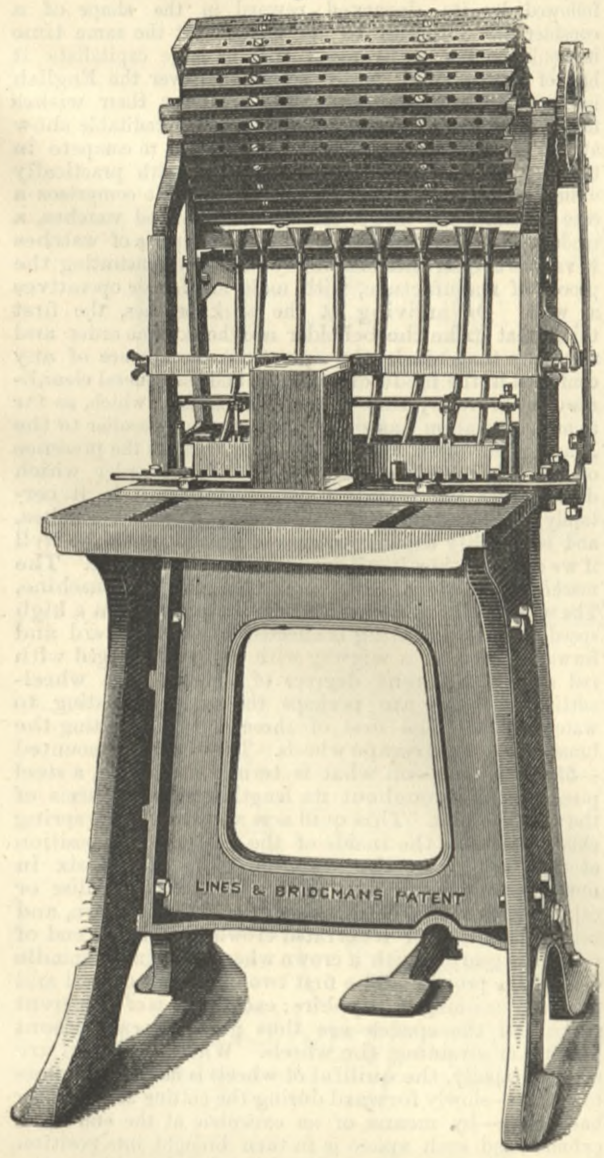
MISCELLANEOUS MACHINERY AT THE INVENTIONS EXHIBITION.

In the West Annexe the Cylinder Box Nailing Company exhibit several of Lines and Bridgman's box-nailing machines. Of these we illustrate one with details. Fig. 1 is a perspective view; Fig. 2, a vertical longitudinal section; Fig. 3 is a front view; and Figs. 4, 5, 6, and 7 are detail views of parts drawn to a larger scale. The machine shown in the above figures is arranged to be driven by a treadle, but a machine is exhibited worked by power, the machine being thrown into and out of action by means of a treadle. In the class of machine illustrated the nails have been driven into the wood by giving motion to the table or platform carrying the wood, and thereby forcing the latter against the nails; but the reverse arrangement is here adopted. The wood is placed on a stationary table or platform, and the nails forced into the wood by means of movable pushers or drivers *b* acting upon the nails. The inventors arrange the nail guides *c* so that all nails may be driven in square, or in such directions that those on each side of the centre nail point either inwards or outwards, the centre nail guide being at right angles to the surface of the wood. The nails are fed to the nail guides *c* in the following manner: A horizontal cylinder *d* is formed with series of holes or sockets d^1, arranged in rows extending across in a direction from end to end thereof, and placed at suitable distances apart from each other. An attendant supplies these holes or sockets d^1 with nails, which are placed with their heads downwards therein. In a line with each row of holes or sockets d^1 is a sliding perforated bar, d^2, the perforations of which, when in one position, are coincident with the corresponding row of holes or sockets d^1 in the cylinder *d*, so as to permit the nails to be fed to such holes or sockets d^1. After the nails have been fed as described, the attendant pushes the sliding perforated bar d^2 endwise, so as to cause the solid parts to cover its corresponding row of holes or sockets d^1 in the cylinder *d*. This sliding of the perforated bar d^2 by the attendant is done in order to indicate to him which rows of holes or sockets d^1 he has fed with nails, and thereby prevent his feeding more than one nail to each hole or socket d^1 for each revolution of the cylinder *d*. In the rotation of the cylinder *d* these sliding bars d^2 are caused to pass a fixed cam *e*, carried by one of the standards a^2, which cam *e*, in the event of the attendant having omitted to slide any of such bars d^2 as above described, will automatically cause the sliding thereof, so as to ensure all the holes or sockets d^1 being covered before they come to the lower part of the cylinder *d*; then, in order to release the nails from the holes or sockets d^1, as they arrive over the funnels or mouths f^1, connected by tubes *f* to the nail guides *c*, the sliding covering bars d^2 are, by means of a sliding cam *g* acting upon a lever g^1, moved endwise until the holes therein again coincide with the holes or sockets d^1 in the cylinder *d*, thereby permitting the nails to fall into the aforesaid funnels or mouths f^1. The nail guides are formed of a bottom grooved plate *c*, which is adjustable by screws *c*, c^2, both as to height and inclination in respect to the table or platform a^1 of the machine, in order to adjust the parts to different thicknesses of wood, and to the angles to which it is required to drive the nails into the wood, whilst by such means nails with either large or small heads can be used, as by tilting the plate *c* a large headed nail can be presented to the wood in a direction parallel to its faces, or in a direction slightly inclined thereto. Over this grooved plate *c* is fixed a series of guides c^4, to which the tubes *f* are fixed. These guides c^4, below their junction with the tubes *f*, are open at their undersides to permit of the falling of the nails into the grooves of the bottom guide plate *c*, and they are also formed with openings c^5—see Fig. 4—for the passage therethrough of the nail pushers or drivers *b*, whilst along the front of the nail guides is mounted a guard plate *h*, which, when the nail pushers or drivers *b* are in their retracted position, stands with its toothed edge resting in the grooves of the bottom guide plate *c*, and thereby prevents the nails from falling or jumping out of their guide grooves, and there remains until the pushers or drivers *b* begin to advance, at which time it is automatically lifted, after which the said plate *h* is again lowered on the retirement of the pushers or drivers *b*. The several grooves of the plate *c* and the guides c^4 are arranged at short distances apart, so that the tubes *f* can be connected with such nail guides as for the time being may be required for use, and by supplying nails to all the sockets d^1 in each row of the cylinder *d*, or to any desired number and arrangement of such sockets d^1, the machine can be readily adjusted to various varieties of work.

Fig. 1



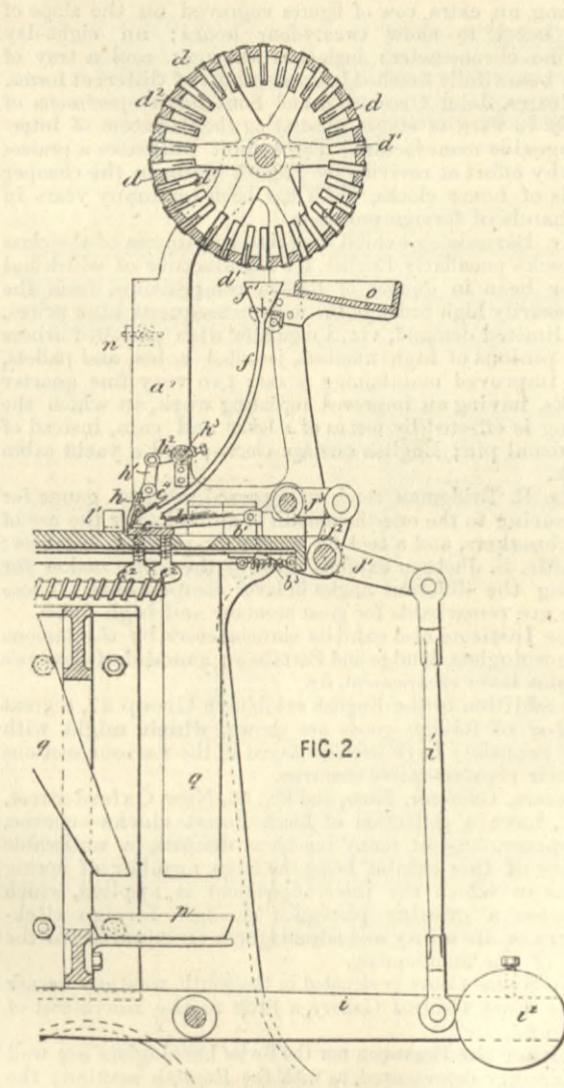
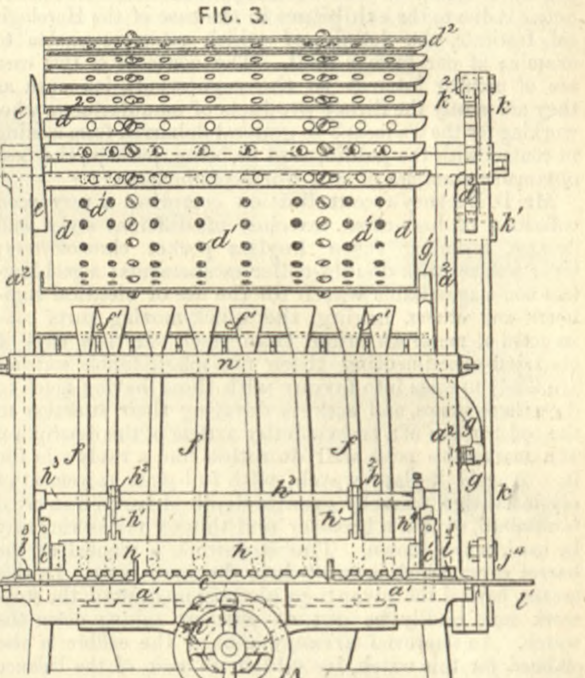


FIG. 2.

FIG. 3.



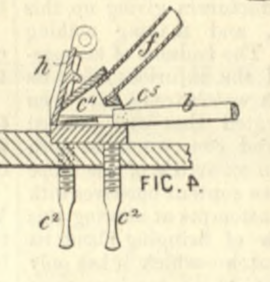


FIG. 4.

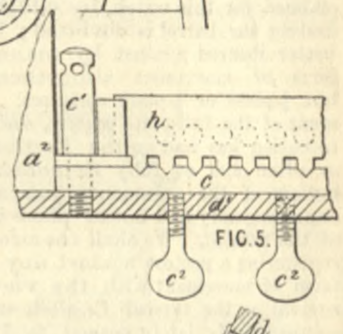


FIG. 5.

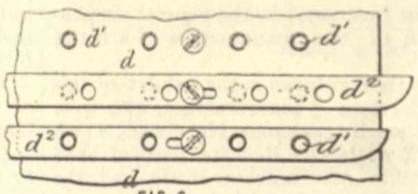


FIG. 6.

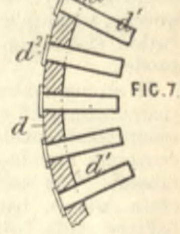


FIG. 7.

LINES AND BRIDGMAN'S BOX-NAILING MACHINE.

Outside, in the South Promenade, Messrs. Dick, Kerr, and Co., 101, Leadenhall-street, E.C., show a number of their specialities in narrow-gauge railway plant, which are well worthy of careful inspection. The locomotive Orient is an outside cylinder side tank engine, of 2ft. 6in. gauge, with cylinders 7in. diameter and 12in. stroke, fitted with Morton's patent valve gear, which has been fully illustrated in THE ENGINEER. The four leading wheels are each 2ft. 3in. in diameter and 4¼in. broad, coupled, and a Bissel bogie is placed in the rear, the arrangement being such as to leave very little overhanging weight at either end. The boiler is set quite independent of the working parts, expansion being allowed for at the fire-box end by means of suitable brackets, so that it can be readily removed for repairs without disturbing the machinery and gear. It is 10ft. 3in. long over all, and 2ft. 3in. diameter, and is made of best mild steel plates $\frac{5}{16}$in. thick, each ring being bent out of a single plate. The outer shell of the fire-box is also of mild steel, the front and back plates being flanged to receive the sides and top, as well as the barrel. The fire-box itself is of copper, the tube plate being ½in. thick, and the crown, sides, and end ⅜in. It is 2ft. 1½in. long, 1ft. 7½in. wide, and 2ft. 6in. deep, giving a heating surface of 21 square feet, and a grate surface of 3½ square feet. The tubes are 1⅝in. diameter, of 12 and 14 b.w.g., and are forty in number. Their length is 6ft. 3in., and the heating surface 114 square feet. The boiler is constructed for a working pressure of 120 lb. per square inch, and has been tested by water to 200 lb. The engine will carry about 6 cwt. of fuel, and has a tank capacity of 165 gals. Its net weight is 6 tons 9 cwt. The workmanship is exceedingly good, and the finish throughout much superior to what is generally to be found in engines of this size and class. The details also have been carefully considered, both with regard to facility of construction and repair, and in regard to durability under the rough usage such an engine is likely to meet with in actual work in foreign countries.

The saloon carriage shown in connection with the foregoing is also a good piece of work. It is arranged to carry fourteen passengers, seven on each side, and is 20ft. 2½in. long by 6ft. 4½in. wide, with a total height from rail to top of roof of 10ft. 3¼in. The body and frame of the car are made of stained teak, with inside facings and beadings, window frames, doors, &c., of American walnut, highly finished and lined. All the door handles, window fittings, and brackets, are burnished and silver plated. The doors slide on brass rollers, and a lavatory and w.c. with all necessary furnishings are placed at one end, with separate doors to each, the lavatory passage being entirely shut off from the saloon. The windows have buffer springs, and are provided with Peters' patent blinds. A raised ventilating roof with ten stained glass windows is placed above the main roof, the windows being pivotted at their centres, and the openings protected with a fine mesh wire gauze netting to exclude dust, sparks, &c. At each end of the raised roof a large mineral oil lamp is fixed, with a funnel, and ventilator to the outside. Both the main and ventilating roofs are made double, so as to permit the free circulation of air. The body of the car is mounted on a strong iron and steel underframe, composed of four longitudinal channels with cross beams of same section, and strong bar iron diagonal braces. The underframe is carried on two four-wheeled bogies placed at 13ft. centres, each with a wheel base of 2ft., the wheels being of cast steel, 14in. diameter, fitted with forged steel axles, springs, and cast iron axle boxes carried in cast steel guide brackets with strong spiral springs. The channels forming the underframe are each 4in. by 2in. by ⅜in., and are firmly rivetted to two headstocks of the same section, with strong wrought iron knees. There are four longitudinal and five transverse channels, all securely braced and tied together with diagonal struts and ties. The body of the car is fastened to the underframe with bolts, and rests on forty-six of Attock and Spencer's patent india-rubber blocks, which relieve the car from all jarring motion. The bogies are formed of two longitudinal channels, each 4ft. long by 4in. by 2in. by ⅜in., with two flat iron flanged headstocks, each 4in. by 2in., firmly rivetted to them. Two centre transverse channel bars carry the cast steel bogie centre socket, which works in an upper bearing socket in the underframe, the centre itself being 1½in. in diameter. The sockets have teak bearing blocks and india-rubber spring cushions. Bearing brackets are fitted to the underside of the frame, and slide on beams fitted to the four corners of the bogie, safety chains being also provided to keep the bogie from slewing too far. A chain brake is applied to all four wheels of one bogie. The central coupling buffers are made of iron and are 10in. diameter on the face. They slide in cast steel sockets, and are fitted with strong volute springs so arranged as to form both buffer and draw spring, and are furnished with the usual coupling links and pins. The body of the car is composed of strong teak frames bound together with cross beams of the same material mortised to the side longitudinals. A third exhibit is an ambulance wagon of 2ft. 6in. gauge, arranged for carrying four passengers on four folding stretchers, sixteen on the outside seats, and two attendants. The underframe is of steel carried on two four-wheeled bogies, with solid disc wheels of crucible cast steel, forged steel axles, and wrought iron central buffers and couplings. The upper or body framework is formed of an inner and outer framing of light angle irons, the outside and middle uprights being made in one piece, bent round at the top and flanged at the bottom for securing to the underframe, and with two longitudinal angles the whole length along the top, the uprights being bound together by flat iron stays fixed with gusset plates at each corner. The inner frame is covered in with strong canvas, buttoned all round the top and sides and ends, with canvas doors at each end and in the middle. The outer covering is also of canvas, a large space being left between the two in order to allow of a circulation of air. The sides of the outside canvas are so arranged as to form a canopy over the folding seats at the sides, when these are in use. At each end there is a platform 2ft. wide, with hand-rail, and two water tanks. The car is got up in a very simple manner, and weighs, without water, 2 tons 2 cwt., the length over buffers being 21ft. 11in.

HOROLOGY AT THE INVENTIONS EXHIBITION.

No. II.

Before taking leave of the English section, some further notice is due to the exhibitors in the case of the Horological Institute, the details of which we were unable to examine at our former visit. The contents of this case are of peculiar interest to the cognoscenti, inasmuch as they are mostly the direct products of manufacturers who, working for the trade, are in general debarred from coming in contact with the public, and as being, perhaps, the best obtainable examples of our home productions.

Mr. D. Buckney's contribution comprises a very good collection of high-class watches of different styles and designs, including fusee keyless pocket chronometers; lever watches with double-roller escapements; a gold keyless non-magnetisable watch for the use of electrical engineers and others, having the quick-moving parts constructed of materials other than steel. In these days of electrical experimenting these non-magnetisable watches are likely to come into favour with those having much to do with dynamos, and makers devoting their attention to the construction of a trustworthy article of this description at a marketable price will doubtless find a ready sale for it. A gold keyless watch, with full-plate movement of original design, whereby greater depth of barrel than usual is obtained, so that a broader and thinner mainspring may be used, is also shown. The stop-work is planted on the barrel cover, which is sunk into the name-plate. By this means, beyond the advantage already mentioned, the stop-work may readily be got at without taking down the watch. An improved arrangement of the calibre is also claimed for this watch, by which all risk of the balance fouling the barrel is obviated; but this danger would be better insured against by manufacturers giving up this form of movement altogether, and making nothing but ¾-plate or ½-plate watches. The badness of arrangement of the full-plate watch, and the injurious effect its retention has had on the English watch trade, have been so often and so fully demonstrated that any detailed review of the arguments *pro* and *con.* would be both supererogatory and out of place in an article of the scope of the present. We shall therefore content ourselves with registering a protest against any attempts at altering this form of movement with the view of bringing about its revival as the typical English watch—which it has only comparatively lately ceased to be—as so much waste of energy, which should be bestowed in the general simplification and organisation of the manufacture of a better model.

In strong contrast to this relapse is the exhibit by this manufacturer of gold keyless ¾-plate watches, with lever escapements, made on an interchangeable system, which combines machine work with the delicate finish of hand labour. The escapements are machine-made, and the train wheels, barrels, plates, jewel-holes, end stones, balance staffs, balance springs, dials, and cases are interchangeable. This is a decided advance on the method, or rather want of method, usually adopted by Clerkenwell manufacturers, and is deserving of their special attention.

Though we doubt the possibility of making the more delicate parts of high-class watches perfectly interchangeable—that is to say, that although escapements may be constructed so far interchangeable as to be capable of performing in different watches—they will not be found to suit them all equally well, and the bankings, drops, intersections, &c., will not be exactly alike in each. That slight variations in one or more of these particulars, which would be sufficient to affect the time-keeping qualities of the watches in which they are exchanged, will be found, we believe, to be inevitable. If it be desired to set this question satisfactorily at rest, let the manufacturers of some of the so-called high-class interchangeable watches send some of them to Kew and have them tested—if they answer their description they will of course come out triumphantly with Class A certificates—and afterwards change the controlling parts, viz., balance, spring, and escapement, taking them promiscuously, without trial, from several watches, and see then if their performance will be equally good. This would be a crucial test, and would effectually silence sceptics. The result of Mr. Buckney's systemisation is, nevertheless, worthy of great praise. It is rendered doubly interesting from the fact that he uses the machine-made movements of Wycherley, Hewitt, and Co., which is a satisfactory proof that the reduction to a method in gauging, &c., is all that is required to place English watchmakers in a favourable position with regard to their foreign competitors in the cheaper grades of work.

Mr. G. H. Harwood's exhibit of watch-case making is very interesting, the specimens of lathe work, &c., shown being of very high quality. They include (1) fine gold alloyed with copper and silver to 18 carats; (2) an ingot of 18-carat gold ready for rolling and cutting wire; (3) after rolling and cutting wires; (4) wire drawn and swaged for case; (5) wires and bottoms blocked to shape; (6) case turned off ready for jointing; (7) case ready for assaying and marking at Goldsmiths' Hall; (8) after assaying and marking; (9) case finished and left from water-of-Ayr stone; (10) case sprung, polished, and ready for wear; (11) keyless dome hunters, for interchangeable movements, &c.

Mr. H. P. Isaac has a fine show of watches and marine chronometers, amongst which may be specified as particularly worthy of notice a two-day marine chronometer, with palladium spring; an eight-day marine chronometer, with reversed laminæ auxiliary compensation balance; a two-day chronometer for sidereal time, with bright works throughout, separate hour circle on dial, and palladium spring; several high class fusee keyless pocket watches; and an original chronometer balance, without auxiliary, constructed with laminated central arm of brass and steel, the brass being uppermost. This arm is in one piece with the rim, the final adjustment being obtained by means of split nuts on upright stalks.

Messrs. Curzon and Tripplin respectively exhibit educational apparatus and models of escapements.

Mr. Thomas Mercer exhibits, besides several fine eight-day and two-day marine chronometers, and balances for overcoming the secondary error, a portable clock with 12in. dial, having chronometer escapement and seconds train, to show time as a regulator; and two chronometer mantelpiece clocks.

Mr. J. Hammersley shows a chronometer timepiece, having an extra row of figures engraved on the slope of the bezel to show twenty-four hours; an eight-day marine chronometer; high-class watches; and a tray of very beautifully finished balance springs of different forms.

Messrs. John Greenwood and Sons have specimens of clocks in various stages, illustrating their system of interchangeable manufacture. This exhibit indicates a praiseworthy effort at reviving the English trade in the cheaper kinds of house clocks, which has been for many years in the hands of foreign producers.

Mr. Barnsdale's exhibit comprises specimens of the class of clocks peculiarly English, the manufacture of which has never been in danger of foreign competition, from the necessarily high finish of the work, consequent high prices, and limited demand, viz., a regulator with polished arbors and pinions of high numbers, jewelled holes and pallets, and improved maintaining power; two very fine quarter clocks, having an improved repeating work, in which the lifting is effected by means of a lever and cam, instead of the usual pin; English carriage clocks; and a yacht cabin clock.

Mr. R. Bridgman sends an improved vernier gauge for measuring to the one-thousandth of an inch, for the use of watchmakers, and a tool for accurately poising balances; and Mr. S. Jackson exhibits a tool by the same maker for testing the different angles in lever escapements. These tools are remarkable for great accuracy and high finish.

The Institute also exhibits chronometers by the famous old horologists, Mudge and Earnshaw; a model of Savage's two-pin lever escapement, &c.

In addition to the English exhibits in Group 27, a great number of foreign goods are shown, which might with more propriety have been displayed in the various sections of their representative countries.

Messrs. Camerer, Kuss, and Co., 56, New Oxford-street, W.C., have a collection of Black Forest clocks—cuckoo, trumpeter, &c.—of many ingenious designs, a noticeable feature of this exhibit being the large number of spring clocks in which the fusee adjustment is applied, which indicates a growing perception amongst foreign clockmakers of its utility and advantages as an equaliser of the force of the main-spring.

The Swiss Court is situated in the south-western corner of the East Central Gallery, a little to the north-east of Group 27.

Neither the Besançon nor the Swiss horologists are well or strongly represented, as with the English section; the same remarks apply to them in regard to the absence of attendants at the cases, and, judging from the work shown, the want of any machinery in motion explanatory of any of the various processes in the results arrived at is equally to be regretted. It has possibly been reasoned by them that, as in most high-class Swiss watches, and particularly so in all the complicated watches—repeaters, clock-watches, calendars, and such-like—the principal and all the finer portions of the work are entirely the result of hand labour; machine work is not characteristic of Swiss watchmaking. Still, when it comes to be considered what a wonderful attraction such Exhibitions prove to the public, and the great strides the Swiss have made in the way of uniformity of calibre, standard sizes, and gauges, and in the consequently greatly increased production of partially machine-made watches and interchangeable parts in all the lower qualities, since the report of the delegate—M. Favre-Perret—to the Philadelphia Exhibition in 1876, we cannot help wishing that some examples had been given illustrating a few, at least, of their methods, if only for purposes of comparison, without even the view of benefitting by anything such examples might possibly suggest.

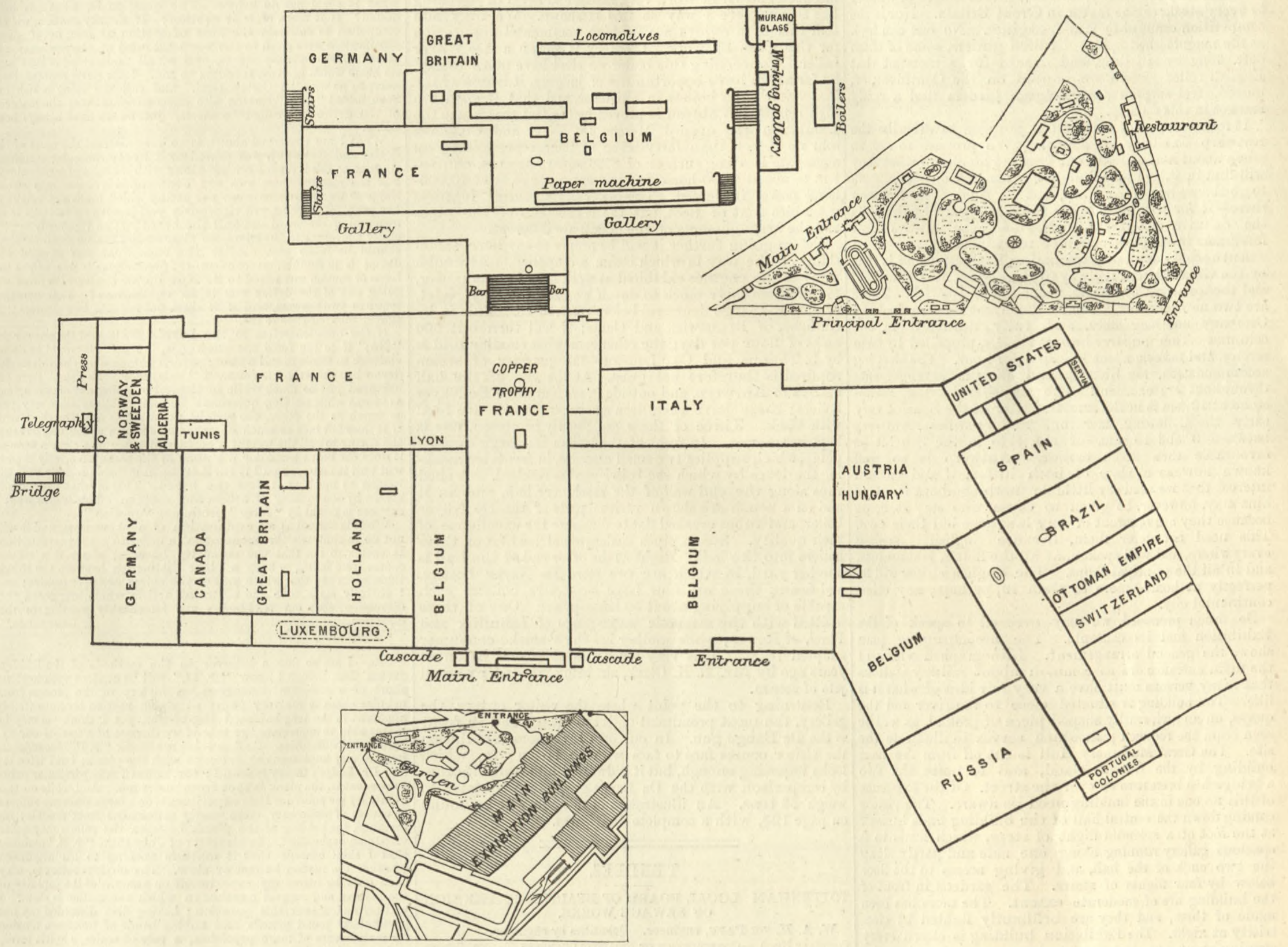
Messrs. Baume and Co., 21, Hatton-garden, in the number and variety of their watches take a premier position. Their exhibit consists of keyless and non-keyless gold and silver watches of various kinds, including a large selection of complicated watches, chronographs, &c., amongst which are some dozen or so of lever movements, which have obtained Class A certificates from Kew Observatory, a satisfactory proof of the excellence of the work and the thoroughness of the Swiss as watchmakers in the true sense of the word. Messrs. Baume and Co. are agents for the Longines Company's machine-made lever watches, a variety of which, and parts in various stages, are here exhibited. These watches are made in the Longines factory on the gauged and interchangeable principle, and the perfection to which their interchangeability is brought is exemplified by a number of the plates—twelve pillar plates and twelve top plates—being pinned or screwed together, looking through which every jewel hole appears as one perfect hole. In this case are also shown a number of machine-made silver watch cases in parts, illustrative of the process of their manufacture.

Messrs. Patek, Philippe, and Co., Geneva, show a variety of very high-class complicated watches, movements and parts, and some good carriage clocks.

Messrs. Weill and Harburgh exhibit musical watches, &c., and watches with twenty-four hour dials.

Leaving the Swiss group by the western door of the East Central Gallery and crossing the Central Avenue, we come to the exhibit of the American Waltham Watch Company, situated in the south-western corner of the West Central Gallery. If anything were required to confirm our remarks concerning the great mistake made by the English and Swiss exhibitors in not having any machinery in motion illustrative of the various processes of manufacture gone through in arriving at certain particular results, the popularity of this exhibit and the interest taken in the different machines which are here shown by the general public, as evinced by the crowds of people at all times surrounding the benches at which the operatives are at work, would sufficiently attest them. This company has certainly laid itself out in a very thorough manner to catch whatever benefits may accrue to it from publicity, and we feel assured its enterprise, and the unsparing efforts it has made in this direction, will be followed by its deserved reward in the shape of a considerable impetus to its trade. At the same time it should be borne in mind that as large capitalists it has, of course, had many advantages over the English individual manufacturers, who, whatever their wishes might have been in the desire to make a creditable show at this Exhibition, could not be expected to compete in this respect with a powerful company with practically unlimited pecuniary resources. The exhibit comprises a case containing a large collection of finished watches, a model of the factory, a case with all the parts of watches in various stages, and machinery in motion illustrating the process of manufacture, with male and female operatives at work. On arriving at the work benches, the first things that strike the beholder are the extreme order and regularity that mark the operations, the absence of any confusion in the mode of working, and the general cleanliness that prevails; this latter characteristic, which, so far as our observation has gone, is an attribute peculiar to the American factories, may possibly be owing to the presence of the lady workers, and that love of order which distinguishes the female mind. Whatever it is, it certainly lends an additional attraction to these work benches, and is a quality the advantages of which it would be well if we could further instil into our home workpeople. The machines include a pivot and staff polishing machine. The staff is held in a chuck of the lathe, rotated at a high speed, and the polishing is effected by the backward and forward motion of a wigwag with polishers charged with red stuff of different degrees of fineness. The wheel-cutting machines are perhaps the most interesting to watchmakers. The first of these is that for cutting the brass club-toothed escape wheels. The wheels are mounted —fifty at a time—on what is termed a quill, *i.e.*, a steel piece notched throughout its length to allow the arms of the wheels to pass. This quill acts as a sort of male spring chuck, which fits the inside of the rims, and is in position at right angles to the mandrel. The cutters—six in number—are mounted in chucks in a revolving disc or capstan, each cutter being brought to bear in its turn, and rotated by means of a serrated crown wheel at the end of its spindle gearing with a crown wheel on the main spindle of the lathe proper. The first two cutters are of steel and the four remaining of sapphire; each cutter is of a different shape, and the spaces are thus gradually cut without bending or straining the wheels. While the cutters are rotating rapidly, the quillful of wheels is made to traverse to and fro—slowly forward during the cutting and quickly back again—by means of an excentric at the end of a cylinder, and each space is in turn brought into position by means of a dividing plate at the end of the quill spindle. The machine for cutting the train wheels is similar to the above, forty wheels being cut at a time. All the wheels are afterwards chucked from the outside and the centre holes drilled, the centres being thus obtained from the circumferences. The points in which the American method differs from the English are in the number of wheels cut at one operation; the cutting of the teeth before the centres of the wheels are found; and in the automatic character of the machinery. But English makers maintain that more than one train wheel cannot be accurately cut, no the teeth properly formed, at a time; the delicacy of the escape wheel teeth of an English watch, however, renders it necessary that three or four be cut together in order to support one another. With regard to the second point, as the crossings (spokes) of almost all English-made wheels are finished by filing after the wheels are stamped, it would be impossible to get them true from the inside of the rims, and, indeed, it is not easy to see how wheels cut in this manner can be so perfect as those which are centred at first, and screwed down firmly during the operation of cutting them one at a time, as any slight excentricity or springing of the steel quill, which projects a couple of inches, would be sufficient to make the cutting irregular, and, as we have already remarked, any benefit derivable from automatic machinery, apart from other considerations, is dependent largely on the output required from each machine in regard to that of the others in a factory; in addition to which, when it is considered that the cost of cutting all the wheels of even a high-class English watch does not amount to sixpence, it will, we think, be admitted, that our system does not stand in need of any very great reforms in this direction. A bevel and crown-wheel cutting machine, and an universal lathe for jobbing purposes, are also shown, which do not call for special mention. The screw-making machine is a very charming piece of mechanism, and forms, from the number of its automatic motions, a central point of attraction. At the time of our visit this machine was making jewel screws, of which it is capable of turning out 4000 a day, although it can be adjusted for any sized watch screws. It requires even less looking after than the wheel-cutting machines, merely requiring to be fed by the attendant as it uses up the wire of which the screws are formed. A piece of wire is introduced from the back and gripped by an American chuck in the mandrel, and the machine is started. While the wire is rotated at a high speed, a cutter in the front advances, turns down the body of the screw to the size for which it is set, and retires. The mandrel then stops, and a rotating die in the poppet head facing the mandrel is advanced, taps the thread of the screw, and being reversed to run off, retires. The chuck then opens, the wire is drawn forward, and a cutter at the other side, facing the first, comes forward and almost cuts off the screw. Parallel to, and at the back of the lathe in which these operations have taken place, is the head slitting tool. A rocking bar now comes forward and takes the screw over to the circular cutter in this tool. After the head is slit this piece retires a little, and a pointer in a cylinder facing the cutter darts forward and gives the screw a poke, which knocks it out of the holder in the rocking bar down a shoot, through which it drops into a box underneath. This process is repeated until the length of wire is exhausted, when the machine stops of itself. A constant supply of oil is automatically pumped upon the work throughout these operations, the whole duty of the attendant, who, we are informed, looks after seven such machines in the factory, being to keep them fed. The arbor roughing out machine is similarly automatic. A length of wire, of the diameter of the pinions to be afterwards cut, is introduced into the split chuck through the back of the hollow mandrel; the cutter advances, forms one end of the arbor and one centre, and retires; the chuck then opens, the wire is drawn forward, and the cutter advancing forms the other end and cuts it off. As the arbors thus formed would not be sufficiently true to allow of the pinion being cut at this stage, they are finished off in another machine similar in principle, being turned on their own centres by means of a carrier and driving chuck. The pinions are cut from these arbors by three circular saw-like cutters of a peculiar make in a machine shown, and—after being hardened and tempered—polished, resting on their centres in sapphire grooves, by means of a wigwag machine with soft metal polishers. The whole of this process of pinion cutting and polishing is in principle identical with that adopted in Lancashire, excepting that the English pinions are cut with only one fly cutter from drawn pinion wire. At another bench is shown a tool of very beautiful construction for gauging the strength of balance springs; it has a graduated face plate, on the under side of which is fixed a strong balance spring attached in the centre to a pivotted staff carrying a hand which points to the degrees on the dial plate, and above which the staff projects. The springs are all colletted and pinned to their studs. The collet of the spring to be tested is pushed on to the projecting arbor, and the stud end of the spring is moved round one turn each way from zero. The operator then taking a mental average of the number of degrees registered as indicated by the hand on the dial plate—for it is curious to note that the springs usually offer greater resistance in the unwinding—places the spring in a correspondingly numbered division of the box for their reception. The balances being all carefully weighed and kept in divisions numbered in like manner, great facility is thus afforded for the selection of balances and springs which experiment has ascertained will be proportional to one another. This is an important consideration in the construction of the commoner watches where time cannot be afforded for the careful adjustment of their compensation or for lengthened time tests, as—it being known that springs of certain lengths, pinned in in particular positions, will give certain known results—it gives a ready means of applying approximately suitable compensation, &c., without resorting to what can only be termed botching, viz., altering the length of the spring by shifting the stud, lightening the balance, and other well-known timers' devices. In addition to the strength gauge for the springs, another tool is shown by which a further trial of the suitability of balances and springs when applied is made. In this tool the balance is made to vibrate conjointly with another balance with spring applied, which is kept as a standard, when, if the balance and spring being tried are correctly proportioned to one another, the vibrations of the two balances will be in unison. The history of the progressive development of the factory system and of watch-making by machinery in America, from its first establishment about the year 1850 to the present day, with its causes and results, would form a study of the most instructive character to both the watchmaker and the economist, in conjunction with which a visit to the exhibit of the Waltham Watch Company would afford some useful information to the former.

In the Old London Street, Messrs. Gillett and Co., of Croydon, have a fine turret clock of improved construction and design, embodying several novel features, which is well worthy of inspection. In the same tower as the clock, and connected with it, is one of this firm's patent carillon machines, which is constructed to play a different tune every hour and half-hour. The clock has a 1½-seconds pendulum, with zinc and steel compensation. The train wheels are of gun-metal, with engine-cut polished pinions, cut from solid steel, the pivots of which act in gun-metal bearings; and malleable cast iron winding wheels and pinions. The improved winding mechanism is an ingenious arrangement, in which the usual maintaining power spring, or springs, and click are dispensed with. It consists of a winding jack, with crypto-multiplying gearing, which admits of the handle of the winder being turned either way without affecting the force of the weight in any way until the clock is down. The gear by which this is effected was described in our account of the clock at the new Law Courts, illustrated in THE ENGINEER 21st December, 1883. The hours are struck on a bell weighing 14 cwt., and the chimes on a peal of eight bells. The clock also ting-tangs on two old bells, with two figures, which are said to have been taken from Glastonbury Cathedral. The barrel or cylinder for letting off the chimes is of a novel design, and consists really of a series of rings, so that the lifting cams, which are bolted between them, can be shifted to alter the chimes either in time or arrangement, as desired. The very fine double three-legged gravity escapement is driven by a train remontoir, in which two cams, acting alternately every fifteen seconds, lift the weights which drive the escapement, so that the force of one of the weights is continually giving equal impulses to the escapement, the minute hand advancing in jumps at like intervals. The clock is so constructed that it throws off the hours, quarters, and tunes at a quarter to ten at night, and throws on at a quarter to ten in the morning. We understand that Messrs. Gillett and Co. were refused space to exhibit this clock in the English group of the Exhibition proper—to which it would have made a valuable addition—on the ground that they already had the allotment in the Old London Street.



GENERAL PLAN OF THE ANTWERP EXHIBITION.

THE ANTWERP INTERNATIONAL EXHIBITION.

No. I.

