
18,540. Handles of Cycles, &c., F. Bartleet, Birmingham.
18,541. Liquid Heating Apparatus, H. P. Miller, London.
18,542. Telegraphs, H. W. C. Cox and R. J. Crowley, London.
18,543. Lighting Pipes, G. E. Seymour and W. C. Hunnibal, Thetford.
18,544. Rubber Stamp for Marking Goods, J. Howarth, Sheffield.
18,545. Fasteners for Belts, A. Dickson.—(*R. C. Dickson, Ceylon.*)
18,546. Raising Pies, E. Frost and G. Holbrook, Longport.
18,547. Tire Valves, W. Bown, G. Capewell, and H. W. D. Ingham, Birmingham.
18,548. Additions to Toe-clips, J. Harrison, Birmingham.
18,549. Mattress to be Used as a Table, B. Franke, Manchester.
18,550. Cartons, C. N. Rickinson, London.
18,551. Exhaust Displacer, F. M. and E. J. Davis, Birmingham.
18,552. Automatic Pot for Coffee, &c., C. Martin, London.
18,553. Pipe Joints, F. W. Kent, London.
18,554. Box or Package for Butter, &c., E. Pontin, London.
18,555. Billiard Tables, H. H. Greaves and J. Salisbury, Manchester.
18,556. Slate Frames, D. Macdonald, London.
18,557. Parallel Rulers, J. Thomas, London.
18,558. Copying Presses, C. J. Davison, London.
18,559. Electric Conductors, &c., A. W. Gamage, London.
18,560. Chain-wheels, W. F. Taylor and G. J. Philpott, London.
18,561. Pudding Basin or Mould, J. W. Bray, jun., London.
18,562. Busk Steels and Whale-bones, J. Koehlhofer, London.
18,563. Metal Bedsteads, J. W. Hoyland and W. H. Sturge, Birmingham.
18,564. Gearing Chains, C. J. Chubb and R. H. Seaton, London.
18,565. Levers and Turning-bolts, H. Carmont, London.
18,566. Horse Collar, N. C. Lindsay and H. Stanbridge, London.
18,567. Boxes for Preserving Butter, J. P. Boyd, London.
18,568. Wirework Grating for Stoves, W. L. Clark, London.
18,569. Apparatus for Treating Ores, J. Harris, London.
18,570. Spark Destructors for Engines, F. V. Hawley, London.
18,571. Pasteboard Boxes, P. M. Justice.—(*H. Inman, United States.*)
18,572. Caps, M. Schneiders, London.
18,573. Printing Machines, C. Pollard and G. Brayshaw, London.
18,574. Lubricating Device, A. J. Boult.—(*E. Raikem, Belgium.*)
18,575. Gas-fired Boilers, G. H. Taylor and C. B. Waller, London.
18,576. Cycle Driving, H. Osborne and J. W. Gaffney, London.
18,577. Making Continuous Hair Felt, J. Newton, London.
18,578. Production of Colouring Matters, H. E. Newton.—(*The Farbenfabriken vormals F. Bayer and Co., Germany.*)
18,579. Driving Gear, W. Smith and H. Morriss, London.
18,580. Making-up Hair for General Purposes, S. Lichtenfeld, London.
18,581. Combined Thread Cutter and Thimble, M. R. Gray, London.
18,582. Opera Glasses, &c., W. Edwards and G. A. Reid, London.
18,583. Driving Gear for Cycles, &c., S. Smith, London.
18,584. Saddles for Horses, &c., J. W. H. Bleck, London.
18,585. Ball Bearings, E. Fries and W. Höpflinger, London.
18,586. Ploughs, W. H. Sleep, London.
18,587. Pedals for Cycles, C. Sangster and R. L. Philpot, Coventry.
18,588. New Condensation Products, C. D. Abel.—(*The Actien Gesellschaft für Anilin Fabrikation, Germany.*)
18,589. Colouring Matters, O. Imray.—(*The Society of Chemical Industry in Basle, Switzerland.*)
18,590. Driving Mechanism for Velocipedes, F. V. Mégret, London.
18,591. Cooling and Freezing Machines, T. Hewitt, London.
18,592. Extraction of Precious Metals, H. L. Sulman and F. L. Teed, London.
18,593. Steam Boilers, A. J. Boult.—(*C. W. Baker, United States.*)

