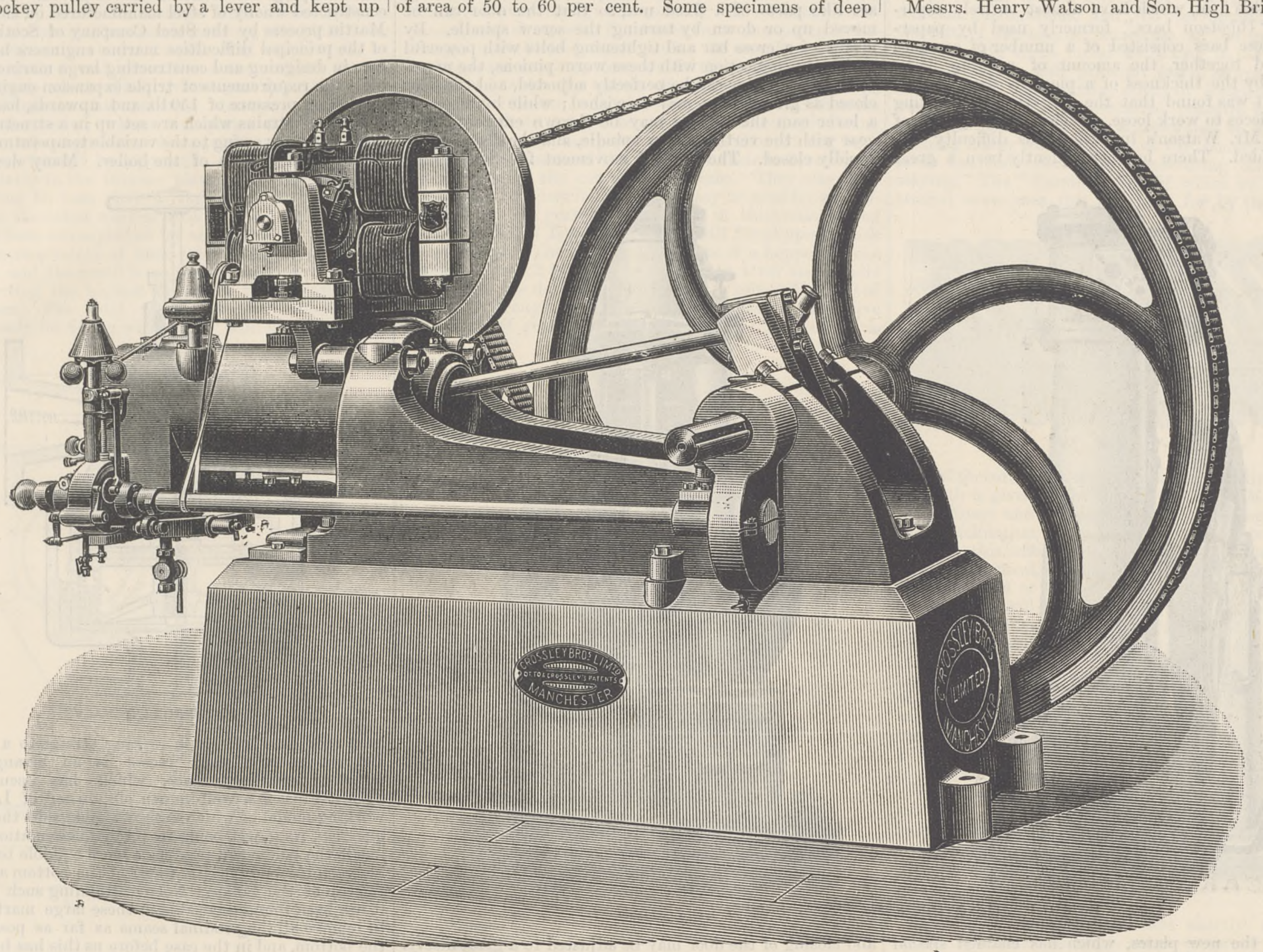
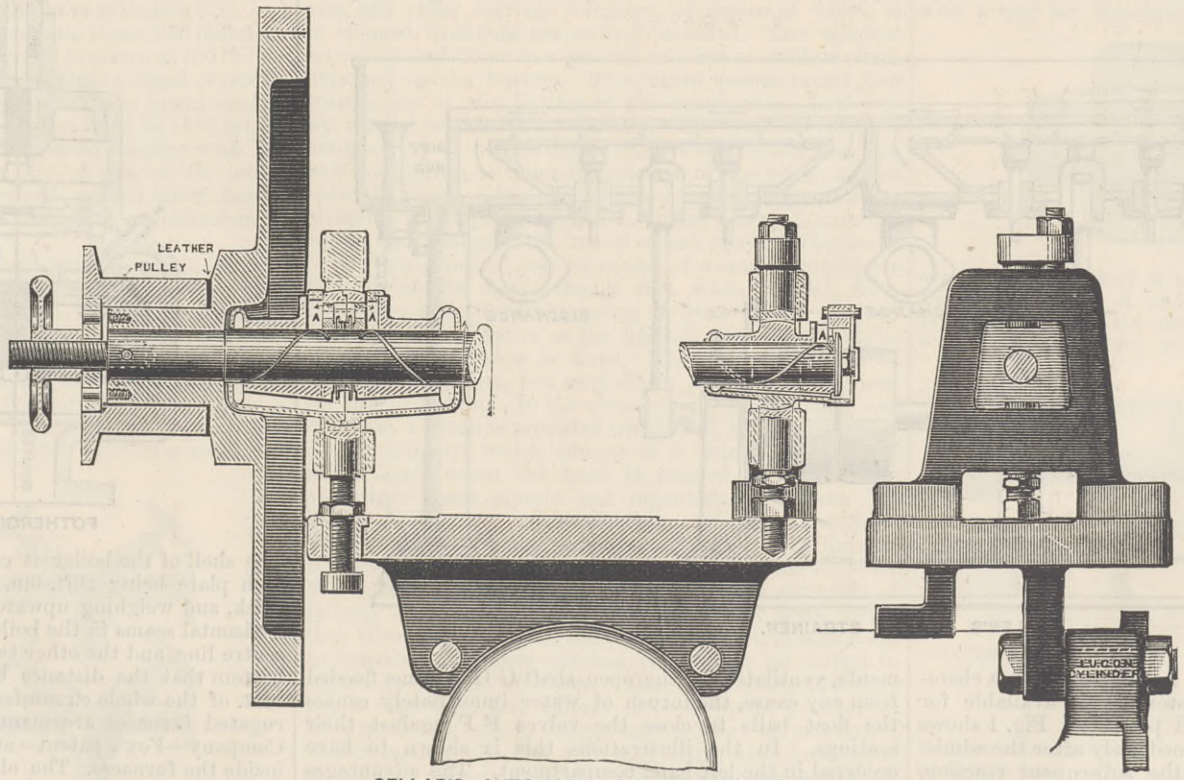
THE NEWCASTLE EXHIBITION.

By the engraving below we illustrate Messrs. Crossley Bros'. 4-horse power Otto gas engine combined with a dynamo. The engine is of the most recent type, with worm gearing for driving the slides and governor, and is fitted with Crossley's patent electric light governor. The dynamo is placed on a saddle bolted to lugs cast on the cylinder jacket, and is driven direct by a link belt from the fly-wheel; a jockey pulley carried by a lever and kept up by means of a screw and spring being used for tightening the belt and ensuring a large arc of contact on the dynamo pulley. The spindle of the dynamo is mounted in swivel bearings of the Sellars type, with a new automatic oiling apparatus, by means of which a stream of oil is kept continually flowing along the bearing. This arrangement is given in detail below. A little brass disc is fitted to the spindle at each bearing, the lower portion of the discs dipping into oil receivers, which extend the full length of each bearing. The oil is carried round and thrown on to a shelf, from which it runs into the cavities A, and so on to the spindle. The spiral grooves then carry it through the bearing into the receiver again. The same illustration shows the friction clutch for throwing the dynamo in and out of gear. This is a simple and neat device which is found to answer well in practice. The whole design is exceedingly compact, no more space being occupied than with an ordinary 4-horse power engine. The dynamo runs with great steadiness, no oscillation in the light being perceptible. It is capable of properly working 45 to 48 16-candle Swan lamps.



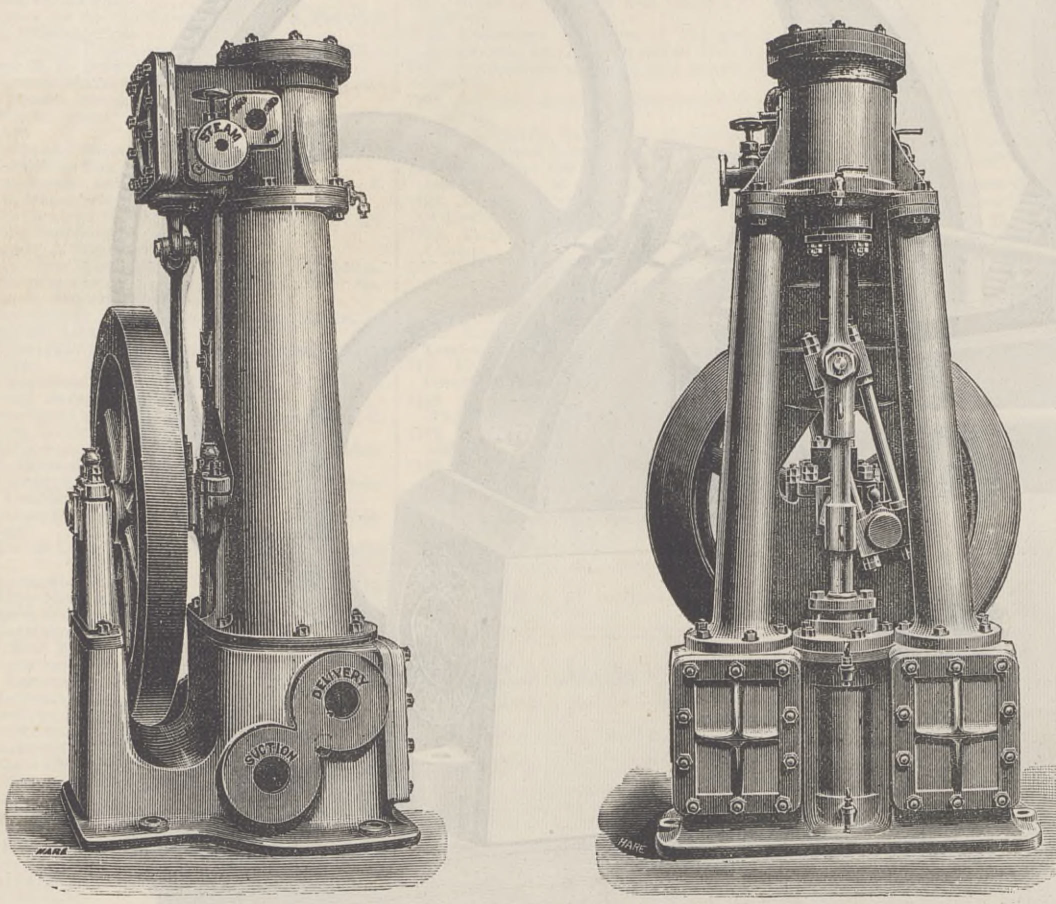
DYNAMO MOUNTED ON FOUR-HORSE OTTO GAS ENGINE.