EVERYONE admits the existence of trade depression, and almost everyone interested has his own explanation of the causes which have brought this depression about. It is urged, by way of comfort, that the depression is universal; but English manufacturers are hardly prepared to admit that this does them a great deal of good. All sorts of remedies are proposed, such as the subdivision of land; the employment of more men and less machinery; alteration in the incidence of taxation; diminution of output; shorter hours of labour, and so on. With none of these do we propose to concern ourselves here. One key to the mystery, as concerns Great Britain, is to be found in foreign competition. Our neighbours used to be supplied with almost everything save the bare necessities of life by us. They learnt by degrees first to supply themselves, and then to supply the whole world. Engineers are no better off in the matter of trade than other men. If they desire to learn a lesson whose gravity it is difficult to over-estimate, let them pay a visit to the Antwerp International Exhibition. They will there find material for observation which will give them to understand what the words foreign competition really mean. Very little indeed has been said in this country about the Antwerp Exhibition. It has been regarded as a small local affair of little account. We can assure our readers, however, that since the Paris Exhibition of 1878 no such collection of machinery has been exhibited as that got together in the great machinery hall of the building; and in our experience no steam machinery of equal perfection of design, beauty of workmanship, and admirable quality of material has ever been shown anywhere. That is to say, ever since 1878 continental, and especially Belgian engineers, have made enormous strides in the construction of steam engines. One sentence dropped in our hearing by an Englishman, a man of wide experience, may well be taken to heart: "When I want a new mill engine I shall come to Belgium for it." Nothing could be easier than to suppress facts and to prophesy soft things. It is to us quite as unpleasant a task to say what we have to say as it can be for our readers to see the words in print. The simple truth is that we never yet saw in England any steam engines of a quality equal to that of several of the engines exhibited. It may be urged that these engines have been got up for exhibition. Very probably; but English engineers also get up engines for exhibition. Again, granting all this, it is still evident that a connecting rod cannot be polished like silver unless its material is steel, absolutely sound, and free from specks; and it is not for a moment to be supposed that special patterns have been got up for a single engine, from which no others are to be made. Lastly, the fact that sales have been freely effected of the engines exhibited is good evidence that they may be regarded as commercial products of the country. A few years ago Belgians either did not or could not turn out such machinery. The fact that they can make it now is a direct source of danger to every steam engine maker in Great Britain. Nor is the competition confined to steam engines. No one can look at the magnificent trophies of rolled girders, some of them 65ft. long by 2ft. deep, and dream for a moment that English rolled girders are wanted on the Continent, or, indeed, feel surprise that Belgian girders find a ready market in this country.

It forms no part of our present purpose to describe the Antwerp Exhibition at length. We propose to say so much about it as will give our readers an idea of what they will find in it, and we strongly advise not only engineers to go themselves to Antwerp, but to send their foremen there—if for no other purpose than to dig up by the roots the delusive idea that Englishmen can always beat foreigners in the construction of machinery.

Antwerp is very easily reached. The best route is that by the Great Eastern Railway to Parkeston, near Harwich, and thence across by the ss. Norwich or Ipswich. These are two new steamers put on by the Great Eastern Railway Company not long since, and fully described in our columns. They are large beamy vessels, propelled by twin screws, and making about 14 knots per hour. The sleeping accommodation, the dietary, and all the arrangements throughout are excellent. The traveller leaving Parkestone at 10 p.m is in the smooth water of the Scheldt very early the following morning, and reaches Antwerp between 9 and 10 a.m.—if the tide in the Scheldt be favourable then much earlier. Antwerp is so well known now as a place of both historical and modern interest that we need say little or nothing about it. One hint may, however, be given to those who stay at home because they are ignorant of any language but their own. This need not deter them, because English is spoken everywhere, and well spoken, at all the hotels, restaurants, and in all the principal shops. The English visitor will be perfectly at home—more so than in, perhaps, any other continental city.

So much premised, we may proceed to speak of the Exhibition and its contents. The accompanying plan shows the general arrangement. Lithographed views of the main entrance are so common about railway stations that many persons must have a very fair idea of what it is like. The building is situated close to the river and the quays, on an awkwardly shaped piece of ground, as will be seen from the reduced plan which serves to illustrate the site. The Great Machinery Hall is cut off from the main building by the Rue de Gand, and to unite the two a bridge has been thrown over the street. Of the existence of this no one in the building need be aware. The visitor coming down the central hall of the building finds himself at the foot of a splendid flight of steps, which leads to a spacious gallery running along one side and partly along the two ends of the hall, and giving access to the floor below by four flights of stairs. The gardens in front of the building are of moderate extent. The most has been made of them, and they are brilliantly lighted by electricity at night. The Exhibition building is closed every evening at six p.m., but the gardens are thrown open for concerts from six to ten, at a charge of half a franc. In the Salle des Fêtes concerts are now and then given. One of the noteworthy features in the gardens is a railway train, consisting of sleeping and refreshment cars, the latter being in regular use as a restaurant. The main entrance, although only built up of wood and canvas, is an imposing structure, which will perform a similar duty for the Exhibition to be held in Madrid next year. At each side is the beak or rostrum of an ancient galley, and under this is a pile of rockwork, built up in Pierre Moulle by Blaton Aubert. Over this rockwork tumbles a cascade. The water for that on the left-hand is supplied by a pair of Körting's pulsometers, while on the right are two pulsometers by Neuhaus, of Berlin. These pump up the same water and use it over and over again. The effect is very pretty. The pulsometers are placed in railed enclosures, and can be seen in action; that is to say, as far as the action of a pulsometer can be seen. Far to the right, close to the entrance to the Portuguese Colonies, is a full-sized wooden model of a 100-ton compressed air hammer, at present being constructed for the Terni Gun Factory, Italy, by Messrs. Cockerill and Co., with a model of the gun roughed out. The real hammer has a wrought iron frame, and from its great height forms a conspicuous object for some distance. Not far from it is a full-sized built-up section, in wood, of one of the new quay walls, which have been so fully described in our pages that more need not now be said concerning them.

Traversing the great central nave, the visitor will have his attention called right and left by the display of art of unusual excellence. In the centre, at the point marked in our plan of the building, will be found a wonderful trophy towering up into the roof. Antwerp is a great export port, and this trophy contains everything, it may be said, that passes through Antwerp, in or out, in the way of merchandise, from tobacco to preserved tomatoes. Further on is another trophy of far more interest to engineers. It consists of copper and brass tubes by Messrs. Laveissiere et Fils, and E. Secretan, St. Denis. This contains some copper tubes of colossal proportions and splendid workmanship, and a copper corrugated fire-box for a locomotive. Passing this we come at once to the bridge stairs before named, and we have on ascending them the entire hall beneath us. The localities of some of the most important exhibits are shown on the plan. The first thing to catch the visitor's eye is the display made by Messrs. De Näyer and Co., Willebroeck. This is nothing less than a complete paper mill, at work every day, producing paper from wood. The first process consists in putting blocks of wood into a species of grinding mill, in which they are rubbed, not to powder, for that would not make paper, but into a species of flocculent dust; this is mixed with water, passes over sieves, and finally assumes the form of "half stuff;" in other words, a species of coarse *papier maché*. This half stuff is then passed in the usual way through a beating engine, reduced to pulp, and finds its way into the tanks, and thence to the machine. Most of the hands employed about this machine are women. Paper-machinery has been shown at work very rarely, and never in anything like so complete a way as this is shown. We may add that this firm enjoys a very high continental reputation for this class of work. Close by is shown a De Näyer boiler. Concerning this boiler we shall have more to say. So far as we have opportunities of judging, it is one of the best water tube boilers in existence, and that it enjoys a high reputation abroad is proved by the fact that since the Exhibition was opened Messrs. De Näyer and Co. have sold no fewer than forty-seven of them, representing an aggregate heating surface of 8196 square metres, equivalent to about 9000-horse power nominal, or at least 20,000-horse power indicated. The boiler in its general features resembles that of Root, but the connections of the pipes and the arrangements of the details are different.

Before going further it will be proper to say here something of the way in which steam is supplied. Although many of the engines exhibited at work are of great power, few of them have much to do—if we except one by Nolet, driving the large flour mill before referred to. This is by Guthner, of Brunswick and Gantz; it will turn out 500 sacks of flour per day; the other somewhat smaller mill is by L. Thunus and Co., Louvain—the quantity of steam required is therefore not great. At the end of the hall nearest to Antwerp, and outside it, are four large De Näyer boilers; these have sheet iron smoke stacks and are fired with slack. Three of these are usually in steam, one is kept in reserve. In front of the boilers is a large donkey pump, which supplies two small cascades, in ferneries masking the doors by which the boiler yard is reached. A shed runs along the end wall of the machinery hall, and in it and on a bench are shown various parts of the De Näyer boiler, and tubes crushed flat to illustrate the excellence of their quality. Steam pipes underground lead from these boilers into the hall. Right at the other end of the hall is another yard, in which are two more De Näyer boilers, and facing these are four large locomotive boilers, each capable of supplying about 50-horse power. One of these is fitted with the magnetic water-gauge of Lehuilier and Pinel, of Rouen, while another has Orvis' smoke-consumer adapted to it. This very much resembles one patented years ago by Mr. D. K. Clark, air being injected by small jets of steam.

Returning to the point where the visitor enters the gallery, the most prominent object to the left and in front is the De Bange gun. In our own Inventions Exhibition the visitor comes face to face with an 11-ton gun, which looks imposing enough, but it is dwarfed into insignificance by comparison with the De Bange gun, which is stated to weigh 52 tons. An illustration of this gun will be found on page 123, with a complete description.

TENDERS.

TOTTENHAM LOCAL BOARD OF HEALTH.—EXTENSION OF SEWAGE WORKS.

W. A. H. de Pape, engineer. Quantities by engineer.

Contract No. 1.—Construction of Straining Chambers, Tanks, Sewer Extensions, Penstock Chambers, &c.

Name.	Special blue brick coping. £	s.	d.	Ordinary bull-nosed coping. £	s.	d.	Concrete block coping. £	s.	d.
J. W. and J. Neave	18,762	0	0	17,975	0	0	17,500	0	0
B. Cooke and Co.	16,290	0	0	14,800	0	0	14,500	0	0
Chas. Wall	15,406	0	0	14,806	0	0	14,806	0	0
Patman & Fotheringham	15,300	0	0	15,150	0	0	15,000	0	0
J. Bloomfield	14,053	12	3	13,354	11	6	13,412	3	6
*W. Brass and Sons, 47, Old-street	13,964	0	0	12,964	0	0	12,464	0	0

* Accepted for concrete block coping.

Contract No. 2.—Smith and Founders' Work.

	£	s.	d.
Davis and Pearson, informal	—	—	—
J. W. and J. Neave, Leytonstone	1891	0	0
Waller and Co., Holland-street, Southwark—accepted	1599	0	0

Contract No. 3.—Sludge Presses.

	£	s.	d.
Messrs. Johnson and Co., Stratford—accepted	1750	0	0

Association of Municipal and Sanitary Engineers and Surveyors.—The Lancashire and Cheshire District meeting will be held at Blackburn, on Friday, August 28th, 1885. The members will assemble in the Town Hall at 11 a.m. Business consists in electing honorary district secretary. Mr. J. B. McCallum, the borough and water engineer, will give a short paper descriptive of Blackburn and its public works. At 12.30 the members will adjourn for half an hour for luncheon at the White Bull Hotel. At one o'clock they will proceed to visit the following places and works of interest:—Blackburn Park, Free Library and Museum, Town Hall and municipal offices, the Exchange, markets, public bath, corporation storeyard and workshops, public abattoirs and cattle market, Audley destructor depôt, water supply to canal, Audley recreation ground, Fishmoor and guide reservoirs, and sewage outfall at Witton. If time permits some of the following can be visited, permission for which has been granted:—Messrs. Greenwood's corn mill; Lancashire and Yorkshire New Railway station, and Darwen-street Bridge; Messrs. Coddington's cotton mills—spinning and weaving; Corporation Gasworks; Messrs. Yates' foundry; Lancashire and Cheshire Telephonic Works; tramways. At 6 p.m. the members will dine together at the White Bull Hotel.

LETTERS TO THE EDITOR.

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

THE LAWS OF MOTION.

Sir,—I have been a most interested reader of the discussion going on in your columns on "The Laws of Motion," and feel grateful to the participants for the pleasure it has afforded me. When the board on rollers was suggested, I shouted, having made just that sort of thing some years ago while wrestling with the mysteries of soaring birds, during which time I got badly tangled with Newton's three laws. I did not use the boys, however, being afraid of the "personal equation," but in place thereof a strong coiled wire spring fastened to a post at one end of the board. A 40 lb. window weight, resting on a neat toy carriage, was tied to the other end of the spring, which was then stretched until the weight with its carriage would run to the opposite end of the board, where it was fastened to another post. It required about a 50 lb. pull to stretch out the spring.

This simple device was quite a wonderful thing, and a course of analytic mechanics explanatory of Newton's three laws could be given with it. When all the parts were supplied, and before the spring was extended, the device seemed to be resting quietly, and, so far as I could see, was in equilibrium. There was nothing unbalanced about it. When the spring was pulled out and the weight fastened to the post, the affair seemed still to be balanced, its equilibrium substantially preserved, and yet it was by no means the same as before the spring was drawn. Something had been added to it by pulling the spring, for it now had the power of doing what it could not do before. The question is, what has been added? Is it force, or is it motion? If we say motion, we are compelled to entertain the idea of motion at rest, but if a new signification were given to the word allowing of the predication of either active or passive states, and we all understood it that way, no harm would be done, it seems to me. I am quite content, however, to go with "A Girton Girl," and call the thing which has been added "force," leaving the successive states of the material of the device to be called "motion," just as we have always been doing.

What I am concerned about is to keep distinct the parts of the device and that which was added to it by my muscular exertions. As long as this is done I can get along with matters of terminology; but the moment these two are confounded I lapse into chaos. Suppose we now suddenly cut the string which binds the weight to the post. The spring will vigorously pull it with its carriage to its own end of the board and pull the board just as vigorously in precisely the opposite direction—so vigorously that no small children should be in its way. After the commotion has stopped the device is in equilibrium once more, precisely as it was before the force or motion was added to it. Now during the time the force was going out of the device was it in equilibrium? That question requires two answers, and if it does not require two answers it is simply unintelligible to me.

If the question refers to the boards and metal the answer is, "No;" if to the force the answer is, "Yes." It would be doing violence to words to call a thing which jumps about as this device does when the weight is released "balanced." But the "force" is balanced just as much while in the act of going out of the spring as it was while residing quiescent therein. It pulls one way just as much as the other, the weight precisely as much as the board. If it does not take as much of whatever it was which was put into the spring to pull the weight a certain distance in a certain time as it does the board a similar distance in the same time, why then it will pull it faster, or pull it further, until it does precisely pull the weight as much as it does the board. This is what I suppose is meant by the equality of action and reaction. This is also what I suppose is meant by "force" producing "motion."

What is wanted is an explanation of a phenomena, and it will not do to obliterate the phenomena in order to get the explanation. It seems to me that the obscurity hovering about this matter comes from failing to keep a clear distinction between the things themselves and that which makes the things active or passive; and I entirely agree with the editorial article which originated this discussion, that our text-books are lamentably wanting in this direction.

I. Lancaster.

Chicago, July 20th.

Sir,—I am so firm a believer in the methods of the Kindergarten that, though I know "Φ. Π." will be content with nothing short of a complete cosmogony, a history of the process from nebular chaos to the very point at which motion becomes visibly apparent in the long-balanced tug-of-war, yet I think we may be better able to appreciate the tale if we dispose of a few of our experimental difficulties. And first let me thank "Φ. Π." for suggesting the very unpleasant experiment with the plank; but I tried it; and Dr. Lodge's theory is sound; for, unless I take particular pains to prevent it, the plank is shot from under me. And while on this point, let me point out that experiments on a large scale are subject to causes of inaccuracy more easily eliminated from models; for instance, the bending of the plank between the rollers may quite vitiate an experiment. In his letter of July 14th, "Φ. Π." assumes that I shall concede that it matters nothing to his argument whether the motion be fast or slow. The obvious retort is, why then does he blame my experiment on account of the rapidity of the motion, and suggest another in which the motion is slow? I will try and answer this question; having first discarded my not particularly round pencils and rubber bands of unknown tension for instruments of more precision, a pair of scales, a spirit level, and a set of carefully turned rollers among the rest.

First I carefully levelled my "floor" with wedges and secured it with a screw, and on it I placed as before the rollers and plank; it is 15in. long, and with its pulley weighs $4\frac{1}{4}$ oz. On this I place a lead roller weighing over 27 oz., nearly a pound and three quarters. This then is the system; it is, so far as the rollers are frictionless, free to move as a whole in one line only, backwards or forwards, and the weight also is free to move along it, backwards or forwards.

(1) A thread is attached to the axis of the rolling weight and led over the pulley, and a scale-pan weighing $\frac{1}{4}$ oz. hung on to it. Now I regard this as an inconvenient modification. The system is no longer self-contained, its motions no longer in one direction. Any motion that takes place necessarily sets the scale-pan swinging, and this may affect the results in a very curiously complicated way. But to pass this by for the present, this weight is insufficient to start the rolling weight. I therefore give it a push, and it rolls on till it comes to the stop fixed on the plank, when its momentum is shared with the plank, and the system moves on as a whole.

(2) I make up the weight of the scale-pan to $\frac{1}{2}$ oz. This starts the roller, and it completes its traverse of 7in. in about 3 secs. For the first 3in. there is no recoil apparent; during the remainder of the travel recoil is just apparent.

(3) and (4) I make the falling weight up to 1 oz., and then to $1\frac{1}{2}$ oz. The rolling weight moves faster; recoil is strongly developed.

But "Φ. Π." will say I should have used a flat sliding weight, to give more friction and better contact. Well, I did—with exactly corresponding results; but it required $1\frac{1}{2}$ oz. to start a slider weighing 5 oz. When started the plank recoiled as before.

Now, consider the meaning of these results. The free fall of the weight is resisted first by the pulley, which it presses down, tending to tilt the board over the front rollers; by a suitable adjustment this alone may very well mask any tendency to recoil; next, as the thread turns over the pulley its pull is resolved into two opposite actions, one pulling the slider forward, the other pushing the plank back—action and reaction equal and opposite. Now, if the thread, after passing over the pulley, was secured to a nail on the plank, there would be no motion; but instead it is fastened to the slider—or roller—a body that is, so far as the movements we are investigating are concerned, only connected with the plank by friction, and, except for considerations of friction, might just as well be placed on the floor, behind the plank altogether. As it is, so much of the retardation of the falling weight as goes to overcome this friction between the slider and plank does not concern us. If the weight is sufficient to overcome it, motion ensues; the acceleration of the weight by gravity is greater than its retardation by friction; the scale pan falls, the slider approaches the pulley with an acceleration equal to the retardation of the scale pan; so far things are balanced, but here is a difficulty. The scale pan moves vertically, the slider horizontally. How is the deviation to be accounted for? Plainly by the pulley, which is attached to the plank, and prevented from moving vertically by the static resistance of the floor, and is hindered from moving horizontally by friction on the supporting rollers; as soon as the acceleration of the slider exceeds this friction, the plank recoils—that is, it recoils if the speed of the moving weight exceeds a certain minimum special to the particular apparatus. After this I will concede that it matters nothing to "Φ. Π.'s" argument whether the motor be fast or slow, always providing that physical facts matter nothing to said argument. With a like proviso I am prepared to admit that the best apparatus for exhibiting the nature of laws which are rigidly fulfilled only when friction is *nil* are those in which friction approaches a maximum, or that Newton referred to molecular action in drafting the three laws, and not at all to interactions of bodies when there is no steady contact or when motion is pumping or violent.

But to return to the Kindergarten, a much better apparatus than "Φ. Π.'s" consists of a plank on rollers, as before, with a stop towards one end, and another piece of board so hinged to it that it may be set at any required angle to the plank. Then with the surface quite level, start the roller along it so that it runs up to the stop; its motion is shared with the plank, and both move on together. Now raise the end of the hinged piece to an inclination of about 1 in 50, and place the rolling weight at the top end and let it roll down. This time the plank recoils smartly, and when the stop is reached the opposite momenta of plank and weight nearly annul one another, a small forward motion of the system remaining, because from several causes the momentum of the weight is greater than that of the plank. You will find this experiment described with a variation in the books as Galileo's inclined plane, with a neat diagram of forces and a statement that the component perpendiculars to the plane produces no motion; but by mounting our plane on rollers we perceive that the preposterous bulk of mother earth has much to answer for in obscuring the true meaning of reaction, and how it is that motion can only mean change in the relative position of not less than two bodies, that no single motion is possible, that motions being always in pairs and balanced, always affect two bodies at least, and that for convenience we call the motion of one body action, of the other reaction, two words which denote the two halves of one effect and imply one another as necessarily as front and back. But if I may judge from my own difficulties in the study of this matter, in the teaching of very different matters, "A Student" will not be helped out of his puzzle by definitions or verbal emendations; by sight, touch, and imagination, by these only does book science become living knowledge; each must travel over the ground for himself, though mighty intellects have gone before to smooth the way for us that follow.

Nevertheless "A Student" seems to be making needless trouble for himself by confusing active and passive, since he treats to "pull back" and "to be pulled back" as equivalent phrases. Surely the facts are plain enough: the stone is pulled to the earth—the stone pulls the earth to it. Of the cause of the pull I know nothing, and I don't see how the phrase "gravitation medium" helps us; but I suppose it suggests analogies which may help some minds, for no two people take in ideas quite at the same rate, or by quite the same methods.

Now for one more toy—the miniature of Mr. Muir's railway—and I have done. Plank on rollers as before; two slips of wood ½in. by ½in. by 3in. nailed to it about 6in. apart, a piece of very stout millboard resting on the slips and screwed down to the plank in the middle, so as to make a pair of curved inclined planes meeting at the centre. Then put your rolling weight at the summit of one, and you will observe some very pretty oscillations.

Kensington, July 26th. W. A. S. BENSON.

THE EFFICIENCY OF FANS.

SIR,—I am obliged to Professor Smith for the copy of his original paper on fan-testing, which I have read in the hope that, if the text differed from the report published in THE ENGINEER, I should be warranted in withdrawing a part, or the whole, of my adverse criticism upon it. But, saving a few clerical errors, I do not perceive that your report differs in any material particular from the text of the original article. It will be remembered that I made three objections to the method proposed by Professor Smith: First, that he set out from the wrong equation; secondly, that he entered the negative head as part of the head doing useful work; and, lastly, that he stated the kinetic energy of discharge to be "all, or nearly all, lost work."

With regard to the first objection, Professor Smith's reply relieves me of all need of verification; for he admits that he set out from the equation for compression or expansion in one of its modified forms, instead of setting out from the correct equation of steady motion.

Concerning the expression $(p_2 - p_1) \cdot V$, what I said was that Professor Smith finally adopted it as representing the useful work done by the fan, and I will here make good this assertion. In equation 4 of the "correct report," I find the useful work set down as $W = 5 \cdot 2 G V$; where, according to Professor Smith's own definitions, G is "the excess of pressure at outlet over that at inlet, in inches on water-gauge." I need not take the trouble to show that the two expressions $5 \cdot 2 G V$ and $(p_2 - p_1) \cdot V$ are perfectly equivalent, p_2 and p_1 being the pressures at outlet and inlet expressed in pounds per square foot.

The small head or lift h certainly forms part of the total work done by the fan, but not of the useful work, as Professor Smith has it in his paper.

Coming now to the third error, which consisted in stating that the energy of discharge was "all, or nearly all, lost," Professor Smith cannot blame me for interpreting the term "lost" as the opposite of "useful;" for my feeble intelligence fails to perceive any middle term between the two. Moreover, a part of Professor Smith's last letter tempts me to think that, even now, he has not given us a clear notion of what he intended by the term "lost;" for he says: "'Lost' was intended to mean, not wasted, but necessarily spent outside the fan, in the same way that the 'drag' of the mine is 'spent' or 'lost.'" Now, if by the term "lost" in this passage Professor Smith means useful work done outside the fan—which, by the way, offers a very good example of the *lucus a non lucendo*—he cannot possibly include under that definition the drag, or work done upon fluid friction. In point of fact, all work done upon friction, whether it arises from the action of solid upon solid, or fluid upon solid, or even fluid upon fluid, is in the most rigorous sense of the term lost, or waste work.

In conclusion I beg to observe that my analogy drawn from the discharge of a fire-hose is perfectly correct within the limits to which I confined it—namely, to show that, for a fan with a fixed area of discharge, the modulus of efficiency increases with the velocity of delivery. There is much more to be said about fans, but being upon my holiday I must renounce the temptation of being led into a controversy upon the subject. R. H. GRAHAM.

Saltburn-by-the-Sea, August 10th.

SIR,—You have republished a paper by Professor Smith on "Testing Fans," read before the Institute of South Staffordshire Mining Engineers. Why about one-fourth of the paper should be devoted to exposing my misdeeds at a meeting at which I was not likely to be present, and before engineers to whom even my name is probably unknown, I do not understand.

It appears that about the substantial points which Professor Smith discussed with me some time since, he has now, in fact, come over to my view. He admits that the term he has added to the ordinary fan formula is insignificant, and he admits that the compression in the fan is not adiabatic. This last admission is coupled with the singular remark that "this heat not being received by conduction, the compression curve remains adiabatic, so far as can be *a priori* surmised." That is, heat generated in the air expands it differently from heat communicated from outside. Professor Smith may be left to the sole merit of this remarkable opinion.

Professor Smith, however, is vehemently angry at my putting forward the "exact" expression $2{\cdot}45\,(p_2 - p_3)$ for the work of adiabatic compression. He says this is a "pure and simple mistake," that "it is three and a-half times as much as it ought to be," and that "it is deduced from the extraordinary conception of adiabatic compression of air considered as an incompressible fluid."

Professor Smith's knowledge of thermodynamics must be remarkably unsound. The expression $2{\cdot}45\,(p_2 - p_3)$, where p_2 and p_3 are in feet of air, is identical with $2{\cdot}45\,(p_2 V_2 - p_3 V_3)$, where $p_2\,p_3$ are in pounds per square foot and $V_2\,V_3$ in cubic feet. Both expressions are well known, and are to be found in any elementary text-book of thermodynamics, if Professor Smith will be humble enough to consult one. The expression may be found in the first two pages of the chapter on thermodynamics in Cotterill's "Applied Mechanics," and is not based on the "extraordinary conception" conjured up by Professor Smith's excited imagination. Professor Smith is a great deal too ready to suppose other people are capable of stupidities. He is now hoist with his own petard, for he has proved that his own estimate of the work of adiabatic compression is three and a-half times too small.

I cannot pretend to say what has led Professor Smith wrong; but possibly he has not noticed that p_2 and p_3 are not expressed in feet of air at constant temperature and pressure, but at the temperature and pressure of the inlet and outlet of the fan.

August 10th. W. C. UNWIN.

GWYNNE v. DRYSDALE.

SIR,—I observe in your last week's issue that you have thought this case sufficiently interesting to your readers to publish the opinion of Lord McLaren, and I think it would give them a better opportunity of judging how the decision was arrived at by placing before them the evidence of two of my witnesses, and likewise the evidence of Mr. Drysdale and his manager, Mr. Thomson. I do not consider it would be fair to ask you to publish this in your columns devoted to literature, as it would occupy too much valuable space. I have therefore requested that the same be printed on pp. iv., v., and vi., set apart for business announcements. Seeing that I have appealed to the Inner Courts against Lord McLaren's decision, and, in the event of the judgment of the said Courts not being favourable, I intend to have the case carried to the House of Lords, I will therefore refrain from making any further remarks upon the question until it has been finally settled.

89, Cannon-street, London, E.C., August 12th. JOHN GWYNNE.

THE TOWER BRIDGE.

SIR,—I am astonished to find from your article of the 7th inst. that the bridge with the big towers is really to be built. Perhaps, notwithstanding the Act of Parliament, the scheme will be reconsidered. We have now in America an example of a too hasty a decision in such matters. The East River Bridge, between New York and Brooklyn, which has cost so much money and has taken so many years to build, is found quite inadequate for the wants of the two cities. There are railways on either side that seek a crossing place, and yet there is no physical junction with the bridge, which has not been made strong enough for ordinary railway trains. If your City Architect really does build his big towers in the Thames river, I guess there will be some strong remarks when the citizens see how much of the waterway they occupy, and it might be advisable to prepare now for alterations. In bridges erected in Germany and other warlike countries, it is usual to leave chambers in the piers in which to place gunpowder for the destruction of the bridge, to stop the passage of an enemy. So in the Tower Bridge, it would be a good plan to leave shot holes for dynamite in the piers, so that the latter could be destroyed when it is found that a bridge without intermediate piers has to be built, for carrying railway trains as well as road traffic. This could be fixed right away, and it would be a very pretty operation, which, no doubt, your English engineers could do as well as could your obedient servant,

August 11th. AMERICAN.

NOVEL METHOD OF ERECTING BRIDGEWORK.

SIR,—Your issue of the 7th inst. contains a notice of the use of public hydraulic power for rivetting-up girders in place. It may interest your readers to learn that a similar and more extended use of the power from the mains of the London Hydraulic Power Company is about to be made at the Charing-cross Railway Bridge extension works, Messrs. John Cochrane and Sons, the contractors, having several months ago made the necessary arrangements with the company. These instances appear to make a new departure in the carrying out of building operations in neighbourhoods where hydraulic power can be readily obtained, the ease and quiet of working being appreciated alike by the contractors and the public.

HUBERT BLAND,
Pro E. G.

London Hydraulic Power Company, Holland-street, London, August 10th.

DUPLEX STAMPING HAMMER.

SIR,—Replying to your question at foot of item about my equitable duplex hammer in your issue of 24th April, I beg leave to say that it was easy to find many points about the Ramsbottom hammer to admire, but I could not see the shadow of a reason for trusting it with die forging. At the instance of many good engineers I made the necessary sketches for getting my work done from a horizontal motion of my rams. Reciprocating the rams in one plane, and the power in another, athwartship therewith, seemed at that time absurd; it seems so now. Gravity, ever on the alert, does not like to be ignored. Its suggestion that I offset the weight of one ram with the weight of the other was accepted as the key to the solution of what, to me, had been a difficult problem. Simple as the arrangement looks now, it took me months to get it. Now, it must be plain that while one ram has gravity with it, the other has not. So being substantially equal in weight, they balance as two bright boys on a tester plank over a fulcrum would. The motor does not have to fight the weight of the rams; it simply overcomes their inertia. The lowest ram has to travel farther and faster than the upper one, until the instant of impact, when the radius bars assume vertical positions.

I iterate, the buttons or forgings must be rolled or spun to approximate size before this hammer can true them to form and set, to fit without taking their skin off. ED. B. MEATYARD.

Lake Geneva, Wis., May 31st.

AN ANOMALY IN BOILER EXPLOSIONS.

SIR,—The single-rivetted joints of a boiler have a strength very little greater than one-half that of the plate.

How does it happen that, when a boiler explodes, the failure almost always takes place through the solid plate, rarely taking the line of a rivetted seam for any distance? This fact is well known, but I have never seen any notice taken of it.

I have now before me drawings of a boiler which exploded on the 1st of June, at Cumnock, in Ayrshire. It was a Cornish boiler, 16ft. long, 5ft. in diameter, and with one furnace tube 2ft. 6in. in diameter. The primary rent started in the bottom of the shell, and extends longitudinally through the two middle rings of plating, the lines of rupture then passing round the boiler in various directions. The shell is torn into three main and numerous small pieces, and both end plates are completely blown out, and detached from the furnace tube. Two rings of the shell plating, the front end plate, and the furnace tube were blown to the left rear; the back end plate and a portion of the shell were blown to the right rear; while the middle portion of the shell was blown to the right, demolishing the engine house and damaging the casting dressing shop in its flight, and finally lodged vertically in the roof of the latter. Some of the smaller pieces were blown to a great distance, and, considering the large number of persons who were on the premises, it is wonderful that so few were hurt. The line of rupture in no place coincides with the line of rivets, save when it crosses a seam; but in one case it runs parallel to a seam, and about 2in. from it.

Why, I would ask, does rupture take place through that part of a structure which is twice as strong as the contiguous parts? Perhaps some of your readers will supply some information on the point to INSPECTOR.

Glasgow, August 4th.

HEDGES' SPEED GAUGE.

SIR,—I was much pleased with Mr. Hedges' remarks about my letter on the subject of his most useful invention—the speed gauge. I think, however, that he must have misunderstood me in one point; for he says, "that it appears that I suppose the volume of the air to be changed. Now, I particularly stated that the results obtained were "due to the volume of the air, viz.:—

$$\Pi \frac{g}{\omega^2} x^2$$

being constant." It must be so if none of the water is allowed to escape, for the water and air together fill the tube, so that if the volume of the former remains constant, that of the latter must do so also, whatever form they assume in the tube. This was the point I wished to draw attention to in the illustration, where the volume of the water—and therefore also that of the air—was incorrectly shown to vary for different speeds.

J. SHIFFNER, Captain, Royal Artillery.

Coombe-place, Lewes, August 8th.

THE INVENTION OF THE BLOCK SYSTEM.

SIR,—In your issue of June 19th, a correspondent asks who was the original inventor of the empty or block system of signalling. I was in hope the question would be answered by people more connected with the person whom I believe to be the original inventor, and is always spoken of as such in his native village. Mr. Edward Umbers, a farmer, living in the village of Wappenbury, near Leamington, is well known to have had a railway laid on his farm premises, and astonished his friends by his discoveries in connection with signal apparatus—I believe he experimented many years. At last he introduced it to a firm of signal makers, who took him by the hand, gathered all he knew, then suddenly showed Mr. Umbers an improvement little different, and left him a ruined man after spending several thousands. Mr. Umbers afterwards was elected a pensioner of the Agricultural Benevolent Institution, and I am not sure if he still lives, but should you need further information I will endeavour to ascertain if he is still alive.

Dunchurch, near Rugby, August 11th. T. H.

MACGREGOR ON GAS ENGINES.

SIR,—Mr. Macgregor's "Compilation on Gas Engines" almost rivals the celebrated work "On English as She is Spoke." The translations from Witz are a curiosity in English literature. It is a pity Mr. Macgregor did not engage a translator who understood English, as the practical parts of the work are marred by the theoretical portion. It is further to the disadvantage of the book that the sources from which most of the material are obtained are not so fully acknowledged as they might be. VERITAS.

Lancaster, July 18th.

THE RAINFALL OF JULY.

THE following facts respecting the very dry month just passed have been communicated to the *Times* by Mr. A. J. Symons:—

Rainfall observations have now been made uninterruptedly in this country for 160 years, not at any one place, but by careful calculation values have been obtained which are probably near the truth for every year from 1726 to 1885. During the whole of this period there is no instance of more than five consecutive years being wet until we come to recent years, and then we have the unprecedented fact of nine consecutive years—1875 to 1883—each wetter than the average; in short, the quantity in those nine years was as great as usually falls in ten years and a-quarter. In 1884—just as in 1834, 1844, 1854, 1864, and 1874—the fall was below the average, and complaints of drought and of deficient water supply immediately arose. Up to the middle of last June the fall did not differ materially from the average, but the latter half of June was very dry.

July has been remarkably dry, as the following table, comprising facts sent by some correspondents, shows:—

Rainfall in July, 1885.

County.	Station.	Av'rage in July, 1870–79.	July, 1885.	Deficiency.
		in.	in.	in.
Middlesex	London, Camden-square ..	2·47	0·52	1·95
Kent	Maidstone, Hunton-court..	2·04	0·21	1·83
Kent	Hythe	2·46	0·47	1·99
Hants	I. of Wight, St. Lawrence..	2·48	0·70	1·78
Hants	Strathfield Turgiss	2·30	0·22	2·08
Herts	Hitchin	2·70	0·10	2·60
Bucks	Newport Pagnell..	2·70	0·14	2·56
Norfolk	Swaffham	3·44	1·10	2·34
Wilts	Salisbury, Alderbury.. ..	2·75	0·16	2·59
Devon	Okehampton..	3·42	2·07	1·35
Devon	Holsworthy	3·23	1·14	2·09
Gloucester	Clifton	3·25	0·97	2·28
Lincoln	Ulceby, Killingholme ..	2·78	0·66	2·12
York	Skipton, Arncliffe	4·95	1·43	3·52
Northumberland .	North Shields	2·55	1·59	0·96
Monmouth	Newport, Llanfrechfa ..	3·69	0·71	2·98
Kirkcudbright ..	Cargen, near Dumfries ..	3·13	2·68	0·45
Kinross	Loch Leven	3·05	1·00	2·05
Forfar	Arbroath	2·64	0·79	1·85
Cork	Black Rock	2·84	1·32	1·52
King's County ..	Portarlington	2·68	1·26	1·42
Galway	Ballinasloe	2·88	2·75	0·13
Down	Waringstown	3·58	1·85	1·73

REMARKS.

Hitchin.—The driest month since the record was begun, in 1849.

Holsworthy.—The driest and finest month for many years.

Ulceby.—A very dry month, some very hot days, but no thunder or lightning.

Newport, Mon.—Very hot until 28th.

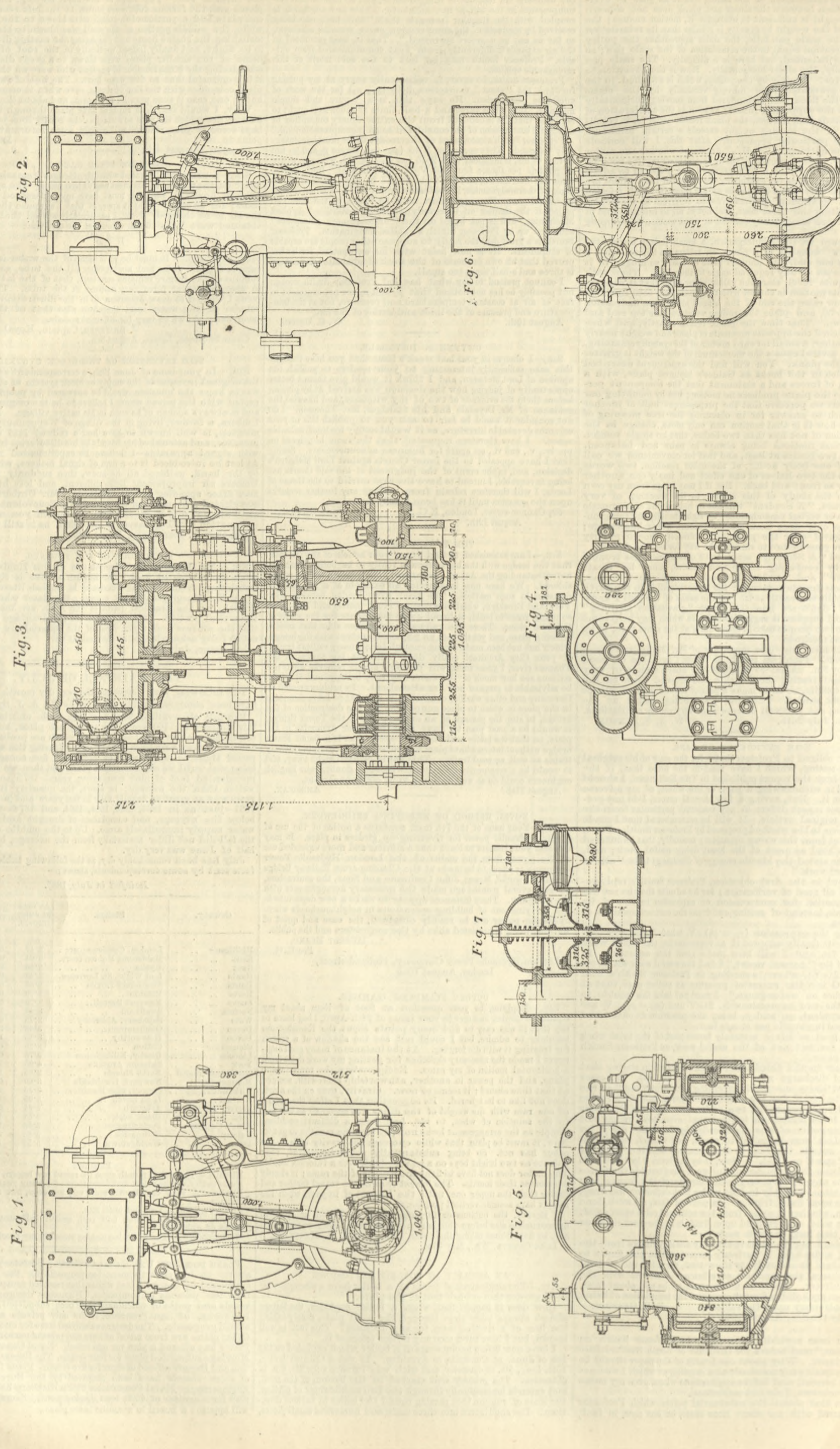
Cargen, Dumfries.—First half cold, second half unusually warm. Swarms of aphides.