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18,594. Mouthpieces of Tobacco Pipes, C. H. Smith, London.
18,595. Baskets for Oil Lamps, W. J. Charles, Birmingham.
18,596. Power Transmitting Apparatus, G. J. Altham, Manchester.
18,597. Gulley Traps, R. Greenwood, Manchester.
18,598. Hair Curler, E. Hales and F. G. Hales, Birmingham.
18,599. Fixing Buckles, W. Plowman, London.
18,600. Gripping Material, A. Pulbrook, London.
18,601. Golf Carrier, W. Simpson, Edinburgh.
18,602. Grease Separating Apparatus, W. J. Baker, Scarborough.
18,603. Construction of Oil Lamps, E. J. Shaw, Walsall.
18,604. Show Stands, T. Pearson, Nottingham.
18,605. Match Striker, G. M. G. Partridge, Seacombe, Cheshire.
18,606. Inner Soles of Boots and Shoes, W. Freeman, Leicester.
18,607. Cleansing Foul Casks, O. Tilley, Leicester.
18,608. Mill Furnace, W. Thompson, Gateshead.
18,609. Vehicle Tires, R. Robinson and W. I. Smith, Sheffield.
18,610. Postal Wrapper and Card, W. G. Thompson, Sheffield.
18,611. Looms, G. O. Draper, London.
18,612. Lamps, J. W. White, Widnes.
18,613. Escutcheons, P. C. Jones, Guildford.
18,614. Gas Engine Construction, W. Clark, Newport, Mon.
18,615. Detachable Cycle Handle, H. Waterson, Birmingham.
18,616. Sanitary Drain Trap, G. Francis and S. Rumboll, Leeds.
18,617. Double Eyeglasses, R. A. Rossborough, Glasgow.
18,618. Machine for Washing Gravel, W. Cooper, Dublin.
18,619. Razor Sharpening Apparatus, R. Howarth, Wolverhampton.
18,620. Device for Opening Envelopes, P. Menzies, Glasgow.
18,621. Expansion Driving Clutches, H. Kitson and J. Evans, Bradford.
18,622. Cornice Pole and Curtain Rings, C. Hide, Worthing.
18,623. Bottling and Corking Machines, E. W. Jenkins, Swansea.
18,624. Wagons, J. Roberts and P. Shone and Son, Liverpool.
18,625. Stop Motion for Power Looms, T. Blackhurst, Darwen.
18,626. Cigarettes, S. Bright, London.
18,627. Opening Windows, P. Burt, Glasgow.
18,628. Cycle Brake, E. Cross, London.
18,629. Disinfecting Apparatus, H. Barling and S. Broomhead, London.
18,630. Apparatus for Preparing Fodder, A. F. Davis, London.
18,631. Amalgamator, W. Tarrant, Liverpool.
18,632. Laundry Machine Tapes, A. Conkling and T. S. Wiles, London.
18,633. Bottle Stoppers, J. C. Grout, Liverpool.
18,634. Knitting Machines, G. J. J. Hoffmann.—(*J. A. House, United States.*)
18,635. Flanging, &c., Machine, W. P. Thompson.—(*F. A. Kirby, United States.*)
18,636. Fixing Long Handles to Broomheads, G. R. Compton and C. F. Cooper, London.
18,637. Cuff, T. G. Boulton, London.
18,638. Apparatus for use in Brewing, T. R. Todd, London.
18,639. Velocipedes, G. Turner and J. M. H. Venour, London.
18,640. Safety Linen Dryer, C. W. Spong, London.
18,641. Anchors, T. S. Forster, Sunderland.