SELLAR'S AUTOMATIC OILING APPARATUS.

The North-Eastern Steel Company, of Middlesbrough, make an excellent show of samples of materials made of its basic steel. Every specimen will be of great interest to those who are desirous of forming an opinion as to which material is best adapted to the various requirements of engineering, and judging by the exhibit, the company appears to have left no problem as to steel or ingot iron unsolved. Flanged plates are shown quite equal to anything which can be done by Lowmoor iron. Bowls dished cold out of flat plate in a way which would do credit to iron or steel of any description. Plates tortured by punching and drifting cold to an almost incredible extent before the material is finally torn asunder. Bars welded together side by side, punched on the line of the weld, and then the punched hole drifted in such a manner as to prove beyond a doubt that the material can be welded perfectly. There are also numerous strips of boiler plates and angles which have been heated and plunged into cold water, and have then stood a test of 27 to 28 tons per square inch with an elongation of over 30 per cent., and a reduction of area of 50 to 60 per cent. Some specimens of deep stamping done cold are very remarkable. Tubes are swelled at the ends and flanged in order to show the quality and to prove also that the welding can be done with certainty. Angles are opened out and doubled over cold, showing a ductility which it would be difficult to equal by any other process. The company exhibits specimens of the various raw materials they use in the manufacture of basic steel, and also the materials used for lining the converters, and they also show a specimen which will be of interest to many others besides those engaged in the iron and engineering industries, and that is their ground slag, which is now largely used, and is of rapidly growing importance as a manure. The slag resulting from steel-making by the Thomas-Gilchrist or basic Bessemer process is charged with 17 to 19 per cent. of phosphoric acid and 45 to 50 per cent. of lime, and when ground very fine is found to be an excellent fertiliser. This manure has been in use in Germany for over five years and is much valued, and Professor Wrightson and Dr. Munro, of the Agricultural College, have carried out some elaborate experiments which have proved that the German agriculturists knew what they were about when they adopted it. No doubt it will make its way in this country also. The North-Eastern Steel Company is, we understand, completing a large milling plant for the manufacture of this manure.

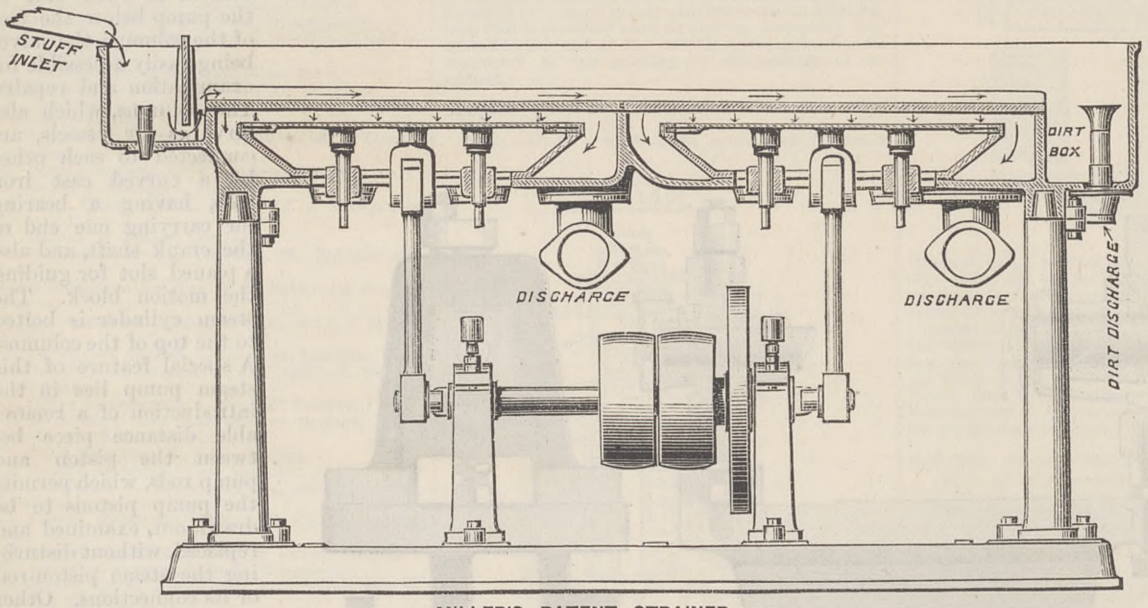
Messrs. Henry Watson and Son, High Bridge Works Newcastle-on-Tyne, exhibit several interesting novelties. Their patent Oriental double-acting steam pump for feeding boilers working at a high pressure, as illustrated by the engravings on page 410, is shown in two sizes. The first has a steam cylinder 8in. diameter and a pump barrel 4in. diameter, both with 8in. stroke. The valve boxes are formed at each side of the pump below the feet of the columns, the valves being easily accessible for examination and repairs. The columns, which also serve as air vessels, are connected to each other by a curved cast iron web, having a bearing for carrying one end of the crank shaft, and also a planed slot for guiding the motion block. The steam cylinder is bolted to the top of the columns. A special feature of this steam pump lies in the introduction of a removable distance piece between the piston and pump rods, which permits the pump pistons to be drawn out, examined and replaced, without disturbing the steam piston-rod or its connections. Other important matters are the avoidance of side strains by the method employed for actuating the crank shaft, and the general simplicity and accessibility of all working parts. A large pump having a 10in. steam cylinder and an 8in. pump barrel, both with 10in. stroke, is arranged for water ballast purposes, and has a duty of about 65 tons per hour. There is also a compact direct-acting duplex steam pump, which has been at work night and day for a year, feeding four Lancashire boilers. The design and workmanship of all these pumping engines are excellent. On the next page we illustrate Miller's patent strainer, of which Messrs. Watson and Son are the sole makers. The paper "stuff" is admitted by the spout at top, and flows over finely-slitted bronze plates below the horizontal arrows. Beneath these are flat oval discs or diaphragms, which are caused to reciprocate at great speed by the connecting rods and shafting below, producing a disturbance which causes the "stuff" to pass through the slits. All dirt and coarse particles are retained on the surface of the plates and passes into a dirt box as shown, while the fine "stuff" goes to the paper machine. A continuous system of dirt removal is thus established. In this connection attention should be directed to the bronze strainer-plates manufactured by this firm, which have almost entirely superseded the "Ibbotson bars," formerly used by papermakers. These bars consisted of a number of separate pieces bolted together, the amount of opening being determined by the thickness of a piece of sheet copper bolted in. It was found that the vibration in working caused the pieces to work loose, so affecting the quality of paper. By Mr. Watson's invention this difficulty was entirely avoided. There has consequently been a great



WATSON'S ORIENTAL STEAM PUMPS.

demand for the new plates, which has enabled special machinery to be put down for their manufacture, and they are now produced with surprising accuracy.

Another interesting novelty is Fothergill's patent non-accumulative steam reducing valve, illustrated by the two sections, Figs. 1 and 2. In this valve two pistons are connected together, the areas of these being to one another as the difference of pressure required. The arrangement is such that when the pressure against the smaller piston exceeds the opposing pressure against the larger one, a passage is opened so that the steam can



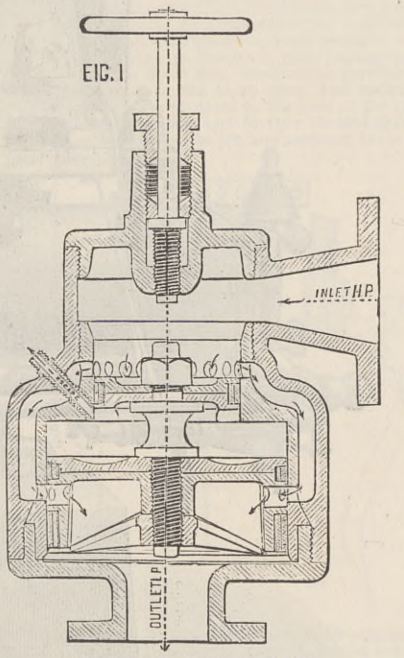
MILLER'S PATENT STRAINER.

pass from behind the smaller and expand into a chamber in front of the larger piston to be available for use at a correspondingly reduced pressure. Fig. 1 shows the position of the pistons immediately after the admission of steam. Fig. 2 shows the subsequent reaction, following which a balance is established governed by the relative piston areas. The valve is so arranged that, should any steam leak past either piston, it immediately escapes by the pipe shown on the illustration. Thus no accumulation of pressure can occur, and the valve is a perfectly safe one. When the valves are in use the pistons are in constant movement, and the reduction of pressure is very accurate. While many reducing valves now sold vary in correctness from 20 lb. 25 lb., Fothergill's valves have a maximum variation, as proved by long-continued working at sea, of only 4 lb. to 5 lb. Messrs. Watson are now supplying them to many of the leading marine engineers in the country, and, we understand, have received excellent reports of their working.

Water-tight doors of simple construction and easily controllable are of immense importance in the arrangement of our large vessels of war or express mail steamers, and M'Elroy's patent door, of which Messrs. Watson and Sons are the sole licensees in England and abroad, seems well contrived throughout. The door is raised by a vertical screw spindle geared with two worm wheels, one on each side of it, and which, when prevented from turning, act like parts of a fixed nut, so that the door can be moved up or down by turning the screw spindle. By means of a cross bar and tightening bolts with powerful springs in connection with these worm pinions, the movement of the latter can be perfectly adjusted, and the door closed as gradually as may be wished; while by means of a lever cam the pinions may be thrown entirely out of gear with the vertical screw spindle, and the door may be rapidly closed. The rate of movement for the opening and closing of the door may be adjusted to a great nicety.

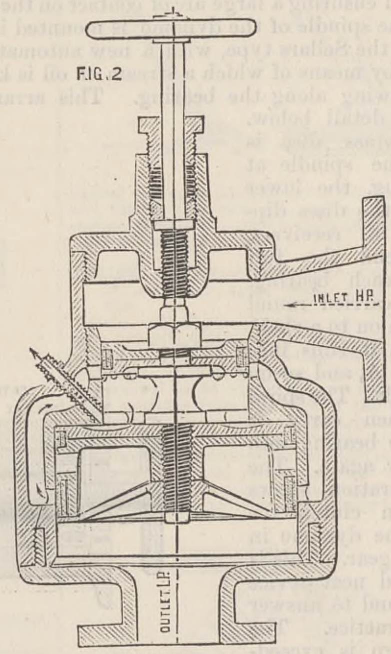
Messrs. Watson and Sons exhibit a patent automatic air valve, designed to secure the effective closing of the ventilating openings in the trunks of war vessels in case of any sudden inrush of water, which might be caused by a shot or collision, into the water-tight compartments. A small tank C D fitted into the steel bulkhead has a central division, in which are rubber valve seats, one on either side of the ventilating opening. Valves F F are hinged on either side of this division, to which are connected copper float-balls E E. Should the water-tight compartments, ventilated by the open shaft G G, become flooded from any cause, the inrush of water immediately causes the float balls to close the valves F F against their seatings. In the illustrations this is shown to have occurred in the left-hand compartment. The advantages Messrs. Watson and Sons claim for their invention are, first, that directly one compartment of the vessel becomes flooded it is immediately cut off from the adjoining compartments; and second, that the valves F F are with certainty closed against their valve seats, and the "list" of the ship does not interfere with their effectiveness, as in several other valves used for the same purpose. We understand that Messrs. Watson and Son are fitting their new valves to several war ships now in course of construction.