Waringstown.—The finest haymaking season in my recollection.

PLANS FOR NEW U.S. NAVAL CRUISERS.—Secretary Whitney, in answer to his advertisement for proposals for the new cruisers authorised by Congress last winter, has received complete proposals from ten persons or companies. Numerous designs for parts of vessels and parts of machinery have been submitted. The Union Ironworks, of San Francisco, is the only private shipyard that offered proposals. The designs submitted were for one large cruiser. Other plans are from naval officers and private persons. Admiral Porter has offered a plan for one vessel. Naval Constructor W. L. Mintonye submitted plans for four vessels. The Bureau of Construction and Repair offered designs for five vessels. Plans for the engines of these vessels have been prepared by the Bureau of Steam Engineering. Naval Constructor Philip Hickborn has submitted a plan for a cruiser of 4500 tons displacement. Secretary Whitney will appoint a board to examine these plans.

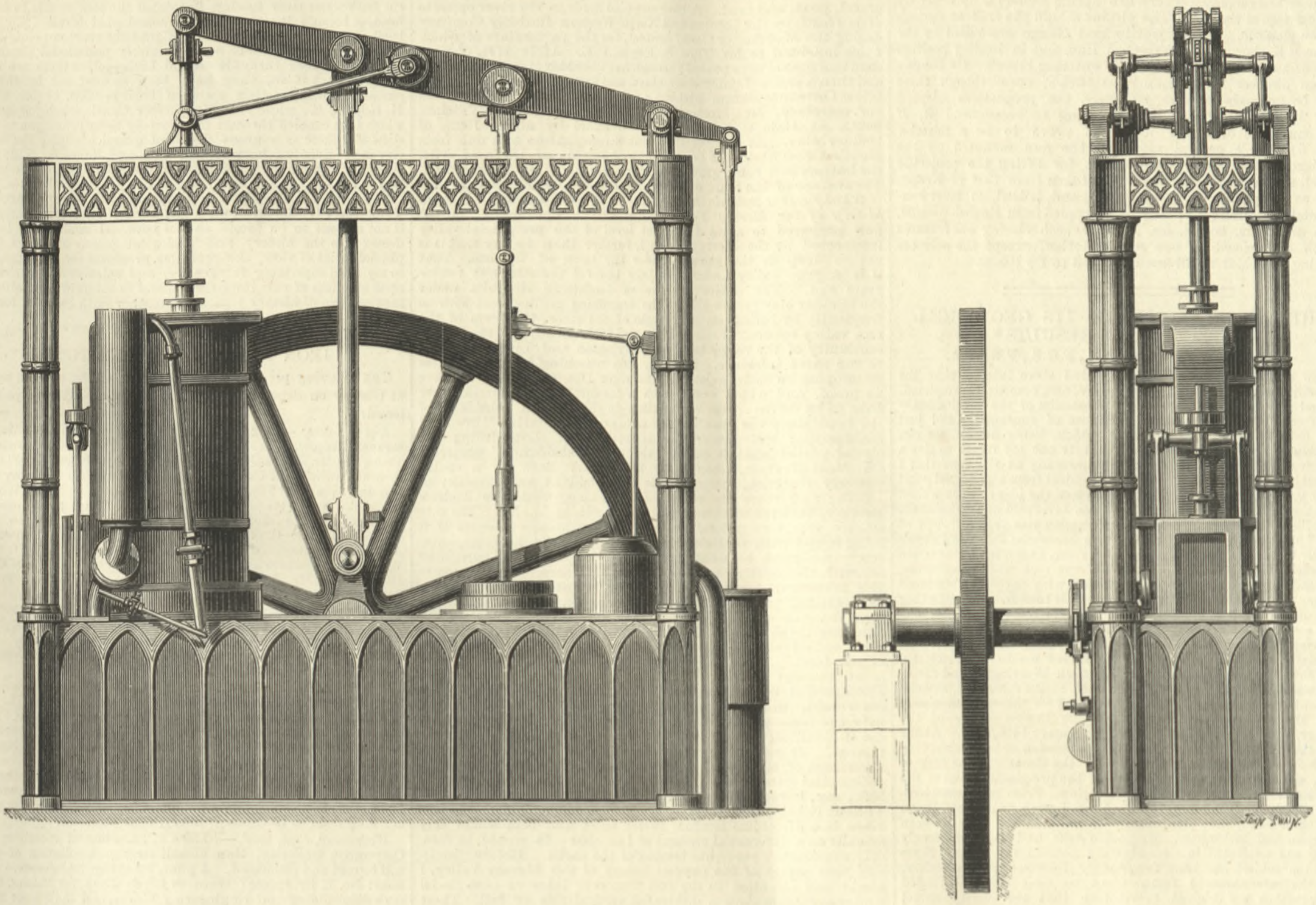
COMPOUND ENGINES FOR PASSENGER BOATS ON THE SEINE.

(For description see page 131.)



GRASSHOPPER ENGINE, EAGLE FOUNDRY, BIRMINGHAM.

ERECTED BY MR. BRUNTON, 1815.



ABOVE we illustrate a very interesting relic of Old Birmingham which has, we fear, by this time found its way to the scrap heap. It consists of a grasshopper or walking beam engine, which was erected at the Eagle Foundry in 1815, by William Brunton, an engineer of considerable note in his day, and the progenitor of several engineers who have made their mark. The Eagle Foundry was established about a century ago by Richard Dearman, and in 1814 Brunton joined the concern after having terminated an engagement with Messrs. Rastrick, Foster, and Co., of Shutt End, Stourbridge. The engine which forms the subject of our illustration was erected to supersede a beam engine put down by Boulton and Watt in 1796, which was not found to answer the requirements of the establishment. The boiler was fitted with one of Brunton's mechanical stokers, and this lasted down to 1876, when the engine finally ceased working. The cylinder is 24in. diameter, the stroke being 4ft. 6in. The slide-valve is worked from a weigh shaft connected with the eccentric rod. The beam is of wrought iron, and the air pump is worked direct from the beam. The usual working pressure was 7 lb. per square inch, the pressure being registered by an open-ended syphon mercurial gauge fitted with a float and index dial at the side. The greatest amount of vacuum ever obtained was between four and five inches. The engine underwent some alterations, a vertical condenser alongside the cylinder having been put up by Mr. Bernard Peard Walker, the former proprietor of the Eagle Foundry.

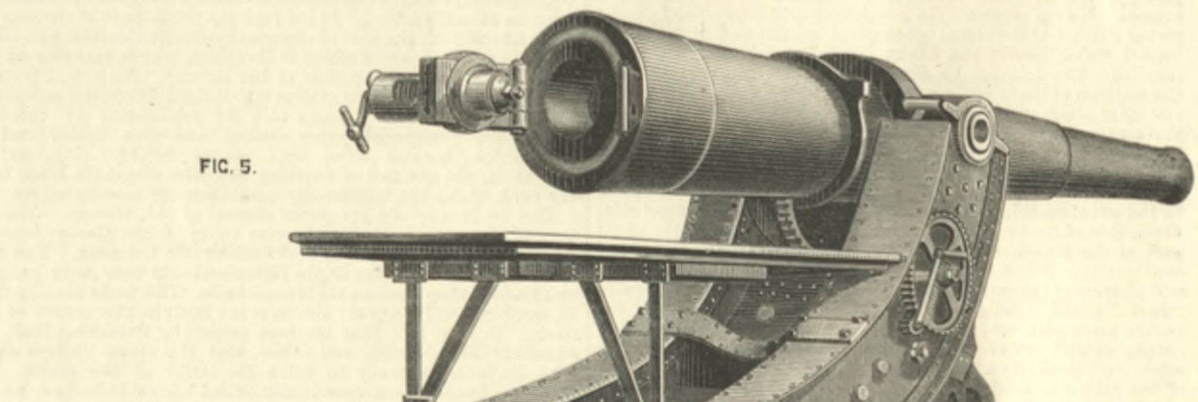
The grasshopper engine was for some years a favourite type of engine in South Staffordshire and Birmingham. Messrs. Rastrick built a considerable number. The original engines at the Chillington Ironworks were of this kind, and were, we believe, erected by that firm. The frontispiece to Robert Brunton's "Compendium of Mechanics," the sixth edition of which was published at Glasgow in 1834, shows an engine of this kind, together with the mechanical stoker. It is there described as "W. Brunton's portable engine," which seems to have been used about that time to denote any engine in which all the parts were contained upon a single bed plate. This fact should be noted by writers on the history of the steam engine, who might otherwise be led to antedate the portable engine, as we now understand the expression, by many years.

It was thought that the Eagle Foundry engine should have been secured for South Kensington, but the authorities either considered the price too high, or that it was not of sufficient interest. Whatever the reasons may have been, it is a matter of some regret that this relic should have been consigned to destruction. Some months ago the Department were fortunate enough to obtain a locomotive engine of the grasshopper type built by Messrs. Rastrick in 1829.

DE BANGE'S 34-CM. (13·4IN.) BREECH-LOADING GUN.

WE illustrate on page 126 the new gun of Colonel De Bange, exhibited in the Antwerp Exhibition with its carriage and platform. A detailed description of this gun will be found in *Le Genie Civil* of July 4th last, with a mathematical investigation of its powers, to which we are indebted for our information. The gun is not the 34-cm. breech-loading French gun spoken of by Colonel Maitland in his paper read before the United Service Institution. The gun described by Colonel Maitland was about 34 calibres long. It consisted of a single steel piece, strengthened by two layers of hoops from breech to about 4ft. in front of the trunnions, but forming the barrel from end to end, and taking all the longitudinal and a great share of the transverse strain. De Bange's gun, on the other hand, is strengthened by hoops from end to end; the hoops being much thinner than those of the other French 34-cm. gun. It will be seen that there are three layers of these hoops even beyond the trunnions. So thin are the hoops, however, that the maximum thickness of the gun, which hardly extends beyond the joint of the breech-block, is only about one calibre, while the inner tube is only 133 mm. (5·236in.) in the thickest part; whereas we should judge from the drawing that that of the other French 34-cm. gun is about 9in. In this Colonel De Bange supports the judgment of Colonel Maitland, who, in his paper, used the following words with regard to the 34-cm. gun:—"The 34-cm. gun consists of a very thick tube or body strengthened with layers of hoops. As in Krupp's guns, the whole of the metal comes into play transversely; but the longitudinal strain is taken by the tube alone. Personally, I do not like this construction; I think too much depends on the tube, and any failure of this part—which is, moreover, specially subject to the erosive action of the gas, would be disastrous in the extreme." That is to say, De Bange shares Maitland's preference for a thinner tube, and it seems that he looks for longitudinal support in the shape of hooking back from the trunnions to breech, although it is not easy to show this in the section. De Bange is said to claim the employment of a new kind of hoop, which is but imperfectly shown in Figs. 1, 3, and 4. The hoops are not true cylinders, but truncated cones. Fig. 4 shows the lower wall in detail, and it may be seen that the tube *a* could not slip back on the ring *b*. If *b* and all the rings had this nature of bite maintained up to the front of the trunnion ring there would be a hold from breech to trunnion on the principle of that of the long jacket on which the longitudinal strain is thrown now in nearly all English guns, but it is difficult to see how it is to be carried through the numerous joints here shown. There is little else peculiar in the design of this gun. De Bange naturally employs his breech-closing asbestos gas-tight rings. The gun cannot be heavy in proportion to its calibre. It is said to weigh 52 tons. It is certainly a long gun; 36ft. 3·4in. is the total length, giving a bore of about 30 calibres long, but, as said above, it is not thick in its walls. De Bange, we learn, hopes to fire projectiles of 600 kg. and 450 kg. (1323 lb. and 992 lb.) weight, with a charge of 180 kg. (397 lb.) The velocities of 1968ft. to 1984ft. are suggested; that would be high with the charge and shot first given. The powers of the gun have not yet been tested. Fig. 5 shows the carriage and platform. The chief features are the shape of the brackets and the provision for check of recoil. The carriage has trucks mounted excentrically, and the gun is brought on them in running up while it is lowered, so as to slide and cause friction

FIG. 5.



THE DE BANGE GUN.

in recoil. There is nothing in this very different from the system used in this country for fifty years. Then there is a hydraulic buffer, consisting of *v* cylinder attached to carriage and *u* piston attached to slide. The crank W connects the cylinder and carriage. There are spring buffers C to bring up the carriage at the end. The chains *a* hold the trail to springs in the platform. The projectile and charge are raised by the crane K K, shown down in dotted line, and in loading position in continuous line, with projectile entering breech. De Bange's design deserves to command attention, even though there may be no special feature to copy, the proportions adopted may be noted. There is something to recommend it, if the multitude of hoops does not prove to be a mistake. Fig. 5 shows a general view of the gun mounted on the carriage. The lever arrangement for lifting the projectile is well shown in it. It is probably taken from that of Krupp, just as many parts of the carriage, and, indeed, in most continental gun carriages, appear to be copied from English designs, such as buffers, trucks, &c. The breech closing has features which are claimed by one and another, except the asbestos packing, for which we all are indebted to De Bange.

THE MERSEY TUNNEL: ITS GEOLOGICAL ASPECTS AND RESULTS.*

By T. Mellard Reade, C.E., F.G.S., F.R.I.B.A.

Few engineering works have excited more interest than the tunnelling under the bed of the Mersey, now practically completed. It had all the elements to take possession of the imagination—great commercial importance, boldness of conception, and just that spice of uncertainty without which, being human, we can scarcely be thoroughly interested. It is not my object to give a history of the undertaking; but commencing at the time that I myself began to feel an interest in the subject from a geological point of view, I will attempt an outline sketch of the ideas that prevailed as to the nature of the river bed between Liverpool and Birkenhead. In 1870 I found that the general impression was that a "shelf of rock" extended across the river from Seacombe Point to Prince's Dock. That is, that the bed of the river, excepting for a certain superficial deposit of mud and sand, was rock all the way across. I found, however, from conversations with several experienced master pilots that this view was not well founded, although they were of opinion that it was rocky bottom from the Birkenhead side a considerable distance across. A series of borings from Warrington down the valley of the Mersey to Runcorn, and especially under the town of Widnes, led me to the conclusion that the rocky bed of the Mersey between Warrington and Liverpool was a river valley and not two rock basins connected, as some eminent geologists supposed. My reasons for this conclusion were fully stated in a paper entited, "The Buried Valley of the Mersey," read before this Society on January 14th, 1873. At the time that paper was written I was in possession of borings showing the depth of the rock over the area of the Great Float at Birkenhead, which conclusively proved that the pre-glacial outlet of the river could not have been in that direction. From many considerations which I cannot recapitulate here, I came to the conclusion that there was a deep depression or gully in the river between Liverpool and Birkenhead filled with drift, and this was strongly stated and reiterated in a concluding note in my paper. Since then the subject has been frequently discussed at this Society, and the information I from time to time obtained tended to strengthen my original conviction that the Mersey tunnel works would be sure to disclose this pre-glacial valley. The excavations of the Atlantic Docks at the mouth of the river disclosed the existence of branching gullies in the rock, deep below low-water mark† and apparently flowing towards the channel of the Mersey. This, to my mind, completed the evidence that the river formerly, as now, flowed past Liverpool, but at a considerably lower lever. In a letter to the *Builder*, February 4th, 1882, while the tunnel works were in progress, I restated the facts upon which I had based these conclusions, and on frequent occasions, at public lectures, at our visit to the Atlantic Docks, and in this room, I have maintained the same view. I trust that these remarks may not be considered egotistical; they are, in fact, necessary to show practical men that geology has, in some instances, attained to the rank of a science. We can previse. So much for prophecy. Now I propose giving a sketch of the actual geological results as disclosed by the tunnel works, leaving the exact figures and levels for a future occasion. The drainage headings, which are considerably below the rail level of the tunnel on the banks of the river, and gradually rise up on either side, until the level portion of the railway under the centre of the river is reached, were successfully driven and bored through the rock from either side until they met on January 17th, and several people had the gratification and novel sensation of walking through under the river, from Liverpool to Birkenhead. In the actual tunnel, at some 300 yards from the Liverpool side, the bottom of the pre-glacial valley was intersected by the upper part of the tunnel, the roof for about 100 yards being in hard boulder clay. Before this was all arched in, I had the opportunity and pleasure of inspecting it, my emotions being on this occasion rather "mixed"—delight at seeing what I had dreamt of for twelve years past, and pleasure at finding that my friends were getting so well out of their difficulty, and that this important work was practically a *fait accompli*. The rock forming the bed of the gully was good and solid, and swept clear of the *debris* which often lies between the boulder clay and the rock. Upon this reposed the hard boulder clay, which was of a similar nature to Bed No. 2, described in the section of the Atlantic Docks, in page 88 of my "Drift Beds of the N.W. of England," Q.J.G.S., May, 1883. It contained similar boulders of Eskdale and other granites, trappean rocks and greywackes, generally much water-worn, as they often are in these lower beds of boulder clay. In one place I observed a thin seam of yellow sand between the boulder clay and the rock; it evidently belonged to the lower bed of the low-level boulder clay and sands. As regards the rock, the dip is from Birkenhead to Liverpool, at about 10 deg., and I am informed that a fault was met with near the middle of the river, but this proved to be water-tight. The rock on the Birkenhead side I know, from having been in the lower heading while Major Beaumont's machine was boring it, was very hard and compact. The rock on the Liverpool side was softer, and more thinly bedded. All of this rock evidently belongs to the division of the Bunter which is called the pebble beds, but probably the rock on the Birkenhead side is at a lower horizon than that on the Liverpool side. The rock under the river was remarkably homogenous throughout, and comparatively free from faults. The throw of this one fault is unfortunately not known. Perhaps when the engineers publish their sections, we may know more about it. At St. George's Church, Liverpool, I am told another fault was met with, and here the tunnel is in a much softer rock. Opposite to Stonier's shop, in Lord-street, the tunnel intersects the bottom of a branch to the Old Pool, filled up with recent silt, and similar to what is met with in the foundations along the line of the Old Pool. Opposite to Whitechapel and Seel's-buildings, the bottom of the Old Pool was touched. Beyond this the tunnel is in rock, shading off at the top to red sand, covered with a thin bed of boulder clay. This portion I am well acquainted with, having had to inspect it for the Liverpool Tramways Company.

Borings in the upper reaches of the Mersey.—Since the publication of "The Buried Valley of the Mersey," a series of borings has been taken by Mr. George Hill, C.E., across the bed of the Mersey from Western Point to Hale Head, for the Upper Mersey Navigation Commissioners. It was supposed that the river was obstructed by rock, which if removed would much improve the navigation. So far from this being found to be the case, the existence of a rock valley was proved, the deepest part bored being 34ft. below Ordnance datum. This valley was filled up with gravel, peat, and sand. A bore was also made in the river opposite Hale Head, by the London and North-Western Railway Company during the Manchester Canal contest, for the particulars of which I am indebted to Mr. Thos. S. Keyte, C.E. After 17ft. of river sand and gravel were passed through hard boulder clay was entered, and then a series of quicksands, clays, and gravels, terminating 62ft. below Ordnance datum without reaching the rock. I learn from our secretary, Mr. Morton, that near to Mr. G. M. Williams' house, at Hale Cliff, the rock is overlaid by about 130ft. of boulder clay. At Halewood, about three-quarters of a mile from Hunt's Cross Station, a boring showed a depth of 137ft. of drift, the bottom bed being gravel 8ft. thick, resting upon Keuper marl. The surface of the marl was about 37ft. below Ordnance datum.

What further light do the foregoing facts throw upon the physical history of the Mersey Valley?—For certain reasons, I am not now prepared to state the exact level of the pre-glacial valley intersected by the Mersey Tunnel, further than to say that it is not so deep as the portion under the town of Widnes. That it is a true valley and not a lake basin I pointed out twelve years ago. The entire absence of lacustrine deposits under the boulder clay proves this. The branching gullies met with so frequently by borings on the margin of the river, the form of the rock valley between Western Point and Hale Head, and the proved continuity of the valley between Warrington and Liverpool point to the same inference. If, then, this reasoning be valid, unless we suppose an outlet existed by the river Dee—of which we have no proof, and which would seem a far-fetched explanation—we seem to be driven for an explanation to differential subsidence of the land since the rock valley was filled with marine "low-level boulder clay and sands." It is well-known that during the glacial period what is called "the great subsidence" occurred. On Moel Tryfaen, about sixty miles from here in a south-westerly direction, marine shells are found at an elevation of 1400ft.; and there are grounds for thinking, with Sir Andrew Ramsay, that the subsidence reached 2000ft. in Wales. The subsidence was very general and over a large area, evidences of it being found both in Ireland and Scotland. It is, however, absolutely unknown to what extent this vertical land movement affected the relative levels of the land surfaces. In addition to this movement, when the rocky gullies we are now considering were eroded and scooped out by running water, the land must have stood at a higher elevation than at present. This vertical movement, the extent of which is unknown, must be added to the great subsidence if we are to realise the total vertical subsidence of the land. The cause and nature of these land movements is at present unknown. They do not appear to have been accompanied by faulting, but this cannot positively be affirmed. No doubt, in course of time observations such as I now have the honour to lay before you will enable us to solve many of the difficulties; but, as you will perceive, it is a painfully slow process. It seems, however, reasonable to conclude that the movement of these great land masses must be to some extent of a differential nature; and it is easy to conceive that a difference of 50ft., say, between Widnes and Liverpool might in that way arise without it being perceptible by any surface dislocations. The distance in a direct line is about twelve miles, and this would only amount to a differential gradient of 1 in 1200. It would, in fact, only constitute a curve-like bending of the earth. Before dismissing this aspect of the physical history of the Mersey Valley, I would call attention to the fact than even later or post-glacial land-movements show a differential vertical rise or fall. There is, for instance, the well known 25ft. beach, found on the west coast of Scotland. This shades off to a few feet in Morecambe Bay, while in the neighbourhood of Liverpool there is an actual post-glacial subsidence; but I must confess that the relation of these movements has never been accurately defined. At the present moment there is a slow change of level going on in the coast of the Baltic. In 1750 there was set up a series of water marks all round the Swedish coast, from the mouth of the Tornea to the Naze, to settle a dispute between the Swedish astrologer Celsius and some Germans, as to whether the level of the Baltic had been rising or sinking. The gauges were renewed in 1851, and again this year, and have been inspected regularly at short intervals, the observations being carefully recorded. The result is that the Swedish coast has been steadily rising, while that on the southern fringe of the Baltic has been as steadily falling. In 134 years the north part of Sweden has risen about 7ft., the rate of elevation gradually declining to about 1ft. at the Naze, and nothing at Bornholm, which remains at the same level as in the middle of last century—*Nature*, December 18th, 1884, p. 150. It is evident that if the differential subsidence of the Mersey Valley begun with the subsidence of the land which the pre-glacial valley drained, and the valley and its tributaries became filled with marine boulder-clay, as we find it is, the absence of anything like later deposits lying upon the rock under the boulder-clay is satisfactorily accounted for.

The erosion of the pre-glacial channel of the Mersey.—The history of the scooping out of the rocky valley of the Mersey between Liverpool and Birkenhead is of considerable interest. You will remember that the rock on the Birkenhead side was more compact and harder than that on the Liverpool side. The beds also dip from Birkenhead to Liverpool; also there is a fault in the centre of the river. It is a fact that has been noticed by Professor Hull, our secretary Mr. Morton, and others, that the river valleys about here have a tendency to follow the strike of the rocks. The Mersey channel to a considerable extent obeys this law, and it has evidently, commencing at a higher level near the Birkenhead side, sawed its way laterally down the bedding plains, reaching the softer but still pretty hard rock on the Liverpool side, guided to some extent by the line of fault. What initiated the direction and position of the Mersey Valley is a complicated question, shrouded in the mystery of geological time, which much further investigation is needed to determine. But of this we may be pretty well assured, that the river has not chosen the harder rocks to erode by preference, but that formerly they were covered with rocks of a softer nature higher in the series, and that the river has eaten down to and exposed the harder beds. Then follows the result, which is expressed in the term "hard-gorge theory." That is, the inner basin of the river being composed of softer rocks, widens by vertical and lateral denudation, while the outlet in the hard rock narrows and deepens. This, with the differential subsidence already spoken of, accounts for the remarkable bottle-shaped form of the estuary of the Mersey, and its natural adaptability for a port.

Post-glacial channel on the Mersey, and the history of its formation.—I must now ask you to carry yourself back in imagination to the time when the land slowly emerged from the deep, after the great subsidence. The whole country was covered with a mantle of boulder clay, sands and gravels, the pre-glacial valleys being filled up, and to some extent obliterated by these glacial deposits. The land as it emerged became subject to the influence of rain, which cut channels through the drift in the readiest way it could to get to the sea. Hence the surface form of the drift would largely determine the course of the rivers. It follows from this, that in some cases the river Mersey left its old channels. It changed laterally its pre-glacial site at Widnes to the gorge at Runcorn, removing the boulder clay from that gorge down to the rock. Once sufficiently sunk into, and settled in its course through the glacial deposits, the position of the post-glacial river Mersey became fixed. Judging from the sections I lay before you, the current of the Mersey, again running at a higher level, with respect to the sea, as a fresh water river, then as now followed what was formerly a tributary only of the old stream. It scooped out all the glacial deposits to the rock, and filled the bed with gravels, peat, and sand, as the section between Hale Head and Widnes shows. It scooped out the glacial beds that filled up the gorge between Liverpool and Birkenhead, which on the subsidence of the river to its present level was aided by the tidal in-rush and out-pour, so remarkable a feature in our noble estuary. Fortunately for the tunnel works, the hard boulder clay filling up the deeper parts of the valley was left, it may be by the course of the fresh-water river having bottomed the rock nearer to Birkenhead, or because the river had reached what is called the "base level of erosion," and from lack of gradient could not clear its bed further. Doubtless there were formerly post-glacial deposits in the river, between Birkenhead and Liverpool, as there are nearer Runcorn; but if so, they have been scoured out by the tidal stream. The interesting series of borings taken by Mr. Charles H. Beloe, C.E., while the Manchester Canal was being opposed, which I am enabled through his courtesy to lay before you to-night, show that there is a great depth of gravel overlying the boulder clay in the river-bed between Garston and Runcorn. This gravel I consider is post-glacial, and due to the destruction of the boulder clay.

This district is doubtless looked upon with horror by geologists whose sport is palæontology; for, saving a few footprints, there is not a fossil to be found in the new red sandstone. Looking deeper into the history and geological genesis of things from a physical point of view, the problems presented for our solution are to my mind supremely interesting, and calculated to throw light upon questions of vast importance, and to aid us in unravelling the tangled skein of history which our mother earth has spun for us.

* Proceedings of the Liverpool Geological Society.

† "The Drift Beds of the North-West of England," Part II., Q.J.G.S., May, 1883.

IRON AND STEEL INSTITUTE.

The following preliminary programme of the autumn meeting at Glasgow on September 1st and following days has just been issued:—

List of papers.—"On the Iron Trade of Scotland," by Mr. F. J. Rowan, Glasgow. "On the Rise and Progress of the Scotch Steel Trade," by Mr. Jas. Riley, Glasgow, Member of Council. "On the Present Position and Prospects of Processes for the Recovery of Tar and Ammonia from Blast Furnaces," by Mr. Wm. Jones, Langloan Ironworks, N.B. "On the Structural Features and Working of the South Chicago Blast Furnaces," by Mr. F. W. Gordon, Philadelphia, and Mr. E. C. Potter, Chicago, U.S.A. "On Certain Accessory Products of the Blast Furnace," by Mr. T. Blair, Wingerworth Ironworks, Derbyshire. "On a New Form of Cupola Furnace," by Mr. James Riley, Glasgow. "On a New Form of Pyrometer," by Mr. A. von Bergen, Middleton Ironworks, Darlington. "On the Ancient and Modern Methods of Manufacturing Tin Plates," by Mr. Philip W. Flower, Melyn Tinworks, Neath. "On the Manufacture of Basic Steel on the Open Hearth," by M. Pourcel, Bilbao, Spain. "On the Forth Bridge," by Mr. Benjamin Baker, M.I.C.E., London.

Tuesday, Sept. 1st.—10.30 a.m., general meeting of members in the Corporation Galleries, Sauchiehall-street, Glasgow. The members of the Institute will be received by the Hon. the Lord Provost of Glasgow, and the members of the Local Reception Committee.* A selection of papers will be read and discussed. 1 p.m., luncheon at the Corporation Galleries. Alternative excursions: No. 1, by train to Hallside Steelworks, thence to Steelworks at Motherwell, &c. No. 2, by train to Gartsherrie and Summerlee Ironworks at Coatbridge, thence to Calder, Mossend, and Langloan Ironworks. No. 3, by train to Earnock Colliery, near Hamilton.

Wednesday, Sept. 2nd.—10.30 a.m., meeting of members in the Corporation Galleries, Sauchiehall-street. A selection of papers will be read and discussed. 1 p.m., luncheon. Alternative excursions: No. 1, by special train to Clyde Bank, for Messrs. Thomson's Shipbuilding and Engineering Works, and the Singer Sewing Machine Company's Manufactory; thence to Dumbarton, for Messrs. Denny's Shipbuilding and Engineering Works. No. 2, by ordinary train to Greenock, to inspect the Docks, Harbour, and Shipbuilding Works. No. 3, by special omnibuses to the Shipbuilding and Engineering Works of Messrs. R. Napier and Co., and Messrs. John Elder and Co., at Govan. No. 4, by special omnibuses to Govan Ironworks, and the Glasgow Locomotive Works. No. 5, by special train to Blochairn Steelworks and Caledonian Railway Locomotive Works, St. Rollox. 7.30 p.m., annual dinner of the Institute at M'Lean's Hotel, St. Vincent-street. Tickets, 21s. each, including wine. Members may procure tickets for friends; evening dress optional.

Thursday, Sept. 3rd.—10.30 a.m., general meeting of members in the Corporation Galleries. A selection of papers will be read and discussed. 1 p.m., luncheon. Alternative excursions: No 1, by ordinary train to Carron Ironworks, near Falkirk. No. 2, by ordinary train to the new Basic Bessemer Steelworks of Messrs. Merry and Cunningham, at Kilbirnie. No. 3, by ordinary train to Addiewell Oilworks. Members are specially requested to indicate, on the form sent herewith, which of the alternative excursions they propose to join, on each of the first three days of the meetings.

Friday, Sept. 4th.—Excursion, per special steamer Columba, to Inveraray, *viâ* the Kyles of Bute, on the invitation of the Local Reception Committee.

Saturday, Sept. 5th.—Excursion to the Forth Bridge Works, South Queensferry. Members going on the excursion will be able to get the late afternoon trains North and South. Detailed particulars of all the excursions will appear in the final programme, to be circulated at the meeting.

Hotels.—Members are informed that the principal hotels in Glasgow are; St. Enoch's Station Hotel, St. Enoch-square; the Central Station Hotel, Gordon-street; the Grand, Sauchiehall-street; M'Lean's, St. Vincent-street; the Queen's, and the George, St. George's-square.

The secretaries' office will be open at the Corporation Galleries, Sauchiehall-street, on the afternoon of Monday, August 31st, for the issue of programmes, members' cards, dinner tickets, &c. The general secretary's address, from August 25th, will be St. Enoch's Station Hotel, Glasgow.

* A large and influential Local Committee has been formed in the West of Scotland for the reception and entertainment of the Institute.

Electrical Lighting in Stockholm.—A company is in formation in Stockholm for the purpose of supplying private consumers with electric light from a central station. The capital will be £10,000 in shares of £15.

Death of Thomas Box.—We announce with regret the death on Sunday, August 2nd, of Mr. Thomas Box, aged sixty-four. Mr. Box was the author of several standard text-books of very great utility, among which we may name one on heat and another on mill gearing.

An Enormous Manufacturing Concern.—The Pacific Mills, situate at Lawrence, Massachusetts, are reported to be the largest textile manufacturing corporation in the world. The capital stock is 2,500,000 dols. The number of the mills and buildings is 23, covering 43 acres of space; there are in use in these mills four large steam engines of 3500-horse power; 42 small steam engines; 50 steam boilers and 11 turbine wheels of 5000-horse power. The annual consumption of coal is 25,000 tons; the annual consumption of gas, in 9000 burners, costs 35,000 dols.; the annual consumption of cotton is 15,000 bales; the annual consumption of wool is 4,000,000 lb., being the product of 750,000 sheep. The annual capacity of the Pacific Mills is: In cottons, printed and dyed, 65,000,000 yards; worsted goods, 35,000,000 yards; or a total of 100,000,000 yards, equal to two and a-quarter times the distance round the world. To make this cloth nearly 200,000,000 miles of yarn are required. To accomplish this work 3600 females and 1900 males, or a total of 5500 persons, are employed. The pay roll for the year ending May, 1884, amounted to 1,790,000 dols.

RAILWAY MATTERS.

IT is proposed to run a special train through the Severn Tunnel next month.

THE most reliable official figures show that there are 29,227 locomotives of all kinds belonging to the railroads of North America. An American paper reckoning the life of a locomotive at twenty-five years, estimates that 1169 locomotives ought to be built annually to maintain the stock. It is believed that last year the renewals of locomotives were far below the necessary requirements.

THE lines of the Birmingham and Midland Tramway Company, between Birmingham and Dudley, and also between Birmingham and West Bromwich, will shortly be opened for traffic. The Board of Trade has granted its certificates, and the requirements of the Smethwick Local Board will soon be met. The lines being of a uniform gauge, the journey will be completed without a break.

DOWLAIS is progressing with arrangements for the Indian steel sleepers. Those made for the London and North-Western were simple in comparison, but there is little doubt that the management will succeed, though it may take a little time. It is rumoured at Tredegar that the company there has secured an order for several thousand tons of these Indian steel sleepers from Government.

THE proprietors of the *South American Journal and Brazil and River Plate Mail* are publishing a railway map of South America. It is printed on four sheets, making, when joined, a map of about 36in. by 45in. Besides railways, the map shows the location of various mining properties, central sugar factories, and estates in which English capitalists are interested. It is a map which will no doubt find wide patronage amongst those interested in South American enterprises.

WRITING on "Poor Steel Rails," a correspondent of the *Railroad Gazette* tells a bad tale of American rails. He says: "The Michigan Central laid in 1881 English rails exclusively; in 1882, 1883, and 1884 American rails, from a different mill each year. Crushed ends occur in the English rails to a slight extent, more frequently in the American rails of 1882, still more frequently in those of 1883, and the 1884 rails are the worst of the lot. How serious a matter this is may be gathered from the statement that of 536 rails laid in one piece of track in July, 1884, 220 rails had been removed by the following February—six months—and 50 per cent. of the lot were taken out, on account of crushed ends, before the expiration of the first year. In one stretch of 17 miles of the 1883 rails, 90 per cent. will not run through the next winter if it is as severe as the last, and the road-bed rigid for so long a time."

THE London and North-Western Railway is now 1725 miles in length and owns 2347 locomotives. The total mileage of these was last year 45,803,381, which means 125,489 every day, 5229 every hour, 87 miles every minute, or 1·45 each second; in other words, the North-Western Company's engines collectively go over a distance equal to the circuit of the earth every four hours and a half. Steel is used in this company's engines more than on any other railway. There are no fewer than 1679 of their engines with steel boilers, with the best results. The quantity of steel rails annually required for renewals is 20,000 tons, every mile run by an engine involving an actual loss to the rails of one-third of a pound of steel, so that 15 cwt. of steel disappears from the rails every hour of the day. The wear and tear to the engines is such as to require a new engine being put into work every five days, this giving a fair idea of the enormous amount of work done at Crewe.

THE prospectus has been issued of the Indian Midland Railway Company, which is an extension of the Great Indian Peninsula Railway system *viâ* Bhopal to Gwalior, Agra, and Cawnpore. The capital is £3,000,000 in 150,000 shares of £20 each, and interest will be payable in sterling at the rate of 4 per cent. per annum, guaranteed by the Secretary of State for India, with one-fourth of surplus profits beyond 4 per cent. The capital is repayable on determination of contract, which is to be determinable at the option of the Government in 1910, 1920, or any subsequent tenth year. The company has been formed by the directors of the Great Indian Peninsula Company, under the supervision and with the support of the Secretary of State for India, with a view to bring the Great Indian Peninsula Railway into direct communication on a uniform gauge with the system of railways that serve the provinces in the North-West of India, and to develope traffic from Bundelkund.

THE *Railroad Gazette* record of train accidents on American lines in June contains notes of 27 collisions, 44 derailments, and 4 other accidents—a total of 75 accidents, in which 24 persons were killed and 115 injured. These accidents are classed as to their nature and causes as follows:—Collisions: Rear, 20; butting, 7—27. Derailments: Broken rail, 2; broken bridge, 3; spreading of rails, 8; broken wheel, 1; broken axle, 5; broken brake beam, 1; accidental obstruction, 1; cattle, 4; wind, 2; misplaced switch, 5; purposely misplaced switch, 1; malicious obstruction, 1; unexplained, 10—44. Other accidents: Boiler explosions, 1; broken axle, not causing derailment, 1; broken excentric strap, 1; car burned while running, 1—4. Total, 75. Three collisions were caused by misplaced switches, 3 by freight trains breaking in two, 3 by failure to signal following trains, 2 by engineers running trains in disregard for signals, and 1 each by mistake in orders, by a flying switch, and by a car blown out of a siding at night.

ON Monday morning an accident, resulting in the death of two persons and injury to seven more, occurred at Huddersfield Railway Station. The London and North-Western Railway Company is having its Huddersfield station enlarged, and a new iron roof put on in place of the old one. The roof outside the station had to be supported on iron pillars fixed at regular intervals along what is intended as an island platform. About eight or nine of these pillars had been fixed, and the roof rested apparently securely on about five of them. A powerful movable platform had been used for the purpose of erecting the new roof, and this had been moved from under it with the view of continuing the erection further along the station. At half-past ten two trains had just passed under the structure when, with a noise like thunder, the whole of the new roof collapsed, and brought with it a number of joiners, who had been working in among the girders. The man who was on the top, named James Brewer, was killed, and another named William Priest, who was sitting on one of the platform seats, was struck on the forehead and killed at once. Several others were injured. The lines were blocked till about half-past two o'clock.

IN the town of Gera, Saxony, a number of men were employed who lived in the town of Ronneberg, 6½ miles distant. It was apparently to keep these men from moving away that the authorities of Ronneberg contracted with the management of the State Railroads to pay 44s. daily, in return for which it should have the right to issue weekly commutation tickets to and from Gera for 200 men. The town sells these tickets every Sunday for about 15d. each, good for the round trip daily for six days, amounting to 78 miles of travel, or 5c. for the round trip. The price paid by the city was just one-half the regular fourth-class fare for this number of tickets. This arrangement first went into effect in December, 1883, and in that month only about 200 persons availed themselves of it. The number has risen since to 300. A special train is provided with third-class cars, in which none but holders of the city tickets are permitted to ride. It leaves Ronneberg at 5.20 a.m., and Gera at 7.30 p.m., giving time for a long day's work. The run is made in 18 minutes. Ronneberg now pays about 62s. per day for the train, which makes it earn about 5s. per train mile, which is not very bad. The *Railroad Gazette* says:—"People who wish to establish a workman's town near a great city might copy this example. By contracting to pay for a train they might offer tickets as a part of the rent, and so help out their real estate speculation. But such an enterprise can be successful only when a large number use the train, and in any new town it may be necessary to pay for the train for some years before the passengers make good the outlay."