18,642. Ammunition for Air, &c., Guns, B. R. Banks, Croydon.
18,643. Covers for Pneumatic Tires, H. Paulsen.—(*C. Maret, Germany.*)
18,644. Show Cards, &c., H. Goldenfarb, London.
18,645. Baiting Needles for Worms, B. Blanikmeister, London.
18,646. Game of Billiards, N. Redler, London.
18,647. Hydraulic Thrust Bearing, T. Smalley, Essex.
18,648. Engine Actuated by Explosion, E. M. Foot, London.
18,649. Pneumatic Separator for Ores, S. S. Allin, London.
18,650. Hydraulic Motors, W. Carter and the Hydraulic Engineering Company, London.
18,651. Binding Pattern-cards, V. Dard, London.
18,652. Grab or Bucket for Dredging Sand, J. Batty, London.
18,653. Manufacture of Oilcloths, C. Hopkinson, London.
18,654. Fastenings for Doors and Windows, A. W. Adams, London.
18,655. Bow Saw, G. Rushbrooke, London.
18,656. Drying and Heating Machines, A. G. Paul, London.
18,657. Heating Apparatus, A. G. Paul and W. P. Skiffington, London.
18,658. Ball Bearings, H. H. Lake.—(*A. C. Farnsworth, A. D. Kelley, H. G. Lee, and L. M. Sendelbach, United States.*)
18,659. Angle-measuring Instruments, G. A. Rudg, London.
18,660. Rims for Wheels of Cycles, W. J. Goddard, London.
18,661. Electric Fuses, The Acme and Immisch Electric Works and E. F. Moy, London.
18,662. Electric Switches, The Acme and Immisch Electric Works and E. F. Moy, London.
18,663. Apparatus for Lighting Buildings, J. S. Roblin, London.
18,664. Heating Systems, A. G. Paul, London.
18,665. Writing Pens, W. Moseley and J. Lewis, London.
18,666. Hanger for Shafting, J. O. Donner, London.
18,667. Type-writers, J. C. Fell.—(*Messrs. Wyckoff, Seamans, and Benedict, United States.*)
18,668. Covering for Earthenware Vessels, W. Gibson, Manchester.
18,669. Potato Harvesters, J. N. Cocker, London.
18,670. Bath-room Soap-dish, H. F. Robinson, London.
18,671. Disinfecting Apparatus, V. B. Lennard, London.
18,672. Door Latches and Locks, J. McLachlan, London.
18,673. Electric Mechanism for Winding Clocks, H. F. Mouquin, London.
18,674. Hollow Rivets, H. Dowler, London.
18,675. Cycle Saddles, H. A. Lamplugh, London.
18,676. Rug Straps, H. A. Lamplugh, London.
18,677. Apparatus for Producing Letters on Bread, R. M. Shaffer, London.
18,678. Manufacture of Curtains, R. C. Wills, London.
18,679. Burning the Vapour of Mineral Oil, S. Pitt.—(*La Compagnie Internationale pour l'Exploitation des procédés Adolphe Seigle, France.*)
18,680. Wheels of Cycles, A. C. Lebaupin, London.
18,681. Excluding Dust from Drawers, C. A. Grant, London.
18,682. Fulminating Compounds, H. Maxim, London.
18,683. Process of Nitrating Cellulose, R. C. Schupphaus, London.
18,684. Mud-guard for Cycles, G. G. M. Hardingham, London.
18,685. Binding Cases, H. R. Jones, London.
18,686. Gear-chains for Cycles, J. B. and J. B. Dunlop, jun., London.