The marine boiler exhibited by the Wallsend Slipway and Engineering Company is of the circular multitubular type, fired at one end, and is intended to exemplify the latest advance in the design and construction of marine boilers for the supply of steam to triple expansion engines. The leading dimensions of the boiler are as follows:—Diameter outside, 14ft. 6in.; length over all, 11ft. 2in.; three corrugated furnaces, 3ft. 6in. outside diameter, each furnace opening into a separate combustion chamber; working pressure, 150 lb.; total heating surface, 2200 square feet; total grate surface, 60 square feet; capable of developing 800 indicated horse-power. The boiler is constructed wholly of steel manufactured on the Siemens-Martin process by the Steel Company of Scotland. One of the principal difficulties marine engineers have had to face in designing and constructing large marine boilers to meet the requirements of triple expansion engines having a working pressure of 150 lb. and upwards, has been the "racking" strains which are set up in a structure of such large diameter owing to the variable temperature between the top and bottom of the boiler. Many devices have



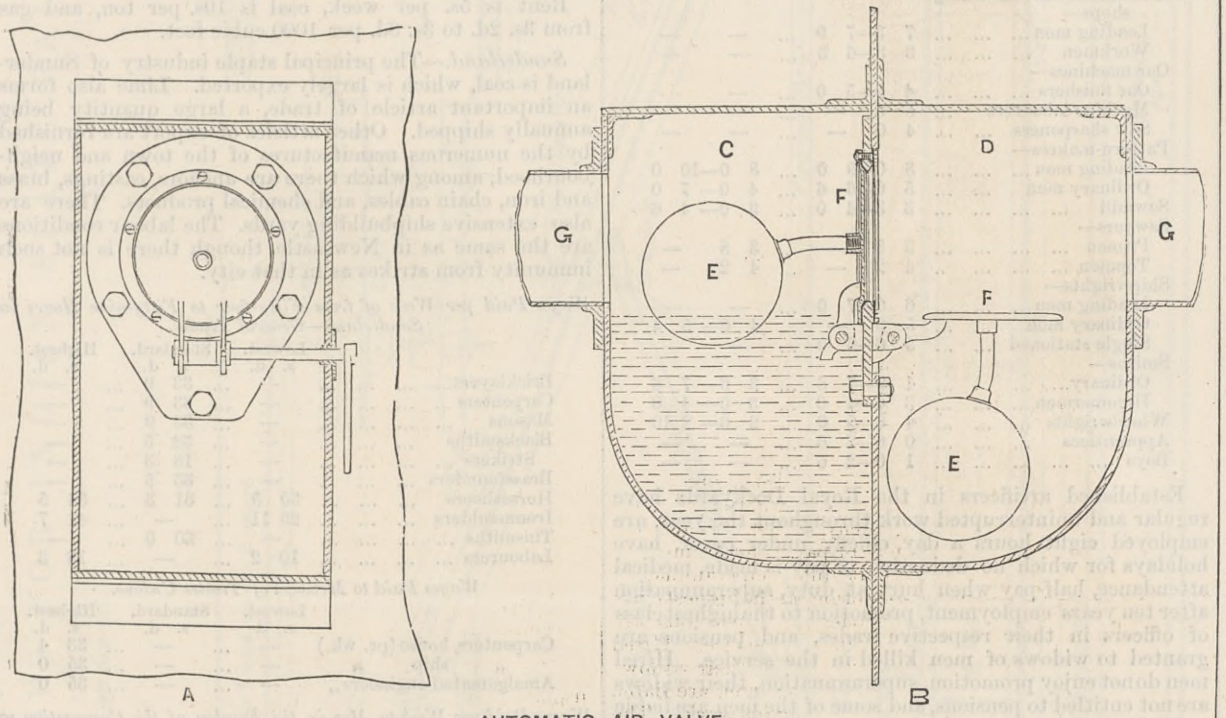
FOTHERGILL'S VALVE.

been used to reduce these racking strains to a minimum, and among the most recent is an arrangement of pipes inside the furnace, which has been patented by Mr. Fraser, a well-known shipowner of Liverpool, a working model of which is shown alongside the boiler in question, its object being to promote circulation of water inside the boiler and produce a more equable temperature between the body of the water at the bottom and that at the top of the boiler. Notwithstanding such appliances it has been found advisable in these large marine boilers to remove all longitudinal seams as far as possible from the bottom, and in the case before us this has been accomplished by the use of very large plates which the facilities possessed by the Steel Company of Scotland and other steel manufacturers have placed at the command of boilermakers.



FOTHERGILL'S VALVE.

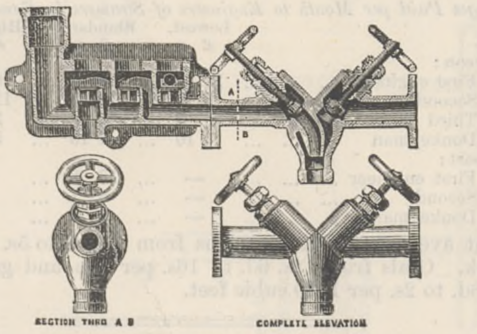
The shell of the boiler is composed of only four plates, each plate being 26ft. 6in. long by 6ft. wide, and 1¼in. thick, and weighing upwards of 62 cwt. Out of the four horizontal seams in the boiler, two of them are above the centre line, and the other two are so far removed from the bottom that the distance between them is fully 40 per cent. of the whole circumference of the boiler. The corrugated furnaces are manufactured by the Leeds Forge Company—Fox's patent—and there is no seam of rivets inside the furnaces. The old-fashioned system of punching holes is now obsolete in the best boiler work. In the present instance all the holes have been drilled after the various plates have been fitted in their respective places. The flanging of the plates has been accomplished by hydraulic presses of special design on Tweddell's system. By this means large areas of plate are heated and bent into the required shape at one operation, thus reducing to a minimum the strain on the material, and avoiding as far as possible the local heating of small portions of plate, which is inevitable where hand labour is employed. All the rivetting has been done by Tweddell's machines. The horizontal seams of the shell and the front and centre circumferential seams of the shell are rivetted by one of Tweddell's fixed rivetters of the latest type. By the use of what is known as the "plate closer," which forms part of the machine, the two thicknesses of shell are held together, as in a vice, with a pressure of 30 tons, while the rivet head is formed in the first instance with a pressure of 40 tons, and by a simple mechanical contrivance the whole pressure of 70 tons is then transferred to finally close it. The principal novelty, however, lies in the mode adopted for rivetting the circumferential seams at the back of the boiler. This is accomplished by the use of Tweddell's portable rivetter, with plate closer attached—which is shown *in situ*—and which works on the same method, and gives the same pressure on the rivet and plate as the fixed rivetter just described. We hope to illustrate this machine shortly. The inside work of the boiler, where the plates are thinner, is rivetted by a fixed machine of less power, and the furnace mouths are rivetted by a portable—shown *in situ*—of a power suitable to the thinner plates and smaller rivets. It will thus be seen that by the use of these modern appliances, the entire work of drilling, flanging, and rivetting—has been accomplished by accurate mechanical processes, the uncertainty of hand labour being reduced to a minimum, and the result is a splendid piece of workmanship, reflecting the highest credit on the designers and constructors. The total weight of the boiler when finished ready for filling with water will be about forty



AUTOMATIC AIR VALVE.

tons. The scantlings are made in accordance with the highest requirements of the Board of Trade, Lloyd's Register, and the Bureau Veritas for a working pressure of 150 lb., and the boiler has been inspected by the surveyors of these societies during construction. The Slipway Company also exhibits a very beautiful little model, worked by electricity, of a pair of compound engines as fitted by them on board the steamers Mameluke and Nedjed, belonging to the Bedouin Steam Navigation Company, of Liverpool, to whom the model belongs. The engines represented by the model have cylinders 37in. and 72in. diameter by 48in. stroke, and develope 1350 indicated horse-power at sea, with a working pressure of 100 lb. per square inch. The company also exhibits a stand of photographs illustrative of the progress of their practice, commencing with the compound engines built in 1880, which was succeeded by the triple expansion engine with the third cylinder placed on the top of one of the other cylinders, this again being replaced by their latest design, in which the three cylinders work on three interchangeable cranks.

Messrs. Richard Garrett and Sons, Leiston, show a compound semi-portable high-pressure non-condensing steam engine, with cylinders 9in. and 13in. diameter respectively, having a stroke of 12in., and provided with separate distributing valves set to cut off steam in each cylinder at half stroke, but in the case of the high-pressure valve, having the excentric adjustable by hand, so that the point of cut-off can be varied from ⅛ to ½ or ⅝ stroke. The engine is fitted with Garrett's improved



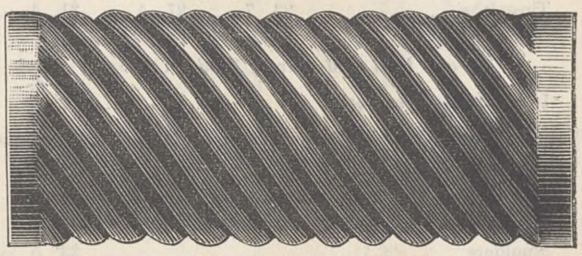
GARRETT'S FEED HEATER.

laminated spring governor operating upon an equilibrium double-beat valve of the Pickering type, and speeded for 150 revolutions per minute. There are two fly-wheels, each 5ft. in diameter and 11in. wide, turned on the soles and edges; they are accurately balanced, and hung one on each end of the crank-shaft. The crank-shaft, which is of Siemens-Martin steel, is 3⅞in. diameter, and fitted with a central bearing. The boiler has a Garrett's corrugated fire-box, giving a heating surface of 49 square feet. The tube heating surface is 214·8 square feet. At the fire-box end the boiler is mounted on an improved wrought iron ashpan, constructed to contain water to assist combustion, and at the smoke-box end upon a wrought iron feed water tank. The feed pump is of the three valve pattern, and works in connection with Garrett's improved water heater, shown in section in the cut below. The pump is kept in constant operation. When not supplying the boiler the water passes through the nozzle, and mixes with the exhaust steam, which is drawn through the annulus. The steam is condensed, and along with the water from the pump is discharged into the feed-water tank. In regular work the feed valve is set so as to provide the boiler with a constant feed, only the excess of water pumped passing through the heater. In this way it is claimed that the feed is raised to a high temperature without producing back pressure on the piston. Messrs. Garrett and Sons also show specimens of the details of their boilers—such, for instance, as the corrugated furnace. They also have a sand and salt distributor, which may be used for spreading a layer of gravel 2in. or 3in. in thickness, or an almost invisible layer of sand or salt for slippery roads or tramways. The apparatus consists of a hopper, in the bottom of which is a slide worked by a lever and handle to regulate the delivery. The sand or salt is distributed through a trough by means of a roller caused to revolve by means of gearing from the wheels. This roller is made up of loose rings strung on the shaft, a steel scraper being attached to each of the rings, to keep the material from clogging in the roller, while clogging in the hopper is prevented by a stirrer worked backwards and forwards by a connecting rod and crank. We believe that about thirty of these distributors are in use in London alone.