NOTES AND MEMORANDA.

THERE is a very interesting new manufacture growing out of the coal-tar colour industry, and that is, the preparation of derivatives of quinoline as substitutes for quinine.

AN experiment, says the *Journal of the Franklin Institute*, illustrating the effects of superheated steam in causing spontaneous combustion, was once tried as follows:—Steam was taken from an ordinary boiler through a pipe 40ft. long; 10ft. from the farther end a collar of wood was fitted closely to the pipe; 10ft. near the boiler a lighted kerosene lamp was placed under the pipe. In ten minutes the wooden collar was on fire.

RAIN water collected at the Meteorological Observatory of Algiers was examined throughout last year, and the following substances determined:—Sodium chloride was present in quantities varying from 17·4 to 52·6 per million, iron as oxide or carbonate from 0·7 to 7·8 per million, whilst the quantity of ammonium nitrite varied from 0·14 to 0·29 per million, whereas of ammonium nitrate only traces were detected, and in two cases none at all.

FEARS have been expressed that the great bronze statue of Liberty about to be erected in New York would be materially affected by voltaic action between the bronze of the exterior and the iron interior framework. Mr. Bartholdi has, however, provided against this by, it is said, interposing small plates of copper covered with rags smeared with red lead. Reference to other statues of bronze carried on iron framing, such as the 75ft. statue of St. Charles Borromeo on Lake Maggiore, or to copper cupolas, such as that of the Theatre of Monte Carlo, which is near the sea, does not bear out the fears expressed.

HERR J. MULLER, a German mining engineer, has introduced the practice of bringing light coins of silver and gold to the standard weight by electro-deposition of the metal on their surfaces. The coins form the cathode of the electrotyping bath, and a band of silver or gold, as the case may be, is used as the anode. For silver coins, the solution that is decomposed by the electric current consists of fifteen grams of chloride of silver freshly precipitated in a saturated solution of cyanide of potassium, to which water has been added to make one litre of solution. Two Leclanché cells form the source of the current. The *Engineering and Mining Journal* says:—"As 101 milligrams of silver are found to be deposited in an hour by this arrangement, the coins are exposed in the bath for a length of time sufficient to supply the silver that they lack. For slight deficiencies there is no defacement of the inscription."

M. PUSCHER, of Nüremburg, has described a simple process whereby he claims to cover iron and any other metals with a black coating similar to enamel, and very much more equal in thickness and regularly distributed, as it is not laid upon the metal with a brush or any similar tool. M. Puscher places in a vase about 18in. high sufficient finely powdered coal to cover the bottom of the vessel to a depth of about ¾in.; and over this at a height of about 1in. is placed a grating which carries the objects to be treated. The vessel is then covered and luted down tightly, and placed upon a brisk fire. The vessel is at once filled with steam, which soon evaporates and is then charged with bituminous vapour. The firing is maintained for about half an hour, so that the bottom of the vessel is kept at dull red heat, after which it is removed, and when cool opened. The remainder of the coal is found in the form of coke; and the objects placed upon the grating, which have been at a fairly high temperature for a considerable time, are found to be covered with a black coating having all the appearances of enamel, but, the *Scientific American* says, of extreme tenacity and a considerable degree of elasticity.

THE experiments of Coulier and Mascart, extended by Aitkin, have demonstrated that in a perfectly most air no formation of fog is possible, however much the temperature is lowered, so long as the air is absolutely free of dust; and that the more air, sufficiently moist, is charged with such foreign particles, the more intense is the formation of fog under a sufficient lowering of the temperature or pressure of the air. Let filtered and completely moist air in a glass ball have its pressure diminished, then will only a few particles of fog reveal themselves to the most careful inspection, even under the powerful light of an electric lamp—particles of fog which, moreover, yield not the slightest coloured image. Admit now into this filtered air a few cubic millimetres of ordinary house air, then will a very fine, silvery, transparent fog at once form itself, of such slight density that even in the case of a considerable area of it the transparency of the atmosphere would be but very little affected. At the first moment of its formation let a reflected image of the sun, or the reflected light of an electric lamp, be viewed through it; the image will be seen surrounded by an intensely luminous blue or greenish light, with a broad, reddish ring, the colouring of which may range through all stages from brilliant purple red to the most delicate pale pink.

AT a discussion on the spontaneous combustion of wood before the French Academy in 1879, M. Cosson described an accident which had occurred in his laboratory a few days before. While the narrator was working in the laboratory, a portion of the boarding of the floor spontaneously took fire. The boards were in the vicinity of an air-hole, fed with warm air from a stove four metres away on the floor below. A similar accident had occurred two years ago, and in consequence M. Cosson had the boards adjoining the air-hole replaced by a slab of marble. The boards which now ignited adjoined the marble. The heat to which the boards were subjected was, however, very moderate, being only that of air at 25 deg. C.—77 deg. F. Nevertheless, M. Cosson said the wood had undoubtedly been slowly carbonised. Being thus rendered extremely porous, a rapid absorption of the oxygen of the atmosphere had resulted, and sufficient heat was thereupon produced to originate combustion. The danger thus disclosed, said M. Cosson, is one to which the attention of builders ought to be directed. In the instance in question, M. Cosson was able to extinguish the fire with a little water, as he was present and witnessed its beginning; but had it occurred at night, during his absence, it would undoubtedly have completed its work of destruction. M. Fayé stated that at Passy, a few days before, a similar case of spontaneous fire, due to the action of the warmth from the air-hole of a stove upon the woodwork, had occurred at the house of one of his friends.

THE Government Astronomer of Hong Kong has published a notice with regard to typhoons, from which it appears that the earliest signs of these phenomena in the China seas are clouds of the cirrus type looking like fine hair, feathers, or small white tufts of wool travelling from east to north, a slight rise in the barometer, clear and dry but hot weather, and light winds. These are followed by a falling barometer, while the temperature rises still further. The air becomes oppressive from increasing dampness, and the sky presents a vaporous and threatening appearance. A swell in the sea, and also phosphorescence of the water, as well as glorious sunsets, are other signs useful to the mariner who is acquainted with the usual conditions in the locality. When the typhoon is approaching the sky becomes overcast, the temperature in consequence decreases, the dampness increases, and the barometer falls more rapidly, while the wind increases in force. Nearer the centre the wind blows so that no canvas can withstand it, and the rain pours down in torrents, but there is no thunder and lightning. Still nearer the centre there is less wind and rain, and the sky is partly clear, but the sea is tremendous. This is therefore the most dangerous position. Typhoons may be encountered in any season of the year, but are most frequent in August and September. They appear to originate south-east of the Philippine Islands. In August and September they frequently pass east of Formosa, or travel towards north-west up through the Formosa Channel, or strike the coast of China. Afterwards they usually recurve towards north-east and pass over Japan or across the sea north of Japan, but not with the violence that is characteristic of tropical storms. During the remainder of the year they most frequently cross the China Sea from east to west.

MISCELLANEA.

THE system of Mr. J. E. Stafford, borough engineer, Burnley, viz., the Beehive refuse destructor for the treatment of towns' refuse, has been adopted by the Municipality of Bombay.

THE agitation among some of the Scotch miners for an increase of wages appears to be assuming a more determined phase, but the state of the trade is not so favourable to their success as it was a month or two ago.

THE sum of 150,000 francs has been voted by the Paris Municipal Council as a subvention to French Syndical Chambers for participation in an International Workmen's Exhibition, to be held in Paris next year.

WE are informed that the "Gandy" belting has just been awarded a medal at the Paris Milling Exhibition, and also a gold medal—highest award—at the New Orleans Exhibition, where the 60in. main driving belts were of Mr. Gandy's manufacture.

PROFESSOR R. H. THURSTON is leaving the Stevens Institute of Technology to assume the position of director of the Sibley College, which has been very much enlarged and enriched through the liberality of the Hon. Hiram Sibley, of Rochester, U.S.A.

FOUR Whitworth Scholarships have been gained by Scotchmen: Hugh O. Bennie, second; Wm. T. Calderwood, 5th, both trained at the Glasgow College of Science and Arts; James Rorison, eighth; and Robert Smith, fourteenth, of Anderson's College and the College of Science and Arts.

A FIRST-PRIZE gold medal for a sheaf-binding reaper has been awarded at Chartres to Mr. Walter A. Wood, in competition with Messrs. Hornsby, McCormick, Osborne, Champion, and Johnson. The trial took place under the auspices of the French Government, and lasted three days.

THE Saddlers' Company have established four studentships, each of the annual value of £30 and tenable for two years, at the Finsbury Technical College of the City and Guilds of London Institute. The studentships will be competed for at the entrance examination to be held at the college on October 1st, and are open to pupils above fourteen years of age who are attending, or who have attended, any public elementary school in the United Kingdom.

A TRIAL was recently made in the presence of the Secretary-General and other officials belonging to the Italian Ministry of Agriculture, in sinking Norton's tube wells. The experiment was highly successful, and good potable water was obtained at a depth of 6 metres (20ft.) below the surface. It is considered that these wells will prove of great utility in the Roman Campagna, and the Minister has ordered further experiments to be made, to which the various agricultural societies will be invited.

MESSRS. WILLIAM BAIRD & CO., of Gartsherrie, have been making experiments with creosote oil—one of the bye products of their manufactures—which show that the oil can be used to advantage in yachts and small steamers as a fuel for raising steam in the boilers. Injected into the furnace of a steam launch the oil has been found to answer well, the cost of the quantity required for propulsion being about ½d. an hour. Of course, in larger vessels it would be greater, but the efficiency and economy attained are such as to indicate that the subject may be worth some attention.

THE annual meeting of the British Society of Mining Students will be held on Tuesday, August 18th, 1885, at the Harton Collieries, South Shields. The whole of the magnificent modern plant of the Harton, St. Hilda, and Boldon Collieries will be shown to the members. In addition to the Harton Collieries, there will be three personally conducted groups of members: (1) Wire Rope Works, Tyne Docks, Plate Glass Works, Gasworks at South Shields, River Tyne Commissioners' Works at the Piers. (2) Wire Rope Works, Tyne Docks, Boldon Colliery. (3) Rope Works, Tyne Docks, Palmer's Shipbuilding and Ironworks, and Hebburn Collieries special pumping plant.

A MEETING of Cleveland ironmasters and operative delegates was held at Middlesbrough on Monday last, to consider the question of renewing the wages sliding scale. Both masters and men appeared desirous of having some arrangement of the kind, but the men wish to make certain alterations. Their representatives claim an advance of wages for certain classes of workmen, whose work is increased proportionately to output. The employers will not, however, entertain any modification, having for effect an increase of the cost of production. No satisfactory arrangement was therefore come to. Another meeting will be held shortly, when the men have had further time to consider the matter.

SPEAKING at Barnsley on Monday, Mr. Thomas Burt, M.P., advocated in the case of colliery explosions that they should be the subject of special investigation by experienced men, such as was held when a great railway collision occurred. He impressed upon his hearers, who were mainly miners, the great danger of omitting to support the roof with props and sprays. Taking the last thirty years, the number of deaths through insufficient timbering was nearly double the fatalities from explosions. Greater supervision was required in regard to timbering, and this could only be effected by Act of Parliament. The authorities should be compelled to supply a sufficient quantity of timber, placed convenient to the work, in order that the miners might protect themselves against danger.

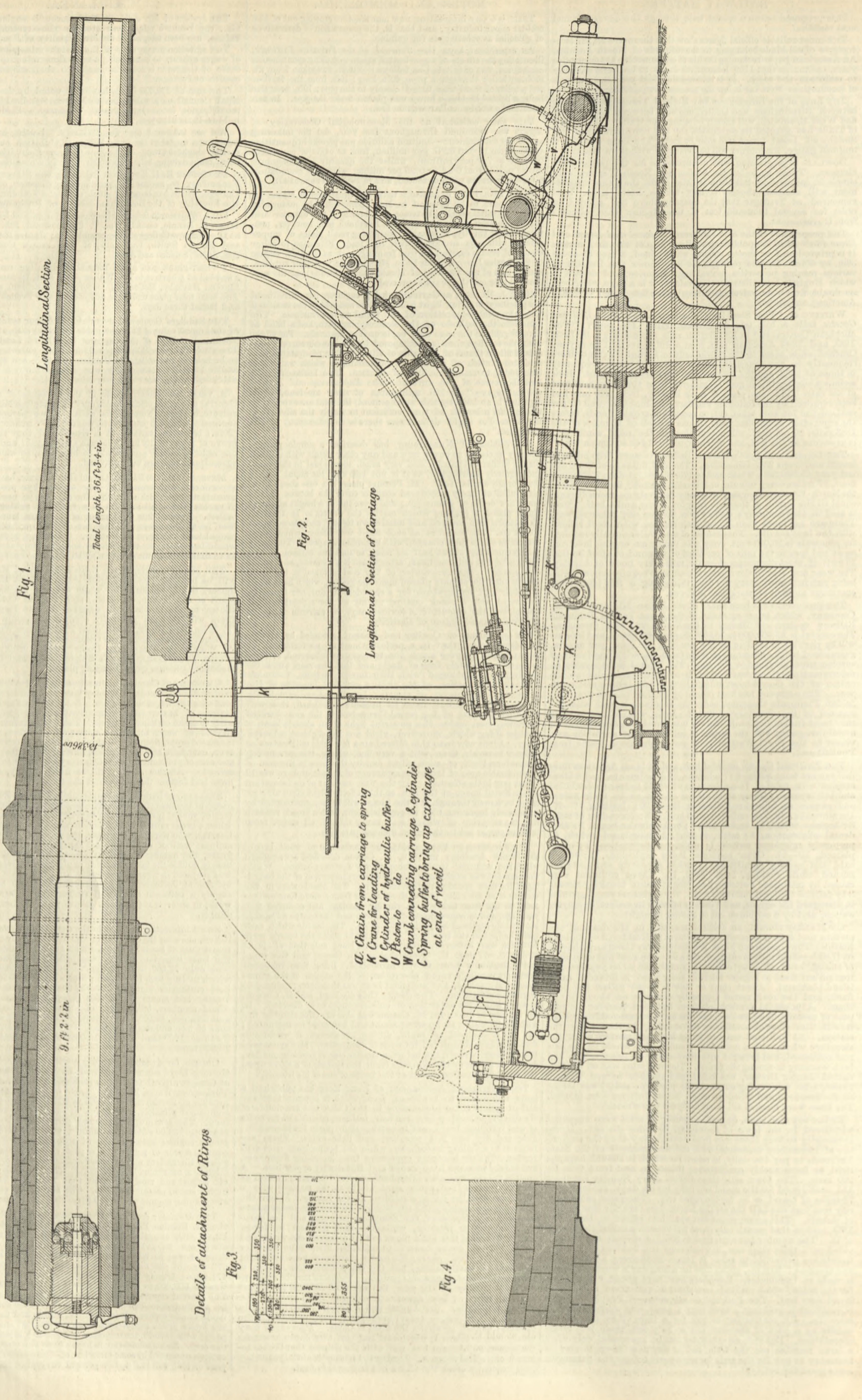
SOME interesting statistics in the coal trade have just been published, showing the character of the Welsh trade. The best customer Cardiff has is Port Said, which took 60,000 tons in July, and the least important amongst the principal Buenos Ayres, which took only 12,000 tons. Newport's principal customer is Genoa, which in July took 15,000 tons; Malta only 5000 tons. Swansea's best customers were the French, Russian, and Genoese ports. During last month Cardiff sent away to foreign destinations, in round numbers, 588,000 tons of coals; Newport, 169,000 tons; and Swansea, 69,000. In the same period Cardiff sent away 13,000 tons of iron and steel; Newport, 7000 tons of iron and steel; and Swansea, 1000 tons. Cardiff, 18,000 tons of patent fuel; Swansea, 29,000 tons.

ORDERS for six sets of pumping engines required for the North German Lloyd steamers being built by Messrs. John Elder and Co., of Glasgow, have been placed with Messrs. W. H. Allen and Co., of York-street Works, Lambeth. Each of these enormous vessels is capable of developing from 7000 to 8000-horse power on the triple compound principle, with 150 lb. of steam pressure on the square inch. The centrifugal circulating pumps will be capable of discharging 10,000 gallons per minute, and will be fitted with compound engines having cranks at right angles. Each boat will contain a pair of pumps and a pair of compound engines. The pumps themselves will be capable of raising water direct from the bilge to a maximum height of 25ft. These vessels will be amongst the largest and most important that have yet been built with so high a steam pressure as 150 lb. The combined power of each set of pumping engines will be 250-horse power for one ship.

THE *Moniteur des Fils et Tissus* reports that the production of the St. Etienne Ribbon Industry for 1884 amounted to a value of £2,441,600, as against £2,742,000 in 1883. The reduction in the above case might have been greater if the figures of the local condition house be taken into consideration. In 1883 there were 672 tons of silk conditioned, while in 1884 the quantity was only 471 tons. During the years 1870 to 1876, the annual production was £3,600,000 to £3,840,000, of which two-thirds was exported. The present exports are only about £725,000, so that the loss can be attributed to diminution of exports, while domestic trade has made some progress. It is, however, remarked that on account of the lower prices now current for raw material and labour, as compared with 1870-76, the reduction in quantity is really only about 20 per cent. Manufacturers are in hopes that the more favourable indications presented by some branches of the trade during the earlier part of 1885 will lead up to a general revival of their industry.

THE DE BANGE GUN, ANTWERP EXHIBITION.

(For description see page 123.)



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VINCENT'S RIVET MACHINES.

(*To the Editor of The Engineer.*)

SIR,—I shall be glad if any of your readers can inform me who are the makers of Vincent's patent bolt and rivet forging machines. J. P. M.
London, August 11th.

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DEATH.

On the 2nd inst, at Ipplepen, Newton Abbot, THOMAS BOX, C.E., aged 64 years.

THE ENGINEER.

AUGUST 14, 1885.

THE AMALGAMATION OF LLOYD'S AND THE LIVERPOOL REGISTRIES.

THE amalgamation to which we referred last week as impending between Lloyd's Register of British and Foreign Shipping and the Liverpool Underwriters' Registry for Iron Vessels is now an accomplished fact. According to the terms of the agreement the further publication of the Liverpool Registry will cease. The vessels now classed, or being built to class, in that Book, will be entitled to the publication of their class in future issues of Lloyd's Register Book, so long as their owners comply with the present rules of the Underwriters' Registry relating to periodical surveys. In case the owners of vessels holding the Liverpool class desire to obtain Lloyd's class, the latter Society undertakes favourably to consider the vessels' claims on the documents produced by the Underwriters' Registry and on the necessary surveys as to present condition, with a view to assigning these vessels the highest class to which they may be entitled free of charge to the owners. In dealing with such cases full allowance is to be made for any compensation for deviations from Lloyd's Rules, and the vessels are given the advantage of any difference in scantlings between the Rules as now existing and those which were in force when the vessels were built. The Committees of Lloyd's Register in London and Liverpool are to be enlarged by the admission of some members of the Underwriters' Registry, amongst whom we are pleased to see the name of Mr. Alfred Holt. The survey of Liverpool classed vessels will, it is stated, be carried out as far as practicable by the present staff of the Underwriters' Registry, who, with a few exceptions, will be taken over by Lloyd's Register. This transfer will not include Mr. Rundell, the talented secretary of the Red Book, nor Mr. West, its respected surveyor-in-chief. The former will enjoy a suitable pension, to which his services and his years fully entitle him; the latter, we have heard, has elected to retire from official life with the intention of entering upon business on his own account, and his invaluable services to the Registry have received a handsome acknowledgment at the hands of the Committee. In all this there is nothing that calls for comment. The terms appear to be perfectly fair towards owners of Liverpool classed ships, who are virtually the only parties directly interested. They will secure the insertion of their vessels' class in a register with a circulation about four times as great as the Red Book, and on precisely the same conditions as they obtained the Liverpool classification.

The arrangements respecting the existing tonnage, however, possess but a passing interest for any but the several owners. What is of much more importance to shipowners in general, and to shipbuilders in particular, is the probable effect of the fusion upon the iron and steel ship construction of the future. Upon this all-important point the terms of union, as published, are not quite so clear as they might have been. The Register Book will contain alternative classes, and the Committee will administer alternative rules as regards vessels already built or building. But in the case of new vessels, there will, as we understand, in future be but one set of rules administered, and these the rules of Lloyd's Register. This may appear to some as being more of the nature of a "surrender" than an "amalgamation" on the part of the Liverpool Registry. Be this as it may, we are not disposed to gainsay the wisdom of the step which has been taken. It has been decided upon, we are assured, solely on the broad grounds of public weal. The Liverpool Book was perfectly able financially to go on, and has been terminated by its conductors simply because they are convinced that the interests of the community will be best served by one strong Registry commanding universal support. It has rendered great and valuable services to the shipping interests in this country and throughout the world since it was established in 1862, and the closing of its history now, when its race is run, is not the least important service for which the public has to thank it. We are aware, however, that there are not wanting those who will be unable to contemplate with equanimity the absorption by Lloyd's Register of the organisation which for many years has focussed the opposition to its requirements and constituted in the opinion of some the most telling argument against its scantlings. There was a time when it might with justice have been said that Lloyd's was only kept within reasonable bounds by the ever-present fear of being outstripped by its younger rival for public favour. But that time is not now, nor has it been within recent years. One at least of our contemporaries has been treating his readers to scraps of ancient history to "point a moral and adorn a tale" in this matter. We have no wish to follow him in his re-slaying of the slain. But we may point out, what he appears to ignore, that the Lloyd's of the present day is a very different body from the Lloyd's of twenty, and still more of fifty, years ago. When first constituted, and for many years thereafter, it was a highly conservative body. It represented but a fraction of those who were most closely concerned in its operations. It adhered rigidly to rules, which, to be currently applicable to a progressive art like shipbuilding, required to be modified constantly. No wonder then that it failed to give general satisfaction. Its weaknesses became the opportunities of its rivals, but only for a time. After having existed in one form or another for upwards of two centuries, and having encountered on several occasions powerful opposition in the shape of rival Books, it stands at the present moment stronger in the confidence of the public than it has ever done before. Ninety per cent. of the shipping built within these shores voluntarily submits itself to the approval of the Association. The secret of its success has been the desire evinced by its managers to keep pace with the times and to lead rather than to follow in the march of events. Its success or failure in the future will depend upon the like quality. In bygone years it was ruled by a comparatively small coterie of shipowners and underwriters in London, who were "deaf as Ailsa Craig" to remonstrance from the outports. Now it has a Board of Directors who number over fifty, and are drawn from all the ports in the kingdom. We are free to confess that even now it does not constitute to our mind a thoroughly satisfactory scientific and practical tribunal such as we think it ought to be. But that is by the way; we are less concerned with the precise methods than with the practical outcome of its policy. In former times, again, the Advising Surveyors had lost touch of the leading shipbuilders and shipowners. Now the Association has a staff in which are included the names of men whose attainments as theoretical and practical engineers are second to those of none in the country. The leading position taken up by many of its officers in the discussion of everything of importance that has agitated the shipping world during the last ten years is evidence of this fact. The names of Mr. John, of Mr. Parker, of Mr. Martell, and of Mr. Milton and others will occur to everyone. Mr. Parker has rendered yeoman's service in making the properties of mild steel more widely known and more intelligently studied than would have been possible without the light which he has been able, by virtue of his position, to throw on the subject. As for Mr. Martell he challenges comparison with the fabled feats of Atlas, as it is an open secret that the forthcoming report of the Load Line Committee will show that he has carried the whole of that august body on his broad shoulders.

Lloyd's Register lives now under totally different conditions from those which existed during its earlier stages, and it has a right to claim to be judged by the public upon the policy which has inspired its actions for the last ten or twelve years rather than by the unfortunate waywardness of twenty years ago. Rules and tables of scantlings are all more or less open to the objection of encouraging a dead level of dull uniformity, which delights the official mind, prone to a sluggish routine. Such requirements should therefore not be used as hard-and-fast rules in every case, so as to shut out possible improvements in construction. They should rather be applied with discrimination, and with a certain amount of elasticity as may be required by different practices for their free and proper development. Above all, there must be given "ample room and verge enough" for the inventive genius of the shipbuilders of the country to work perfectly unshackled within the limits of safety. Under the present enlightened *régime* we have lost all fear of being hampered by the Registry with unreasonable restrictions. But for some time its measures will be scanned with more than the usual degree of jealous care, and will have to run the gauntlet of universal criticism. For our part, we hope and believe it will be guided aright in the future as it has been in the immediate past. Let it but continue in the path it has trodden with so much success, and it will receive nothing but praise for the union which has now been completed.

THE ROYAL COMMISSION ON MERCHANT SHIPPING.

THE only tangible result of Mr. Chamberlain's endeavour while President of the Board of Trade to bring in the shipowners of Great Britain guilty of the loss of the lives of hundreds of seamen every year, was the appointment of a Royal Commission to take evidence and ascertain whether the charges in question are or are not substantiated by facts. The Commission has adjourned for a time, and before doing so decided to publish the evidence laid before it so far. The case of the Board of Trade is complete; that of the shipowners is not yet finished. It is impossible to read the report without feeling that it is wholly unsatisfactory in many respects, but most of all in that no dispassionate individual can fail to be struck by the prominence given to matters of opinion, and the apparent impossibility of arriving at facts.

The Board of Trade contention is (1) that loss of life at sea is excessive and increasing; (2) that this loss is, to a great extent preventable; (3) and (4) that over-insurance is a common practice; (5) that under-manning is also common; (6) that the criminal law has failed to prevent owners from sending unseaworthy ships to sea; (7) that the powers of detention conferred by the Act of 1876 on the Board of Trade have failed; (8) that the power of over-insurance and freedom from responsibility mainly contribute to the loss of life; and (9) that the system of wreck inquiries has not altogether succeeded, and requires amendment. Inasmuch as the loss of life at sea is caused almost altogether by wrecks, collisions, or the foundering of steamers at sea, it is evident that loss of life, in the Board of Trade sense, is synonymous with loss of property. Taking it for granted that the shipowner cares nothing for the lives of his crew, it has therefore also to be taken for granted that he does not care for his property, which is apparently absurd. Put in another way, it may be said that the shipowner who values his ships will not permit them to incur risks which will probably lead up to their total loss, and that, in thinking directly of the welfare of his property, he must indirectly take care of his crew. In part the Board of Trade does not dispute this, but urges that the system of insurance covers the ground, and permits the shipowner fully insured to run risks which he would not dream of incurring if he were not sheltered by the underwriters. This contention is no doubt plausible; but what are the facts? On the showing of Mr. Thomas Gray, one of the assistant secretaries of the Board of Trade, the total loss by wreck in a period of nine years amounted to 2,816,072 tons, involving a pecuniary loss by total wrecks alone of £26,739,664, and this without counting the value of cargoes. If all this loss was met by the underwriters, then it appears that those gentlemen paid no less than £3,000,000 per annum for ships wrecked alone. It is by no means to be supposed that all this money came out of their own pockets. On the contrary, it is perfectly well known that it comes ultimately out of the pockets of the shipowners, and we are unable to find that any evidence was adduced to prove that because a ship was well insured her owners were entirely indifferent to her safety. Mr. Chamberlain would, as is well known, if he had his own way, limit the insuring powers of shipowners. But it is not too much to say that no evidence worthy of the name has been brought forward to prove that such an extreme step is necessary. The contention that it is based on the assertion that the proportion of loss of life at sea to the number of hands employed is increasing. In fact, it has no other basis to rest on. If it could be shown that the number of deaths is falling off while our trade is augmenting, then the necessity for parliamentary interference could hardly be said to exist. Indeed, it would be extremely difficult, under such circumstances, to persuade the public that interference was necessary. With this truth in view, both sides have regarded the ratio of deaths to numbers employed as a crucial question, and it is in dealing with this question that the report is most unsatisfactory. Never, indeed, has there been supplied a more complete verification of the assertion that anything may be proved with figures. Mr. Thomas Gray, in his evidence, stated that in the nine years before referred to 24,616 persons lost their lives by wrecks and casualties to British vessels, and of those 21,224 were seamen and 3392 were passengers. A table, put in by Mr. Gray, of the gross death-rate amongst seamen by wrecks and casualties, showed that the rate of loss in 1883 was higher than in any year except 1881, which was the year referred to by Mr. Chamberlain in his speech. That was a year of very bad weather. In 1875 the proportion of drowned and killed per thousand employed was 12·36, or 1 in 81; and in 1881 it was 19·15, or 1 in 52. In 1882 it was 1 in 68; and in 1883, 1 in 56; so that 1 in 60 was not, he said, an exaggerated statement of the loss of life in 1881. This is a very plain statement, and as such its accuracy was at once impeached by Mr. Scrutton, a gentleman largely engaged in the West India trade. "Mr. Gray," said the witness, "has under-estimated the number of seamen employed in 1881 by over 49,000 men, or about 24 per cent." Lascars were entirely omitted from Mr. Gray's return. The Board of Trade figures differed also from those given on behalf of the Board before the Select Committee on "Unseaworthy Ships in 1879;" from the figures given by the Registrar-General of Seamen, and from the figures of the last census return. With regard to the number of lives lost in 1881, he showed that 426 of the total of 1123 lost by drowning other than by wreck, and 76 of the 273 deaths from accidents other than by drowning, or a total of 502, must be deducted from the lives lost in that year, and corresponding deductions from the other eight years. With regard to the number of vessels on which the percentage of loss was calculated, some very serious error must have occurred, for while Mr. Gray stated that the number of vessels registered in 1881 was 24,468, and the number employed 18,948, he gave the number of crews in both cases as 209,481. Then the witness declared there was a difference of 3000 between the registered and employed vessels of a certain size. From these facts, he argued, no reliance could be placed in Mr. Gray's figures under this heading. Another remarkable fact in Mr. Scrutton's opinion was that in the year 1880 the Secretary to the Board of Trade submitted figures to a Select Committee on Merchant Shipping which proved that down to that date the loss of life and property at sea for more than half a century was regularly decreasing. This was at the time when the Board of Trade set itself in opposition to the Plimsoll agitation. Now Mr. Gray produced an entirely new set of figures, and drew an entirely opposite conclusion. Mr. Scrutton proceeded to state that Mr. Gray's system of grouping his figures into triennial periods was misleading, and pointed out that in 1880 the Secretary had adopted a quinquennial period with entirely opposite results. Mr. Gray was recalled, and admitted there was something in Mr. Scrutton's argument, and that counting seamen ashore, the percentage would be 1 in 76, instead of 1 in 56, a very considerable difference. Mr. Chamberlain, seeing Mr. Gray's admission in print, at once wrote to the *Times*, to explain what Mr. Gray had said, and concludes with the following passage :—"In fact, the Board of Trade maintained the absolute accuracy of their original calculation, which showed a proportion of loss in a single year of 1 in 56·96. But we now have it from Mr. Gray, in addition, that, even if the shipowner's method of calculation were adopted, the loss of life would still be higher than the loss in any other trade whatever, and therefore calls urgently for some legislative remedy."

This dreary squabbling about figures is in every way to be deplored as not only an absolute waste of time, but direct evidence that there is an absence of grasp of the merits of the case manifested by the Board of Trade. The question is not whether the loss of life is such and such a percentage, but whether it is or is not avoidable. We have not the least doubt, and the shipowners as a body have not the least doubt, that there are certain black sheep who cannot be got at under the existing law, and therefore some changes in the law are expedient. It is much to be regretted that Mr. Chamberlain has anything to do with the matter, because his impulsiveness and his want of accuracy entirely preclude him at once from approaching the subject with a dispassionate judicial mind, and saying anything which can be accepted without hesitation. Mr. Chamberlain's method of dealing with the questions raised would injure any cause in the minds of unprejudiced, thoughtful men. Nothing, for example, can be more illogical than the concluding sentence of his letter to the *Times*: "The loss of life is higher than the loss in any other trade whatever, and therefore calls urgently for legislative remedy." The slipshod construction of this sentence is only equalled by its slipshod logic. There is no necessary connection of any kind between the loss of life in a given trade and legislative interference. It is admitted on all hands that life at sea is more dangerous than life on shore. The whole point of the question for discussion is, Is it possible by legislation to make life at sea as safe as life on shore? If this cannot be done, then the trade of a seaman must be attended by greater loss of life than any other trade. No one has ever yet shown that legislation can diminish the risk incurred by seamen—that is to say, reasonable legislation. There is, indeed, direct evidence to the contrary. It was held that if Mr. Plimsoll's views were adopted there would be a great saving of life effected. They were adopted, and yet Mr. Chamberlain states that more lives are lost than ever. We by no means assert that the law as it exists at the present moment is just what it ought to be, but we do assert, as we have asserted before, that very great harm may be done by grandmotherly legislation. Any law-making which interferes with a great industry should be carried out with much caution; and it is above all things necessary that there should be no party bias, no display of acrimony on the part of the would-be legislator. Mr. Chamberlain succeeded in putting the shipowners on their trial; it is not too much to say that the form taken by his indictment would have been enough to ruin a far better cause in the eyes of all impartial men. Legislation, may, as we have said, be made to do something to diminish sea risks, and to improve the position of the seaman; but Mr. Chamberlain and the officials of the Board of Trade have done nothing to lead the public to believe that they are fit and proper persons to guide the course of legislation. Up to the present, at all events, the labours of the Commission have failed to prove that legislation can do much good, and to indicate what direction it ought to take. As we have said, time has been wasted in squabbling over figures, and listening to more or less crude and one-sided expressions of opinion. Commissions very often leave questions just where they found them. We have no reason to conclude that we are now to be favoured with an exception to this rule.

SPECIALISM IN ENGINEERING.

There has been much discussion lately in the medical profession concerning the advantages and drawbacks of that division into specialties which is becoming every year more usual, and which, judging by the success of the special practitioners, is appreciated by the public. Although the analogy between the two professions is but partial, there are many points in which the arguments on either side in regard to medicine would apply to engineering science also. It is obvious that a man who has devoted himself to one branch of a profession should understand it better than those who have followed a variety of branches, or who have only an incidental knowledge of the matter in question; but at the same time there are dangers attending too exclusive an adherence to one line of practice. As in medicine, so in engineering, a knowledge of first principles and a scientific training are requisite before actual work in any direction can be safely adopted; and just as a man would be deemed presumptuous who professed to treat the ear or the throat without having first gone through the curriculum of medical training, so should an engineer first be possessed of the broad groundwork of science. But while, fortunately for the health and lives of the community, a certain course of training for the medical profession is prescribed by law, and no one can enter it but by an authorised portal, there is no such limitation for engineers; and to this absence of restriction much of the charlatanism which undoubtedly exists is due. The rapid extension of technical schools will, it may be expected, clear the air in this respect, and every year reduce the number of those who have not the general and preliminary—if even it be but a rudimentary—knowledge of science to enable them to measure properly the graver problems which afterwards come before them.

Specialism has been defined as "a deliberate concentration of a man's best powers on a single subject." In engineering the division into special branches tends every year to increase, and within proper compass it is in the interests of the public that it should be so. Life is too short for any man to learn all about every kind of work, and even without any desire to narrow unduly his scope of practice, an engineer often glides into that one branch of the profession which he likes best, or for which he is best suited—though one does not follow from the other—or which by mere accident falls to his lot.

One of the dangers of specialism in engineering, as in medicine, is the tendency of the practitioner to magnify the importance of the particular subject with which he is acquainted, and his inability to take a broad or general view of the problem to be solved. Egotism, which is at the bottom of most human misfortunes, prejudices, and errors, unwittingly leads a man to make prominent his own particular hobby. If an engineer be an inventor he is apt to bring his invention to the front whenever he can; if he be a patentee, the royalties which his clients may have to pay him may not always be well expended, and he will probably lack the judicial mind to appraise fairly the inventions of other men. Therefore, while it is natural and desirable that an engineer should pursue that branch of practice to which he has given most study, and in which he has had most experience, his specialty must not be too narrow in its scope. Thus, while a man who has made waterworks his business, will presumably be better able to decide on the best kind of pumping engine than would a man who, starting with the same scientific training, had spent his after years in constructing harbours and breakwaters, the inventor of a pump who had applied it successfully to particular cases of water supply, and who had acquired some fame in that regard, would hardly be the man to decide impartially between entirely different systems of pumping; or one who has devised a peculiar form of wrought iron bridge or bridge floor might not readily bring his mind into that condition which would enable him to recommend for a peculiar case the adoption of a stone arch or cast iron girders. Too narrow an outlook of this kind discredits the profession in various ways. There are empirical engineers as there are quacks in medicine, and the public are too ready to believe in those who make lavish promises. The new boiler that is to save 50 per cent. of fuel is an old acquaintance, and the motor which is to get something out of nothing seems to offer irresistible attractions to the lay mind. Students who are starting in life should especially beware of the bye-paths of the profession, and should be slow to believe in radical alterations in old methods. Not that novelty and invention are to be avoided. On the contrary, they are the main spring of all progress, and a healthy discontent with one's own work, and within proper limits with that of others, is a good omen for future improvement. But those whose experience is limited should hesitate to condemn as inefficient and antiquated what may appear to them to have insufficient justification. Although the proverb that "what is, is right," is not a safe guide in science, still the presumption is always in favour of what has endured and done its work for many years. The general rules of George Stephenson for railway and locomotive construction, and of Watt for the steam engine, survive innumerable attempts to prove them wrong, and are likely to do so for some time to come. And while there are, as we have stated, dangers in too narrow a specialism, yet, when an engineer has practised in one groove for a long time it may be still more dangerous to take him out of it. Outsiders cannot be expected to understand how diverse are the branches of the profession, and will sometimes consult an engineer on matters about which he is entirely ignorant. There is, then, but this one safeguard—that the practitioner is wise enough to know his own ignorance, when he can either plainly say so to his would-be client, bidding him go elsewhere, or, deeming himself better able to choose a right man than the client appears to be, he can himself obtain the aid of one who does know all about the case in question. Great failures, and even notorious disasters, have been caused by engineers of eminence, who, being called upon to do something outside their own line of practice, and of which they have but little knowledge, have been too egotistical or greedy, or perhaps merely too ignorant, to seek aid and advice from others.

INTERNATIONAL RAILWAY CONGRESS AT BRUSSELS.