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18,687. Protectors for Folders, L. B. Phillips, London.
18,688. Automatic Bell for Cycles, T. F. Gunter, London.
18,689. Reversible Hinge, W. M. Tudman and J. Pedley, Birmingham.
18,690. Automatic Grain Weighers, H. Richardson, Lichfield.
18,691. Machinery for Spinning, J. and R. S. Dawson, Bradford.
18,692. Pneumatic Tires, W. A. Rothwell, Manchester.
18,693. Chimney Pot, J. Fielden, Halifax.
18,694. Construction of Wheel, W. Ives, Halifax.
18,695. Advertising Arrangement, S. J. Henochsberg, Liverpool.
18,696. Instantaneous Switches, F. H. Starling, Nottingham.
18,697. Cycles, A. King, Nottingham.
18,698. Gear Cases for Cycles, S. A. Newman, Birmingham.
18,699. Sack-hoist for Thrashing-machines, F. J. Burrell and T. Hibberd, jun., Thetford.
18,700. Door Springs, W. A. Gill and P. E. Ayton, Birmingham.
18,701. Combination School Desks and Seats, A. Bruce, Dundee.
18,702. Pneumatic Razor Strap, C. A. Moon and J. McCullagh, Dublin.
18,703. Mantelboard, A. Travis, Burnley.
18,704. Steam Generators, E. P. Plenty, jun., and J. W. Davis, London.
18,705. Dredger Rake, J. Hansard, Llanelly.
18,706. Safety Valve for Boilers, J. and H. Parker, Bradford.
18,707. Securing Cycle Pedals, W. H. Toussaint and W. E. Ginder, Birmingham.
18,708. Making Iced Drinks, H. W., S. M., and P. Chinnery, Walthamstow.
18,709. Axes, W. Smith, Birmingham.
18,710. Non-slipping Boot Protector, W. C. Phillips, Bradford.
18,711. Creating Draughts for Fires, R. C. Sayer, Bristol.
18,712. Casks, A. J. Twyford, London.
18,713. Whist Marker, C. J. Dury and W. B. Marchington, London.
18,714. Treadles for Railway Signals, J. G. Dixon, London.
18,715. Fuel-saving Compound, A. W. Summers, Bristol.
18,716. Pipe Barrow, R. Malabar, Liverpool.
18,717. Taps, S. Plumbly, Leicester.
18,718. Stretchers, J. Leemann, London.
18,719. Propelling Apparatus for Ships, T. Armstrong, London.
18,720. Portable Easel, J. Ashford and H. A. Terry, Birmingham.
18,721. Ornamenting Wood, J. Jones and A. Leach, Manchester.
18,722. Firing Off Flashing Signals, J. G. W. Berckholtz, London.
18,723. Pieces for Ladies' Dresses, F. Nüsken, Germany.
18,724. Copying Apparatus, W. M. Williams, London.
18,725. Bicycles, J. W. Adams, Liverpool.
18,726. Driving Gear for Cycles, H. A. Skinner, Manchester.
18,727. Distilling Sulphuric Acid, G. Krell, Liverpool.
18,728. Combing Machines, T. Kitson and A. Smith, London.
18,729. Chicken House and Run, H. P. Boscher, Twickenham.
18,730. Braces, F. W. Duerdoth, London.
18,731. Curved Tubes, J. and G. H. McDougall, Birmingham.
18,732. Construction of Roofs, A. Föppl, London.
18,733. Duplex-fronted Picture Frame, J. Webb, London.
18,734. An Improved Fire-grate, A. Chappell, London.
18,735. Cycle Wheels, W. Pirrie and M. J. Manning, London.
18,736. Cradles for Children, W. McAuslan, Glasgow.
18,737. Flyers for Spinning Machines, J. P. Dalby, Leeds.
18,738. Bicycles, F. Mitton, Keighley.
18,739. "Plumb Rules," W. Bryden, London.
18,740. Fastening Garments, N. S. Arthur, Edinburgh.
18,741. Injectors, W. Brierley, Rochdale.
18,742. Internal Combustion Engines, W. L. P. Webb, Cheltenham.
18,743. Collectors for Electric Conductors, A. H. Bagnold, London.
18,744. Fixing Stereo Plates, &c., A. S. Coghill, London.
18,745. Reaction Turbines, A. C. E. Rateau, London.
18,746. Self-feeding Device for Boilers, G. Eustace, London.
18,747. Caps, M. Schneiders, London.
18,748. Lamps for Burning Paraffin, J. G. Bowerman, London.
18,749. Advertisements, S. Robson and B. Tottenham, London.
18,750. Mechanism for Propelling Cycles, H. O'Shea, London.
18,751. Suspenders, E. A. Gordon and E. G. Kerr, London.
18,752. Rail Fastenings, T. H. Green, London.
18,753. Transmitting Telegraph Signals, J. M. McMahan, London.
18,754. Transmission of Signals, J. M. McMahan, London.
18,755. Closing Electric Circuits, J. M. McMahan, London.
18,756. Detachable Outer Cover for Tires, W. Moss, Manchester.
18,757. Insulators, W. Parrott, A. Essinger, and T. Harden, London.
18,758. Water-tight Joints, H. H. Lake.—(*F. Krupp, Grusonwerk, Germany.*)
18,759. Solitaire and Shear Sharpener, W. S. Freeman, London.
18,760. Cover for Boilers and Furnaces, A. E. Adams, London.
18,761. Fastening for Miners' Lamps, L. Lhoneux, London.
18,762. Toilet Mirrors, A. F. White, London.
18,763. Mudguard for Trousers, R. Raffety, London.
18,764. Cocks, H. L. Doulton, London.
18,765. Purifying Sewage, W. E. Adeney and W. K. Parry, London.
18,766. Attaching Fasteners to Clothes, E. G. Fuller, London.
18,767. Switches, D. Bates, T. Harden, and O. L. Peard, London.