An apparatus, interesting to railway travellers, is shown by Mr. Edward Clennett, an official of the North-Eastern Railway Company at Hartlepool. It consists of an improved arrangement for automatically raising railway and other carriage windows, by means of which, it is claimed, draughts are entirely avoided. The window moves up and down in a groove, and has an endless chain attached to the bottom. This chain passes round two rollers, one at the bottom of the door and one half-way up, placed within the panelling. The bottom roller is actuated by a coil spring, which, when wound up, has sufficient power to cause the rotation of the roller, and so raise the window, but its action is controlled by a friction strap on the top roller, which, unless released, fixes the roller, and prevents the travel of the chain. The brake is put in and out of gear by means of a small knob inside the carriage or compartment, this, when pressed, frees the brake, and allows the spring to draw up the window. Instantly the pressure on the knob is removed the brake acts, and the window is fixed. The window is lowered by pulling it down, but very little pressure is required for this operation. In the event of any part getting out of order, a catch is provided which will hold the window at the top, but which admits of it being lowered and raised again when the knob is pressed in. The whole apparatus seems simple and ingenious, and costs but little. It has, we understand, been tried for over three years in some of the carriages of the North-Eastern Railway Company, and has been found to answer well. We certainly think it deserves the serious attention of railway men, who, judging by the tenacity with which they stick to the leather strap arrangement, almost seem to consider they have reached the end of all things in regard to carriage windows. Many travellers, however, think otherwise, and believe it to be quite possible to have a window which, though easy to move up and down, will be moderately dust and rain tight, and form some sort of an efficient barrier between the outer and inner atmospheres.

The Farnley Iron Company, Leeds, exhibits a new form of corrugated boiler flue—Fenby's patent—and we are glad to draw attention to the novel features it presents, for which the manufacturers claim—rightly, we think—special advantages. The corrugated form in boilers and boiler flues is not new, for it was suggested more than thirty years ago, as may be seen in various books on the subject, and in more than one English patent long since exposed. There was at that time, however, no special need for the strength which corrugations afford; and in the absence of the need the simple cylindrical tube of a Lancashire or Cornish boiler was naturally preferred. But as higher pressures of steam came into vogue, the strengthening of internal flues against collapse became a serious question for engineers, especially when, as in marine and land boilers of considerable size, flues and fire-boxes of large diameter were to be dealt with. To provide that strength in a plain cylinder requires such an increase in its thickness as to greatly retard the transmission of heat.

The revival of the corrugated tube by Sampson Fox, annular corrugations, and the corrugated fire-box by Garrett, of Leiston, are examples of the great strength given to thin sheet metal by fluting it. Flues and fire-boxes made on this principle have, however, one great defect—they have little strength longitudinally, and under the influence of external pressure, as in a boiler, are liable to elongate like an accordion, so that instead of forming a stay for the ends of the boiler, they tend to press the ends outwards, necessitating other means of staying. The "Farnley" flue, of which we give an illustration, overcomes this difficulty, for by the rapid spiral


THE FARNLEY FLUE.

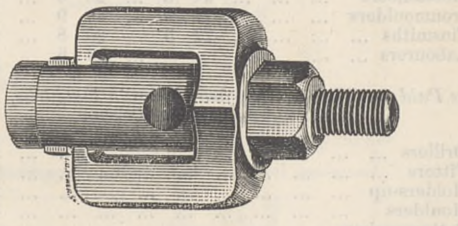
form of the corrugations a longitudinal as well as a transverse strength is given to the flue or fire-box Merely to alter the ordinary annular corrugations by giving them a slow spiral inclination, like a single threaded screw, would not produce this effect; the angle must incline sufficiently from the vertical, so that each corrugation shall form a stiff spiral rib or skew arch running from end to end of the flue. It will be seen by this that before the flue can collapse or "come down," the ends must draw together more or less, and of course bring with them the boiler ends, whereas in the ordinary flue with annular corrugations this is not the case, as it is evident that each or any of the corrugations might unfold itself without in any way supporting or receiving any support from the boiler ends. It is also claimed by the manufacturers that the whirling action of the flame along the spiral flutes is of considerable aid in the proper combustion of the gases.

The Farnley Iron Company has erected special machinery, capable of dealing with flues up to 9ft. in length and 5ft. 6in. diameter, and the reputation of this company for best Yorkshire iron and for all material for boiler work will doubtless extend to its new enterprise. The flues are made in Farnley iron or mild steel, as required.

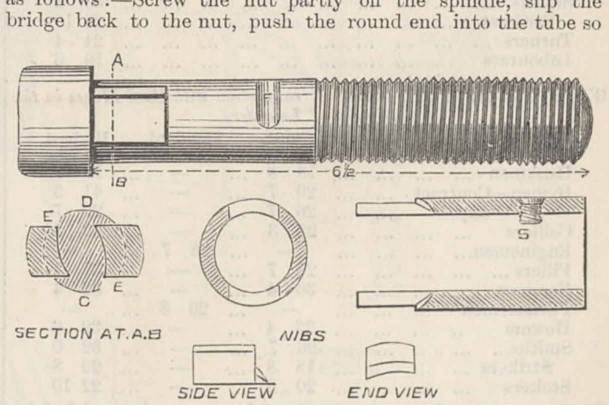
We understand that tests are shortly to be made under hydraulic pressure, so as to prove the rigidity of the flue against collapse and its general behaviour under pressure, a special testing apparatus being now constructed for this purpose, the very full tests already made having been upon model flues only.

WILLIAMS' FERULE EXTRACTOR.

The accompanying illustrations illustrate a very simple tool, by means of which the old method of taking out boiler ferules with a long bar, injurious to the tubes and to the boiler, is



avoided. The method of using the extractor is explained by the makers, Messrs. A. and H. Williams, Worthy, Winchester, as follows:—Screw the nut partly off the spindle, slip the bridge back to the nut, push the round end into the tube so



that the nibs are behind the ferule, place the finger and thumb of the left hand on the hollow case, and give the spindle a half turn with the right; this shoots the nibs out behind the ferule, by pushing them over the corners E, see section, and on tightening the nut the ferule is extracted with perfect ease.

It is stated that the Buffalo Electric Light Company has entered into a contract with the Niagara Falls Hydraulic Tunnel and Power Company to take 10,000-horse power, at 15 dols. per horse-power per annum, for lighting the city and manufacturing purposes. The route for the proposed cable has been surveyed from Niagara Falls, a distance of 20 miles. Negociations are also pending for lighting and supplying power to other towns in the vicinity.

WAGES IN GREAT BRITAIN.

No. XI.

Derby.—Among the manufactures of Derby are cast iron, cement, lead, red and white, lead, pipe and sheet. There are also some extensive foundries and iron and tin forges where iron bars, plates, sheets, and tin-plates are manufactured into gasometers, steam boilers, &c. Derbyshire is singularly rich in minerals, there being an abundance of coal, iron, and lead, all of which are extensively worked.

Wages Paid per Week of Fifty-four Hours in Derby—General Trades.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	32 5	34 4	37 1
Carpenters	32 5	36 6	39 5
Masons	39 5	40 7	41 9
Blacksmiths	31 4	34 4	36 6
Strikers	—	26 1	—
Horseshoers	26 2	27 11	31 4
Ironmoulders	29 11	31 9	33 9
,, Burton	31 0	31 9	—
,, Chesterfield	27 0	29 11	33 9
Tinsmiths	23 7	27 4	31 4
Labourers	—	20 10	—

Wages Paid to Members of Trades' Unions.

	s. d.
Ironfounders per week	32 0

Wages Paid per Week of Fifty-four Hours in Foundries, Ironworks, and Machine Shops in Derby.

	s. d.
Drillers	26 0
Fitters	31 1
Holders-up	24 11
Moulders	33 5
Patternmakers	33 5
Planers	26 0
Rivetters	30 1
Smiths	35 2
Strikers	26 4
Turners	27 0
Labourers	20 6

Wages Paid per Week in and in connection with Coal Mines in the District of Derby.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bankmen	19 3	—	20 10
Bymen, Contract	31 4	—	43 9
,, day	21 11	—	31 5
Colliers	24 9	—	34 5
Enginemen	—	30 5	—
Fillers	29 3	—	33 0
Foremen—above and below ground	38 7	—	40 7
Furnacemen	—	21 11	—
Hewers	24 9	—	34 6
Smiths	28 1	—	34 0
Strikers	19 10	—	21 11
Stokers	21 11	—	24 2

Rent averages 4s. 6d. per week, coal 12s. per ton, and gas 2s. 6d. per 1000 cubic feet.

Leicester.—The staple manufacture of Leicester is cotton and worsted hosiery, which furnishes an important export, and both in the weaving and other accompanying processes employs the larger part of the population. There are also some iron foundries and shops for the making and repairing of machinery used in the various factories. The labour conditions are the same as in Nottingham.

Wages Paid per Week of Fifty-four Hours in Leicester.—General Trades.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	30 7	31 4	34 11
Carpenters	30 7	34 4	37 1
Masons	36 1	38 3	39 2
Blacksmiths	29 6	32 4	34 4
Strikers	—	24 6	—
Horseshoers	24 8	26 3	29 6
Ironmoulders	27 0	31 9	32 11
Tinsmiths	22 3	25 8	29 6
Labourers	—	19 8	—

Wages Paid per Week of Fifty-four Hours in Foundries, Ironworks, and Machine Shops in Leicester.

	s. d.
Drillers	24 6
Fitters	29 4
Holders-up	23 6
Moulders	31 9
Patternmakers	31 6
Planers	24 6
Rivetters	28 3
Smiths	33 2
Strikers	24 10
Turners	24 4
Labourers	19 6

Wages Paid per Week in and in connection with Coal Mines in the District of Leicester.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bankmen	18 8	—	19 8
Bymen—Contract	29 7	—	41 3
,, day	26 7	—	29 7
Colliers	23 3	—	32 5
Enginemen	—	28 7	—
Fillers	27 7	—	31 1
Foremen	36 4	—	38 4
Furnacemen	—	20 8	—
Hewers	23 4	—	32 6
Smiths	26 7	—	32 0
Strikers	18 8	—	20 8
Stokers	20 8	—	22 10

Rent averages from 4s. to 4s. 6d. per week, coal is 14s. per ton, and gas 2s. 6d. per 1000 cubic feet.

Plymouth.—Plymouth owes its importance to being a great naval station. There are also manufactories of various kinds, and several foundries and shipbuilding yards. The trade, both coasting and foreign, is important and increasing.

Average Wages Paid per Week in Plymouth—General Trades.

	s. d.
Bricklayers	25 0
Carpenters	29 2
Masons	20 10
Blacksmiths	20 10
Strikers	19 0
Brassfounders	20 10
Ironmoulders	35 9
Millwrights	20 10
Tinsmiths	29 2
Labourers	18 9
Wages paid to members of trades unions—	
Carpenters, per hour	0 6¾

Wages Paid per Day of Eight Hours in the Royal Dockyards.