Several conferences have been held upon subjects more or less intimately connected with railways, but it appears that no official Railway Congress has taken place until that opened at Brussels on Saturday last, 8th inst., under the patronage of the King of the Belgians and the Belgian Government, to mark the fiftieth anniversary of the inauguration of Belgian railways. The organisation and direction were entrusted to a Commission nominated by Belgian Ministerial decree of 13th December, 1884. The object of the Congress is to ascertain what improvements can be introduced into the making and working of railways. The Congress consists of members of the Organising Committee, the delegates of the various Governments and of railway administrations to which invitations have been sent. The President of the Organising Committee is M. Fassiaux, Secretary-General of the Railway, Post, and Telegraph Department of Belgium; M. Belpaire, Administrator of the Belgian State Railways, vice-president; and M. Aug. de Laveleye, secretary; while among the reporters are M. Blancquaert, engineer-in-chief and director of the traction and rolling stock of the Belgian State Railways; M. De Bruyn, president of the Soc. Nat. des ch. de f., vicinaux; M. Lebon, director of the Grand Central Belge; Baron Prisse, director of the Ghent and Antwerp line; and M. Ramaekers, engineer-in-chief, director of permanent way and works for the Belgian State Railways. Germany is represented by Herr Thielen, Herr Funk, and others; Austro-Hungary principally by Bela Ambrozovicsur; Egypt by M. H. P. Le Mesurier, M.I.C.E., and Scander Bey Fahmy; France and Algeria by M. Picard, M. Brame, M. Worms de Romilly, M. Banderali, and others; Russia by M. W. de Werchowsky, M. A. Gortschakoff, M. Louis Perl, and others; and Turkey by Hy. Wiener. England is represented by Sir Andrew Fairbairn, M.P., Mr. J. W. Wilson, Mr. J. F. S. Gooday, of the Great Eastern Company; Mr. Alec Wood, Mr. Basset, and Mr. James Grierson, of the Great Western Railway; Mr. J. S. Forbes, Mr. Godbold, and Mr. Morgan, of the London, Chatham, and Dover Railway; Sir Jas. Alport, Mr. J. W. Maclure, and Mr. R. J. Underdown, of the Midland Railway; Sir Isaac Lowthian Bell—unfortunately absent—Mr. David Dale, and others, of the North-Eastern Railway; Mr. Stephen and Mr. Newton, of the North London; Sir J. Mellor, Col. Surtees, Sir A. M. Watkin, and Mr. Myles Fenton, of the South-Eastern Railway. British India is represented by Lieut.-Colonel Luard and Mr. Bedford Leslie, of the East Indian Railway; and the U.S.A. by Mr. Edw. J. Jeffery, superintendent of the Illinois Central Railway, and Mr. J. C. Sims, jun., secretary of the Pennsylvania Railway. The other States that have sent delegates are Brazil, Bulgaria, Denmark, Spain, the new Congo State, Greece, Italy, Luxembourg, Mexico, Holland, Portugal, the Argentine Republic, Roumania, Servia, Venezuela, Sweden, and Norway. The inaugural meeting was held on Saturday afternoon, in the Palais des Académies, when the Belgian Railway Minister, M. Vandenheeraboom, rendered homage to Leopold I., and Mr. Charles Rozier, former Ministers of State, for their share in bringing about the adoption of iron ways, and traced the history of railways in Belgium, which was the first country after England to adopt them. Belgium now possesses 4356 kilometres—2706 miles—of railways, of which 3109 kilometres are worked by the State, and 1247 by private companies. The number of passengers had increased from 421,000 in 1835 to 51,000,000 in 1884; while the goods traffic had risen from 102,000 tons in 1840 to 21,000,000 tons in 1884. The Minister expressed a hope that the outcome of the present figures would be an International Railway Union, like the Postal Union, and the Telegraph Union, at which questions of tariff, gauge, &c., would be decided and made as uniform as possible. M. Fassiaux was then elected President of the Congress, and Sir Andrew Fairbairn, Herr Thielen, M. Van Kerkwysk, and M. de Merchowsky, vice-presidents; with M. Aug. de Laveleye, secretary. In the evening the members were officially received by the Burgomaster and others of Brussels. Among the papers submitted to the Congress was a special notice, prepared by the locomotive and rolling stock director of the Belgian State Railways, giving the summary description of the various types of locomotives adopted. The Congress was divided into four sections, corresponding with the following subjects:—The subject matter for deliberation is divided into four sections, viz.: (1) Permanent Ways and Works; (2) Traction Rolling Stock; (3) Working; and (4) Subjects of general interest. The sections held meetings in the morning, while the whole Congress assembled in the afternoon to receive and deliberate upon the several reports. On Thursday an excursion was made to the Charleroi district, and on Friday to the Liège district, both having been arranged by the Bourse des Mitaux et des Charbons.

THE SAN FRANCISCO FIRE BRIGADE.

Our Metropolitan Board of Works has just lately been placed in a dilemma arising out of the difference in constitution of our own fire brigade and those of our American cousins. The dilemma has had a result which may possibly seem to support a charge of want of hospitality against this country; but we do not see that in the circumstances of the case the Board could have come to any other resolution than it has done. It has long been customary for the leading officials of different countries to whom the suppression of fire is entrusted to maintain a sort of *entente cordiale*, and to exchange views as to the result of their experience. There is, indeed, a sort of Freemasonry among the corps of all nationalities, the effects of which have undoubtedly been beneficial. But in America the fire service is constituted upon quite a different footing to that it is based upon among ourselves. In that country it is, to a large extent, in the hands of what we may term almost social clubs, the members of which gladly welcome their brethren from this side of the water, and their hospitality towards such has been repeatedly and prominently shown. When, therefore, the members of the San Francisco Fire Brigade lately intimated to our Metropolitan Board of Works that they desired to visit England, the members of that Board scarcely felt themselves authorised to act in the way which is open to the fire clubs in America. It is true that it was signified to the Board that their desiring visitors would pay all their own expenses; but, nevertheless, the members of the Board of Works fulfil so many varied duties that they could scarcely undertake, even under such conditions, to act as hosts. We trust this fact will be plainly realised in America, and not lead to any feeling that the kindness shown by them to officials from England is not fittingly realised or acknowledged.

ROLLING STOCK IN LANCASHIRE.

It would seem that the directors of the Lancashire and Yorkshire Railway take a less gloomy view of the trade outlook than is taken by many persons, if the additions to the rolling stock during the past six months are to be the test. During that time they have expended close upon £60,000 on new locomotives, £30,000 for additional carriages, and £1761 for other working stock. In all, the value of the rolling stock is put down in the accounts as £5,422,000 to the end of June last; and in the current half-year it is proposed to expend £78,100 additional on working stock, so that it would seem that the directors expect that there will be additional work to be done. The company has in progress a line between Pendleton and Hindley, a loop line from Pemberton, and others, so that some additional use must thus arise. As to the locomotive stock, the company has expressed the opinion that this part of the expenditure during the past half-year was eminently necessary. It had previously 842 locomotive engines and 63 duplicates, and at the end of June there were 184 locomotives under repairs, or awaiting repairs. The line is one on which the passenger traffic is very heavy in proportion to its length, nearly two-thirds of the mileage run by trains being of late passenger trains. This proportion is likely to be increased, for during the past year or so the Lancashire and Yorkshire Railway has increased both the number and the area of the express trains that are run on its lines, and it is probable that the tendency will be for it still farther to increase them. In that case we must expect that when the new locomotive shops it is constructing at Horwich are completed, it will increase both the number of its locomotives and probably also the proportion of what may be called locomotives for the quicker trains. It is certain that the travelling public now asks for a fuller and a speedier service than it used to do, and in the popularisation that the Lancashire and Yorkshire is now undergoing, that need will be increasingly met.

THE NEW HULL AND BARNSLEY RAILWAY.

Barnsley has been feasting Lieut.-Colonel Smith, the chairman of the new Hull and Barnsley Railway, and the other directors of the undertaking. Mr. W. Pepper, in proposing the toast, "Success to the Hull and Barnsley Railway and Dock," expressed his belief that in a very little time the manufacturers in Mid-Yorkshire would find that the line had emancipated them, and would be a very great benefit to the district and to the Ridings round them. They were already blocked with traffic, and all the gigantic railways around them could not find them spare rolling stock to carry on their traffic. In a very little time his opinion was that they would want a second Alexandra Dock. Lieut.-Colonel Smith, in his reply, indicated pretty clearly that the Hull and Barnsley Company did not intend to enter on a war of tariffs with the existing undertakings. He looked forward to Hull being turned to what it ought to have been many years ago—a coal port. The South Yorkshire coal industry had been for a long time tied down by charges which had prevented practically its being shipped at the port of Hull. He admitted that the amount of coal shipped at Hull had increased, but contended that it had increased in spite of, and not in consequence of the facilities which had been offered to it. By adding to these facilities, and by endeavouring to remove the oppressive charges which weighed upon the industry, the company were entering upon a task of very great magnitude, in which by quiet perseverance they expected to succeed. His advice to the South Yorkshire coalowners, however, was this:—"Do not be disappointed if at the very outset this line and this dock do not fulfil your most sanguine expectations with regard to charges." This is a prudent policy, and the shareholders of the Hull and Barnsley line will generally recognise the wisdom of a young company fighting shy of a war of exhaustion with wealthy and old-established undertakings.

SALFORD IRONWORKS' SCIENCE SCHOOL.

RESULTS OF SCIENCE AND TECHNOLOGICAL EXAMINATIONS.

The efficiency of the method of teaching adopted at this School, namely, science teaching in connection with the workshops for the apprentices, is proved by the fact that three students of the School have won Whitworth scholarships. Mr. W. Mather takes a very earnest interest in the School, and Mr. Thos. Jones is the tutor. One student, R. H. Unsworth, is now an apprentice. T. Clarkson has gained the first Whitworth scholarship, value £200; R. H. Unsworth the third, value £150; Thos. Galbraith, the value £100. This is the second year in succession that one of the students has gained the first Whitworth scholarship, Mr. Stanfield having been placed first in 1884. T. Clarkson has also gained a "National" scholarship, value £60 per annum, tenable for three years; and R. H. Unsworth, a "Royal" exhibition, value £50 per annum, tenable for three years.

Plane and Solid Geometry.—Honours: First class, A. Hilton, R. D. Whitehead; second class, R. Stanfield, T. Clarkson, J. W. Butterworth, H. C. Dawson. Advanced: First class, R. H. Unsworth; second class, T. H. Price, H. B. Whitmore, W. Reavey. Elementary: First class, J. Brez, S. Jackson, J. Robinson, J. Webster: second class, A. Crompton, J. Kerr, J. Monk, W. Murphy, R. Nuttall, W. H. Nixon, J. C. Walker.

Machine Construction and Drawing.—Honours: First-class, R. Stanfield, T. Clarkson, R. H. Unsworth. Advanced: First-class: T. H. Price, R. D. Whitehead, H. B. Whitmore; second-class, J. Brez, H. Boothroyd, H. C. Dawson, A. R. Edmondson, C. Holland, S. Jackson, J. Robinson, W. Reavey, H. Sharp, T. Thorp. Elementary: First-class, A. Crompton, W. T. Hannah, W. Murphy, R. Nuttall, W. H. Nixon; second-class, E. Ainsworth, J. H. Clark, W. Crookell, A. Eden, S. R. Hollingsworth, R. W. Harrison, J. H. Higson, E. Kelsall, J. Kerr, J. Morris, C. Rowbotham, J. A. Smith, J. C. Walker.

Building Construction.—Honours: Second class, A. Hilton. Advanced: First class, P. A. Ramage. Elementary; Second class, P. Gerland, A. H. Johnson, J. Monk.

Mathematics.—First stage: Second class, J. C. Sidebotham, R. D. Whitehead.

Applied Mechanics.—Advanced: First class, R. Chrrley, J. Miley: second class. A. J. Bell, H. Boothroyd, A. R. Edmondson, S. Jackson, H. Sharp, R. D. Whitehead. Elementary: First class, T. H. Price, J. Robinson; second class, E. Mathews, H. McKerrow, J. Monk, T. Thorpe, H. B. Whitmore.

Steam.—Honours: Second class, R. H. Unsworth. Advanced: First class, J. Robinson, H. Sharp, R. D. Whitehead; second class, A. J. Bell, H. Boothroyd, R. Chorley. Elementary: First class, J. Miley, T. H. Price; second class, A. R. Edmondson, P. Gerland, T. T. Hindle, S. S. Jackson.

Mechanical Engineering.—Honours Grade: First class, R. Stanfield, R. H. Unsworth; second class, J. Galbraith, P. A. Ramage, J. C. Sidebotham. Ordinary Grade: Second class, J. Miley, J. Robinson, H. McKerrow.

Tools.—Honours Grade: First class, A. Hilton. Ordinary Grade: First class, A. J. Bell.

The Telephone in Stockholm.—The Stockholm Allmäuna Telefonbolag has just had its annual meeting, from which it appears that the lines at the beginning of 1884 numbered 785, and at the end of the year 2288. The length of the lines is nearly 2000 miles, and the capital £15,000. The profit for last year was £2000, the dividend declared being 8 per cent. The assets were estimated at £25,000.

Window-glass Making in the United States.—Recently the president of the American Window-glass Workers' Union, said:—"It is also noticeable that the grade of glass is getting better. There is not so much poor glass sold now as formerly. It has been demonstrated that it is as easy to make clear smooth glass as a second quality. The only difference is that it takes a little more time in the flattening. Very few people know how great are the possibilities of Pittsburgh glass manufacture opened by the introduction of natural gas. The intensity of the heat and the purity of the flame makes a better grade of glass possible at a cheaper rate than ever before. To illustrate this: It is now possible to make a heat in thirteen hours, while it formerly took from twenty-two to twenty-four hours. And the quality of the glass is better."

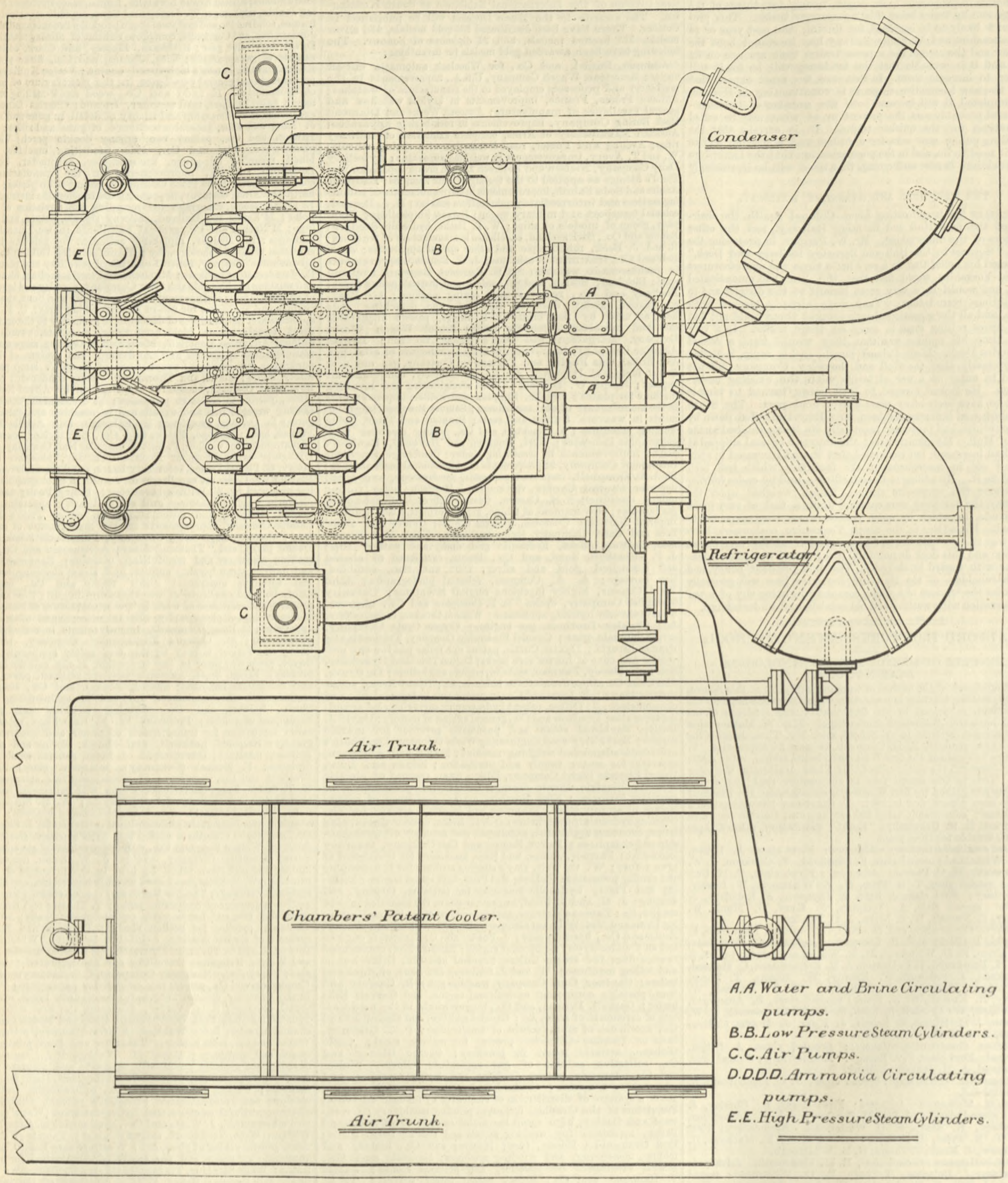
THE INVENTIONS EXHIBITION.

A supplement to the *London Gazette*, published on Wednesday, contains the jury awards—subject to revision—made in the Inventions Division of the International Exhibition at South Kensington. The awards in the Music Division will be published in October. There have been distributed 235 gold medals, 438 silver medals, 515 bronze medals, and 24 diplomas of honour. The following have been awarded gold medals for inventions:—

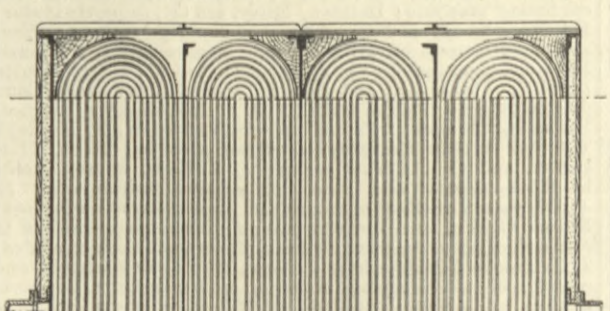
Adamson, Daniel, and Co., for Wheelock automatic cut-off engine; American Watch Company, U.S.A., improvements in the machinery and processes employed in the manufacture of watches; Antoine Frères, France, improvements in keyless watches and general excellence of manufacture; Aqueous Works and Diamond Rock Boring Company, improvements in rock-boring apparatus; Austrian Manufactory of Arms, complete exhibition of military rifles; Aveling and Porter, road locomotive with spring wheels; W. and T. Avery, improvements in weighing apparatus; Aylesbury Dairy Company, Nielsen and Petersen Danish cream separator and Fjord's fittings as applied to the testing of milk samples; Badische Analin and Soda Fabrik, improvements in the manufacture of colouring matters and intermediate products from coal tar; H. J. Barrett, colonial transport and military wagon; Barrow Shipbuilding Company, group of models of ships; W. F. Batho, hydraulic dredger; Baume and Co., Switzerland, excellence in manufacture of watches; R. and. J. Beck, microscopic and other optical apparatus; John Bell and Co., treatment of asbestos; J. W. Benson, improvements in machine-made watches; Sir H. Bessemer, Bessemer iron and steel; Bickford, Smith, and Co., safety and instantaneous fuses; Bradbury and Co., rotary shuttle sewing machine; G. Bray, combination water dust or slop van, and detaching pole head as used by fire brigade; T. Briggs, patent adjustable cart and noiseless automatic brake; Bristol Wagon Works Company, Margetsen and Hek's patent tip van; British Alizarine Company, improvements in the manufacture of alizarine, &c.; British Gas Engine and Engineering Company, gas engines; British Mekarski Improved Air Engine Company, compound air engines; Joseph W. Britton, U.S.A., straightening and levelling machine for plates; Brooke, Simpson, and Spiller, improvements in the manufacture of coal tar colours; Samuel Brookes, improvements in weavers' frames and reels; Brunton and Trier, stone working machines; J. Buckton and Co., testing machine with autographic indicator; Burt, Boulton, and Haywood, Boulton's patent improvements in creosoting timber; Cambridge Scientific Instrument Company, improvements in philosophical instruments; Sir A. C. Campbell, improved goniostat, spectroscope, and speed indicator; Captain Cardew, volt-meter; J. Harrison Carter, rolling milling machinery; M. Casson, Casson-Bicheroux direct-acting gas furnaces; Government of China, general exhibit, also diploma; Imperial Maritime Customs, general exhibit; Chubb and Sons' Lock and Safe Company, locks and safes; Clark and Standfield, floating docks, hydraulic grid dock, and patent slip; J. P. Clebnikoff, Sons, and Co., Russia, excellence of chased and enamelled gold and silver; Clift and Son, combination carriage; A. A. Common, celestial photographs; John Ward Cousins, highly ingenious surgical inventions; Coventry Machinist Company, cycles; R. E. Crompton and Co., improvement in electric lighting appliances; William Crookes, radiometers, &c.; Crossley Brothers, gas engines; Crypto Cycle Company, crypto-dynamic gear; Cunard Steamship Company, Transatlantic steamer Etruria; Dexter Curtis, patent zinc collar pad for the prevention and cure of horses' sore necks; Dalton Time-lock Syndicate, time lock; Davey, Paxman, and Co., engines and boilers; De Grave, Short, and Co., improvements in balances, &c.; Denny Bros., screw steamer Arawa; E. Dent and Co., improvements in turret clocks and chronometers; J. Dillon, patent hydrographic surveying and sounding apparatus; Doulton and Co., general exhibit of pottery; David J. Dunlop, combined steam and pneumatic governor for marine engines; East Ferry-road Engineering Works Company, Duckham's hydrostatic suspended weighing machine; Easton and Anderson, apparatus for water supply and purification; Edison and Swan United Electric Light Company, Edison Swan systems of electric lighting; Electric Power Storage Company, improvements in secondary batteries; Eley Brothers, general excellence of manufacture of ammunition; Ellington and Woodall, system for distributing hydraulic power in towns; J. H. Evans, ornamental turning lathes, counting apparatus, excellence and accuracy of workmanship and cheapness; Falcon Engine and Car Company, tramway locomotive; Farmer, James, and Sons, machinery for treatment of town refuse; W. O. Felt, Day's shading medium for lithographic and similar processes; Fielding and Platt, high speed engine; Fielding and Platt, hydraulic machines for rivetting, forging, and flanging; J. C. and J. Field, improvements in the manufacture of candles, &c.; Thomas Fletcher, gas fires and furnaces; Fleuss Breathing Dress and Safety Lamp Company, Fleuss breathing apparatus; Forder and Co., hansom cabs; J. Fowler and Co., traction engines and an "under-type" compound engine; Samson Fox, corrugated furnace flues for steam boilers; Furnival and Co., Gill's hot or cold rolling machine; W. and J. Galloway and Sons, engines and boilers; Gardner Gun Company, machine gun; R. Garrett and Sons, portable compound agricultural engine, and Garrett-Ellis beater; Gaskell, Deacon, and Co., improvements in the manufacture of carbonate of soda, &c.; Gevelot and Co., and Gaupillat and Co., excellence of manufacture of ammunition; P. C. Gilchrist, basic or Thomas-Gilchrist process for making steel; Carlo Giuliano, artistic merit in jewellery; George Glover and Co., collective exhibit of gas apparatus; Glover, Walter and Co., James's patent doubling and laying machine, and rope making machine; Goulard and Gibbs, successful working out of a system of distribution of electricity by induced currents; Proprietors of the Graphic, improved printing machinery; Greenwood and Batley, high speed horizontal engine; Greenwood and Batley, machines for working metals and cutting twist drills; Paul Grunwaldt, Russia, furs; Haching and Co., looms, and folding, measuring, and winding machines; Hancock and Co., general excellence of jewellery and precious stones; James T. Hampson and Co., Scott's patent safety stirrup; T. R. Harding and Son, weavers' combs, card pins, &c.; James Hargreaves, improvements in manufacture of sulphur of soda; Harrild and Sons, letterpress and lithographic printing machines; Hartmann and Braun, Germany, perspectograph and interest calculating machine; Hathorn, Davey, and Co., domestic motor; Hathorn, Davey, and Co., differential gear for pumping engines and improvements in valves for water-pressure engines; Thomas Hawksley, instruments for assistance of the deaf; Henry Heath, hat-making, hats, &c.; Heberlein Self-acting Railway Brake Company, automatic friction brake; A. J. A. Heck, stability balance; Heenan and Froude, "Tower" spherical engine; W. T. Henley's Telegraph Works Company, excellence of cables; Hick, Hargreaves, and Co., Corliss engine; J. J. Hicks, improvements in thermometers and other philosophical instruments; E. J. Hill, patent method of raising and lowering carriage windows; Hill and Clarke, boat lowering gear; A. Hilger, improvements in philosophical instruments; Hillman, Herbert, and Cooper, cycles; T. H. Brooke Hitchin, baby carriages, disconnecting wheels, and general good workmanship in carriages; Geo. Hodgson, improvements in power looms; Holland and Holland, various novelties in details and general excellence of workmanship in fire-arms, 100; Holtzapffel and Co., turning, carving, &c., in wood and ivory, 100; Hooper and Co., good workmanship, taste, and finish in carriages; R. Hornsby and Sons, String-binding "Appleby" reaping machine, and a finishing threshing machine; Hotchkiss and Co., excellence in quick firing and revolving guns; J. and F. Howard, apparatus for trussing and binding straw as it issues from the threshing machine, and a string-binding Appleby reaping machine; Hulse and Co., machines for working metals; Humber and Co., cycles; Hunter and English, floating crane; Hydraulic Engineering Company, hydraulic engine, hydraulic balance direct-acting lift, and water-saving arrangements applied to hydraulic machinery; India-rubber and Gutta-percha and Telegraph Works Company, india-rubber and gutta-percha; W. J. Ingram, exhibit of printing machinery; Jadoffsky, Russia, cigarette machine; Government of Japan, general exhibit, also diploma; Kiritsu Kosho Kwaisha, bronze vase; Professor Fleeming Jenkin, telpherage; W. Jessop and Sons, crucible cast steel stern frames, solid rudder, and cast steel stern propeller brackets and blades; Jordan, Son, and Commans, complete exhibit of mining machinery; David Joy, valve gear; Kirkham, Hersey, and Clark, collective exhibit of gas apparatus; Kite, James, and Co., filter presses; Kitson and Co., Parson's high-speed engine; Victor Kullberg, improvements and general excellence in the manufacture of marine chronometers; J. H. Ladd and Co., wood screw-making machinery; Laird Brothers, mail steamer, Ireland; Charles Lancaster, excellence of workmanship and nicety of detail in guns and rifles; J. Lang and Sons, general excellence of guns and rifles; J. A. Lawton and Co., patent cee spring double perch Victoria phaeton; A. Légé and Co., tide predicting machine, combined recording tide-gauge, anemometer, barometer, &c.; I. Levinstein and Co., improvements in the manufacture of coal tar colours; Litho Plate Company, patent litho plates; Luckhardt and Alten, Germany, improvements in scientific instruments; E. F. MacGeorge, clinograph for mapping the deviation of bore-holes; M'Kenzie and Holland, railway signals, points, and crossings; M'Naught and Co., general excellence in workmanship of carriages: Dr. Maddox, replacing collodion by gelatine in the emulsion process of photography; Manufacturing Goldsmiths' and Silversmiths' Company, general exhibit of jewellery and plate; H. R. Marsden, stone breakers; Mather and Platt, sampling, bleaching, and washing machine; Maxim Gun Company, novelty and ingenuity of automatic firing arrangement; Merryweather and Sons, steam fire engines and appliances for use in extinguishing fires; C. F. Mills, application of the principles of descriptive geometry to the cutting of sheet metal; Robert Mole and Sons, matchets, swords, &c.; Colonel Alexander Moncrieff, Moncrieff travelling siege carriage, manufactured by Easton and Anderson, and system of hydro-pneumatic gun carriages; proprietors of Morgan's lamp patents, safety lamps; Morton and Thompson, ejector condenser; Nobel's Explosives Company, successful application, by Alfred Nobel, of nitro-glycerine to explosive purposes; T. Nordenfelt, method of casting wrought iron and excellence in machine and quick-firing guns; L. Oertling, excellence in balances, &c.; Achille Parise, France, locks; Philippe, Patek, and Co., Switzerland, excellence of manufacture of watches; Patent Triangular Nail Company, patent triangular nails; Phosphor Bronze Company, phosphor bronze alloys; G. Planté, France, secondary battery and scientific research; Platinotype Company, excellence of results in photographic printing produced by W. Willis's invention; Henry Pooley and Son, platform weighing machines and self-indicating apparatus, poly-graded steelyard, and automatic grain scale; Price's Patent Candle Company, improvements in the manufacture of candles, &c.; Pulsometer Engineering Company, Pulsometer steam pump, Deane pump, and "Thames" filter; A Ransome and Co., cask-making machinery and tree-felling machine; Ransomes, Sims, and Jeffries, straw-burning engine, and straw chopping, bruising, and softening apparatus; John Rigby and Co., improved safety bolt and excellence of workmanship in gun; Ross and Co., progress and excellence of work in the manufacture of lenses, since the early days of photography, also microscopic and other optical apparatus; G. Rung, Denmark, improvements in meteorological instruments; St. George's Engineering Company, bicycles; Saxby and Farmer, railway signals and safety appliances; B. J. Sayce, prominent share in the invention of the collodio-bromide process; Ernest Scott, Ashton's positive actioned power meter and continuous indicator; Shand, Mason, and Co., steam fire engines and other appliances for use in extinguishing fires; Sharp, Stewart, and Co., planing machine and general excellence of exhibit; Professor W. S. Hele Shaw, sphere and roller mechanism for transmission of power, and improved integrators; Shepherd, Rothwell, and Hough, sewing and circular knitting machines; Government of Siam, general exhibit—also diploma; F. Siemens (Germany), tempered glass; Siemens Brothers and Co., excellence of electric-lighting arrangements; H. T. Simon, Simon-Carves coke ovens with continuous recuperation of heat and recovery of bye-products; W. B. Simpson and Sons, decorated enamel iron and Anglo-Limoges enamels; W. F. Stanley, improvements in philosophical instruments; L. Sterne and Co., gas engine; Stothert and Pitt, Wild's patent single chain dredger; William Sugg and Co., collective exhibit of gas apparatus; Surrey Machinist Company, cycles; J. W. Swan, incandescent lamps; and part taken taken by him in the invention of carbon printing; W. R. Sykes, combined electric interlocking and blocking system for railways; Tangye Brothers, special steam pump, automatic condenser, and hydraulic jacks; T. Thomas and Sons, self-sustaining lifts and hoists with an automatic brake; Archibald Thomson, coupling for broken shafts; Thomson and Houston, systems of electric lighting, exhibited by Laing, Wharton, and Down; J. and G. Thomson, Transatlantic steamer America; Todd and Wright, Livingstone travelling car and improved patent dog cart; Troy Laundry Machinery Company, U.S., laundry machinery; Umpherson and Co., patent rag engine for paper pulp; Vacuum Brake Company, vacuum automatic continuous brake, with universal coupling; S. A. Varley, designing the first self-exciting dynamo machine; Venice and Murano Glass and Mosaic Company, enamel mosaics; Ernst Wahliss, Austria-Hungary, pottery; W. Warne and Co., india rubber; Waterlow and Sons, printing processes and machinery; Major H. Watkin, R.A., ingenuity in devising and applying practically scientific and accurate instruments to various military purposes, and the electric light for powder factories; Watson, Laidlaw, and Co., self-balancing centrifugal machine and hydro-extractor (Weston's patent), self-balancing electro-centrifugal machine and hydro-extractor (Watts' patent); also oil separator; J. Watts and Co., band sawing machine, Francis William Webb, exhibit of railway plant; Thomas Webb and Sons, general exhibit of glass, &c.; Westinghouse Brake Company, automatic air brake and passenger communication for railway trains; White Star Line, Transatlantic steamer Britannic; Whitehead, fish torpedo; Henry Wilde, discovery of the indefinite increase of magnetic and electric forces from quantities indefinitely small; Willans and Robinson, Willans' compound engine and electric governor; W. E. Williamson, apparatus for registering fares; W. A. Wood, string-binding Wood-Holmes reaping machine and a grass mowing machine; W. B. Woodbury, the part taken by him in inventions in connection with permanent photographic printing: S. Worssam and Co., wood-working machinery; Worthington Pumping Engine Company, Worthington steam pumps; Wright, Alexander, and Co., collective exhibit of gas apparatus; Wycherley, Hewitt, and Co., improved machinery for the manufacture of watch movements; Yale and Towne Manufacturing Company, U.S.A., locks; Charles R. Yandell and Co., U.S.A., embossed leather for chairs, screens, &c.; Young's Paraffine Light and Mineral Oil Company, improvements in the manufacture of products from shale, and in lamps for burning mineral oils; William Young and G. Beilby, improvements in the distillation of shale and coal.

The following gold medals have been awarded by the Society of Arts on the recommendation of the Juries:—Sir Henry Bessemer, F.R.S., for the invention of Bessemer steel; Percy Gilchrist, for the Thomas-Gilchrist basic process of steel making; Hathorn, Davey, and Co., for their domestic motor; Samson Fox, for the invention of corrugated iron flues for steam boilers; Crossley Brothers, for the "Otto" gas engine; Ralph Tweddell, for his system of applying hydraulic power to the working of machine tools and for the rivetting and other machines which he has invented in connection with that system; Badische Anilin and Soda Fabrik, for their improvements in the manufacture of colouring matters and intermediate products from coal tar; William Crookes, F.R.S., for his improvements in apparatus for the production of high vacua, and for his invention of the radiometer.

CHAMBER'S REFRIGERATING MACHINE.



On Friday, the 26th of June, a number of gentlemen interested in refrigeration assembled at the Victoria Docks, by invitation of the Chambers Refrigerating Syndicate, to witness the working of a new air-refrigerating apparatus which has been erected at the D jetty in connection with cold storage rooms. The system is the invention of Mr. J. Chambers, a New Zealand farmer, who came over to England a year or two ago, for the purpose of developing his ideas, and carrying them into practice, his object being to produce cold air for the preservation of meat and other similar purposes, at a cost considerably below what can be accomplished with the ordinary cold-air machines working by compression. It is, of course, well known that as regards abstraction of heat, much more economical results are attained by the evaporation of volatile liquids than by any system employing the compression and expansion of gases, machinery for producing ice being invariably constructed on the former plan, the liquids generally used being ether, sulphurous anhydride, and ammonia. No serious attempt to cool air by the same means had, however, been made, and it has remained for Mr. Chambers, an amateur, to show how it can be done successfully on a commercial scale. Mr. Chambers was specially stimulated by the motive of securing for himself and fellow colonists, as large producers of stock, the most advantageous means of disposing of it, hoping that he would be able to reduce the cost of freezing and storing on board ship to such an extent as to leave a much larger margin of profit to the grower. His apparatus is not a machine for refrigerating in the full meaning of the word, but merely for applying the effect produced by the evaporation of ether, sulphurous anhydride, ammonia, or any other suitable liquid to the cooling of air, so that any ordinary ice machine may be used, and the same plant may, if desired, be employed for making ice at the same time that it is cooling air



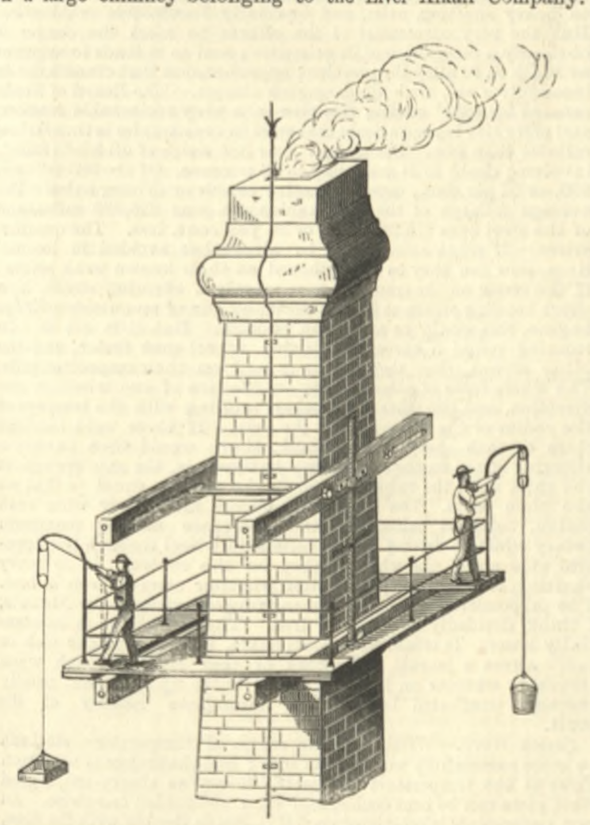
CHAMBER'S AIR COOLER.

for freezing or preserving meat. In the machine at the Victoria Docks ammonia has been adopted as the refrigerating medium. It, as well as the whole plant exhibited, has been designed by Mr. W. H. Beck, London, and consists of two duplicate vertical compound steam engine, with one surface condenser common to both, and two pairs of duplicate single-acting ammonia compression pumps, with two separate and independent crank shafts, two air pumps, one water-circulating and one brine pump, one ammonia condenser, and one ammonia refrigerator. The general arrangement is shown above. The steam cylinders, which in each engine are respectively 9in. and 14in. diameter, are placed on each side of the ammonia pumps, and indicate at the ordinary working speed of 100 revolutions per minute 32·37-horse power. The ammonia pumps are 9in. diameter, and are provided with glands sealed in the usual way with a liquid lubricant. The refrigerator and condenser each consist of coils of wrought iron piping contained in cylindrical iron casings, the former having thirty-six coils of 1in. and six coils of ¾in. pipes, and the latter eight coils of 1in. pipes, the surface in each being about the same. The condensing tubes are kept cool by a circulation of cold water, while the refrigerator is surrounded by brine, made of water and magnesium chloride, which is cooled by the evaporation of the liquid ammonia within the coils and utilised as hereafter described. Briefly, the action of the machine is as follows:—Assuming the condenser to be charged with liquid anhydrous ammonia—which, by the way, can now be obtained in this country as an ordinary article of commerce—the pumps are started and the valves opened between the refrigerator and condenser, and also between these vessels and the pumps. Liquid ammonia therefore flows into the refrigerator; but as the pressure here is less than that in the condenser, owing to the exhausting action of the pumps, it immediately vaporises, abstracting the heat necessary for vaporisation from the brine surrounding the tubes. The vapour is delivered by the pump into the condenser, where it is liquefied by the combined action of pressure and the cooling water, according to well-known laws, which need not be here repeated. Excluding leakage, which is not great in a well-designed machine, there is no loss of ammonia, the charge being continually evaporated and condensed as just described. For each pound weight of ammonia formed into vapour about 900 thermal units are abstracted, the degree of cold produced being dependent on the pressure at which vaporisation occurs, and, of course, varying according to the use to which the apparatus is being put. In the present case, where a low temperature is required, the refrigerator pressure was about 15 lb. absolute, the brine being reduced to zero Fah.; but as the boiling point of anhydrous ammonia at ordinary atmospheric pressure is 37 deg. below zero Fah., a lower working temperature may be produced if desired.

The air cooler which is the subject of Mr. Chambers' patent, is shown in section, page 130. It consists of a rectangular iron tank divided into four compartments, through which the brine cooled in the refrigerator is caused to circulate, and a series of 960 copper U tubes, 1in. internal diameter, and averaging about 10ft. long, through which the air to be cooled is driven by an ordinary fan, the tubes being secured to gun-metal tube plates forming the top of a box or base so arranged as to cause the air to pass in succession through each set of cooling tubes. The principle of the patent lies really in providing for the removal of the greater portion of the moisture from the air as water before the freezing point is reached. The vapour thus condensed is deposited on the tubes and runs down into the box at the bottom, from whence it is discharged by means of drain cocks. Should any portion of the watery vapour be converted into ice, it is generally deposited upon the last rows of tubes. Means are therefore provided for reversing the air current, so that the warmer incoming air meets the ice and melts it. In practice, however, air from the outside is only used for a comparatively short time, for as soon as the cooling rooms are brought down to the desired temperature, or even before this, the machine draws its supply from the rooms themselves, and therefore deals with air which contains a very small amount of vapour in solution. The quantity of cold air produced per hour in full work is 240,000 cubic feet, the temperature being about zero Fah. Assuming that the cold rooms are maintained at 20 deg. Fah., each pound of air will abstract 4·6 units, which gives a total value of about 92,000 units for the 240,000 cubic feet, with an indicated horse-power of 32·37, as previously stated. An ordinary air machine on the compression system will produce air at a temperature of 70 deg. below zero Fah. Each pound therefore raised to 20 deg. Fah. will take up 20 units, so that 4600 lb., or say 46,000 cubic feet, will be required to do the same cooling work as the 240,000 cubic feet at zero. In this case the indicated horse-power would be 90, or 2·8 times that developed in the Chambers apparatus. The consumption of fuel would not, however, be in the same proportion, for greater economy could be obtained with the larger engine, and we are probably well within the mark in taking it in the proportion of 1 to 2·5. Against this, however, must be put the increased first cost of the Chambers apparatus; its much greater complication, and more expensive maintenance; besides which on board ship we should think the use of ammonia is quite inadmissible. On the whole, therefore, while fully recognising the greater economy of the system when worked with an ammonia refrigerating machine, we should say that the field for its application lies altogether on land, chiefly in those cases where the manufacture of ice is to be carried on conjointly with the preservation of foods. At the same time we wish Mr. Chambers every success, and will be only too glad if by the adoption of his process an increased stimulation should be given to the trade in frozen meat between the colonies and this country.