SELECTED AMERICAN PATENTS.

From the United States Patent Office Official Gazette.

523,417. Steam Engine Indicator, *H. A. Spiller, Boston, Mass.—Filed November 4th, 1892.*

Claim.—(1) An indicator provided with two pistons having different areas, as set forth. (2) An indicator provided with two pistons connected together and having different areas, with a cylinder having bores to

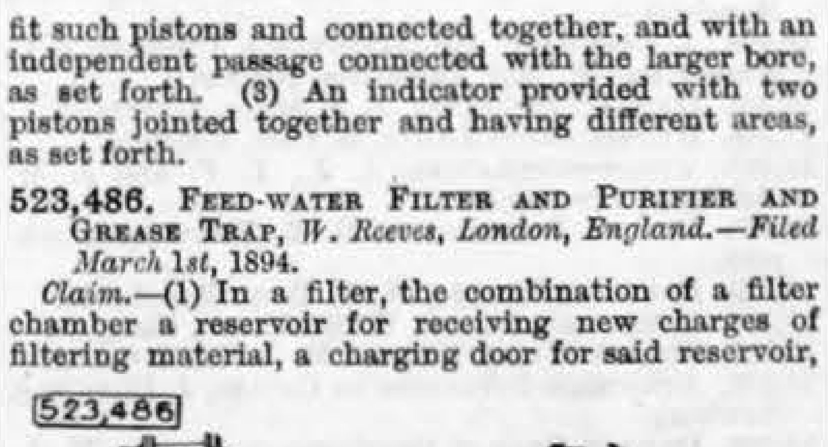
523,417

fit such pistons and connected together, and with an independent passage connected with the larger bore, as set forth. (3) An indicator provided with two pistons jointed together and having different areas, as set forth.