	Established workmen. s. d. s. d.	Hired workmen. s. d. s. d.
Bricklayers	4 6 —	4 0—4 6
Carpenters—		
Leading men	6 0—6 6	— —
Ordinary men	4 6 —	2 10—4 10
Single stationed men	5 0—5 6	— —
Masons	4 6 —	3 0—3 4
Braziers	4 9 —	4 0—5 0
Caulkers—		
Leading men	6 0—7 0	4 0—5 4
Ordinary men	5 0 —	— —
Coppersmiths—		
Leading men	8 0—9 6	8 0—10 0
Ordinary men	5 0—6 6	4 0—6 6
Engine-keepers	4 3 —	— —
Fitters—		
Leading men	8 0—9 0	8 0—10 0
Ordinary, ship branch	5 0—7 0	4 0—8 0
Ordinary, steam branch	5 0—7 0	— —
Founders—		
Leading men	8 0—9 0	8 0—10 0
Ordinary men	4 9—7 0	4 0—7 6
Locksmiths	4 9 —	4 0—4 6
Metal mills and sheathing shops—		
Leading men	7 3—7 9	— —
Workmen	3 3—6 3	— —
Oar machines—		
Oar finishers	4 0—5 0	— —
Machine labourers	5 6 —	— —
Saw sharpeners	4 0 —	— —
Pattern-makers—		
Leading men	8 0—9 0	8 0—10 0
Ordinary men	5 0—6 6	4 0—7 0
Sawmill	3 3—4 0	3 0—4 6
Sawyers—		
Pitmen	3 8 —	3 8 —
Topmen	4 2 —	4 2 —
Shipwrights—		
Leading men	6 0—7 0	— —
Ordinary men	5 0 —	4 0—5 4
Single stationed	5 6—6 0	— —
Smiths—		
Ordinary	4 9—7 6	3 6—7 6
Hammermen	3 6—4 0	3 0—4 0
Wheelwrights	4 0—5 0	2 6—2 10
Apprentices	0 6—2 6	— —
Boys	1 0—2 6	— —

Established artificers in the Royal Dockyards have regular and uninterrupted work throughout the year, are employed eight hours a day, chiefly under cover, have holidays for which no deduction of pay is made, medical attendance, half-pay when hurt at duty, superannuation after ten years' employment, promotion to the highest class of officers in their respective trades, and pensions are granted to widows of men killed in the service. Hired men do not enjoy promotion, superannuation, their widows are not entitled to pensions, and some of the men are liable to be discharged on the completion of certain work. The average rent paid by the better class of workmen in Plymouth, is 2s. per week for one room, and 3s. 6d. per week for two rooms; labourers paying less, and getting worse accommodation. There are several blocks of artisans' dwellings at about the above rates and also at 1s. 6d. and 2s. 6d. for one and two rooms, respectively, with very fair accommodation. Large numbers of dockyard workmen and skilled artisans have small houses of their own, which they pay for in the shape of purchase money and rent. Coal is 16s. and 17s. per ton, gas 1s. 11d. per 1000 cubic feet.

Exeter.—Though Exeter is the centre of an extensive district, there are few manufactures, the cotton and woollen industries, which were once so flourishing, being nearly extinct. There is a considerable trade of a miscellaneous nature. There are some ironfoundries in the city, and paper mills and tanyards in the vicinity.

Average Wages Paid per Week in Exeter.—General Trades.

	s. d.
Bricklayers	25 0
Carpenters	29 2
Masons	21 0
Blacksmiths	21 0
Strikers	19 0
Brassfounders	21 0
Ironfounders	24 11
Mechanics—brass	29 6
,, iron	30 0
,, paper	27 6
Tinsmiths	29 0
Labourers—brass	15 0
,, general	18 0
,, iron	15 6
,, paper	17 6

Wages Paid to Members of Trades Unions.

	s. d. Lowest.	s. d. Highest.
Stonemasons—Shepton Mallet (per hour)	0 5	0 6
Coach-makers—Taunton ... (per week)	20 0	30 0

Rent paid by labourers in Exeter is from £6 to £8 per year; by mechanics, from £8 to £10 per year. The lowest rent of a single room, about 10ft. square by 7½ft. high, is 1s. 6d. per week. The Industrial Dwellings House Company have eighty-two tenements let at from 2s. 6d. to 4s. 6d. per week, and a few of a superior class let at 5s. 6d. per week. A great many more houses have been built than what have been pulled down, and there is every year an increasing number of small houses, ranging in value from £12 to £14. Coal is from 16s. to 18s. per ton, and gas 3s. 6d. per 1000 cubic feet.

Southampton.—The importance of Southampton is due to its being a mail packet station and a shipping port. The only manufactures not connected with shipping are castings, coaches, and sugar refining. The feeling between employers and employed is fairly cordial; their great contentions of the past years having been placed on a better understanding. Although strikes take place occasionally, disputes between employers and workmen are usually settled by arbitration, which is usually decided by representative working-men and employers. Co-operative societies have prospered, and not only enabled the working classes to purchase the necessaries of life at a reduced cost, but their establishment have had a good effect on trade in general.

Wages Paid per Week of Fifty-six and a-half Hours in Southampton.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
General trades:—			
Bricklayers	21 9	31 0	35 6
Carpenters	26 10	31 0	35 6
Masons	26 10	31 0	35 6
Blacksmiths	26 10	31 0	35 6
Strikers	24 8	26 10	31 4
Brassfounders	28 4	32 5	36 6
Coach builders	20 3	30 5	49 7
Cutlers	25 4	27 10	40 7
Horseshoers	20 0	25 4	30 5
Iron moulders	20 0	—	37 10
Millwrights	25 4	27 10	30 5
Nailmakers (hand)	20 3	23 4	26 4
Tinsmiths	20 3	25 5	30 5
Labourers	18 3	20 3	22 3

Wages Paid per Week in Iron Shipbuilding Yards in Southampton.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Holders up	27 3	33 3	39 6
Platers	35 6	45 6	54 9
Labourers	18 3	19 9	21 3

Rent is 5s. per week, coal is 19s. per ton, and gas from 3s. 2d. to 3s. 8d. per 1000 cubic feet.

Sunderland.—The principal staple industry of Sunderland is coal, which is largely exported. Lime also forms an important article of trade, a large quantity being annually shipped. Other articles of export are furnished by the numerous manufactures of the town and neighbourhood, among which there are anchors, castings, brass and iron, chain cables, and chemical products. There are also extensive shipbuilding yards. The labour conditions are the same as in Newcastle, though there is not such immunity from strikes as in that city.

Wages Paid per Week of from Fifty-four to Fifty-nine Hours in Sunderland—General Trades.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	—	33 9	—
Carpenters	—	33 9	—
Masons	—	33 9	—
Blacksmiths	—	32 5	—
Strikers	—	18 3	—
Brassfounders	—	33 5	—
Horseshoers	30 5	31 3	34 5
Ironmoulders	29 11	—	41 7
Tinsmiths	—	30 0	—
Labourers	10 2	—	18 3

Wages Paid to Members of Trades Unions.

	Lowest. s. d	Standard. s. d.	Highest. s. d.
Carpenters, house (pr. wk.)	—	—	33 4
,, ship ,,	—	—	35 0
Amalgamated engineers ,,	—	—	35 0

Wages Paid per Week to Men in the Employ of the Corporation of Sunderland.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Blacksmiths	33 6	—	35 6
Joiners	—	33 10	—
Masons	—	33 6	—
Road inspectors	—	58 4	—
Labourers	—	24 4	—

Wages Paid per Week of Fifty-four Hours in Brass and Ironworks Foundries, and Machine Shops in Sunderland.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Boys, first-class	8 0	—	15 0
,, second-class	5 0	—	7 0
Finishers	—	35 6	—
Fitters	—	32 5	—
Foreman, foundry	45 4	50 8	60 8
,, general	60 8	91 3	101 8
Ironmoulders	—	35 3	—
Mechanics	34 6	—	36 6
Pattern-makers	—	34 6	—
Labourers	22 3	—	25 8

Wages Paid per Week of Fifty-three Hours in Iron Shipbuilding Yards in Sunderland.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Caulkers	—	35 6	—
Cutters	24 4	38 6	40 7
Drillers	24 4	28 4	30 5
Heaters—boys	—	11 3	—
Holders-up	—	26 4	—
Platers	—	33 6	42 6
Rivetters	—	32 4	—
Smiths	—	33 6	—
Strikers	—	24 0	—
Labourers	18 3	21 3	30 5

Wages Paid per Month to Engineers of Steamers in Sunderland.

	Lowest. £ s.	Standard. £ s.	Highest. £ s.
Ocean:			
First engineer	14 4	15 4	16 4
Second ,,	9 9	10 12	12 2
Third ,,	6 2	7 2	8 2
Donkeyman	4 10	4 16	5 1
Coast:			
First engineer	—	10 3	—
Second ,,	—	6 1	—
Donkeyman[1]	—	5 3	—

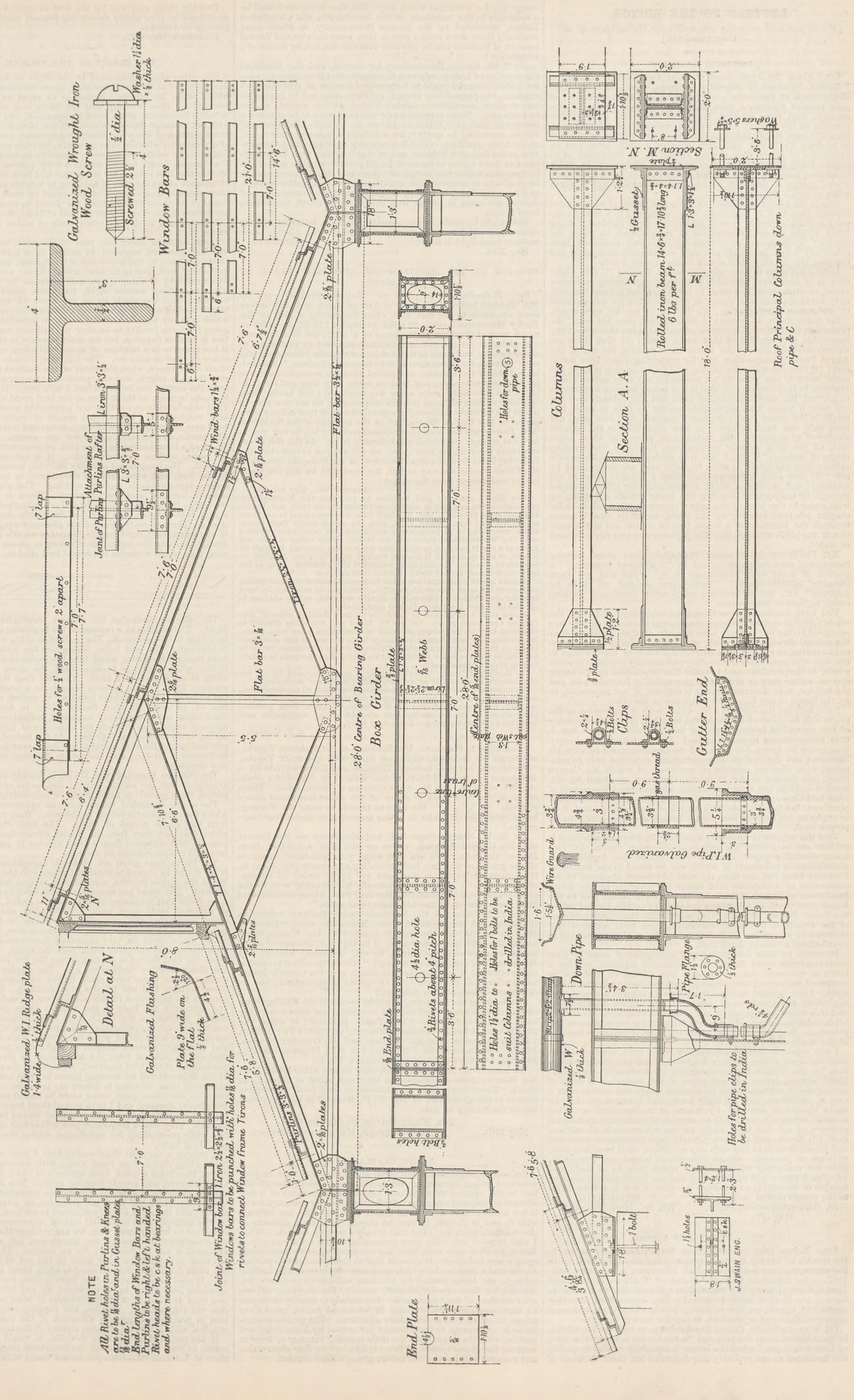
Rent averages for three rooms from 4s. 8d. to 5s. 6d. per week. Coals from 12s. 6d. to 16s. per ton, and gas from 1s. 8d. to 2s. per 1000 cubic feet.