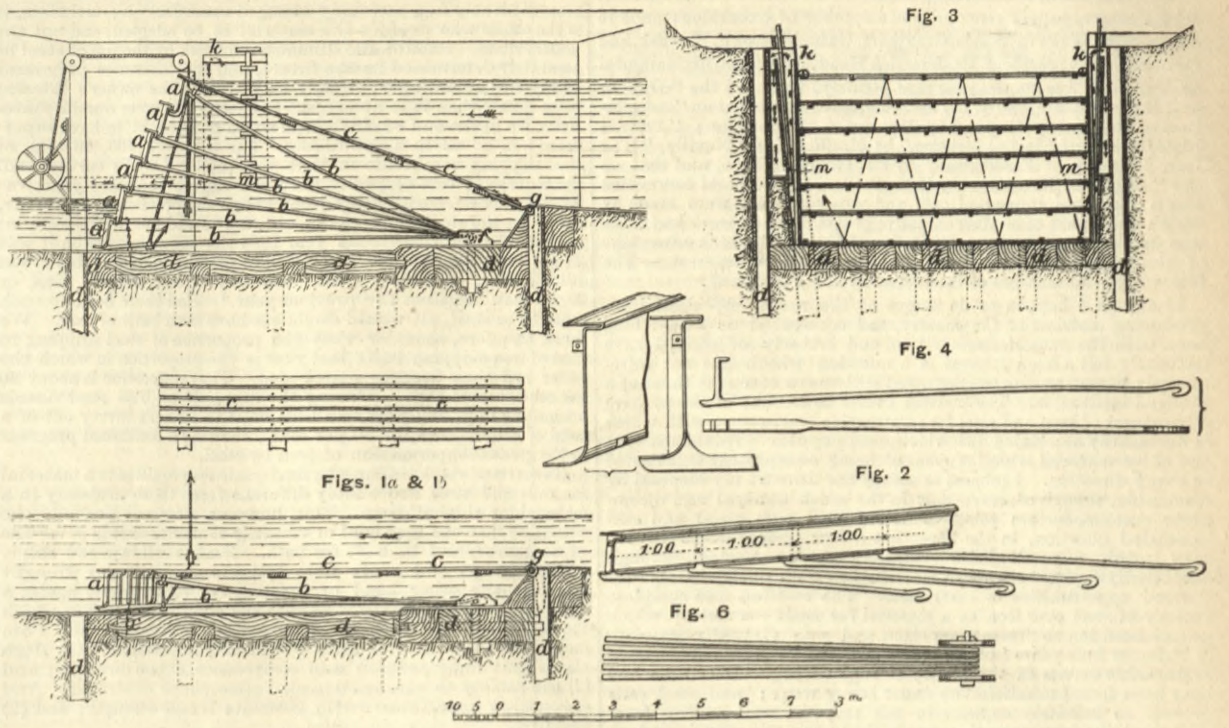
BROWN AND PORTER'S CHIMNEY CLIMBER.

THE accompanying engravings illustrate a device for facilitating the safe climbing of tall chimneys for the purpose of repair or extension. It is made by Messrs. Brown and Porter, of Leith Chambers, Moorfields, Liverpool, and has already been employed on a large chimney belonging to the Liver Alkali Company.



The apparatus consists of two stout timber grippers capable of being secured to the chimney to be climbed by means of two long bolts, one on each side the chimney; to these upper grippers are suspended by means of four chains, two others precisely similar, capable also of being bolted to the chimney, and to the latter is attached the stage. The lower and upper grippers are also connected by means of two steel screws two inches in diameter. The operation of climbing the chimney is as follows: Supposing the upper grippers to be screwed fast, and the lower ones to be loose, then the weight of the stage is being sustained by the chains; the two screws are now operated, and the stage is thereby gradually raised; when the desired height is reached, the lower grippers are secured by tightening up the bolts, which takes off the weight from the upper ones, so that the latter can now be raised to a greater height by simply working the screws the reverse way; when the chains are again tight, the upper grippers are secured as before, the lower ones released, and the operation of lifting is continued. This chimney climber will save a great deal of time lost by the methods of "Steeple Jacks," and its certainty and safety will no doubt ensure its general use.

CZVETKOVIC'S AUTOMATIC FLOODGATE.



AUTOMATIC AND WATER-REGULATING FLOODGATE.

THE floodgate illustrated above is the invention of M. D. Czvetkovics of Essegg, and consists chiefly in a system of peculiarly-shaped louvres—Fig. 1*a*—of any required number acting upon one another between two vertical embankments, river-sides, bridge piers, &c., the louvres being raised automatically by the vertical pressure of the water. The louvres operate by means of connecting-rods which fold up fan-fashion without producing any friction, and are drawn up—unfolded—automatically, thereby causing the water to be dammed up to any desired height. Fig. 1*a* shows the longitudinal section of such a floodgate—constructed of wood and iron—with the louvres drawn up, *i.e.*, in action; Fig. 1*b* represents it in its submerged state, *i.e.*, in repose; *a a* are the single louvres or water-gates; *b b* the connecting-rods; *c c* the protecting grate of cross-bars, and *d d* the floor. The louvres are made of sheet iron; their height depends upon the required height of the dammed up water, and varies between 20 cm. and 25 cm.; their top and bottom edges, as shown in Fig. 2, are bent at right angles, thereby forming ledges. The length of the louvres corresponds to the width between the parallel river-sides, bridge piers or other steam works; they are connected with a horizontal axis *f*—Fig. 1*a*, *b* and Fig. 6—by means of peculiarly-shaped iron connecting-rods—Fig. 4—which admit an extension of 1 metre—Fig. 3. The entire floodgate is folded up and laid down below the surface of the upper water. A protecting grate of wooden crossbars, hinged on to a firm horizontal axis *g*, is laid level upon it, either loosely resting on the topmost louvre, or coupled to it; in this latter case the grate—its specific gravity being less than that of the water—causes the top louvre to be more easily lifted by the pressure of water, and this force likewise diminishes the weight of all the other louvres. This grate, which protects the whole apparatus, both in action and in repose, from floating bodies carried down by the stream, is so constructed as to admit only of sand and small pebbles passing through it; and these, as will be subsequently explained, are swept away by a continuous current of water.

As soon as the floodgate, as seen in Fig. 1*b*, is laid down in the bed of the river, the topmost louvre offering resistance to the stream causes the water to swell. From this moment the hydrostatic pressure begins to bear upon the bottom ledge of the topmost louvre and lifts it in the same proportion as the surface of the upper water rises, till its bottom ledge catches up the top ledge of the next louvre. The result of this is that the upper water will be dammed and will rise, thereby increasing the difference between the levels of the upper and lower water, and increasing also the hydrostatic pressure which, bearing progressively upon the bottom ledges of all the louvres as a vertical lifting power, assists the first—topmost—louvre in raising the next heavier louvre from the sill of the floodgate. In the same manner all the louvres are successively lifted from the sill of the floodgate, till finally an open space is formed between the last—undermost—louvre and the sill. This space affords an undershot sluice to the surplus dammed-up water. The louvres and their connecting-rods, as the chief components of this self-acting floodgate, differ in their relative strengths. They as well as the iron axis *f*—Fig. 1*b*—which supports the whole structure, are calculated by the rules of hydrostatics and executed with a corresponding coefficient for safety. When the apparatus is laid down this safety coefficient is multiplied by the number of louvres in the respective floodgate. The louvres are made of two or three plates of sheet iron, instead of which fluted sheets may also be used on account of their greater stiffness.

The broader the bottom ledges of the louvres the greater will be the concavity of the surface and the greater the upward force. The breadth of the ledges therefore is determined by the absolute weight of the louvres and such portions of the connecting-rods as are borne by the water, due regard being had to the maxim that a body immersed in water loses as much of its weight as the volume of the water it displaces amounts to. Thus if we suppose the height of the topmost louvre, with an absolute weight of 20 kilog. per metre run to be 40 cm., so that its bottom ledge is by so much as 40 cm. below the surface of the water, this bottom ledge would have to be 5 cm. in breadth, because a body of such dimensions displaces 20.000 cm. of water per metre run, equal to a weight of 20 kilog. Further, supposing the bottom ledge of the second louvre after the first has been lifted 40 cm. by the pressure of water to be 80 cm. below the surface of the dammed water, and supposing the absolute weight of this portion of the structure to 50 kg. per metre run, then by dividing the absolute weight of this part, converted into cubic centimetres of water, by the actual height of water at the floodgate, *i.e.*, in this case by 80 cm., then the result would be inversely 50.000 : 80 = 6·25 cm. as the breadth which would have to be given to this ledge in order to displace 50 kg. of water per metre run by this second louvre—in other words, that this portion of the floodgate may be lifted by the pressure of the water. But as the breadth of these bottom ledges does not depend solely upon the weight of the single component parts of the apparatus, but also upon the louvres together constituting an impermeable barrier to the water, and therefore linked together by means of their ledges as efficiently and as densely as possible, it is usually necessary to make the bottom ledges broader than would appear necessary by the above calculation. By thus broadening the ledges the single louvres, however, lose too much of their absolute weight, and are therefore unable to offer the requisite resistance to the pressure of water; in other words, the louvres would be lifted by the pressure of the water above the surface. In order to prevent this, the connecting-rods of the last louvre but one (Fig. 1*a*) are firmly anchored to the bed of the river in such a manner that this louvre can only be lifted from the sill by so much as the clear height of the last louvre. This perpetual play of the undermost louvre obviates a chief drawback in all the existing constructions of floodgates, namely, that of getting choked up with sand, as the small pebbles, sand, &c., which cannot be withheld by the protecting grate are carried off with this undershot sluice.

ENGINES OF EXPRESS PASSENGER STEAMER FOR THE SEINE.

WE illustrate on page 122 the compound condensing engines of some new passenger boats on the river Seine. Our engravings, copied from engravings in our contemporary *La Génie Civil*, explain themselves. Figs. 1 and 2 are end elevations; Fig. 3 a longitudinal section; Fig. 4 a sectional plan through the crossheads; Fig. 5 is a sectional plan taken through the cylinders; Fig. 6 a section between the cylinders; and Fig. 7 is a section through the air pump. The diameter of the high-pressure cylinder is 10·63in.; that of the low-pressure cylinder, 16·142in. The stroke is 11·811in. The number of revolutions, 200 per minute. The diameter of the air pump is 11·417in.; its stroke is 6in.; diameter of feed pump, 3in.; stroke, 1⅜in.; indicated horse-power, 80. The boiler pressure is 85 lb. on the square inch.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—John Ferguson, chief engineer, to the Monarch; Frederick Wise, engineer, to the Monarch; Lemuel C. Saywell, assistant engineer, to the Monarch.

WHITWORTH SCHOLARSHIPS.—The following list of candidates successful in the competition for the Whitworth Scholarships, 1885, has just been issued:—

Name.	Age	Occupation.	Address.	Value of Scholarships awarded.
				£
Clarkson, Thomas ..	20	Engineer	Manchester ..	200
Bennie, Hugh O. ..	20	Engineer	Glasgow	150
Unsworth, Robert H. ..	20	Engineer	Pendleton, near Manchester ..	150
Martin, Harold M. ..	21	Engineer	Gateshead ..	150
Calderwood, Wm. T.*	25	Mechanical dra'tsman	Glasgow	150
Richards, John*	22	Blacksmith..	Cardiff	150
Dolby, Ernest R. ..	23	Engineer	Leeds	150
Rorison, James	21	Engine fitter	Paisley	150
Moulton, Arthur J. ..	20	Engineer apprentice.	Preston	150
McNeill, William ..	22	Mechanic	Birmingham ..	100
Moreton, George W. ..	24	Fitter	Crewe	100
Mallinson, Stephen E.	24	Assistant analyst ..	London	100
Jenkins, Henry C. ..	23	Engineer & millwri'ht	London	100
Smith, Robert	24	Engineer	Glasgow	100
Nash, Thomas W. ..	21	Engineer	London	100
Burstall, Henry F. W.	19	Engineer apprentice.	London	100
Stopher, Arthur J. ..	22	Mechanical engineer.	Nottingham ..	100
Wells, Sidney H. ..	19	Marine eng. appr'tice	London . ..	100
Milnes, George	24	Fitter	Charlton, Kent	100
Begbey, Henry	22	Engineer	Old Charlton, Kent	100
Goodman, John	23	Engineer	Brighton.. ..	100
Crummie, Mark H. ..	21	Mechanical engineer.	Hull	100
Marsh, Oliver	22	Fitter and turner ..	Crewe	100
Galbraith, Thomas ..	23	Pattern-maker	Manchester ..	100
Bowles, Joseph H. ..	23	Engine fitter	Stratford.. ..	100

* Equal.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The Institution of Mechanical Engineers met last week at Lincoln, where several papers were read, and a number of excursions made to engineering works in Lincoln, Grantham, Gainsborough, Newark, and Grimsby. The president, Mr. Jeremiah Head, delivered his inaugural address, and five papers were read, namely, that on the "Dunbar and Ruston Steam Navvy," by Mr. Joseph Ruston, that on "Adaptation of the Robey Engine," by Mr. John Richardson; "Private Installations of Electric Lighting," by Mr. R. H. C. Neville, "The Iron Industry of Frodingham," by Mr. George Dove, and that on the "Spherical Excentric," by M. L. Poillon. The local committee was a large and influential one, and arrangements were made by which every part of a rather extensive programme of work and visits was carried through to the satisfaction of those who took advantage of the opportunity afforded of visiting works of interest. —The following is an abstract of the address of the President:—

Living as I happen to do in one of the most important iron-producing districts of the country, and connected as I have long been with the manufacture of iron, and latterly of steel, I have naturally felt a keen interest in a question which has not infrequently arisen at our meetings, and still more often at those of a kindred institution. The question I refer to is that of the relative advantages of iron and steel for constructive purposes; with which is necessarily associated the wide-spread popular expectation that the older material is on the point of being completely superseded in every direction. I propose to occupy the time at my disposal by discussing, though of course only in the most general and incomplete manner, certain points connected with this great and still unsettled question, in the hope that a few observations thereon may prove not altogether uninteresting or useless, though admittedly expressing only an individual opinion derived from very limited opportunities of observation. The sudden and complete victory of steel over iron as a material for rails—a victory which commenced ten to fifteen years since, and was virtually complete in three or four years from its commencement*—is one of the most remarkable events in the history of engineering. Iron rails had long been found unsatisfactory under heavy wear; and steel rails proved so infinitely superior in this respect, and so free from collateral disadvantages, that once fairly to try them was to adopt them for evermore. It was not to be wondered at, in view of such a revolution actually accomplished, that there should exist a general expectation that it would be followed by a similar revolution in all other departments of constructive engineering where wrought iron had hitherto been the material used. Consequently for the last seven years† high metallurgical and engineering authorities have continuously warned us that the universal use of steel in all departments of consumption, instead of wrought iron, was immediately imminent. Experience, however, has not altogether justified these predictions; and a little reflection will convince that they were at least premature. Steel rails have long been produced at as low as or at even a lower price than they ever were of wrought iron. They can be made of equally good quality by either the Bessemer or the Siemens process, with either acid or basic-lined vessels; and almost any iron ore can now be utilised in their manufacture. Steel bars, angles, or plates, on the other hand, of the quality required by Lloyd's or by the Board of Trade officials, cost about 46 per cent. more than if of ordinary wrought iron.‡ Although they can be made from ingots produced by any of the processes referred to, these latter, as a matter of fact, are at present almost exclusively the product of acid-lined open-hearth furnaces. Not much pig iron enters into their composition, except the purest brands of hematite; and the ores whence these are smelted are mainly obtained from foreign countries.§ Again, the qualities required in rails are entirely different from those most needed in constructive material. Rails must, of course, be tough enough not to break under traffic. Of some, but quite minor importance, is the power to resist corrosion. But the one quality of paramount necessity, the one by virtue of which above all others steel for rails has superseded iron so signally, is the ability to withstand abrasion, disintegration, or crushing, under heavy rolling loads. According to Mr. Price-Williams, a steel rail, *cæteris paribus*, will last as long as nine iron ones.‖ This obviously, and this alone, brought about the great, sudden, and complete revolution in regard to the material to be used thenceforward for this particular purpose.¶

The remarkable anti-abrasion qualities of steel are manifestly of equal value when it is used for tires; and there also it has consequently almost completely superseded iron. But for the great constructive works for which bars, angles, and plates are so largely used, such, for instance, as ships, bridges, and boilers, it is obvious that anti-abrasion qualities need not be considered at all. If, therefore, for these purposes also steel is destined completely to supersede iron, it must be by reason of its superiority in other respects. I now propose to consider wherein it is superior to iron for these other purposes, and to what extent; wherein, if at all, it is inferior to it, and how far this is likely to interfere with its progress; and to notice, as we proceed, in what departments of consumption it has, as a matter of fact, already superseded partially or entirely the older material.

Shipbuilding.—Steel, as now made to Lloyd's requirements, is superior to iron for shipbuilding purposes for two reasons, which I am inclined to consider of primary importance, namely: (1) It is very much more ductile; (2) it is equally ductile in both directions of the grain. To these reasons may be added three others, which I look upon as of secondary importance, namely:—(1) It has 30 per cent. more tensile strength in the direction of the grain. (2) It has 50 per cent. more across the grain. (3) Its elastic limit is 21 per cent. more in either direction of the grain.** I have placed tensile strength and elastic limit in a secondary position as compared with ductility, because in the former respect iron has always proved itself at least equal to the ordinary demands upon it. Indeed, the examples of the Great Britain steamship, built in 1845, the John Bowes in 1851, the Great Eastern in 1857, and many others still afloat, prove that, if a well-built iron ship be kept off the ground and free from collisions, its life is practically unlimited. Serious collisions have the same disastrous result, whether iron or steel be the material concerned. The circumstances wherein steel most strikingly shows its practical superiority are when minor accidents occur, such as slight collisions, grounding in moderate weather, and so forth. In such cases steel ships have repeatedly remained tight, and returned safe, though in a battered condition, when, had they been of iron, they might probably have become total losses. The benefits of marine salvage, however, usually accrue to the underwriters, and not to the shipowner. The former have an obvious interest in saving to the utmost, whilst the latter may even gain by the loss of his ship. Apart from humanitarian considerations, no fully insured owner would wish to recover his ship in a seriously damaged condition. Nevertheless, it is the owner who decides the material to be adopted, and not the underwriters. Should the diminution of risk by the use of steel be accurately determined in the future, and the insurance premiums be adjusted accordingly, then it may become the owner's interest more clearly than it is at present to specify the more ductile material. Up to the end of 1883 steel could not be said to have superseded iron at all in shipbuilding. For although 166,428 tons of steel shipping were made in that year under Lloyd's survey, still the tonnage of iron shipping surveyed during the same year was 933,774 tons, or considerably greater than any previous year. So far, therefore, the steel used was in addition to and not in replacement of iron. In the disastrous year 1884 the total tonnage built was 28 per cent. less, whilst the tonnage of steel shipping built was 132,457 tons, or 20 per cent. less, and of iron 661,201 tons, or 29 per cent. less than the previous year.* Had there been no such material as steel, all would doubtless have been built of iron. We must, therefore, consider that the proportion of steel shipping to that of iron shipping built last year is the proportion in which the latter had then become superseded. That proportion is about 20 per cent., or one-fifth. During the first half of 1885 steel vessels amounting to 67,469 tons had been built to Lloyd's survey out of a total of 221,423 tons, or 30 per cent., showing a continued progress in the gradual supersession of iron by steel.

Bridges and roofs.—The physical qualities requisite in a material for rails and tires are widely different from those necessary in a material for shipbuilding. This, however, does not preclude the possibility that one material of versatile character should cover the whole ground, and be best for both. Next to railways and ships, perhaps bridges and roofs have hitherto absorbed more wrought iron than any other kind of constructive work. Here, again, a little thought will convince us that the order and degree in which the qualities of the material are essential must be altered. I am inclined to place in the rank of primary importance:—(1) High elastic limit under tension and compression in one direction; and (2) non-liability to corrosion under atmospheric conditions. And of secondary importance:—(1) Ultimate tensile strength; and (2) ductility.

A series of experiments made some time since at the Teesside Ironworks proved that the elastic limit in tension of ordinary Cleveland iron-bridges plates $\frac{3}{8}$in. to $\frac{1}{2}$in. thick is 13·7 tons per square inch. The ultimate tensile strength ascertained at the same time was 21 tons with and 18·2 tons across the grain; and the extension in 8in. length was $7\frac{1}{2}$ per cent. with, and 3 per cent. across. A curious and important fact, though little known, is that the elastic limit in iron plates is equal in either direction, as it is in steel, although the ultimate strength and ductility are inferior in the cross direction.† On account of the greater cheapness of iron, and perhaps for other reasons, the use of steel has not yet made much headway in this country as a material for bridges and roofs, except where very long spans are required. In such exceptional cases the weight of the structure itself is by far the greatest source of strain; and therefore it becomes imperative to use a material which affords a high elastic limit in proportion to its weight. In certain other countries, notably America, the practice is somewhat different, steel being relatively more in use. But there, no cheap finished iron is obtainable, as here; and their rivers being larger, there is more demand for wide spans.

Boilers.—Next in importance to the specialities already discussed, steam boilers may perhaps be classed. Apart from the question of corrosion and certain minor difficulties which I shall hereafter refer to, it is hard to find any respect in which mild steel is not better than iron for boilers. Moreover it is not here under any disadvantage as regards original cost. Iron boilers have always been made of special qualities, which on the average cost as much as modern steel. Indeed in those cases, and they are many, where the highest South Yorkshire brands have habitually been specified, steel with far superior capabilities is obtainable at a very much lower price. Can we wonder that marine boilers are now scarcely ever built of iron? The very material, weight for weight, costs less than formerly. To this advantage must be added the gain of displacement, if they be made thinner in proportion to tensile strength; or, which is of more importance, the extra steam pressure carried if the full thickness be retained. To obtain adequate furnace room and heating surface, marine boilers must be of large diameter; and to withstand the ever increasing pressure needed for multiple expansion, the thickness and tenacity of boiler shells must be the utmost consistent with safety. These requirements, with the large areas and heavy weights which they involve, are more easily met by steel than by iron. As in the case of steel for shipbuilding, the insistence by Lloyd's and by the Board of Trade surveyors on a very high tensile strain, without relaxation for the greater thicknesses, has led to certain difficulties and dangers. No one is more alive to these than Mr. W. Parker, chief engineer to Lloyd's; and in his hands any modification of rules suggested by experience may safely be left. Engineers and surveyors generally must recognise that greater thicknesses, whether in steel or iron, involve less work upon the material; and less work means less tenacity. This ought to be understood, accepted, and allowed for. Otherwise the manufacturer is compelled to increase the amount of carbon in his steel in proportion to thickness, and perhaps beyond safe limits; and thus are incurred the risks of such disastrous failures as have occasionaliy taken place. For boilers other than marine the supercession of iron by steel has not been nearly so rapid, nor is it at all complete. In Lancashire, where large diameters are in vogue, and where Mr. Adamson and other able engineers have long advocated and set the example of using steel, it is now largely employed. But throughout the country generally the older material is still mostly preferred, at all events for shells. For difficult work, such as flanged tubes and double-flanged end-plates, the diminished proportion of wasters attending the use of steel is rapidly leading to its extended adoption.

Rolling stock.—Iron or steel under-frames for rolling stock are much commoner on Continental than on English railways. A metallic framework is always more permanent and satisfactory, and usually ligher than a timber one of equal strength. But experience has shown that the latter material does well enough, and in case of collision the *débris* is more easily dealt with by splitting up and burning. A crumpled-up iron or steel under-frame is an exceedingly awkward thing either to handle, to remove, or to annihilate. It must, however, be borne in mind that, as in the case of ships, it is impossible so to construct fabrics that they shall withstand serious collisions without inconvenience; and the possibility of abnormal occurrences should not be allowed to handicap normal use. On the North Eastern Railway excellent hopper mineral wagons made entirely of iron have been in use for fifteen or twenty years, and apparently with satisfactory results. Recently a large number have been built at Darlington of basic steel, for West Coast traffic. A saving of weight has thereby been obtained, and increased power to resist damage from tipping the minerals in and hammering the sides by the workmen to shake them out.

Railway sleepers.—A still more important use for iron or steel in the future is, or should be, for railway sleepers. Here again some foreign and colonial railways are in advance of our own; for iron sleepers have been in successful use abroad at least fifteen years. Considering the growing scarcity of timber all over the world, together with the ever increasing need for it, we ought surely to look with jealousy upon its continued use in such enormous quantities for sleepers, where metal would answer the purpose. It is a form of waste which should be reprehended in the public interest, just as should the use of coal for ballasting or other obviously wasteful purpose. The same timber which becomes useless for sleepers in say nine years would last at least a century in the roof or flooring of a house. Piles of Baltic timber driven twenty-two years since, and always immersed in water, I lately examined, and found still perfectly sound. Had they been used as sleepers, they would have needed replacement twice already.

Bar iron.—Whilst rolled steel is gradually taking the place of rolled iron in so many directions, there is one in which it seems as yet to have made little or no progress; and that is in competition with ordinary bar iron. Makers of this speciality agree in saying that only a very small percentage of their output is as yet of steel, although they are equally willing and able to supply either material.

Rolled joists.—Until lately this speciality was almost entirely monopolised by the Belgians. Now large quantities of rolled joists are produced at Middlesbrough. There appears to be no advantage in making them of steel, as in that material they are more difficult to get sound at the edges, less easy to straighten, and generally more costly to produce. And if made thinner than the ordinary sections for iron, in order to reduce their cost in steel, they are deficient in stiffness. It is noteworthy that, at their present market price of £4 2s. free on board at Antwerp, rolled joists are the cheapest form in which finished iron of any kind is, or perhaps ever has been, produced.

Castings.—Steel castings began to come into extensive use about twenty-three years since. They were then made of crucible steel only, and no great size or weight was attempted. An urgent need had long existed for a material which could be cast in a mould, and which should yet have the toughness and tenacity of wrought iron. Portions of machinery that are subjected to severe strain, such, for instance, as the pinions and clutches of reversing rolling mills and the propelling gearing of steam plough engines, are cases in point. No increase of substance would give the requisite strength so long as the material remained cast iron; inasmuch as the destructive force depending on the inertia of the parts would increase proportionately. But the difficulty was entirely obviated by the use of steel castings; for the strength and toughness in that case are largely increased without increasing the inertia. Before the time named, articles of enormous weight, such as screw-propellers, were occasionally made even of cast brass or gun-metal, at a twelve-fold expense compared with cast iron, in the hope of obtaining a slight increase of tenacity and some little ductility. The modern alloys of manganese, and phosphor-bronze, and Dick's metal, which in some forms are claimed to be as strong and tough as wrought iron, were then unknown; and therefore the need of a better material for castings was more urgent than it would otherwise have been. The cost of steel castings has been greatly cheapened latterly by the employment of the Bessemer and open-hearth processes. But the expectation which is occasionally expressed, that steel castings are about to supersede iron ones altogether, does not seem at all likely to be realised. For, in the first place, steel castings are from three to five times dearer than iron ones; and, in the second place, whilst their general superiority is beyond question, iron castings have still the advantage in certain respects. In a majority of the cases where cast iron has hitherto been used, mass, and the stiffness due thereto, are required rather than great tenacity or ductility. For columns, water and gas mains, engine frames, cylinders, condensers, bed plates, and for very many other purposes, steel would not answer better, if, indeed, so well as iron, even though there were no difference in price. Again, for wearing surfaces, such as the motion blocks and bars of a steam engine, nothing works better than cast iron upon cast iron, if only the areas be sufficient; and this property is still more remarkable in the case of pistons in cylinders and slides on slide faces, working, as they often do, for long periods and remaining in excellent condition, with no other lubrication than the steam itself.

Forgings.—Concurrently with steel castings, steel forgings have gradually been coming more and more into general use. For very fine and delicate work, such as the spindles and pinions of watches and clocks, high carbon crucible cast steel has been used for an indefinite period, and long before the days of Bessemer or Siemens. Cost is nothing, homogeneity everything in such cases; and capacity to harden is scarcely less valuable. A streak of cinder, of little moment in a large forging, might render a very small one weak at a vital point. With regard to gun and rifle barrels, a complete revolution has taken place within the last few years. The system of coiling and then welding wrought iron strips to form a barrel has virtually passed away; and solid steel, rolled from the ingot, and then drilled through from either end, is the system which now prevails both here and abroad. A similar change has taken place with respect to heavy ordnance. But there are certain specialities within the general class of forgings, with respect to which it is by no means yet clear that steel is superior to wrought iron. I refer to heavy shafting, axles, and especially locomotive crank-axles. But the very earnestness of the efforts to meet the danger is obviously a recognition of its existence; and so it tends to augment as much as to allay the prevalent apprehension that crank-axles in locomotives are, after all, dangerous things. The Board of Trade returns for 1884* confirm this view in a very remarkable manner, and show also beyond a doubt that steel in crank-axles is thus far less reliable than iron. During last year 385 axles of all kinds failed, involving death to 24 and injury to 73 persons. Of the 385 failures, 200, or 52 per cent., were locomotive crank or driving axles. The average mileage of the iron crank-axles was 216,333 miles, and of the steel ones 173,287 miles, or 20 per cent. less. The question arises:—If crank-axles cannot be altogether avoided in locomotives, how can they be strengthened at their known weak points? If the strain on the crank pin were merely a shearing strain, or a short bending strain, as it is on the crank pin of an outside cylinder engine, this would be more than enough. But it is not so. In running round a curve, one driving wheel goes faster, and the other slower, than they should to roll on their respective rails. The whole force of adhesion acts on the tire of one wheel in one direction, and the other in the other, tending with the leverage of the radius of the wheel to twist the axle. If there were bearings close to each cheek of each crank, there would then be only a shearing strain on the crank pins; but as it is, the axle springs at the gaps, until the twisting strain on the pins is equal to that on the plain parts. The same thing occurs alternately when each piston, being at half-stroke, and therefore making maximum rotary effort, is driving the opposite side wheel through the opposite side crank pin, which is then on the centre. As to heavy shafting, it is still an open question whether steel or iron is best. The preponderance of opinion among forgemasters in the North is, I think, decidedly in favour of iron. The price also is substantially lower. It is said that a steel shaft, having a slight nick or fault across a journal, will break or tear right through when strained; whereas an iron one, being built up in layers, usually remains unaffected beyond the immediate locality of the fault.

Smith Work.—Within a certain range of temperature steel can be more successfully worked than iron; but that range is narrower. Thus at the temperature familiarly known as cherry-red, a good steel plate can be bent double, and then redoubled crosswise. An iron boiler-plate is considered good if it bends double with the fibre, and to a right angle across, at a full red heat. Steel plates are best worked at a low heat, iron ones at a somewhat higher heat. At a welding heat steel plates require the utmost care to avoid burning or fusing, after which they become quite brittle. A number of steel plates which I saw lately being dished hot to a very awkward form, between two dies under a steam hammer, were mostly failing. The men were advised to lower the temperature to cherry-red, and the remaining plates all stood the test. Steel is

* "Manufacture of Iron and Steel," by Sir I. Lowthian Bell, p. 379

† *Journal of the Iron and Steel Institute*, No. 2, 1878, p. 436 and following; and also No. 1, 1881, p. 31.

‡ For this comparison wrought iron plates are taken at £4 17s. 6d., and steel plates at £7 2s. 6d. per ton.

§ "Manufacture of Iron and Steel," p. 386.

‖ *Journal of the Iron and Steel Institute*, No. 1, 1881, p. 30.

¶ Sir I. Lowthian Bell, judging from experience obtained on the North Eastern Railway, doubts the correctness of Mr. Price-Williams's estimate, and thinks double is more nearly correct than ninefold. ("Manufacture of Iron and Steel," page 380). The degree of superiority will no doubt vary with the position, aad in direct proportion to the severity of traffic. Under any circumstances the advantage is very considerable.

** For this estimate I have taken steel—plate—to have 27·3 tons per square inch ultimate tensile strength either way of the grain and 16·6 tons elastic limit. Iron—plate—I have taken to have an ultimate tensile strength of 21 tons with, and 18·2 tons across the grain, and 13·7 tons elastic limit either way. The elastic limit of steel was recently determined for me by Mr. P. C. Gilchrist, on a Wicksteed machine, by the average of ten specimens of mild steel tried. The elastic limit of iron is the average of eight specimens tested at the Tees Side Iron and Engine Works, Middlesbrough. There was virtually no difference with and across grain—see p. 11, "Bridges and Roofs."

* Yearly statements of Lloyd's Register of Shipping, 9th January, 1884, and 8th January, 1885.

† It seems clear that mild steel has much less practical advantage over wrought iron when used for bridges and roofs than when used for ships.

* Returns of Accidents and Casualties reported to the Board of Trade during 1884. (Eyre and Spottiswoode, London.)

less easily welded than iron. Thus the blow-holes, or piping, which occasionally occur in ingots, are never welded up in subsequent rolling. They become enlarged, and are the cause of the lamination which is not infrequently found in steel plates. Mr. Adamson, in the course of his paper read at Paris in 1878,* gave it as his experience that some steel could be welded, but not all. He believed that for this purpose the carbon contained should not exceed 0·125 per cent. It is still true that all steel will not weld with ease and certainty; and it is not yet quite clear wherein the difference lies. It must not be forgotten that there are welds and welds. A good weld is one where the welded piece will afterwards bear the same cold bending through the weld as through the neighbouring solid part. Probably there are very few welds, though to all appearance perfect, which would stand this test. As an instance of good practice in welding steel, I may mention that at Messrs. R. and W. Hawthorn's works at St. Peter's, Newcastle, marine boiler flues 7ft. long are soundly welded at one heat. A V-groove joint, carefully planed out, is adopted; and certain fluxes are used to fuse the scale, which would otherwise prevent adhesion of the surfaces. Flue rings, conical tubes, and other details of boiler-work, involving welding and subsequent flanging, can now be made of suitable steel almost as easily as of iron; and when made, they are incomparably better. For to make a welded and flanged tube of iron not more than $\frac{5}{16}$in. thick, a very high quality of iron must be used; and even then the tube will be found unable to stand subsequent rough usage, such as setting cold to suit deviations in the dimensions of the flues. The repeated heatings undergone during welding and flanging have indeed taken the "nature" out of the iron, and left it brittle. But steel tubes when finished and annealed will stand battering about cold, without any fear of damage whatever.

Corrosion.—No inquiry into the relative suitability of such materials as wrought iron and steel for permanent constructive works would be complete which took no account o f their respective capacities to resist corrosive influences. Both of them are obtained from the mixtures of metallic and non-metallic oxides which we call ores. These ores when found are, as regards further oxidation, in a staple condition; whereas the purer the derived metals the more unstable they are. They are always seeking, as it were, to return to their primitive condition; and this return we call corrosion. The British Admiralty appointed a committee in June, 1874, to examine into the causes of corrosion in marine boilers. This committee investigated the subject very carefully, perseveringly, and conscientiously. Nothing done before or since can compare in extent or importance with the results of their labours. They took evidence of leading chemists, metallurgists, engineers, iron and steel makers, naval engineers, inspectors of steamer lines, Board of Trade and Lloyd's officers, foreman boiler makers, and others; and they visited the principal localities and works in the country where there was a reasonable prospect of obtaining information. After three years of laborious work they published their final report in 1877.

The following is the pith of the committee's conclusions in their own words:—"It was reasonably expected that . . . those materials made by fusion, and consequently free from cinder, and in a condition of more perfect mixture, should have resisted the 'pitting' action much better than piled iron. Such, however, is not the case.† Not only does iron withstand corrosion much better than steel; but the commoner brands of iron withstand it better than those of higher qualities."‡ In May, 1881, Mr. W. Parker, chief engineer surveyor at Lloyd's, read a valuable paper before the Iron and Steel Institute on the "Relative Corrosion of Iron and Steel." In his view the deductions made by the Admiralty Committee were open to exception, because he thought sufficient care had not been taken to avoid galvanic action. He had therefore made experiments himself, taking extra precautions to obviate this danger. He also operated upon discs made of iron and steel plates, arranged in groups of eleven similar specimens each. Some of the experiments were specially made to ascertain the effect, protective or otherwise, of scale. In the remainder, which alone need here be considered, the discs were turned bright, in order that the intrinsic anti-corrosive properties of the metals might severally be tested. Two of the specimens in each group were of common iron containing a maximum of cinder; five were of high quality iron from South Yorkshire; and four were of the best brands of modern mild steel. The specimens composing each group were separated by glass ferrules to ensure insulation, and they were otherwise arranged to obviate all known or possible objections. One group was exposed to the atmosphere on the roof of a London building for 415 days. A second was fixed under sea-water level at Brighton 437 days. A third was subjected to the action of bilge water in a steamer 240 days. And three other groups were hung in the water spaces of different marine boilers for 361 days. The results are given by Mr. Parker in a tabulated form.§ If an average be taken of the behaviour of the three classes of materials under the six different conditions to which they were subjected, it will be found that South Yorkshire high-class iron corrodes 9·4 per cent. more than common iron, and mild steel 40 per cent. more. Thus the Boiler Committee's conclusions were decisively confirmed by the experiments of Mr. Parker, who certainly, from the tone of his paper, could scarcely be considered a willing witness.‖

Whether the advantage lie with iron or with steel as regards intrinsic anti-corrosive qualities, it must be admitted that neither metal can safely be left long without protection. Indeed maintenance of an innocuous protective film seems to be the grand desideratum, whether the internal surfaces of a boiler, or the external surfaces of other structures, be in question.

Electrical Conductivity of Solid Mercury and other Metals at Low Temperatures.—The following abstract is given in the *Journal of the Chemical Society* of a paper by Cailletet and Bouty (*Compt. Rend.* 100, 1188-1191):—The electrical resistance of most pure metals decreases regularly with a reduction of temperature from 0 deg. to −123 deg., and the coefficient of variation is practically the same in all cases. The resistance of mercury decreases at the point of solidification in the ratio of 4·08 : 1, and the resistance of solid mercury decreases with the temperature. Between −40 deg. and −92·13 deg. it is represented by the formula $R_t = R_{-40\,\text{deg.}} \dfrac{1 + at}{1 - 40a}$, where $a = 0{\cdot}00407$, a value closely approaching that for other metal. The values of a for several metals are as follows:—

	a	Limits of temperature.
Silver	0·00385 ..	+ 29·97 deg. to −101·75 deg.
Aluminium	0·00388 ..	+ 27·7 to − 90·57
Magnesium	0·00390 ..	0 to − 88·31
Tin	0·00424 ..	0 to − 85·08
Copper	0·00418 ..	0 to − 58·22
,, ...	0·00426 ..	− 68·65 to −101·30
,, ...	0·00424 ..	− 113·08 to −122·82

The variation in the resistance of platinum and iron differs from that of other metals below zero as well as above. The formula $R_t = R_0 (1 + at)$ holds good in the case of iron when $a = 0{\cdot}0049$, but in the case of platinum the value of a, which is 0·0030 at 0 deg., increases as the temperature falls, and becomes 0·00342 at −94·57 deg.; or, in other words, the lower the temperature the more closely does the value of the coefficient for platinum approach that for other metals.

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* *Journal of the Iron and Steel Institute*, 1878, pp. 395-6.

† Third report of Admiralty Boiler Committee, p. xxxvii.

‡ Ibid., p. xvii.

§ *Journal of Iron and Steel Institute*, No. 1, 1881, p. 46, Table II., column 9.

‖ All these experiments confirm Mallet's reports (Brit. Assoc. 184-43) on this subject so extensively dealt with by him.

LAUNCHES AND TRIAL TRIPS.