523,486. Feed-water Filter and Purifier and Grease Trap, *W. Reeves, London, England.—Filed March 1st, 1894.*

Claim.—(1) In a filter, the combination of a filter chamber a reservoir for receiving new charges of filtering material, a charging door for said reservoir,

523,486



a communicating thoroughfare between said filter chamber and reservoir, and another thoroughfare independent of the filter chamber between the reservoir and the inlet pipe of the filter, substantially as described for the purpose specified. (2) In a filter, the combination of a filter chamber having its influx and efflux sides formed by strong grids covered on that side which faces the flow of the liquid with gauze or the like of fine mesh and filled with absorbent filtering material, a reservoir for receiving new charges of filtering material, a charging door for said reservoir, a communicating thoroughfare between said filter chamber and reservoir, another thoroughfare independent of the filter chamber between the reservoir and the inlet pipe of the filter, a chamber containing a layer of zinc balls situated below said filter chamber, a by-pass communicating with the inlet and outlet pipes of the filter, and a filter chamber in said by-pass, substantially as described and for the purpose specified.

523,633. Device for Inserting or Removing Tubes in Ordnance, *M. Gledhill, Manchester, England.—Filed July 21st, 1892.*

Claim.—(1) The combination, with a built-up gun, of a hydraulic apparatus comprising a cylinder *b* screwed on the breech end of the outer tube or hoop of the gun, a piston *c* working in said cylinder, a socket *e* secured to the said piston and to the breech end of the liner, and a withdrawing rod *g* engaging the piston *c* at its rear end and the liner at its forward end, substantially as described. (2) The combination with a built-up gun, of a hydraulic apparatus comprising a

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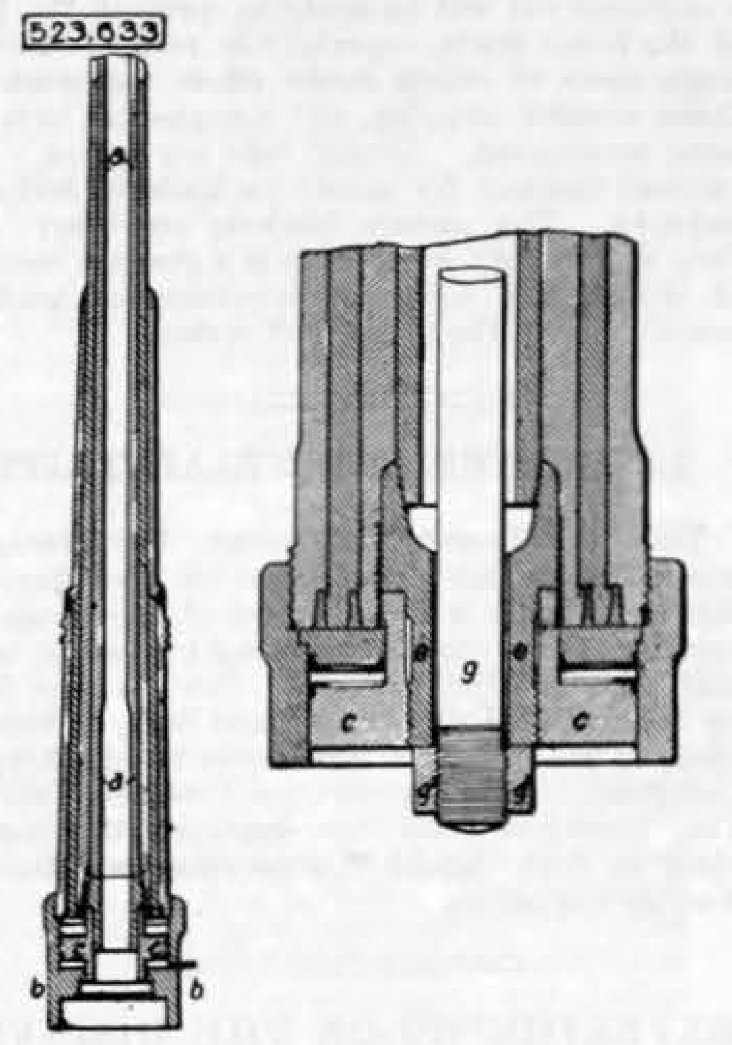
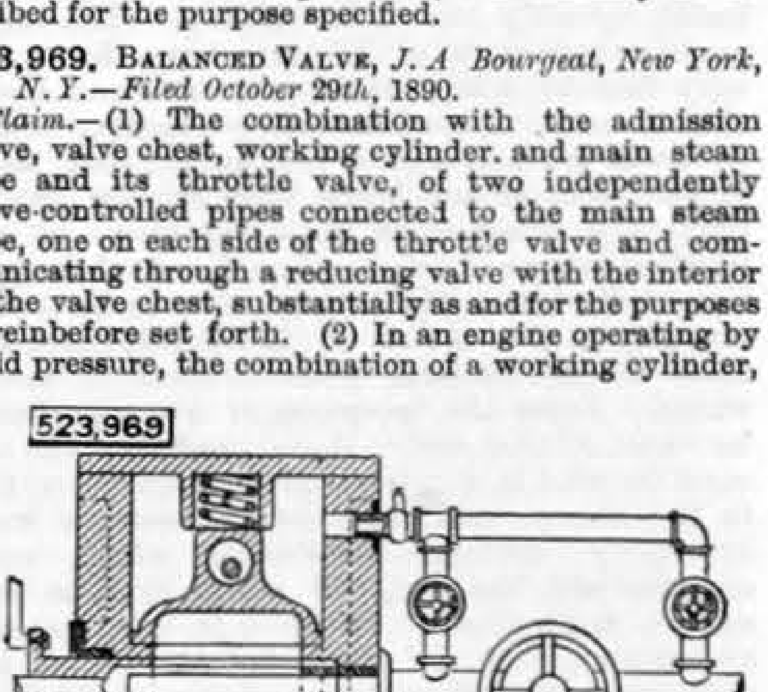