[1] Find their own provisions.

The Queen and the Civil Engineers.—At the ordinary meeting of the Institution of Civil Engineers on Tuesday it was proposed by Mr. Woods, president, seconded by Mr. Berkley, vice-president, and carried by acclamation, that a loyal and dutiful message be sent by telegraph to the Queen, most respectfully offering the homage and congratulation of the members on the anniversary of her Majesty's birthday. The president has received the following reply from Major Edwards, R.E., C.B., "I am commanded by the Queen to thank you and the members of the Institution of Civil Engineers for your kind telegram of congratulation, received last evening."

CONTRACTS OPEN—WORKSHOP ROOFS FOR INDIAN STATE RAILWAYS.

(For description see page 415.)



LETTERS TO THE EDITOR.

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

DOMESTIC DRAINAGE.

SIR,—Since the appearance of your two leading articles on "Recent Advances in Domestic Drainage," and "The Sanitary Registration of Buildings"—on pages 296 and 316 respectively of your present volume—I have been watching your correspondence columns with some interest, hoping to meet with some further remarks on the subject. But with the exception of a few lines on page 319 from Mr. J. Botting—part of which appears to be a sort of apology for having unluckily invented a drain plug, and an expression of regret that anyone should be so ill-advised as to make a really practical use of so useful an implement—in which he offers a feeble and half-hearted defence of the "pot-and-patch-work" system of drainage, no one seems to have though it worth while to tackle the subject.

This is the more remarkable, as the matter is one of such general interest that if it is mentioned ever so slightly in a mixed company scarcely a person present fails to cite some incident, coming fairly within his own observation or recognizance, in which the ordinary systems—or no systems—of domestic sanitation have grievously failed, involving not only considerable annoyance and expense, but in many cases severe illness or even death.

It does not seem to have occurred to Mr. Botting (1) that whenever it is considered desirable to test any engineering structure, vessel, or connection, it is usual to carry that test beyond the ordinary working pressure or strain, in order to allow for deterioration or unforeseen contingencies; (2) that if, to use his own words, "the house drain, on account of fatty matter, does not rust," the protection thus afforded is continued and extended throughout any reasonable prolongation of that house drain; (3) that there are various methods, such as the Bower-Barff process, the use of Dr. Angus Smith's composition, &c., for protecting pipes from corrosion; (4) that our water companies, who do not convey sewage, but water more or less pure, do not encounter any very serious inconvenience in that respect; (5) that it is of nearly as much importance to prevent the contamination of wells and the saturation of the soil near a house with putrescible matter as it is to avoid bad smells in the house itself; (6) that a range of cast iron pipes will have only one joint in three, or less, according to the lengths employed, as compared with earthenware pipes, and these joints free, as you have already pointed out, from any "obstructing ridges of cement;" (7) that cast iron drains are not liable to subsidence and leakage if, as often happens, they are undermined by rats; (8) that when taken up, they have a sensible value as old material; and (9) that a slight obstruction may often be forced through by temporarily plugging the lower outlets and filling up with water to the level of the upper closets or other inlets—a far simpler job than opening up the drain, especially when it passes through the basement of a house, but, of course, out of the question if the pipes will only bear the pressure due to a few feet head of water.

Mr. Phillipson, in a recent pamphlet, gives some amusing instances of such stoppages caused by "a withered bouquet," "a portion of dress with whalebones in it," "lint and tow from chemists' establishments," "room-paper scraped off walls by painters," &c., not to mention temporarily insufficient flushing owing to frost or other causes.

You have incidentally mentioned the advantage of having the whole drainage system of a house constructed accurately to drawings ready for laying in; but you have scarcely, if at all, indicated that the natural division of the work, whether in building a new house or in altering an old one, is to entrust the whole of the drainage to the man who undertakes the lavatory and sanitary fittings—in other words, to the plumber—and to make him responsible for the entire system, rather than to divide the responsibility between him and the builder, with the result that it is difficult, if not impossible, to fix the blame of any failure on either one or the other.

I can imagine the derision with which such a suggestion as the above will be received by those who have had practical experience of the proverbial incompetence of the "plumber fiend;" but is that incompetence insurmountable? Hitherto he has had every temptation to scamp his work and no encouragement to learn his business; but the system of registration, extended only to competent men, whether masters or workmen, of which Mr. George Shaw, late master of the Plumbers' Company, seconded by Mr. Scott-Moncrieff, has been the earnest advocate, and the refusal of some first-class and conscientious firms to employ any but registered plumbers, bid fair to raise this branch of engineering—and it is, or ought to be, nothing less than a branch of engineering—to its proper level.

That the subject is gradually assuming its proper importance is evident not only from the animated discussion elicited by Professor Corfield's paper, recently read before the Architectural Association—a full report of which will be found in the *Builder* of February 12th, but also from the marked interest displayed by the conference of architects, held under the auspices of the Royal Institution of British Architects, during their recent visit to the Kensington Court Estate, where the sanitary details, carried out by the North British Plumbing Company under the superintendence of the architect, Mr. J. J. Stevenson, have been schemed and executed in accordance with the principles so ably enunciated in your leading article of April 15th.

It would be both interesting and instructive if some of your correspondents could furnish a comparative estimate, say for a house of moderate size, of the cast iron system of drainage as compared with what I have already called the "pot-and-patchwork" style. I am inclined to think that, even as regards first cost, and neglecting the questions of efficiency and future maintenance, cast iron would not appear to any great disadvantage. As for the brick manholes which Mr. Botting takes under his protection and patronage, they are about the worst and most indefensible features of the whole affair.

I will conclude this all-too-lengthy letter by a brief quotation from the draft of the sanitary Regulation Bill proposed for adoption by the Illinois State Association of Architects:—Sect. 12: Metal sewage drains and soil pipes, if not enamelled or made of non-corrosive material, shall be covered inside and outside with a coat of asphaltum, and all their joints and connections shall be made absolutely air-tight by means of molten lead or other metallic substance, and shall be capable of sustaining an internal pressure of not less than 15 lb. to the square inch of surface. Sect. 13: Every soil and every waste pipe hereafter constructed and placed as such in any such city or village, shall be of cast iron, or brass, or porcelain—except subordinate lateral and connecting pipes not exceeding 8ft. in length, which may be of lead—and when such pipe is put up for use, it and the joints thereof shall be capable of sustaining an internal pressure of not less than 15 lb. to the square inch of surface. W. SILVER HALL,

39, Hartington-street, Derby, Wh. Sc., Mem. Inst. M.E.

May 17th.

THE LIGHTING OF LISBON.

SIR,—Before even recommending British tenderers to go to the trouble of having the *termo* properly examined, referred to in the correspondence published in THE ENGINEER, p. 402, May 20th, 1887, under directions from the Board of Trade in London and Lord Salisbury, many of your readers will doubtless be anxious to have some further light thrown by Mr. James Duff, or other accredited agents, on the following points which at present seem somewhat dark and mysterious, to say the least of it, viz.:—

(1) Why should Mr. Consul Brackenbury, as well as Dr. Giffen, in their letters term the proposal "a tender for lighting the town of Lisbon with gas," when the former is especially careful to qualify the invitation as one probably only intended for those desirous of competing for municipal wants only—this view being confirmed by a reference to the manifesto of the Secretary to the Chamber at Lisbon, translated by Mr. George Brackenbury, in whose mind evidently there must exist a notion that some definite and limited amount of business can be put into rational English by means of a translation?

(2) If Mr. George Brackenbury be correct, and the Municipal Corporation of Lisbon only wish to intimate that they think that gas for public purposes ought to be provided free or at other people's expense, the proposition, though extreme, may not be impossible under given conditions, neither hinted at or named, so far as I can see. Thus, suppose a new company were to be granted a charter to include—(1) Gas in Lisbon to be sold at fixed rational values, according to quality, for a definite number of years—*i.e.*, at least two qualities. (2) All companies to supply into Corporation mains fuel and lighting gas of fixed quality free, but repayment at fixed values to be made for all private supplies made from Corporation mains per meter or otherwise. (3) All companies to be at liberty to compress all qualities of gas to 500 atmospheres, and be compelled to do so on demand by private consumers, and deliver the same in proper iron bottles at or about the definite fixed prices.

This might be made to pay clearly—*i.e.*, with sufficient private demand, of which no estimate appears to be given. All this tends to show more light is needed. TENERIFFE.

May 23rd.

THE USE OF THE WESTINGHOUSE AUTOMATIC BRAKE ON INCLINES.

SIR,—Referring to the paper on "Railway Brakes," read by Mr. Marshall before the Society of Arts in March last, the author drew attention to the fact that when descending a pass in the Rocky Mountains having 22 miles averaging 1 in 40, six miles of which were of the average steepness of 1 in 27, the Westinghouse "straight-air" or non-automatic system was used in preference to the automatic, and came to the conclusion that the latter form was not "suitable for the descent of very long steep inclines." We challenged this at the meeting, and stated that the non-automatic was by no means necessary, and that on many very long and steep inclines the automatic brake alone was employed; but having since specially written for more positive information, we are now able to quote the valuable testimony of several officers of four railway companies in the United States, and as the columns of the Society of Arts Journal are not open to correspondence, we beg to ask you to be good enough to publish the following facts. At the risk of encroaching too much on your space, we will ask you to reproduce the following letter from the superintendent of the Colorado division of the Union Pacific Railway in full, the gradients on this line being longer and steeper than the others:—

Denver, Colo., May 3rd, 1887.