On the 7th of August the Baghdadi, which was recently built and engined by Messrs. Wigham Richardson and Co. to the order of the Persian Gulf Steamship Company, went on her trial trip. She is 255ft. long by 34ft. 9in. beam and 25ft. 6in. deep, and is fitted with engines of the triple expansion type, with cylinders 21½in., 33in., and 55in. diameter and 39in. stroke, the boiler pressure being 150 lb.; mean speed, 12 knots; mean revolutions, 78; steam pressure, 148 lb.; vacuum, 29in. The engines are Tweedy's patent system, in which the high-pressure cylinder is placed centrally. The vessel is fitted with Tweedy's patent condenser, which causes the winches to work economically and with little noise. Both hull and machinery have been superintended during construction by Messrs. Flannery and Baggallay, of London, consulting engineers to the company, and the trial, which was in every respect successful, was attended by Mr. James Darby, managing director to the company, Mr. Wigham Richardson, and most of the leading consulting engineers of Newcastle.

On Saturday, August 8th, there was successfully launched from the shipbuilding and engineering works of Messrs. Oswald, Mordaunt, and Co., at Southampton, a handsomely modelled iron sailing ship of 2150 tons net register, and of the following dimensions:—Extreme length, about 280ft.; extreme breadth, about 40ft. 6in.; depth of hold, about 24ft. 8in. The vessel is to the order of Messrs. T. and J. Brocklebank, of Liverpool, and exceeds the highest requirements of both Lloyd's and Liverpool Underwriters' Registry. She is full-rigged. Ample accommodation is provided in full poop for captain and officers, whilst the petty officers and crew are berthed in large iron deckhouse amidships. The vessel is fitted with Harfield's patent combined capstan windlass, for working anchors and chains. The vessel on leaving the warp was gracefully christened the Bactria by Miss Gertrude Mordaunt.

On the 10th inst. Messrs. Robert Duncan and Co. launched from their building yard at Port Glasgow a handsome iron sailing ship of about 1500 tons register, for Mr. George F. Smith, of St. John's, New Brunswick, contracted for through Messrs. J. and R. Young and Co., of Glasgow. She will be commanded by Captain Andrews, late of the clipper ship Constance, who has superintended the construction in conjunction with Messrs. MacNicoll and Co., naval architects and consulting engineers, Glasgow, who drew out the specification to suit the owner's ideas. She was named Timandra, by Mrs. Andrews, wife of Captain Andrews. The dimensions are 245ft. by 38ft. 9in. by 22ft. 6in., and the ship has been built under special survey to class 100 A1 at Lloyd's, with two decks laid; topgallant forecastle iron deck house for crew; full poop for cabins, &c., with teak charthouse on top, forming companion entrance; masts, topmasts, continuous bowsprit and jibboom, and lower and topsail yards all of steel; Clark, Chapman, and Co.'s patent windlass; lighthouses forward, hydrant water service, and all the latest improvements. After the launch she was towed into harbour to be inclined for the stability calculations and fitted out, after which she will load in Glasgow for Sydney.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, August 1st.

A slight improvement in the price of and demand for iron is observed, but the improvement is temporary. The supply of pig iron has been growing at the rate of 4000 tons per week for six months, while the consumptive demand has been reduced over 4000 tons per week. Nearly one hundred furnaces have been cast out of statistical computation during the past six months, because of the improbability of their employment, due to the inroads of steel.

The production of pig iron for the past twelve months foots up 4,473,408 tons. This represents about one-half the nominal producing capacity. The rail output for the past twelve months has been 975,697 net tons; of steel ingots, 1,486,994 tons. The production of ingots which do not go into rails is steadily increasing. The feeling in iron and steel manufacturing circles is that an improvement is not so improbable as was felt two or three months ago. Some 3000 miles of railroad will be completed during the next four months. A great deal of bridge-work will be required, and contracts for large lots are now in negotiation.

The iron nail-makers are in a quandary. The Western nail-makers have all along preferred to let their nailers strike than to pay the higher wages demanded. The Eastern makers have shut down four weeks. A project is now on foot to build a large Bessemer plant with 150,000 tons capacity. Danville, a manufacturing town in the interior of the State, has been spoken of. A year ago a dozen manufacturers put up 100,000 dols. to try what was known as the Henderson process of steel making. Though it proved to be a laboratory success, it was not a commercial success, and another attempt is now being made with the Clapp-Griffith process at Harrisburg, the State Capital. One hundred miles west of Philadelphia a great deal of doubt is finding expression as to the adaptability of the Clapp-Griffiths process, and it will be thoroughly tested before meeting with adoption on a large scale. Iron nails are selling at 1.90 dols. and 2 dols.; bar iron at 1.35c. to 1¾c. per pound; steel rails at 26 dols. to 28 dols.; pig iron at 14 dols. to 16 dols. for forge, and 15.50 dols. to 18 dols. for Nos. 2 and 1 foundry; plate iron, 1.90c. to 2c.; angles, 2c.; beams and channels, 3c. Autumn trade is at hand, and building enterprises are being pushed with great vigour.

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

(*From our own Correspondent.*)

Upon 'Change in Birmingham to-day—Thursday—and in Wolverhampton yesterday offers were rejected in a style which showed the resolve of established firms to do their utmost to keep prices on at least a paying level.

The marked bars of Earl Dudley and of Messrs. Barrows could not be bought at any reduction whatever upon the circular quotations of those firms. The quotation of £7 10s. for Staffordshire marked bars is therefore upheld in the face of offers by some firms to supply iron of equal quality at £1 less money. Nor would the high-class boiler-plate makers give way under the pressure of the steel plate firms. These latter were offering basic boiler-plates at £7 10s., but iron plates of the Monmoor brand were strong at £8 10s.; and there were a few plate firms who quoted £9 10s. upwards for boiler sorts.

Best stamping sheets showed the effect upon quotations of the abundant supply of steel blooms and billets suitable for working up in the thin sheet mills and the tin-plate works. Quality for quality deep stamping sheets were never cheaper.

Galvanised sheets are in considerable outturn. They were to be had to-day at from £6 15s. for doubles to £7 15s. for trebles, while sheets of 24 gauge for working up in the ungalvanised condition were to be had at £6 12s. 6d.

Strip and hoop iron of a good quality was procurable at £6 easy, and common bars were plentiful at £5 10s.

Engineers and the founders of machine castings are, certain of them, buying high-class pigs somewhat freely. A twelvemonth's requirement of hematite iron is here and there being contracted for by such firms, at the prevailing low rate of 53s. per ton. All-mine pigs are quoted by a few makers in the Dudley district up to as high as 65s.; but less special sorts are to be had in Staffordshire and Shropshire at 57s. 6d. down to 55s. Spring Vale (Staffordshire) iron was yesterday quoted 52s. 6d., 45s., and 35s. respectively; while Derbyshires of excellent quality were 39s. to 40s., and the Wellingborough brand 40s. 6d. per ton.

Cold blast iron is selling somewhat better, mainly for engineering purposes, and for chilled rolling casting in particular. Blaenavon cold blast, for which £6 is demanded, is reported to have been purchased by such firms in a larger aggregate during the past month than for a long time past.

Certain of the Welsh steel firms are pushing business in this district in plating bars. These they are now offering wholly of Bessemer steel delivered into South Staffordshire at the astonishingly low figure of £5 12s. 6d. The quality is warranted of a specific temperature, and the bars are, of course, homogeneous. Such metal at such a figure finds but little difficulty in securing a market. The price which the makers obtain cannot be much over £5, for it costs 8s. to carry the bars from South Wales to South Staffordshire, and then there is the agent's commission. Yet the price, low as it is, leaves a profit, since the Bessemer blooms are taken hot from the moulds direct to the bar rolls, and 70 tons a turn can be got out. Though 120 tons of rails may be rolled in a turn, still a margin of probably over 12s. 6d. per ton in favour of plating bars leaves the plating bar branch the source of more profit, ton for ton, than the rail branch. A year or so ago £7 10s. was asked for these same bars, and they are being used for purposes for which the edge tool people used to pay even as high a figure as £18 per ton to the Sheffield steel makers.

Shropshire wire rod makers quote drawn wire rods, Nos. 8 and 9, delivered Liverpool, £7 5s., and rolled ditto, Nos. 0 and 6, £6 per ton.

Northamptonshire iron ore is being delivered into the centre of South Staffordshire at from 5s. 6d. to 5s. 8d. per truck, or at half-a-crown per ton free on trucks at the mines.

About 430 tons of wrought and cast iron for the construction of bridges are required by the Midland Company, and specifications are this week being sent in.

Tenders are being sent in to the directors of the Bombay, Baroda, and Central India Railway Company for the supply of Staffordshire iron, fish-plates, nuts and bolts, and other hardware stores.

One of the most encouraging features of trade at the present time is the improvement which, it is generally admitted, marks the Cape business. The spring and axle makers in particular are very pronounced upon this point. Certain of them have received more Cape orders during the last few weeks than for six months previously, and they are now setting their works on increased time.

More is doing with the United States and Canada, the latter country taking considerable quantities of machinery, fencing, and agricultural tools. The South American markets show a little revival, good orders having been received from the River Plate for mining and agricultural tools and constructive ironwork.

A good harvest in France is having the effect of causing a better demand for English iron and hardware goods, and the Levant trade is a little stimulated by the authorisation of the payment of the Egyptian indemnities.

Heavy ironfounders are well supplied with orders.

Estimates for the supply of wrought and cast ironwork required for a new bridge over the Douglas Channel are being sent in from this district to the Cork, Blackrock, and Passage Railway Company.

It is hoped that the contract for steam pump and engines required by the Walthamstow Local Board may find its way into this district.

Cast iron pipefounders are endeavouring to secure the contract for 4000 tons of pipes from 18in. to 12in. diameter for the Corporation of Ayr.

Wrought iron tube makers are busy on gas and water companies' orders, and also on Indian and Australian contracts.

The vice and anvil trade is not brisk, and the girder trade is kept together only indifferently by the shipping orders.

Some rim and mortice firms of repute are so filled with repeat orders from New Zealand, Australia, and the Cape that they are compelled to lay down increased machine plant.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The condition of the iron trade in this district remains practically without change. Complete stagnation seems to have taken settled possession of the market, and as low prices—which in some cases have been gradually forced down to below the actual cost of production—have failed to bring about any improvement in trade, makers and manufacturers are being driven to face a lessening of the production as the only resource by which they can obtain relief from the present unsatisfactory condition of the market. By seeking rebates on railway rates for carriage, and by cutting down wherever possible any other incidental charges, efforts are made to bring down prices to as fine a point as possible with the view of meeting the market; but as regards any further concessions, so far as they trench upon the actual cost of production, the limit would now seem to have been reached. As to reducing the production, the blowing out of furnaces both in Lancashire and the neighbouring districts has already been so far carried out that they are not working up to more than about half their output, and in some cases makers with their present restricted production are kept sufficiently well supplied with orders by the small occasional sales they are able to make at their quoted rates that they decline to meet buyers with any further concessions, and there seems to be a disposition generally to bring the output of iron to the level of the requirements of the market rather than attempt to force a larger volume of trade by any further giving way in prices. Whether such a restriction of the output can be carried out as will enable makers to command any better prices is very doubtful, but certainly there is a growing indifference about any pressure to secure business in the present unsatisfactory condition of the market, and some of the makers are declining to accept offers at under their present quoted rates.

There was again only a very slow business doing at the Manchester iron market on Tuesday, with prices nominally unchanged from last week. For pig iron the inquiry continues extremely small, with, if anything, a lessening weight of business coming forward in the market. The Lancashire pig iron makers still quote 38s. 6d., less 2½, and for district brands quoted prices are about 38s. to 39s., less 2½, delivered equal to Manchester, with sellers here and there at about 6d. per ton under these figures. Outside brands, both Scotch and Middlesbrough, are very low in price, and the best named North-country makes are to be got at about 41s. 4d. net cash, delivered equal to Manchester, with ordinary g.m.b.'s to be got at 1s. per ton under this figure.

The hematite trade continues without improvement, and good foundry brands are still to be got without difficulty at about 51s. to 51s. 6d., less 2½, delivered into the Manchester district.

In finished iron, with the exception that one or two large makers are moderately well off for work, there is generally only a slow trade doing on the basis of £5 5s. for Lancashire and North Staffordshire bars delivered into the Manchester district.

A general slackening down of inquiry is reported amongst engineers, and a state of lethargy appears to be coming over trade. Locomotive builders are still kept tolerably busy finishing work, but they have no calls of any weight upon them for the future. In railway rolling stock there is also but little new work coming forward, and this is being keenly contested for. A few of the tool makers are still moderately well employed, and boiler makers are fairly busy, but it is on old orders, which are running out much faster than they are being replaced. Both in small engine building and heavy engineering work trade is in a depressed condition, and the shipbuilding trade, reported to be again getting into a state of revival, has disappointed the hopes of employers in this branch of industry.

Now that the promoters of the Manchester Ship Canal, after a struggle which will be memorable in the history of private Bill legislation, not only for the determined persistency with which it has been fought, but for the protracted character and costliness of the inquiry before the several Parliamentary Committees, have secured the requisite powers for carrying out the scheme, it will be of interest to give briefly their own views with regard to the conditions on which the parliamentary sanction for their undertaking has been obtained. During the week I have had conversations both with Mr. Daniel Adamson, who has been the leading spirit from the inauguration of the project and throughout the whole of the proceedings before Parliament, and Mr. Leader Williams, who, as the engineer of both the schemes that have been brought before Parliament, deserves great credit for the able manner in which he has fought out his plans before the various committees. Neither in regard to the alterations which have been made in a few of the details connected with the construction of the canal nor in the conditions which have been imposed with regard to the raising of the capital for carrying out the work, does either Mr. Adamson or Mr. Leader Williams at all consider that the prospects of the scheme have in any way been appreciably injured. The chief alterations in the scheme, so far as the engineering details are concerned, are that here and there along the route as marked out on the plans submitted to the committee, the line of the canal has been brought rather more inland, with the object of diminishing the tidal abstraction as much as possible. These alterations are, however, of very little moment, and they are all within the limits of deviation already marked out by Mr. Leader Williams. A slightly increased cost for cutting out of the solid will be involved, but this extra expenditure will be saved in other directions, and as the cutting will dispense with the necessity of erecting and maintaining water-tight puddled walls in the estuary, the actual construction of the canal will be rendered easier of execution. The only other alteration upon the plans submitted to the committee which calls for any notice is the raising of the level of the lock at Eastham; but this still leaves an entrance channel which will be 8ft. deeper than the best sills of the most modern docks at Liverpool, and 14ft. deeper than the docks at Garston. With regard to the conditions imposed as to the raising of the requisite capital, these would seem to be rather onerous and likely to be prejudicial to the successful floating of the project; but Mr. Adamson looks upon them as simply affording a guarantee to the shareholders, and not as stipulations which will at all affect the carrying out of the scheme. The condition as to the raising of five millions of capital is simply a repetition of the clause which the promoters themselves offered last year when it was hinted they might not be able to find the money, and in addition they further offered this year to raise the whole of the purchase money for the Bridgewater Canal. It is clear that so large a scheme as the Manchester Ship Canal could not be attempted unless the promoters were in the position that they had three-fourths of the capital guaranteed in advance, and the promoters have every confidence that not only will the required capital be forthcoming, but Mr. Adamson is sanguine that actual operations may be commenced in six months. Next week a meeting of the subscribers to the promotion expenses is to be held, and then it will be decided what definite action shall be taken for the further carrying on of the project for which they have at length obtained the sanction of Parliament.

In the coal trade the business doing is still limited to the smallest possible dimensions, and pits are only kept very irregularly employed about three, four, or five days a week, just as they are able to move away their output or load up into wagons. House-fire, steam, and forge coals and engine classes of fuel all meet with a very poor demand, and where anything like quantities have to be moved very low prices are taken, but the average quoted rates at the pit mouth remain about as under:—Best coal, 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common coal, 5s. to 5s. 6d.; burgy, 4s. 3d. to 4s. 9d.; best slack, 3s. 6d. to 4s.; and ordinary qualities, 2s. 2d. to 3s. per ton.

Here and there collieries are tolerably busy with shipping orders, but generally a falling-off is reported in this branch of trade, and there is only a moderate business doing on the basis of 7s. to 7s. 3d. per ton for good qualities of steam coal delivered at the high level, Liverpool, or the Garston Docks.

Barrow.—The hematite pig iron trade of this district has within the past week undergone a slight change for the better. Unfortunately the increased activity which is manifested is from one quarter only, and this is not likely to be maintained, as the orders which have been given, although comparatively speaking of a fair tonnage, are simply given out to cover what is absolutely necessary. Owing to the prospective tariff which was to be levied in Russia, buyers bought somewhat heavily; indeed, in some cases, large stocks were purchased, but these stocks have now, in some important instances, become exhausted, and it has become necessary to give out fresh orders. During the past week orders representing 16,000 tons have been given in this immediate district, and it is expected an order of 8000 tons by another firm in the district will be received in a day or two. Steel makers are only partially employed, and their immediate prospects do not appear to be very bright. Prices unchanged. Iron ore selling slowly at late rates. Other industries unchanged.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE official returns of trading with foreign countries for July are once more discouraging in regard to Sheffield productions, while the exports of the whole country decreased by £1,866,076 as compared with the corresponding period of 1884. The iron and steel exports show a total of £1,880,691 for the month, against £2,280,333; and £2,404,333 for the months of July, 1884, and 1883. In hardware and cutlery the value exported was £243,779 against £268,938 for July, 1884, and £316,937 for July, 1883. Russia and Australasia are the only increasing markets, the former market advancing from £3893 to £4572, and the latter from £49,763 to £55,203. The Argentine Republic shows the heaviest drop, from £12,943 to £7833; Germany, from £16,752 to £12,544; Holland, from £8553 to £6775; France, from £10,923 to £9694; Spain and Canaries, from £8039 to £6170; the United States, from £34,463 to £31,397; Brazil, from £11,159 to £10,188; British North America, from £10,164 to £9674; British Possessions in South Africa, from £7739 to £5533. The values of steel are getting "small by degrees and beautifully less." In July, 1883, unwrought steel was sent to France, United States, and other countries to the value of £112,235; July, 1884, £93,759; last month, £81,340. France shows diminishing values in these periods of £11,950, £11,813, and £7213; and the United States of £33,737, £25,590, and £20,680. The fall to the United States markets this month is less than formerly, but the total trade is now so attenuated that a decline of £3000 on the month is serious enough.

Steel rails and railroad of all sorts show singular results. There has been practically no export trade in rails during July, the total quantities being only 3500 tons, of which British East Indies took 3360 tons, the only other markets which did any business being Spain and Canaries, Egypt, Chili, and Australasia. For the corresponding periods of 1883 and 1884 the quantities were 14,853 and 13,946. In railroad of all sorts the values for July of the past three years have been respectively £520,931, £428,859, and £347,382. Sweden and Norway show an immense increase on July of 1884, when a value of only £154 was taken; last month the value was £19,568; Spain and Canaries have increased from £1187 to £3428; Italy, from £8096 to £14,325; Peru, from £2902 to £5598; British Possessions in South Africa, from £1515 to £12,520; British East Indies, from £82,692 to £116,777; and Australasia, from £75,448 to £78,540. On the other hand, Russia has fallen from £18,550 to £16,003; Egypt shows a decline from £10,610 to £38; Germany, Holland, the United States—£19,140 last year—and Mexico are blank; the Argentine Republic has fallen from £86,233 to £7864; Chili, from £14,777 to £1702; and British North America, from £85,534 to £47,107.

A similar analysis of other articles shows results of a very unsatisfactory nature. Pig iron for example, was exported in July of 1883 to the value of £410,672; in the following July the amount dropped to £280,986, and last month to £169,622. British North America are the only markets which show an improvement. In bar, angle, and bolt the three periods mentioned show values of £156,426, £171,206, and £131,454; hoops, sheets, and plates, £307,114, £294,610, and £270,711.

The South Yorkshire collieries show a considerable improvement during July in the coal trade with Hull, 70,909 tons being sent, as compared with 54,692 tons in 1884, or an increase of 16,217 tons. The quantity sent in the last seven months of the year was 679,216, or a decrease of 37,264 tons when compared with the first seven months of 1884, and a decrease of 63,580 tons when compared with 1883. The Elsecar Collieries, belonging to Earl Fitzwilliam, head the list for July with 24,008 tons, against 4424 tons in July, 1884, an increase of about 20,000 tons. Shireoaks sent 13,696 tons, an increase of 7616 tons. Manvers Main, which last month headed the list, is now third, with 9144 tons, an increase of nearly 3000 tons. The New Oaks, which has now direct communication, sent 944 tons, against 80 in July, of 1884. Otherwise the new Hull and Barnsley Railway does not appear to have materially affected the trade.

In the heavy industries and light staple trades of the town there has been no change during the week. The prospect of another abundant harvest is causing a run on agricultural machinery and implements.

Sheffield cutlery with the United States has been a diminishing business of late years, though the American manufacturers have almost completely failed in their rivalry. France and Germany have been our most successful competitors. Statistics kindly supplied to me show the values to have run thus:—1881, £271,940; 1882, £266,554; 1883, £250,316; 1884, £190,680. When the return for 1885 comes out, the total will be still less.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE Cleveland iron market held at Middlesbrough on Tuesday last, was but moderately attended, and prices were scarcely so firm as at the market of the previous week. The weakness was, however, entirely on the part of merchants, who were again selling small lots of No. 3, g.m.b., at 31s. 10½d. per ton. Makers would not quote less than 32s., and, indeed, some of them demanded 32s. 3d. to 32s. 6d. Some brands of forge iron can be readily obtained at 31s. per ton, but as a rule sellers ask 31s. 3d., and the leading makers quote 31s. 6d.

Warrant holders continue to add to their stocks, and will not part with them for less than 32s. 6d. per ton; some even ask 33s. The stock in Messrs. Connal and Co.'s store increases daily; during the week ending Monday last 2185 tons were sent in, making the total quantity held 62,891 tons.

Shipments from the Tees show some improvement this month in respect of pig iron; the quantity sent to Germany in particular is considerably more than it has been of late. Up to Monday night 25,694 tons had been exported, or nearly 4000 tons more than during the corresponding portion of July.

The finished iron and steel trades show no signs of improvement. Only small orders are being given out, and at miserable prices. Most of the mills in Stockton, Middlesbrough, and the district generally, will be closed next week on account of Stockton races. Messrs. Bolckow, Vaughan, and Co. have been obliged again to close their steel works at Eston. There are several contracts on their books for steel plates, but they have greatest difficulty in obtaining specifications. No change has taken place in the quotations either for steel or for manufactured iron.

The accountant's certificate, issued in respect of the Durham coal trade sliding scale, shows that the net average selling price of coal for the three months ending June 30th was 4s. 7·2d. per ton. The present rate of wages will remain unaltered.

According to the Cleveland ironmasters' returns, issued on the 4th inst., the total make of iron of all kinds in the Cleveland district during July was 211,346 tons, being an increase of 3378 tons as compared with June. The total stocks in the whole district amounted at the end of the month to 416,014 tons, that being an increase of 9889 tons since June 30th.

Considerable satisfaction has been expressed in the North that Mr. David Dale, of Darlington, has been placed upon the Commission to inquire into the depression of trade. There are, however, few who expect any direct results of a beneficial character from the inquiry. But it is quite possible that the increased attention which will be given to the subject, and the discussions which will everywhere take place, may end in forming a more sound and unanimous public opinion upon it than now exists. The difficulty is not so much to point to the causes of depression as to say how they can be more quickly remedied. Depression of trade is itself the result of, and punishment for, past sins and follies. It is itself the powerful but unpleasant means whereby Nature gradually corrects our extravagances and prejudices, and forces us to do more and better work in return for the right to live. In good times, when money is easily made, all classes engaged in trade progress in indolence and self-indulgence at an amazing rate. In the bad times, which inevitably follow, they are gradually brought to their senses by stern necessity. The come at last to cut down all "superfluities of naughtiness," and to devote themselves to the real good of the community as patriotic citizens always ought to do. They cease to think merely what they would like themselves, and come to put first and foremost what is required of them by others. When the whole producing population has gone through this trying but wholesome ordeal so as to cut down personal and industrial waste to the minimum, and so as to increase personal and industrial efficiency to the maximum, then there is no doubt bad times will end and good times will supervene of themselves. If the Royal Commission finds this out, it will find out what every sensible man knows already. But still it will do good if it adds the weight of its authority to even trite ideas of a wholesome character. If, on the other hand, it decides that over-production or foreign contumaciousness, or general want of confidence, or anything else expressed by big words or sentences, is the cause of the prevailing depression, or in any other way diverts men's thoughts away from themselves and their own individual habits and efforts, it will be of no use whatever. If the industrial classes, who form five-sixths of the entire population of this country, could have their eyes opened, so as to at once cease to spend any of their time or money in extravagances and vices, there would be such a considerable proportion of the national income available for other and beneficial purposes that the bad times would be no more heard of, nor the Royal Commission either.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

BUSINESS in the Scotch iron trade shows very little, if any, improvement since last week. The shipments have been small, amounting to 7031 tons, as compared with 7598 tons in the preceding week, and 9727 tons in the corresponding week of 1884. Messrs. William Dixon have relighted a furnace for ordinary iron at Govan Ironworks, and have turned two furnaces—one at Govan and one at Calder—from hematite to ordinary iron. The total number in blast is now 93, against 95 at this date last year. In the course of the week 2540 tons of pigs have been added to the stock in Messrs. Connal and Co.'s stores, which now exceed 614,000 tons.

In the warrant market, business was done on Friday at 41s. 6d. per ton cash. On Monday the tone was very quiet at 41s. 4½d. to 41s. 3½d. cash. Tuesday's market was also slack at 41s. 3d. cash. Business was done on Wednesday at 41s. 4½d. to 41s. 3½d. cash. The market was depressed to-day—Thursday—with business at 41s. 3d. to 41s. 2½d. cash at the close.

The current values of makers' iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s. 6d.; No. 3, 44s.; Coltness, 48s. 6d. and 45s. 6d.; Langloan, 47s. 6d. and 45s. 6d.; Summerlee, 46s. 6d. and 44s.; Calder, No. 3, 44s. Carnbroe, 45s. 6d. and 43s. 6d.; Clyde, 46s. and 42s.; Monkland, 41s. 3d. and 39s.; Quarter, 41s. and 38s. 6d.; Govan, at Broomielaw, 41s. 3d. and 39s.; Shotts, at Leith, 48s. and 47s.; Carron, at Grangemouth, 51s. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 46s. and 41s.; Eglinton, 41s. 3d. and 38s.; Dalmellington, 42s. 6d. and 39s. 6d.

The past week's shipments of iron and steel goods from Glasgow embraced four locomotives and tenders valued at £9240 for Huelva; £10,300 worth of machinery, £411 sewing machines, £1803 steel goods, and £23,000 iron manufactures. There is a want of animation in most departments of the manufactured iron trade. Railway sleepers and other materials are still in fair request for India, but the policy of the Indian Government under the new Ministry, of postponing some of the railway enterprises in India, is regarded with dissatisfaction. The makers of sugar plant are not so well supplied with orders as some time ago.

For about two years the well-known Scottish ironmasters, Messrs. Merry and Cuninghame, have been engaged in erecting, at their Glengarnock Works in Ayrshire, a complete plant for the manufacture of steel on the Thomas-Gilchrist system. The works are now so far completed that the manufacture has commenced, and a party of several hundred gentlemen connected with the iron, engineering, and shipbuilding trades, was carried to Glengarnock by special train from Glasgow, on Friday of last week, to attend the formal opening of the works. The occasion was most interesting, inasmuch as it marked the beginning of an industry which will be of immense advantage to the district and to Scotland generally in the future. It is well known that ordinary Scotch pig iron had hitherto been found unsuitable for conversion into steel in consequence of the amount of phosphorus it contains. The Scotch steel works have accordingly been using Cumberland and Spanish hematite in large quantity to produce the mild steel for which there is now a large and increasing demand for shipbuilding, engineering, and general constructive purposes. The inquiry for Scotch pigs has in consequence been declining to an alarming extent of late, so much so that the industry was threatened with a very serious collapse at no distant date. The application of the basic process of making steel has averted this calamity, and made it possible to produce the material—quite good for almost every purpose for which steel is used—direct from the Scotch clayband ores. The significance of the new departure made by Merry and Cuninghame is, therefore, very great. The guests of the firm had an opportunity of witnessing the process of making steel through nearly every stage. At present the ore is calcined at the pits, but kilns are to be erected at Glengarnock for this purpose, and when they are finished it will be possible to see the ironstone as it comes from the earth passed through a succession of operations until the resultant products are plates and the other steel articles which are being produced at the time. On Friday, a blast furnace 65ft. in height and 18ft. 6in. in diameter, was tapped in presence of the assembly, the molten metal directed into bogies and carried by an underground railway to the converter, then subjected to a great heat for a short time, and afterwards—the phosphorus being expelled and the necessary quantity of spiegeleisen added—emptied into ingot moulds. Ingots were also carried from the re-heating furnaces and hammered into shape for being manufactured into ⅝in. plates in the rolling mills, and the last stage of the operation shown was the cutting of the plates to the required size by a powerful steam shears. The machines for effecting all these different purposes have for the most part been already noticed in the columns of THE ENGINEER. There are three sets of blowing engines of 6000-horse power collectively, four converters, fourteen boilers at the old and sixteen at the new works, rolling mills, hydraulic cranes, a 12-ton steam hammer, and ten heating furnaces. Most of these were shown in operation. The steel made has been subjected to every necessary test, and found to be of excellent quality.

There are at Glengarnock four old and three new blast furnaces, besides two additional ones nearly completed. They are of improved type, and so constructed that the gases are carried to the furnaces throughout the works and utilised for heating purposes.

The coal trade is reported less active on the whole, although the shipments are fair at some of the ports. In the course of last week there was shipped at Glasgow 19,191 tons; Greenock, 1053; Irvine, 2479; Troon, 3621; Ayr, 6262; and Grangemouth, 21,644 tons.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE strike at the important naval steam coal colliery of Penygraig still continues, and 600 men are out of work by it. The matter came under the deliberations of the Rhondda district of miners this week, and the result is that a protracted strike seems inevitable, the meeting deciding to object to a resort to arbitration, and advising the support of the colliers on strike. It would appear that the colliers complain of dangerous practices on the part of the management, such as stopping the working of a heading, and the building up of two "boshings." In the opinion of Mr. Wales, the inspector for South Wales, this course was calculated to make this fiery colliery more dangerous to work, though he admits that, at the time of the inspection, the colliery was safe. The point urged by the management is, that the proprietors have an equal interest with the men in avoiding a catastrophe, and they will willingly submit to arbitration, and let Mr. Burt, or any other competent authority, decide between them. This the men refuse, and so the matter remains.

The coal trade generally is dull, but there is more vivacity, comparatively, at the port of Swansea than at the other principal ports. At a meeting of the Harbour Trust this week a satisfactory report was read, and Mr. F. Yeo was appointed chairman. In the course of the proceedings Sir H. H. Vivian, Bart., M.P., said it should be their object to deepen the harbour another 12ft. or 14ft., and then Swansea would deserve to be called the ocean coal port of the United Kingdom.

I am glad to note the zeal of the Harbour Trust. The past few years' work has been most substantial and creditable. At the same time, looking at the weak prices prevailing at Swansea, slackness of the anthracite trade, and closing of the Lower Resolven, there could be brisker times than are now enjoyed.

The coal trade everywhere is dull. Cardiff only exported 125,000 tons of coal to foreign destinations last week, and the total of Newport was only 25,000 tons. Swansea showed an increase of 3000 tons between the last and preceding week.

A company is starting the Prince's Graving Dock and Engineering Company at Swansea. Capital, £100,000 in £10 shares.

Another company now being floated is the Britannia Steel Works, near Merthyr, which has been recently started by private enterprise. Still, another company in these days when capital is seeking good investment is that of Brecon men, who are starting a steamship company for Llangorse Lake.

That our ironworks are not altogether idle is shown by the list of exports of manufactured iron last week. To Madras, 2526 tons; Havannah and Matanzas, 1000 tons; Gothenberg, 300 tons. This was the total of the consignments from Newport, Mon. Cardiff sent away also 1100 tons. Iron ore has been rather weaker again, and has thus added to the depression in the shipping trade.

As I anticipated, buyers of tin-plate are holding back and trying to overthrow the policy of makers, and break up the confederation. Of course this action will tell on the weak ones, to whom, possibly, support may have to be extended. But it must be borne in mind that stocks are low, and buyers cannot long remain defiant. Makers say that they are determined to get more remunerative prices, and that, rather than continue their mills and work at the old ruinous figures, it would be better to give up the business.

Local makers, it is reported at Swansea, are very busy, and prices firm for all classes to goods. Special plates are in good demand.

NEW COMPANIES.

THE following companies have just been registered:—

Clifton and Kersley Coal Company, Limited.

This company proposes to purchase from Messrs. T. D. Grimke, Edward Pilkington, and others, the Clifton and Kersley Collieries, Lancaster. It was registered on the 31st ult. with a capital of £400,000, in £100 shares. The subscribers are:—

	Shares.
*E. Pilkington, Clifton, colliery proprietor	1
*A. Pilkington, Eccles, colliery proprietor	1
*T. D. Grimke, Prestwich, colliery proprietor	1
*L. Pilkington, Clifton, colliery manager	1
C. Pilkington, Hayton, engineer	1
*W. W. Pilkington, Prescot, glass manufacturer	1
*R. Pilkington, Rainford, glass manufacturer	1

The number of directors is to be six; the first are the subscribers denoted by an asterisk; qualification, 25 shares.

Great Harwood Spinning Company, Limited.

This company was registered on the 30th ult. with a capital of £20,000, in £5 shares, to acquire the Butts Spinning Mill, Delph-road, Great Harwood. The subscribers are:—

	Shares.
*A Birtwistle, Great Harwood, cotton manufacturer	1
*J. Kemp, Great Harwood, cotton manufacturer	1
*C. Smith, Great Harwood, cotton manufacturer	1
*T. Bate, Great Harwood, mill manager	1
*T. Eddleston, Great Harwood	1
T. Mercer, Great Harwood, butcher	1
J. Boardman, Great Harwood, farmer	1

The number of directors is to be five; qualification, 10 shares; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

Mechanical Telephone Company, Limited.

This company proposes to purchase from the Telephone Association, Limited, the British Letters Patent, No. 9050, dated 17th June, 1884, for an improved mechanical telephone. It was registered on the 31st ult. with a capital of £100,000, in £5 shares. The purchase consideration is £42,000, payable £21,000 in cash, and the residue in fully-paid shares. The subscribers are:—

	Shares.
Wm. Francis Splatt, J.P., Torquay	1
W. H. Williams, 12, Bishopsgate-street, colliery proprietor	1
J. Bailey, 4, Cutbill-road, Denmark-hill, engineer	1
W. Harding, 67, Crayford-road, Tuffnell Park, surveyor	1
J. G. Pyle, 7, Lamell-street, Stoke Newington, clerk	1
L. J. Langmead, 2, Violet Villas, Upland-road, East Dulwich, accountant	1
Otho Fitzgerald, Sunnyside, Teddington, accountant	1

The number of directors is not to be less than three, nor more than seven; qualification, shares or stock of the nominal value of £500; remuneration, £600 per annum, and when the dividend upon the ordinary shares exceeds £15 per cent. per annum, a further sum equal to one-tenth part of the sum to be divided as dividend amongst the shareholders.

Glazed Brick and Tile Company, Limited.

This company was registered on the 5th inst. with a capital of £50,000, in £5 shares, to trade as brick and tile manufacturers and merchants. An unregistered agreement of the 9th ult. between Joseph Cox Marsh and G. C. Silk is adopted. The subscribers are:—

	Shares.
G. C. Silk, 68, Guildford-street, W.C.	1
W. Wigginton, 9, St. Germains-road, Forest-hill, architect	1
Captain S. F. Treffery, R.N., Military and Royal Naval Club, Albemarle-street	1
A. Taylor, Boleyn-road, Upton, Essex	1
C. H. Austin, 20, Connaught-terrace, Wandsworth	1
J. Cartwright, 20, Leyton Park-road, E.	1
A. J. Lithgow, 19, Millman-street, Bedford-road	1

The number of directors is not to be less than three, nor more than five; the subscribers are to appoint the first and act *ad interim*; qualification for directors other than the first, 100 shares. The company in general meeting will determine remuneration.

Prince's Graving Dock and Engineering Company, Limited.

At Swansea, this company proposes to carry on business as graving dock owners, shipbuilders and repairers, engineers, shipowners, &c. It was registered on the 5th inst. with a capital of £100,000, in £10 shares. The subscribers are:—

	Shares.
C. E. Strick, Woolpack-buildings, Gracechurch-street, secretary	1
C. C. Chambers, 86, Lansdowne-road, W., merchant	1
*Sir W. Hy. White, C.B., East Sheen	1
*J. Scott, Greenock, shipbuilder	1
*H. P. Barlow, Godstone, director of a company	1
J. Halcrow, 7, Westminster-chambers, secretary of a company	1
F. C. Strick, London and Swansea, shipowner	1

The number of directors is not to be less than three, nor more than five; the first are the subscribers denoted by an asterisk; remuneration, £1000 per annum, or such larger sum as the company in general meeting may determine.

Unified Diamond Mines, Limited.

This company proposes to acquire and work diamond mines in South Africa or elsewhere, and particularly the various claims in the four diamond mines of Kimberley, known as the Kimberley Mine, Old De Beer's Mine, Dutoitspan Mine, and Bultfontein Mine. It was registered on the 1st inst. with a capital of £10,000,000 in £20 shares, with the following as first subscribers:—

	Shares.
*The Marquis of Tweedale, Haddington, N.B.	1
*Charles Jacques Posno, 19, Finsbury-circus, merchant	1
*Sir Henry Barkly, K.C.B., 1, Bina-gardens, S.W.	1
*John Young, The Chalet, Harrow, director of the Bank of Africa	1
G. J. S. Mosenthal, 138, Leadenhall-street, merchant	1
H. F. Tiarks, 145, Leadenhall-street, merchant	1
*J. C. E. D'Esterre, 1, Windsor Villas, Plymouth	1
*J. Wernher, 29, Holborn Viaduct, merchant	1

The number of directors is not to be less than ten, nor more than thirty; qualification, 50 shares; the first are the subscribers denoted by an asterisk, and Rear-Admiral R. C. Mayne, H. Mosenthal, C. Amedée Bocher, B. Isidore Salles, M. P. Amichau, J. B. Boisonnas, and H. Hoskier. Each director and member of a local committee will be entitled to £150 per annum, and £1 1s. for each meeting he attends; the chairman of the board (the Marquis of Tweedale) will be paid an additional £600 per annum, the vice-chairman an additional £400 per annum, the deputy-chairman an additional £200 per annum, and the chairman of each local committee an additional £150 per annum. After £6 per cent. per annum dividend has been paid, £5 per cent. of the remaining profits of that year will be divided amongst the members of the board and the chairmen of the local committees.