two-chambered cylinder *b* screwed on the breech end of the outer tube or hoop of the gun, a piston *c* working in one of said chambers, a socket *e* for coupling said piston *c* with the rear end of the liner *a*, a piston c^2 working in the other of said chambers, and a rod *g* extending through the bore of the gun, said rod having a head g' at its forward end engaging the muzzle end of the liner and a liner g^2 at its rear end for connecting the rod with the piston c^2, substantially as described for the purpose specified.

523,969. Balanced Valve, *J. A. Bourgeat, New York, N. Y.—Filed October 29th, 1890.*

Claim.—(1) The combination with the admission valve, valve chest, working cylinder, and main steam pipe and its throttle valve, of two independently valve-controlled pipes connected to the main steam pipe, one on each side of the throttle valve and communicating through a reducing valve with the interior of the valve chest, substantially as and for the purposes hereinbefore set forth. (2) In an engine operating by fluid pressure, the combination of a working cylinder,

523,969

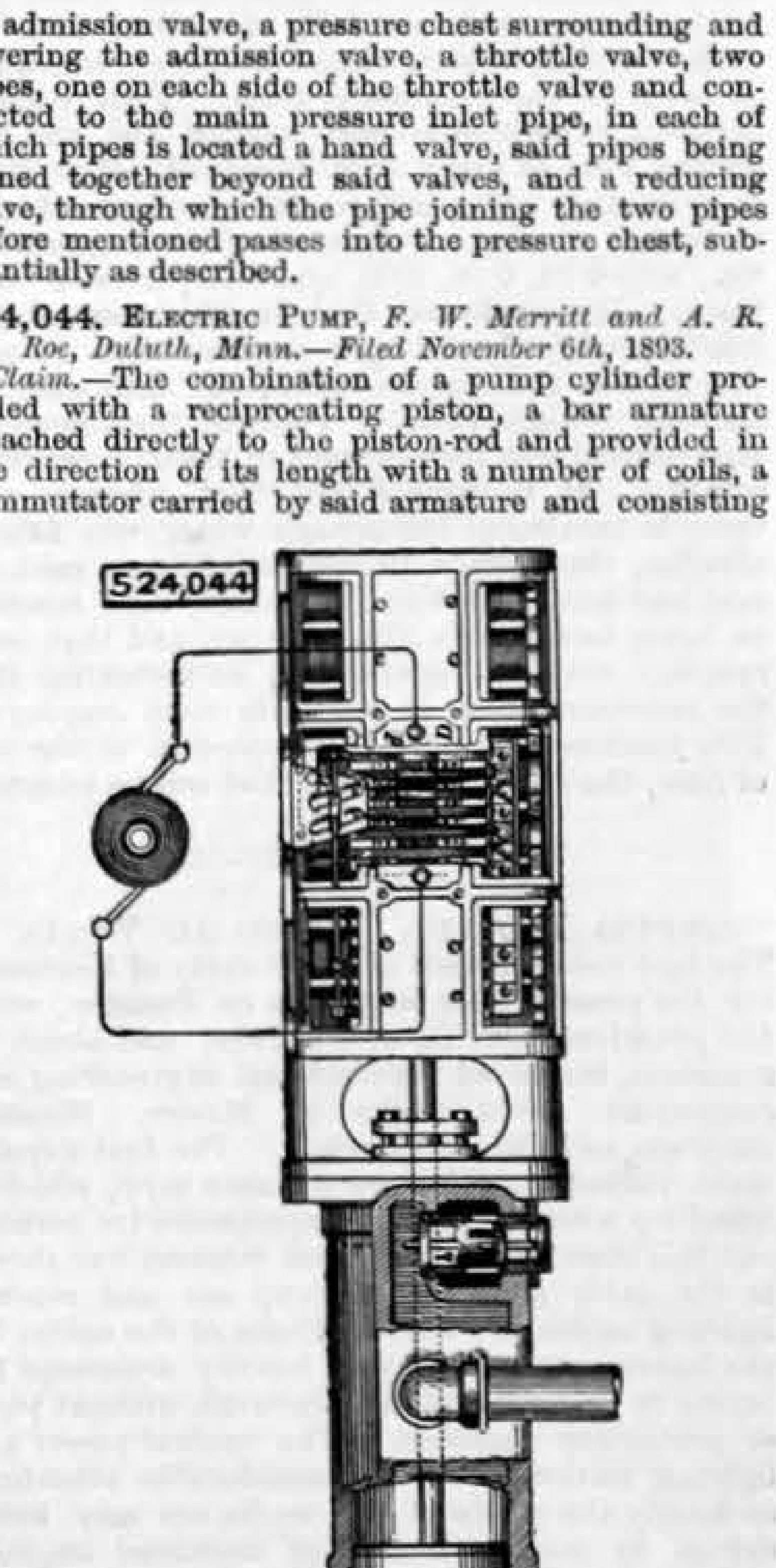


an admission valve, a pressure chest surrounding and covering the admission valve, a throttle valve, two pipes, one on each side of the throttle valve and connected to the main pressure inlet pipe, in each of which pipes is located a hand valve, said pipes being joined together beyond said valves, and a reducing valve, through which the pipe joining the two pipes before mentioned passes into the pressure chest, substantially as described.

524,044. Electric Pump, *F. W. Merritt and A. R. Roe, Duluth, Minn.—Filed November 6th, 1893.*

Claim.—The combination of a pump cylinder provided with a reciprocating piston, a bar armature attached directly to the piston-rod and provided in the direction of its length with a number of coils, a commutator carried by said armature and consisting

524,044



of a series of insulated contact plates arranged parallel with the axis of the armature and connected with corresponding coils thereof, a series of field magnets of alternately opposite polarity arranged parallel with the movement of the armature, and a switch arranged to reverse the current through the field or armature coils at the end of each stroke of the armature, substantially as and for the purposes set forth.