Dear Sir,—I am very glad to state to you that the Westinghouse automatic brake has been in use on our Denver, South Park, and Pacific Railroad since February, 1883, at which time we commenced to use them on engines and cars. About June, 1884, the entire South Park equipment—consisting of 74 locomotives and about 1300 cars—were supplied with the Westinghouse automatic air brake. Since using it I do not know of a single instance in which any damage has occurred through its failure, or of a time when it has not worked properly when handled by competent persons. Its simplicity renders it very effective. It is, in my opinion, the most perfect brake that has been devised.

I would invite your attention to the first special rule of our time tables, and one of the most important, to wit:—"Straight air must not be used on Colorado Division." This rule is rigidly enforced, and is obvious to all who have used the automatic and straight air.

On our High Line district to Leadville we have about 19 miles of continuous 4 per cent. grade. On our St. Eleno and Gunnison district to Gunnison City we have about 30 miles of continuous 4 per cent. grade. No trouble has ever been experienced from the use of the automatic brake on these heavy gradients. Although trains sometimes break in two, yet so positive is the working of this brake, that the train is certain to stop almost immediately.

The liability of damage to brake-rigging is greatly lessened by the use of automatic over straight or ordinary brakes in cases of emergency.

The automatic brake is used on these districts under all circumstances, and its operations have been entirely satisfactory. I do not feel that I can say too much in favour of this brake. I know from personal observations of its superiority over straight air or any device ever invented for hand-brakeing.—Yours very truly,

J. K. CHOATE.

In addition to the above, Mr. Hackney, of the Atchison, Topeka, and Santa Fé Railroad, writes on April 30th last from Topeka, "We have on our road between Trinidad and Raton a grade for a distance of five miles of 185ft. to the mile—1 in $28\frac{1}{2}$—and a grade of 106ft. per mile—1 in 50—for a distance of eleven miles. There are no sags or level track in either of the above-mentioned pieces of track. . . . . We have no trouble in using the Westinghouse automatic air brake in either ascending or descending these grades."

Mr. N. W. Sample, Supt. M.P. and Machinery on the Denver and Rio Grande Railroad, writes on the 29th April last, from Denver, Colorado, "We are now using your automatic brake on all the grades of this line, both ascending and descending—that is, the automatic feature is used and will apply under all circumstances. . . . There is no necessity for changing over to the plain brake, even in descending Marshall Pass, which is continuous 211ft. per mile—1 in 25—for twenty-one miles."

Mr. T. F. Oakes, of the Northern Pacific Railway, writing on the 29th April last, from St. Paul, Minnesota, says, "Trains of 400 tons weight are successfully handled by the Westinghouse automatic on 2·6 per cent. grades—1 in $38\frac{1}{2}$—for distances of about ten miles each at three points, to wit, Bozenian, Mullan, and Missoula," and concludes by saying: "It is our intention to operate trains after 1st of June on the switchback over the Cascade Mountains, where a $5\frac{1}{2}$ per cent.—1 in 18—grade is encountered, and no difficulty is anticipated in doing so."

Summarising the foregoing, it will be seen that the Westinghouse automatic brake is worked both in ascending and descending very steep inclines, as follows:—Union Pacific Railroad: 30 miles, 1 in 25; 19 miles, 1 in 25. Atchison, Topeka, and Santa Fé: 5 miles, 1 in $28\frac{1}{2}$; 11 miles, 1 in 50. Denver and Rio Grande: 21 miles, 1 in 25. Northern Pacific: 10 miles, 1 in $38\frac{1}{2}$; 10 miles, 1 in $38\frac{1}{2}$; 10 miles, 1 in $38\frac{1}{2}$; to be shortly operated, 1 in 18.

We know of no trains being controlled by any other brakes than the Westinghouse on inclines so long and steep as those given above. These facts speak for themselves, and form a complete answer to the allegations of Mr. W. P. Marshall in his paper read before the Society of Arts.

THE WESTINGHOUSE BRAKE COMPANY.

May 24th. Alb. Kapteyn, Manager and Secretary.

A NEW COMPLAINT.

SIR,—A correspondence has been going on some time in your esteemed paper concerning colour-blindness, which, though the fact be old, appears to me to have assumed the character of a new ailment consequent upon the introduction of a new industry, for as it is a hindrance, in a material sense, to those who are afflicted with it, and is chronic, it may be classed with such ailments as rheumatism, gout, &c. But that is only a passing remark. What I wish to point out, with your permission, is that quite recently at Berlin another new complaint has cropped up, also consequent upon a new industry. It appears that at this moment two parties, a male and a female—telegraph operators—both otherwise healthy subjects, are being treated by the here well-known professor, Dr. Mendel, for their special ailment, namely, the dropping off, one after another, of the finger nails. The malady is exactly analogous to that occasioned by working in whitelead works, quicksilver mines, in spinal and a few other affections. The professor attributes it at present to the constant jar caused by hammering and pushing with the finger ends the little pointing hammer or lever in working the Morse system of telegraphy; but further observation and research will be required before giving a final decision.

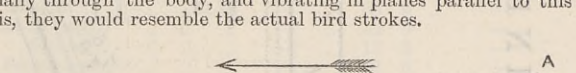
Possibly these may not be the first cases, and now it has been mentioned in your widely circulating journal, others may turn up, perhaps in America. U.

Rheinland, May 24th.

THE FLIGHT OF THE PELICAN.

SIR,—One who is interested in the flight of heavy birds, and desires to get at the facts presented, meets with numerous obstacles which baffle his efforts. Motion is so rapid as to give but a moment for close scrutiny, and the birds best adapted to teach valuable lessons are often hard to approach, and not to be met with but in out-of-the-way places. When viewed at a distance the exact position of wings is difficult to determine, and the condition of atmosphere, whether calm or windy, whether steadily flowing or disturbed by conflicting currents, cannot be decided with certainty. I at length found in the common grey pelican of the Gulf of Mexico the best subject for study that had been encountered, and at once set about the task of reducing to weights and measures the phenomena of translation in air presented by these birds. On the coasts of Southern Florida they are found in abundance, and so completely mysterious is their method of flight, that its explanation will carry with it that of other birds of either active or silent wings.

I was engaged about one year in the work, was starved, shipwrecked, poisoned, captured by natives as a madman, punctured to the leg bone by the horny tail of a stingaree, and was forthwith acquainted with pain in its most intense form; was overtaken and overturned by a water spout, half drowned by summer squalls wherein nothing seemed right, too much water in the air for breathing, and too much air in the water for swimming, but at length worked out the case sufficiently exact for practical purposes, which was my object, and the result is herewith given. When going from one locality to another the pelican's method of translation is by slow flapping, but for short journeys in the same vicinity it has recourse to a mixture of active and silent wing progression, either in wind or calm air. The following is made in the absence of air disturbance, when the water of the shallows frequented is as smooth as a mirror, and the splash of a two-pound mullet leaping from the surface can be heard half a mile away. No progress could be made in wind, as the motion of the bird could not be related to fixed objects without needless and perplexing trouble. An average bird weighs 16 lb. Its extreme spread of wings is 7ft., and the total area of under surface of wing, body, and tail is 8 square feet. The stroke, two vibrations, occupies one second. The tips move 3ft., and a liberal estimate gives 18in. of downward movement of the entire surface for each stroke. It is not in excess of that amount. The integument covering the wing bones from the elbow to the body and wrist projects downwards in front, $1\frac{1}{2}$in. in the centre, tapering both ways to nothing. The wings are slightly concave beneath, and convex above. There is no flexing nor stretching the wings in the down and up vibrations; I am safe in saying that they do not vary 1in. in length during the entire stroke. There is no twisting of the pinions during the vibrations. If the wings were rigid boards hinged to an axis passing longitudinally through the body, and vibrating in planes parallel to this axis, they would resemble the actual bird strokes.



The diagram indicates the various peculiarities exhibited in flight. The position at *a* represents the beginning of the first vibration from the lowest point. The inclination of the wings was 30 deg. to horizontal, the bird being 10ft. above the water. Ten strokes were then made, during which time the inclination was reduced to 10 deg., when the wings became silent, the space travelled being 530ft. in ten seconds on a level. The bird then floated on an easy gradient 420ft. further in seven seconds to a position as close to the water as possible without touching it, ending with an inclination of 16 deg. It then floated 175ft. in five seconds, with diminishing speed and slowly increasing inclination. A sharp turn upwards would then be made for a distance of 10ft. in one second, ending in an inclination of 40 deg. At the instant of reaching the greatest height the bird would throw itself over to the front to an inclination of 30 deg., and resume its flapping, the period being now complete.

The distance travelled was 1135ft. in twenty-three seconds, an average of 49ft. per second nearly; and, so far as could be determined, these periods of flight might be indefinitely repeated.

The above numerical values have an appearance of exactness which does not strictly belong to the case. They were not obtained from any single period of flight. The total distance and time given does not vary from the actual observation, but the components were corrected from a great number of estimates, and are intended to approximate an average.

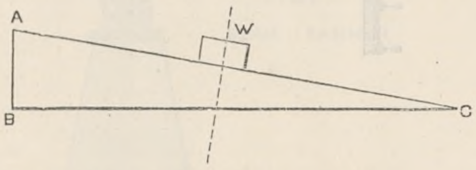
The inclinations given are obviously approximations, but there is no doubt in regard to continual changes in the order set down. When the degree is given, a reasonable margin for error must be allowed. The speed per second is also subject to error, but there is no doubt that it changes substantially as stated, the overlapping of different birds upon each other showing wide differences in speed, confirming the measuring and timing of the flight. The pelican is so large and heavy, and its motion so slow, that the position of its wings could be very accurately determined at all points of their movements excepting when near the water. At first I supposed the bird floated in contact during the low part of its period, but closer scrutiny undeceived me. The ripples in the shining surface of the water were made by the air pressures beneath its lower surface, and not by the wing feathers. The only way to come at the inclination in this position was to wade into the water and submerge the body to the nose, so as to get the eyes in a normal position on the bird's level. The pelican is a mirth-provoking creature in appearance. The position in which its head is carried gives it an air of pompous dignity, with which its clumsy and seemingly affected method of flight does not harmonise, so that one is relieved from the tediousness of observation by the comicalities of the bird observed. At nightfall they would assemble at the kegs selected for roosting places in great numbers, and were extremely tame, seeming to ignore my presence. As they arrived from all directions good views could be had in every way. They were heavy sleepers, and I have picked them from their perches as my boat floated quietly by the marginal bushes before they could awaken. They would frequently pass within four or five feet of my face while prospecting for subsistence during the above described periods of flight.

A pelican is the most exasperating bird I ever encountered. It floats a long distance on rigid wings, with constantly diminishing speed, then takes a quick turn upwards in which its momentum is much lessened, and goes to flapping again. This is saying, "I am storing up power now by the tremendous muscular exertion of my large wings which will keep me going for an interval while I rest them;" and the story is well calculated to mislead. If it were not for the multiplication table, and certain requirements of cause and effect not to be dispensed with, we might admit the muscular force to be competent to produce the translation, but as it is, no such explanation can be tolerated for an instant. The flapping is far too weak to sustain the bird while in the act of doing it, much less while floating for several seconds when there is no flapping at all. It goes without saying that there is some mechanical activity operating here which has never found its way into any text-book, as a brief application of Hutton's tables of wind resistances to the case will demonstrate. Besides, the flapping ought to drive the bird in precisely an opposite direction, if the authorities we are supplied with determine the case instead of the facts.