RETARDED EBULLITION AND SUPERHEATED WATER.*

THE following by H. Walther-Meunier is from the *Bulletin de la Société Industrielle de Mulhouse*, 1885, p. 113. The author, in response to numerous inquiries, has studied the question of the possibility of boiler explosions caused by the superheating of water in the boiler—that is, the heating of water to a temperature higher than that due to the pressure. He notices the results of various laboratory experiments on the subject, which lead to the following conclusions:—"That the state of absolute repose is indispensable for the production of the phenomenon of superheat of water; and that the presence of air or other gas, even in indefinitely small proportions, maintains ebullition under normal conditions. He finds from the official statistics of boiler explosions for six years 1877-82, in England, France, and Germany, that the proportion of explosions from unknown causes were eight in one hundred and fifty for England, thirteen in one hundred and fourteen for France, and three in one hundred for Germany. These average about 6½ per cent. But, on closer examination, the proportion of totally unknown causes for France is reduced to 3 per cent. For Germany, there is no cause classed as totally unknown; and for England only 1 per cent., making a total average of 1·1 per cent. of totally unknown causes. This percentage is easily explained, in face of the difficult and laborious work of investigation after an accident, without needing to ascribe its origin to the existence of superheated water. The author maintains that, in a steam boiler, whether at work or at rest, there is continual agitation and circulation arising from differences of temperature; and that superheating of water in the boiler is impossible. Besides, the presence of the smallest quantity of air is sufficient to impede or prevent superheating of water—a condition which is always fulfilled in practice, and which is clearly confirmed by the fact noticed by the author, that, at the temperature of discharge of condensing water, 86 deg. Fahrenheit, the tension of the vapour is 0·041 atmosphere, whilst there is never less than 0·12 atmosphere of back pressure, making the difference 0·079 atmosphere, which is only explained by the pressure of air. After a consideration of the conditions of boilers of different types, the author concludes that all boiler explosions may be explained by bad materials, bad construction, bad design, or want of care and precaution.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Aug. 8th, 1885:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 16,026; mercantile marine, Indian section, and other collections, 5856. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1619; mercantile marine, Indian section, and other collections, 333. Total, 23,834. Average of corresponding week in former years, 31,519. Total from the opening of the Museum, 24,204,225.

A RAILWAY JOURNEY THROUGH A BURNING FOREST.—During the recent hot weather a curious, but somewhat alarming, incident occurred on a railway in Finland. On approaching the town of Kaipios the driver of a train saw that the forest on both sides of the line was burning furiously, enveloping it entirely in smoke and flames. Afraid of proceeding, he dispatched a messenger to the town, and after waiting for three-quarters of an hour, during which the fire had extended to both sides of the train, an engine arrived through the burning forest with the message that the line could be safely passed. Doors and windows having been well closed, the train steamed into the burning mass and succeeded in running the gauntlet safely; but the passengers passed an anxious quarter of an hour, the heat being terrific.

SALTERS' COMPANY AND TECHNICAL EDUCATION.—The following resolution was passed at a meeting of the Court of the Salters' Company, held on July 31st, 1885:—"That the Court of the Salters' Company being informed of the need of increased funds to enable the City and Guilds of London Institute to maintain in efficiency the various branches of work for the advancement of technical education to which the confederated companies are pledged, hereby agrees to raise its annual subscription to the Institute from £525 to £1000, payable in moieties during the pleasure of the Court in the months of May and November, and that the Right Hon. the Lord Mayor, as master, be requested to signify the same to the late Lord Chancellor Selborne and Sir Frederick Bramwell, vice-presidents, chairman of the Council, and chairman of the Executive Committee respectively, adding an expression of the gratitude which the Salters' Company feel for the signal services which they have rendered to the interests of technical education, and of the Livery Companies in helping and directing the combined efforts of the City and Guilds of London in associating art and science with the furtherance of industrial progress."

* "Proceedings" Institution of Civil Engineers.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office Officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index, and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the number of the Specification.*

Applications for Letters Patent.

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

4th August, 1885.

9264. RAILWAY CHAIRS, E. S. Cartman, London.
9265. NON-CORROSIVE CORRUGATED HOOPS, G. Horobin, Wolverhampton.
9266. FASTENINGS for JEWELLERY, &c., S. Cartlidge, Longton.
9267. AUTOMATIC FEED-WATER REGULATOR, F. Rainey, Birkenhead.
9268. SOAP LIMING MACHINES, &c., W. Priestley, Leeds.
9269. SKEWERS for HOLDING YARN, I. and A. Wallwork, Manchester.
9270. REMOVING DUST, W. R. Lake.—(*E. Kriess, Germany.*)
9271. CASTING ENGRAVINGS, &c., J. R. Hayman, Wolverhampton.
9272. METHOD of DETERMINING the DIFFERENCE in LEVEL between OBJECTS, H. T. Butcher and H. H. Dalrymple-Hay, London.
9273. SIMPLIFYING READING of METERS, S. Lindley, Sunderland.
9274. TELEPHONIC TRANSMITTERS, R. H. Ridout, London.
9275. MACHINES for FACING, &c., GAS RETORT MOUTHS, &c., J. Ruscoe, Manchester.
9276. SHIPS' DOWNCAST VENTILATOR, R. Munn, Glasgow.
9277. CLASP KNIFE with MARLINE SPIKE, R. Clarke, Sheffield.
9278. COUPLING, &c., STEAM PIPES, M. Stephenson, Preston.
9279. DISTRIBUTING INK in PRINTING MACHINES, G. Taylor, Nottingham.
9280. TORCHES, W. P. Thompson.—(*H. Wellington, U.S.*)
9281. VACUUM LAMPS, W. P. Thompson.—(*H. Wellington, U.S.*)
9282. RUDDER BRAKE, G. McColl and W. B. Cumming, Liverpool.
9283. PURIFYING WATER, T. W. Duffy, Liverpool.
9284. WATER, &c., MOTOR, W. P. Thompson.—(*E. B. Benham and H. B. Richardson, U.S.*)
9285. CONNECTING the ENDS of BANDS for SPINNING, &c., MACHINERY, D. Padgett, Bradford.
9286. ROLLER CAMERA SLIDE, W. T. Morgan and R. L. Kidd, Richmond.
9287. SEMOLINA or MIDDLINGS PURIFIER, G. F. Thompson, Warwick.
9288. CARRYING PHOTOGRAPHIC PLATES, E. E. Pickard, Brockley.
9289. CONNECTIONS of SPEAKING, &c., TUBES, F. H. W. Higgins, London.
9290. SETTING BLADES, C. Davies, Liverpool.
9291. HEAT TRANSMITTERS, J. H. L. Tuck, London.
9292. BINDING for CARPETS, C. E. Knapp, London.
9293. TRANSMITTING AUDIBLE SIGNALS, A. F. St. George and H. J. Briscoe, London.
9294. WATCHES, R. Thorneloe, Birmingham.
9295. ELECTRIC SCRATCHING BOARD, T. Haydon and T. Gaunt, London.
9296. FOOTBALLS, F. Fowkes, Manchester.
9297. JOINT for PIPES, B. J. B. Mills.—(*J. Joubert, France.*)
9298. ECONOMISING FUEL, A. H. W. Brown, London.
9299. ENGINES, W. R[...]ss, London.
9300. WATER STRAINERS, A. Emanuel, London.
9301. SLOP HOPPER, A. Emanuel, London.
9302. GAS BATTERIES, A. R. Upward and C W. Pridham, London.
9303. REGULATING the FLOW of GAS, &c., O. Pintsch, London.
9304. SEWING MACHINE TABLE, H. J. Haddan.—(*D'Arcy Porter, United States.*)
9305. SPLICING LEATHER BELTS, E. Foulds, Halifax.
9306. GAS GOVERNORS, T. Caink, Malvern Link.
9307. VESSELS, A. J. Boult.—(*E. Swindell, U.S.*)
9308. NUT LOCKS, J. H. Burdick and E. H. Burdick, London.
9309. CANCELLING MACHINES, M. V. B. Ethridge, London.
9310. COPYING MACHINES, A. J. Boult.—(*W. F. McKay, Canada.*)
9311. PURIFYING WATER, J. Howes, Liverpool.
9312. VESSELS, A. J. Boult.—(*Z. Oram, U.S.*)
9313. SAFETY TRUCK APPLIANCE for RAILWAY CARS, J. Gerhardt, London.
9314. CABLE RAILWAYS and TRAMWAYS, O. D. Orvis and N. B. Adams, London.
9315. FIRE EXTINGUISHERS, E. P. Alexander.—(*G. A. Lindgren, United States.*)
9316. FURNACES, W. L. Wise.—(*J. G. Hänsel and F. L. Krumbiegel, Saxony.*)
9317. ELECTRO-VAPOUR and WATER BATH, G. W. Kincaid and P. W. Seymour, London.
9318. ROTARY PUMP and BLOWER, H. Salomo, London.
9319. TREATING PAPER, and other FIBROUS MATERIAL, H. W. Morrow, London.
9320. GOVERNING the SPEED of ENGINES, E. F. Piers, London.
9321. SHEARS and SCISSORS SHARPENER, J. W. Hilton, London.
9322. KEENE'S CEMENT, C. J. Howe, London.
9323. TIPPING BILLIARD CUES, L. N. Loeb.—(*J. Neuhaus, Germany.*)
9324. NIGHT LAMP, A. M. Clark.—(*J. Decoudun and H. Chasles, France.*)
9325. REGULATING DEVICES for ELECTRIC LAMPS, W. Lahmeyer, London.
9326. HARD SUGAR, W. R. Lake.—(*F. O. Matthiessen, United States.*)

5th August, 1885.

9327. SOFFIT LOCK TILES for CEILINGS, &c., J. D. Denny, Ruabon.
9328. SODA WATER PUMPS, J. P. Jackson, Liverpool.
9329. NEUTRALISING the EFFECTS of SHOT, &c., to SHIPS, A. I. Rath, Manchester.
9330. EYELETING MACHINES, J. Carter, Manchester.
9331. PREPARING or DISPENSING MEDICINES, W. Watson, Glasgow.
9332. PERIODICALLY ADJUSTABLE ELECTRIC SWITCHES, H. Hart, Glasgow.
9333. HARVESTING MACHINES, W. P. Thompson.—(*A. C. Miller, United States.*)
9334. COUPLING and UNCOUPLING LOCOMOTIVES, W. M. Trousdale, Leeds.
9335. HIGH-PRESSURE TAPS, J. Hookham, Eastbourne.
9336. BALL VALVE, J. Hookham, Eastbourne.
9337. AUTOMATICALLY COUNTING RAILWAY CARRIAGES, &c., W. E. Gedge.—(*H. Mohr, Germany.*)
9338. INCREASING the DRAUGHT of FURNACES, W. A. Martin, London.
9339. SOFTENING and PURIFYING WATER, J. Cowan, London.
9340. RETAINING WINDOWS or SLIDES in ANY POSITION, A. E. Bingemann, London.
9341. PREPARING HYGIENIC and DISINFECTING SUBSTANCES, &c., E. B. Watson, Crouch End, and H. B. Fulton, London.
9342. STEAM ENGINES, W. H. Wheatley and J. W. Mackenzie, London.
9343. SUGAR, W. H. Schwartz, London.
9344. MINERS' CAGES, &c., L. Jacobs.—(*M. Lewinson, Australia.*)
9345. CUTTING VEGETABLES and FRUITS, J. W. Thompson, London.
9346. SCREWS for MILL STANDARDS, J. Conway, D. R. David, and L. Howell, London.
9347. OIL BATHS for TOUGHENING STEEL, R. W. Taynton, London.
9348. ADJUSTABLE HEADSTOCKS, J. P. West, London.
9349. RAILWAY FROGS and SWITCHES, P. M. Justice.—(*C. B. Price, United States.*)
9350. STOVES, &c., G. H. Mottershead and A. Smith, London.
9351. KILNS, E. Grooters.—(*L. Grooters, Belgium.*)
9352. EXTRACTING FAT from DISSOLVABLE MATERIALS, M. Bauer.—(*J. Merz, Austria.*)
9353. DISINFECTANT, W. R. Lake.—(*M. R. Garcia, France.*)
9354. GAS HEATING APPARATUS, H. P. Miller, London.
9355. TIMEPIECES, W. R. Lake.—(*H. W. Hayden, U.S.*)—24th February, 1885.
9356. BREECH-LOADING GUNS for MINIATURE AMMUNITION, R. Morris, London.
9357. SAFETY APPLIANCE for RIFLE RANGES, R. Morris, London.
9358. COMPENSATING PENDULUMS, T. Buckney, London.
9359. WHEEL TIRES, R. B. Black and W. Jones, Glasgow.
9360. OPENING CANISTERS, H. Morris and D. D. Danziger, London.
9361. BOOTS, SHOES, &c., H. Jennings, London.

6th August, 1885.

9362. BOOT and SHOE TREES, S. H. and S. H. Hodges, Street.
9363. SODA-WATER MACHINERY and PLANT, W. Bruce, Liverpool.
9364. VAN for ADVERTISING PURPOSES, W. T. Beaumont, and T. Grime, Manchester.
9365. LIGHTING by COAL GAS HOUSES, &c., H. Baker, Derby.
9366. FIRE GRATES for BOILERS, J. Magneé and E. Beneken, Liverpool.
9367. ADVERTISEMENT or ADVERTISING, S. J. Ewing, Birmingham.
9368. BALING PRESS BOXES, W. Turner, Salford.
9369. PROTECTION of BOOT and SHOE SOLES and UPPERS, S. Chamberlain, Leeds.
9370. CUTTING or EXCAVATING DRAINS, &c., J. W. Wailes, Liverpool.
9371. POWER LOOMS, W. Jepson, Manchester.
9372. STONE BREAKING, &c., MACHINES, W. H. Baxter, Halifax.
9373. TRICYCLES, T. Leaker, Bristol.
9374. FASTENING BOOTS, W. T. Symons, Winsford.
9375. PORTABLE and ATTACHABLE PIANO, J. H. Abbott, London.
9376. POTATO DIGGING MACHINES, R. Gasch, London.
9377. TREATING VEGETABLE SUBSTANCES for the PRODUCTION of FIBRE for SPINNING PURPOSES, C. Court, S. Hersee, H. C. Williams, and S. Hersey, London.
9378. STOPPERING BOTTLES or JARS, F. J. Beaumont, London.
9379. COMPOSITE MOULDS for MOULDING PLASTIC ARTICLES, S. B. Furnival, Birmingham.
9380. PRESERVING CRUDE ANIMAL FATS, P. A. Newton.—(*S. Hornemann, Germany.*)
9381. FILING LETTERS, &c., B. J. Rubinstein, London.
9382. GEARING for VELOCIPEDES, H. N. Rooper, London.
9383. PRINTING MACHINE, A. M. B. Harcourt, London.
9384. SIGNALLING on RAILWAYS, T. T. Powell, London.
9385. HANDLES of CRICKET BATS, B. Warsop, London.
9386. LANGETS, &c., applicable to FORKS, &c., T. Norris, London.
9387. STOVES for HEATING the BLAST of BLAST FURNACES, W. Thomlinson, London.
9388. ELECTRIC TRAMWAYS or RAILWAYS, M. Volk, London.
9389. LOCKS, &c., for DOORS, &c., J. Day and T. Wrigley, London.
9390. DRYING, &c., PRINTED EARTHENWARE IN BISCUIT STATE, J. Bevington, London.
9391. STOPPER for BOTTLES, &c., G. Skudder and G. King, London.
9392. PURIFICATION of SEWAGE WATERS, &c., J. Beck, London.
9393. VALVE GEAR for DOUBLE-ACTING ENGINES, J. F. Meyjes, London.
9394. HATCHING and REARING CHICKENS, R. S. Ellis, London.
9395. COMPOUND STEAM ENGINES, H. H. Lake.—(*R. Cox, U.S.*)—9th June, 1885.

7th August, 1885.

9396. YARNS, B. and C. H. Cooper and R. Embley, Manchester.
9397. STONE-BREAKING, &c., MACHINES, C. Mason and A. Hill, Leicester.
9398. SAFETY LAMPS, W. Clifford, Sheffield.
9399. CIGAR, &c., HOLDERS, B. Sudlow, Manchester.
9400. DRIVING PULLEYS, &c., A. House and A. C. Wells, Manchester.
9401. COUPLING, &c., RAILWAY TRUCKS, G. Turner, Manchester.
9402. MINIATURE BILLIARD BAGATELLE, J. Tufnail, Reading.
9403. SHAPING MACHINES, W. P. Thompson.—(*J. H. Mehrtens, Germany.*)
9404. BISCUIT BRAKE, D. Thomson, Glasgow.
9405. STRIKING PLATES, &c., for LOCKS, N. Fellows and H. Winkley, London.
9406. BEVERAGE, T. D. Harries, Aberystwith.
9407. REGULATING, &c., VALVES, J. G. Smeaton and T. McG. McDonald, London.
9408. SCREENS for SIZING WHEAT, &c., J. Clayton, London.
9409. SOUNDING APPARATUS for SHIPS, J. Gordon, jun., and G. Lowdon, Dundee.
9410. LOCKS, G. Lowdon, Dundee.
9411. WATERPROOFING PAPER, &c., W. Macrone, London.
9412. VARNISHING, PAPER, &c., W. Macrone, London.
9413. VARNISH, W. Macrone, London.
9414. DRY COLOURS, W. Macrone, London.
9415. ELECTRIC BATTERIES, J. H. Johnson.—(*L. A. W. Desruelles, France.*)
9416. HEATING, &c., AIR, I. G. Betts, London.
9417. VENTILATING and COOLING, &c., AIR, I. G. Betts, London.
9418. FOLDING SASHES, J. Carter, London.
9419. COATING IRON and STEEL SHIPS, &c., T. Harrison, London.
9420. HEELS for BOOTS and SHOES, G. F. Redfern.—(*H. Baumgarten, Austria.*)
9421. BOOTS and SHOES, T. Shimeld, London.
9422. DECORATING GLASS, W. W. Boulton, London.
9423. PROPELLING MECHANISM, W. L. Wise.—(*Baron F. von Palstring, Germany.*)
9424. EXPANDING CLIPS for BOTTLES, R. B. Breidenbach, London.
9425. SODA CRYSTALS, &c., F. J. P. Cheesbrough.—(*J. Hawliczek, Austria.*)
9426. SHIELDS for PROTECTING HATS, J. E. Mills.—(*T. Lever, U.S.*)
9427. PHOTOGRAPHIC CAMERA SHUTTERS, T. Caldwell, London.
9428. SPLIT or SELVAGE MOTION, J. W. Shorrock and T. B. Taylor, London.
9429. BUTTONS, R. Bateman, Birmingham.
9430. HOOKS for CURTAINS, &c., R. W. S. Barraclough, London.
9431. BOILERS, L. W. Leeds, London.
9432. REMOVING the HUSKS from COCOANUTS, J. P. West and H. J. W. Raphael, London.
9433. RAG ENGINES, H. J. Haddan.—(*J. P. Korschilgen, Germany.*)
9434. NEEDLES, B. H. Smith, Birmingham.
9435. VENTILATORS, T. Jenkins and R. B. Perress, London.
9436. INSULATING or COATING WIRES, F. Walton, London.
9437. FORMING, &c., ICE SURFACES, W. W. Nightingale, London.

9438. Utilising the Motion of Locomotives, W. F. B. Massey-Mainwaring, London.

8th August, 1885.

9439. Printing Machinery, J. Salmon, Manchester.
9440. Taps of Syphon Bottles, T. H. Williams and C. Lauterbach, Brentwood.
9441. Umbrellas, &c., W. E. Heys.—(*H. Büxenstein, Prussia.*)
9442. Glazed Earthenware Conduits for Subterranean Telegraph, &c., Lines (W. H.), Earl Poulett, London.
9443. Spring for Closing Doors, W. Fryer, Birmingham.
9444. Steering Vessels, W. P. Thompson.—(*D. F. de S. A. de la R. y Muniz, Spain.*)
9445. Shuttle Guards in Looms for Weaving, W. F. Robinson, Halifax.
9446. Carburetting Atmospheric Air, &c., W. G. Hudson and C. R. Bonne, Manchester.
9447. Projecting Advertising Lamp, E. Rogers and H. Stephens, Birmingham.
9448. Tricycles, &c., F. C. Kilner, Leeds.
9449. Actuating the Shuttle-boxes of Looms, G. Hodgson, London.
9450. Cleaning the Grooves of Tramway Rails, R. Sellers, London.
9451. Rapid Vehicles, N. Besobrasoff, London.—*6th July*, 1885.
9452. Liquid Meters, O. Brown, London.
9453. Regulating, &c., the Flow of Liquids or Gases, P. M. Justice.—(*J. E. Holmes, United States.*)
9454. Artificial Millstones or Burrs, H. J. Haddan.—(*R. Meissner, Germany.*)
9455. Cricket Bats, R. F. J. C. Allen, London.
9456. Pointing Wire Nails, &c., H. J. Allison.—(*S. Loring and E. S. Morton, United States.*)
9457. Hoop and Driving Handle for Children, R. Jaques, Newcastle-on-Tyne.
9458. Fastenings for Earrings, W. H. Stokes, London.
9459. Distributing Vaccine Virus, &c., for Surgical Uses, G. Brownen, Upper Tooting.
9460. Sewing Needle, W. R. May, London.
9461. Permanent Way of Tramways, C. D. Abel.—(*E. L. Humbert, France.*)
9462. Digging Subterranean Galleries, F. J. Brougham.—(*T. R. von Grasern, Austria-Hungary.*)
9463. Saltcellar, D. Falcke, London.
9464. Fountain, J. H. Fay, London.
9465. File Fabrics, C. Spannagel, London.
9466. Actuating the Brakes of Vehicles, J. C. Colman and F. Beauchamp, London.
9467. Pumps, F. P. Preston, London.
9468. Ocarinas, A. N. Mezzetti.—(*E. Mezzetti, France.*)
9469. Closets and Urinals, W. Macfarlane, London.
9470. Breaking-down Coal or other Minerals, T. Nicholson, London.
9471. Fishing Reels, J. Calder, Glasgow.
9472. Driver for Vessels in or on Air or Water, C. E. Austin and W. Burchell, London.
9473. Perambulators, T. McGrah, Sheffield.
9474. Utilising Atmospheric or Solar Heat for Raising Water, &c., C. Tellier, London.
9475. Lamp Burners, H. H. Lake.—(*S. Loewy, Hungary.*)
9476. Separation or Recovery of Tin from Scraps of Tinned Plate, H. H. Lake.—(*P. A. Vergez, France.*)
9477. Utilising Heat from Lamps, &c., H. H. Lake.—(*M. R. von Pichler, Austria.*)
9478. Metallic Tubing, H. H. Lake.—(*E. Levavasseur and H. Witzenmann, France.*)
9479. Bee-hives, J. A. Abbott, London.
9480. Magnetic Compasses, E. A. Reeves, London.
9481. Affixing Tips to Billiard Cues, J. E. Reaney, London.

10th August, 1885.

9482. Winding and Doubling Yarns, &c., S. Brooks, London.
9483. Automatic Cooking Apparatus with Alarm, G. H. Winscom, Newport.
9484. Metallic Air-tight Boxes, W. H. and R. Moon, London.
9485. Pistons, C. H. Cooper, Glasgow.
9486. Disinfectants, W. D. Borland, Stowmarket.
9487. Stiffening Certain Portions of Ladies' Wearing Apparel, A. Gobert, Paris.
9488. Automatic Signals, J. Nicholson, Gateshead.
9489. Measuring, &c., Grain, E. O'Brien, Liverpool.
9490. Driving Gear for Velocipedes, H. Watson, Gourock.
9491. Single Boss Roller, W. C. Burton, Rochdale.
9492. Boiler for Heating Purposes, J. Anderson, Belfast.
9493. Envelopes for Extracting Oil from Seed, C. Benson and J. W. Garrett, Kingston-upon-Hull.
9494. Ascertaining Levels, &c., at a Glance, J. Kent and E. J. Chabrel, London.
9495. Adjustable Gearing for the Rolls of Mangles, W. E. Smith and G. Robinson, London.
9496. Furnaces for Melting, F. P. y Pablos, Paris.
9497. Fractional Globes for Educational Purposes, W. and E. Quartermain, East Dereham.
9498. Adjustable Patterns for Drafting Garments, A. McDowell, London.
9499. Scribing Angles, &c., F. J. Beaumont and E. J. Chabrel, London.
9500. Lowering and Raising the Lifts of Mangles, J. Canfor, South Norwood.
9501. Anchors, J. Davies, Birmingham.
9502. Brushes, F. J. P. Cheesbrough.—(*J. A. Read, U.S.*)
9503. Propelling Canoes, J. Pembery, Mortlake.
9504. Hand Guard for Batsmen Playing Cricket, J. Jeffrey, London.
9505. Shutter for Photographic Lenses, G. Lowden, Dundee.
9506. Pressure Reducing Valves, J. R. Fothergill, London.
9507. Heel Trimming Machines, H. J. Allison.—(*A. F. Smith, United States.*)
9508. Dust Guards for Car Axle Boxes, F. J. Roberts, London.
9509. Belt Buckle Drinking Cups, W. R. Johnston, New York.
9510. Violet and Blue Azo-dyes, H. J. Haddan.—(*The Farbenfabriken, vorm Bayer and Co., Germany.*)
9511. Nuts for Screwed Bolts, G. Wilson, Anerley.
9512. Shade Reflectors, O. Guibout, London.
9513. Guiding Vessels, A. Kellett, London.
9514. Solid Drawn Cartridge Cases, J. Bernström, London.
9515. Musical Instruments, A. J. Boult.—(*W. F. L. Utendörffer, Germany.*)
9516. Timekeepers, A. J. Boult.—(*A. Kaiser, Switzerland.*)
9517. Combined Coupling and Buffer, T. V. Riordan, London.
9518. Tobacco Pipes, J. Carter, London.
9519. Water-closet Apparatus, C. Winn, London.
9520. Hydrants, J. Baker, London.
9521. Tobacco Pipes, J. Rose, Tunbridge Wells.
9522. Electrical Accumulators, C. P. Elieson, London.
9523. Driving Bands, H. Barrett and J. J. Varley, London.
9524. Match-box Holders, E. A. Jahncke and H. W. Herbst, London.
9525. Gumming Envelopes, J. Richmond and W. Whiting, London.
9526. Electro-dynamic Motors, T. J. Handford.—(*F. J. Sprague, United States.*)
9527. Motors for Electric Railways, T. J. Handford.—(*F. J. Sprague, United States.*)
9528. Bakers' Oven, A. Gates.—(*C. Jung, Austria.*)

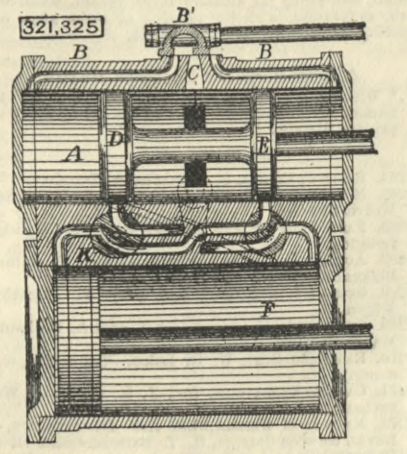
SELECTED AMERICAN PATENTS.

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

321,325. Compound Steam Engine, *I. A. Turner, Detroit, Mich.*—*Filed March 12th*, 1884.

Claim.—(1) In a steam engine composed of two cylinders side by side, with a division wall common to both, wherein the steam passages connecting said cylinders are formed, the two-way valves located within said passages and coupled to a wrist pin common to both valves, whereby the same may be simultaneously operated, in combination with the piston heads D E, secured to a single stem and working within the cylinder A, with the exhaust port C of said cylinder located between them, and the single valve B[1], controlling the admission of steam alternately to the ends of the cylinder A, and at the same time exhausting the steam from the opposite end

321,325

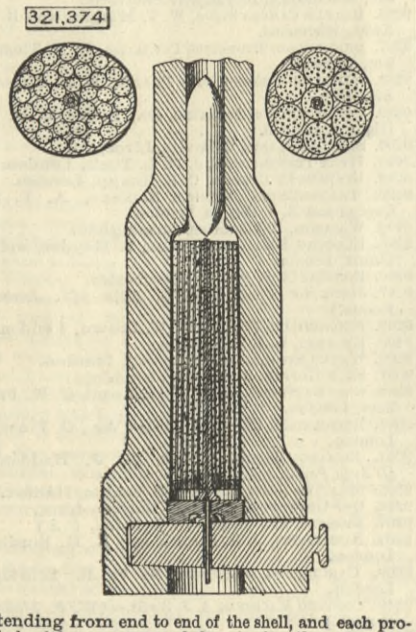


through itself into the space between the heads D and E, substantially as shown and described. (2) In a compound engine, two cylinders A and F, valves K between the same, the cylinder A, provided with two separate ports B, starting from the ends and terminating at a point a short distance from the centre, an exhaust port C, leading from the centre of the cylinder to the atmosphere, and a passage leading from the outside of said cylinder at a point between the nearest ends of said ports B into the centre of the cylinder, in combination with a valve B, constructed to alternately open and close communication between the ports B and the exhaust port C through the passage C[1], substantially as described.

321,374. Cartridge, *Azel S. Lyman, New York.*—*Filed January 26th*, 1885.

Claim.—(1) A cartridge consisting of a shell charged with a solid cake of powder or other explosive material having longitudinal holes running through it from end to end, and protected by said shell from the action of fire upon its outer surface, substantially as and for the purpose set forth. (2) A cartridge consisting of a shell charged with solid cakes of powder or other explosive material packed in the shell and

321,374

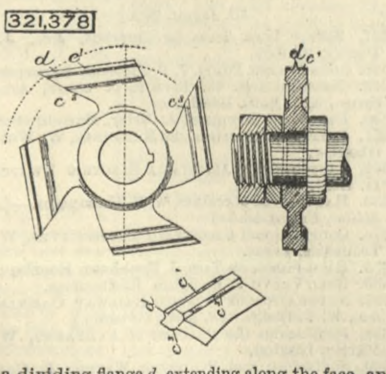


extending from end to end of the shell, and each provided with one or more holes piercing them longitudinally, and being protected from the action of fire upon their outer surfaces, as and for the purpose set forth. (3) A cartridge consisting of a shell charged with a solid cake of powder, which is protected from the action of fire upon its outer surface by said shell, and at its rear end by the head of the shell, said cake and the head of the shell being pierced by longitudinal holes, as and for the purpose set forth. (4) A cartridge consisting of a shell charged with a solid cake of powder pierced from end to end by holes extending also through the head of the cartridge, the cartridge being provided with a projection extending rearwardly and adapted to bear against the gun, and thereby form an open space back of the head of the cartridge, as and for the purpose set forth. (5) A cartridge consisting of a shell charged with a solid cake of powder pierced from end to end by holes extending also through the cartridge head, and provided with a firing-tube arranged to direct the igniting flame to the front end of the powder cake, as and for the purpose set forth.

321,378. Cutter Head, *James B. Mahaffey, Baltimore, Md.*—*Filed February 24th*, 1885.

Claim.—A rotatable cutter head provided with an eye for attachment to a mandril or shaft, and having a tongue cutter with a straight peripheral face c^1,

321,378



and a dividing flange *d*, extending along the face, and a depression c^3, parallel with the peripheral face, as set forth.

321,941. Friction Clutch, *Albert B. Bean, New Haven, Conn.*—*Filed June 11th*, 1885.

Claim.—(1) In a clutch, a friction band or ring C, having one end cast integral with the pulley, and the other end secured to and actuated by a lever, and adapted to clutch a disc or drum fastened on the shaft, substantially as described. (2) The combination with the friction disc F, of the friction band or ring C, having one end cast integral with the clutch pulley, the lever *h*, pivotted to the band, the adjusting stud *r* in the end of the lever, and the cone *g*, all arranged and operated substantially in the manner and for the purpose specified. (3) In a clutch, a friction band or ring cast or formed integral with a pulley, arm, or other revolving part and adapted to clasp and operate

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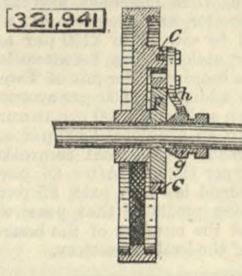
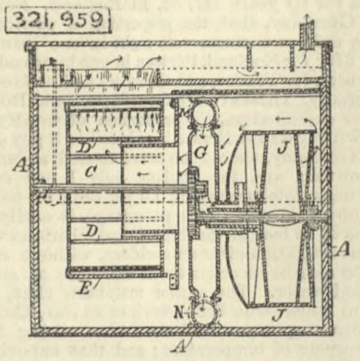


a friction disc or drum, substantially in the manner described. (4) In a clutch, the friction band or ring C, cast integral with an arm *u* secured to the pulley shaft and adapted to clasp a friction disc, in the manner specified.

321,959. Gas Machine, *Aaron W. Frail, Ashland, Mass.*—*Filed October 1st*, 1884.

Claim.—(1) The combination, with the case A, perforated generating cylinders D and E, and the driving wheel J, of the tubular part or pipe G, for the purpose stated, all constructed and operated substantially as shown and described. (2) The combination, with the case A, provided with a pan B, the top part of the case A having the partitions or divisions *j*, of the perforated cylinders D and E, tubular part G, and driving wheel J, all constructed and operated substantially as and for the purpose stated. (3) In a gas machine, the part G, provided with an inlet pipe M and an outlet pipe N, for the purpose stated, and constructed with bearings for one end of driving shafts, as described, and made hollow to allow of the air passing through into the driving wheel, for the purpose stated, in com-

321,959



bination with the driving wheel J and perforated cylinders D and E, substantially as shown, and for the purpose stated. (4) In a gas machine, the generating wheel C, made of two perforated or gauze cylinders D and E, the outer one being provided with lifting troughs or buckets, for the purpose stated, and means for revolving said generating wheel, substantially as described, in combination with the tubular part G and driving wheel J, substantially as shown and described.

321,967. Device for Making Dies for Forming Auger Heads, *Frank W. Hastings, Wallingford, Conn.*—*Filed January 19th*, 1885.

Claim.—The punch herein described, having its lower end or side cut away to form the plane surface B, one-half *a* of a turn or twist of an auger or bit, one-

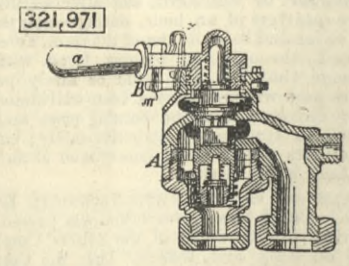
321,967

half *b* of a conical point, and the part *c*, the half turn or twist increasing in thickness from its outer edge and having the thick part of *c* to form a cutting lip, substantially as shown and described.

321,971. Automatic Air Brake, *William B. W. Howe, jun., and Albert Gärtner, Savannah, Ga.*—*Filed June 2nd*, 1884.

Claim.—(1) As an improvement in the Westinghouse automatic air brake system, an engineer's brake valve having a main valve capable of partial rotation, combined with a lever, and means, substantially as shown and described, for automatically giving a limited rotation to said lever and main valve, as set forth. (2)

321,971

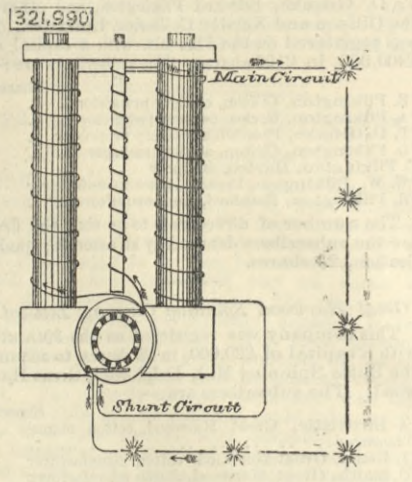


The engineer's brake valve A and handle *a*, having the pin *m*, combined with the spring B, having one end secured to said valve, and its other end free, and adapted to engage with the pin *m*, substantially as and for the purpose set forth.

321,990. Device for Preventing Sparking in Dynamo-electric Machines, *Richard H. Mather, Windsor, Conn.*—*Filed July 1st*, 1884.

Claim.—(1) A dynamo-electric machine provided with a magnet whose north or south pole is adjacent to the like pole of the armature, substantially as and for the purpose specified. (2) In a dynamo-electric machine, a spark-preventing device consisting of an electro-magnet whose helix is located in the main circuit of the machine, and one of whose poles is adjacent to the like pole of the armature, substantially as set forth. (3) In a dynamo-electric machine, a spark-preventing device consisting of an electro-magnet which is attached to the field magnet, is located in the main circuit, and has one of its poles adjacent to the like pole of the armature, substantially in the manner and for the purpose specified. (4) In a dynamo-electric machine, an electro-magnet in circuit with the armature and having one of its poles adjacent to the like pole of such armature, substantially in the manner and for the purpose specified. (5) In a dynamo-electric machine, a device to prevent sparking, consisting of one or more magnets so placed that the neutral point or points of the armature of such machine shall be within the magnetic field thereof, substantially as and for the purpose specified. (6) In a dynamo-electric machine, a device to prevent sparking, consisting of an electro-magnet in circuit with the armature and so placed relatively to the armature that one of the poles of such magnet

321,990

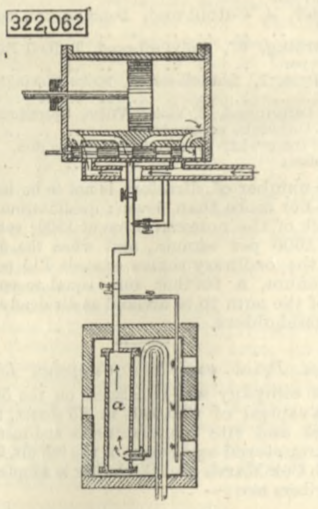


and the like pole of the armature shall be next to each other, substantially as specified.

322,062. Combined Fuel Converter and Gas Engine, *L. H. Nash, Brooklyn.*—*Filed November 27th*, 1882.

Claim.—(1) The combination with a gas engine of a gas generator consisting of an air-tight reducing chamber having oil and steam supply pipe connections heated within an enclosing chamber, and having a direct communication with the valve system of the engine, whereby the gas is produced, decarbonised, and supplied direct from the producing and mixing chamber under pressure sufficient to enter the engine cylinder, substantially as described, for the purpose specified. (2) In combination with the valve system of a gas engine, a gas generator consisting of a heated air-tight chamber, into which oil is introduced under pressure with steam, and means for introducing air under compression into said mixing chamber or its gas-discharging connection, substantially as described, for the purpose specified. (3) In combination with the valve system of a gas engine, a gas generator consisting of an air-tight cylinder *a*, suitable pipes for supplying hydrocarbon oil and air under pressure

322,062

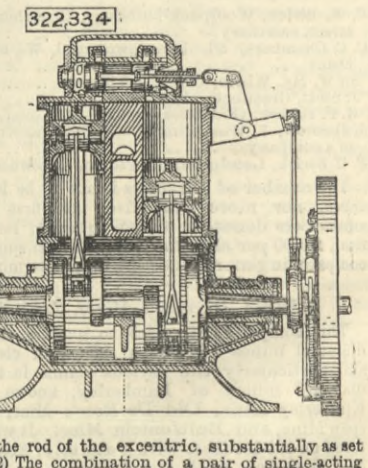


with steam to said cylinder, an enclosing heating chamber for said cylinder, and means, substantially such as described, for heating said air-tight gas producing and mixing cylinder and its oil-supplying pipe. (4) The combination with the valve system of a gas engine of a gas generator therefor, consisting of a heated reducing cylinder *a* having pipe connections with the working cylinder, a pipe for introducing hydrocarbon oil under pressure into said cylinder, a steam jet to spray the oil therein, a chamber inclosing said generator, and gas burners placed within said inclosing chamber supplied from the producer and heating the oil before its introduction into the generator, substantially as described.

322,334. Steam Engine, *H. Herman Westinghouse, New York, N.Y.*—*Filed May 12th*, 1885.

Claim.—(1) The combination of one or more single-acting cylinders, each having its piston coupled to a crank pin upon a shaft fitted to rotate in a closed crank case or receptacle, a main or distribution valve adapted to reciprocate longitudinally to the cylinders in a valve chest communicating therewith by ports opening into their upper ends, an excentric located upon the shaft exterior to the crank case, and a bell crank or angle lever having one of its arms connected to the valve stem and the other coupled by a universal

322,334



joint to the rod of the excentric, substantially as set forth. (2) The combination of a pair of single-acting cylinders, each having its piston coupled to a crank pin upon a shaft fitted to rotate in a closed crank case or receptacle, a main or distribution valve reciprocating longitudinally to the cylinders in a valve chest communicating therewith by ports opening into their upper ends, a centrifugal governor or regulator fixed upon the crank shaft exterior to the crank case, an excentric mounted freely on the shaft and coupled to said governor, and a bell crank or angle lever having one of its arms connected to the valve stem and the other coupled by a universal joint to the rod of the excentric substantially as set forth.