If the period of stroke were doubled, it would still be incompetent to buoy the bird during the downward vibration. Nothing short of ten such vibrations per second would suffice for this work, and they must be continuously downwards. The bird occupies one-half the time in performing the upward vibration, and it is difficult to see how great loss is prevented in this part of the stroke. Indeed, I utterly failed to induce an artificial device, built as nearly in the shape of the bird as possible, to sustain its 16 lb. weight by any velocity of vibration I was able to give it to the limit of strength of materials. Momentum is not pertinent to the case. There are no localised points of resistance in still air upon which momentum could perform duty. Flight is confined to a zone of air between the water and a plane 10ft. above it, in which the atmosphere is both homogeneous and quiet, and its resistances to the motion of bodies through it are necessarily reactive only. The question is not whether the momentum at the end of the active wing component of the period is sufficient to carry the bird through the silent part, but how any momentum whatever is obtained. There is little use in being particular about the quantity, when it is impossible to find any cause for the least atom of it. The first thing is to buoy the bird. If there be then motive power left over, it may be employed in generating lateral motion. As the case stands, a weight of 16 lb. is sustained in free air, and carried 1135ft. on a path averaging horizontal by a motive power derived from eight square feet of surface driven on still air 15ft. in ten seconds!

When the fact of alternating adverse vibrations is considered, the extreme liberality of the above estimate is apparent; and since the flight of the pelican was worked out I have abandoned all hope of obtaining a solution of the phenomena from recognised mechanical authorities. When confronted with heavy bird flight or the mystery of soaring, mechanical science in its present attitude stands in a position of helpless and pitiable imbecility.

When reference is made to bodies placed on inclined planes, as examples of the resolution of gravity found in soaring, care must be taken not to carry the parallelism too far. If the length of the



plane were 25, and the height 5, the parallel component of a 20 lb. weight would be 4 lb. The fall of *w* from *a* to *b*, a distance of 5ft., would be no more than sufficient to move it from *c* to *a*, friction ignored—that is, to lift 20 lb. 5ft., or 4 lb. 25ft., requires the same force.

To put it in a different way. A force that will lift a weight a given distance will lift one-fifth of that weight five times as far, and no more; or a weight on the short arm of a lever will balance only one-fifth as much if the other arm be five times as long. The normal component falling from *a* to *b* would not answer. It requires the total weight to move one-fifth of it five times as far.

In soaring we have the same result. By substituting air pressures against the normal component we may remove the plane, and hold the weight against the parallel component, as the air friction would not suffice. There is now uniform motion on the normal line, and the substitution of a parallel force to take the place of friction, but it seems obvious that the dynamic result is the same. If the weight were pulled up the incline with velocity sufficient to give a horizontal resultant, it would require all the force developed in the air pressures, and a little more, to do it. It would require all that would be developed by the total weight, as in the other case. Motion on the soaring resultant, or horizontal, is produced by the normal motion, which not being present in the other case, lateral motion would be on the inclined path; still, this does not change the essential similarity of the two. So far the parallelism is unstrained, but the next step can be taken by the soaring activity alone.

It is obvious that the friction between plane and weight, in the absence of motion, is about one-fifth that of the normal pressure. It is equally obvious that the force required to hold the soaring plane against the parallel component is about one-fifth of the air pressures, which equal the normal component. If we can use this amount of the escaping pressures to apply against the parallel component, it will be neutralised, and we need no longer hold the plane in the normal line. Plane construction does this. The birds are supplied with a front ledge to the underside of the wings, suitably constructed feathers on the surface, and elastic tips at the rear edge to utilise the pressures under the wing for this purpose. These devices serve to throw an amount of normal pressure equal to the parallel pressure, 90 deg. from the normal line, so that normal, in effect, directly opposes parallel pressure to an extent which completely obliterates it, and leaves the excess still working on the normal line, with a velocity lessened by the amount of work done in cancelling the parallel component.

We have now departed completely from the inclined plane and weight. There is now uniform motion on the normal line which is not in the gravity resultant, and the soaring body has sacrificed a part of its gravitating force to get there. It has lost precisely that component which is needed to push it into the vertical. If we could conceive of an angular, pivotted device, which might be employed on the inclined plane and weight, to throw normal pressure over 90 deg., neutralising the parallel component, it would resemble the soaring plane. The excess of the normal would then be the only force acting on the weight. The fluid air pressing in all directions furnishes just the device needed for the purpose, but to employ it necessitates the soaring plane, and I know of no other method which can give it.

We are now in the presence of a soaring bird, and it will work us no harm to take off our hats and do a little thinking. When we now pull the plane laterally, or "up the incline," what resistance is encountered? None conceivable but atmospheric friction, and for all practical purposes we may mark this down = 0. To pull the plane 1ft., or 10ft., or 100ft. edgewise is very much the same as not to pull it at all. No atom of gravity resists such motion; the time and space relations which existed between the parallel and the normal components vanished with the parallel factor. There can be no relation between something and nothing. Whether the normal be now one-fifth of the parallel motion, or any other multiple or fraction of it, affects the normal force only, and that in the slightest degree. Neither does it affect the air resistances. It is indifferent to a particle of air from what direction the body comes which pushes it out of its place. It resists such body in a direction normal to its pushing surface in all cases. The reactions of free air resemble inertia reaction, being determined in direction by the active force. A few particles may be pressed much, or a greater number less, with the same result. Hence lateral motion does not interfere with normal motion in the least.

It is obvious that the vertical of the soaring plane is on the normal line, and its horizon parallel to itself, and that these do not coincide with the gravity resultant nor the sea level. The soaring plane has been pushed out of the vertical, and by bringing it back, so that the two are the same, it is at once seen that parallel motion lifts no weight. It is a constant falling from its own level that produces the soaring resultant. If we take two planes properly constructed for soaring, and alike in all respects, and place one of them on the soaring inclination and the other horizontally in air, the latter would descend on a resultant of five horizontal to one vertical velocity, interpreted by the direction in which its gravity acted. The other would do precisely the same thing, the only difference between them being in rate of motion produced by loss of a gravity component from the soaring plane. Both would come down with uniform velocity, compressing and otherwise disturbing the air beneath. These pressures retarded at the front, push the plane sideways, setting up parallel motion in one case, and cancelling the parallel component in addition in the other; and yet physicists are busily engaged keeping soaring birds in air by invisible flappings, independent feather motions, conflicting air currents, or by blank denial of fact. I. LANCASTER.

Chicago.

THE FASTEST VESSEL AFLOAT.

SIR,—I see by a note in your impression of the 6th inst. that an inaccurate notion may be formed of the relative speeds of torpedo boats built by Messrs. Thornycroft and Yarrow. Referring your readers to an account of the trial of Messrs. Yarrow's boat on page 326, you point out that a speed of 27·277 knots was attained on that occasion, while Messrs. Thornycroft's boat made a *mean* speed—the italics are mine—of 26·11 knots, a comparison which might lead your readers to the erroneous conclusion that the Yarrow boat is the swifter.

I find, on looking up the article referred to, that Messrs. Yarrow's boat was said to have made 27·277 knots, but that this was with the tide! The mean speed, which of course can alone be fairly compared with Messrs. Thornycroft's 26·12 knots, was only 25·101 knots, or fully a knot behind the Thornycroft boat. Of what value the fact of making a speed of 27·277 knots with the tide can be I am at a loss to imagine, as this is merely the speed of the tide plus that of the boat.

By running in a sufficiently rapid river this kind of "fastest record" might be beaten by the veriest steam tug afloat. It is as if a passenger in a train running at fifty-seven miles an hour were to walk across his compartment in the direction of the train's motion at a speed of three miles an hour, and then boast of having walked at a pace of a mile a minute. By a report of a later trial of the Thornycroft boat, which appears in the *Daily Telegraph* today, I find that a mean speed of 26·18 knots was attained, while the speed with the tide was over 29 knots, so that both the mean and the maximum speeds were considerably in excess of any recorded of Messrs. Yarrow's boat. FAIR PLAY.

May 11th, 1887.

[Our reference was to absolute maximum speeds past the shore. Perhaps our correspondent will say whether the Thornycroft boat was light, or in fighting trim like the Yarrow boat.—ED. E.]

GOVERNMENT CONTRACTS—WASTE OF BOLTS AND RIVETS.

SIR,—In contracts for iron work for the Government and Indian State railways, and other work, it is always stipulated that there shall be "an addition of 50 per cent. to the net quantity of rivets, and of 10 per cent. to net quantity of bolts required for waste." Can any correspondent tell me what becomes of all these rivets and bolts, for surely it cannot be that the Government workmen spoil half as many rivets as they use, and one out of every ten bolts?

London, May 24th. WYBROW.

CONTRACTS OPEN.

INDIAN STATE RAILWAYS.—IRONWORK FOR ROOFING FOR WORKSHOPS AND RUNNING SHEDS.

THE work required under this specification comprises the construction, supply, and delivery in England, at one or more of the ports named in the conditions and tender, of the whole of the ungalvanised wrought ironwork for two repairing shops, each 112ft. long and 84ft. wide; one running shed, 112ft. long and 56ft. wide; one repairing shop, 308ft. long and 140ft. wide; one repairing shop, 140ft. long and 112ft. wide; one repairing shop, 112ft. long and 28ft. wide.

All bolts and washers and everything necessary for the completion of the work in India, with an addition of 50 per cent. to the net quantity of rivets and of 10 per cent. to the net quantity of bolts required for waste. The above quantities include the 10 per cent. extra on the holding-down bolts. In addition to the above, the contractor is to supply one ton of service bolts and half a ton of ordinary plater's washers, to be selected by the Inspector-General for use in erection of the work in India. The ironwork is delineated generally on two sheets of drawings, numbered F 645 and F 646, which may be seen at the office of the Director-General of Stores, India-office, and from which the engravings, page 413, are made. The galvanised work shown on the same drawings is the subject of a separate contract.

The wrought iron must be of such strength and quality as to be equal to the following tensional strains, and to indicate the following percentage of contraction of the tested area at the point of fracture:—

	Tensional strains per square inch. Tons.	Percentages of contraction of fractured area.
Round and square bars, and flat bars under 6in. wide	24	20
Angle and flat bars 6in. wide and upwards	22	15
Plates	21	10
Plates across the grain	18	5

The rivet iron must be of such a quality that any rivet will stand the following tests:—Bending double upon itself whilst cold or red hot without showing signs of fracture. The shank being nicked whilst cold and bent double, showing the fibre of the iron to be of good quality. Flattening down the head whilst red hot until its diameter is equal to two and a-half times that of the shank without showing signs of cracking at the edges. Punching through the shank when at a red heat, with a taper punch, a round hole the diameter of the rivet without showing signs of cracking or splitting.

The edges of all plates, and the ends of all bars of all kinds, must be planed dead true to dimensions, or, where planing is impossible, must be dressed off fair with hammer, chisel, and file. No rough edges fresh from the shears will be permitted anywhere throughout the work. Wherever necessary for the division of the work for transport the rivets are to be left out, but the holes must in all cases be made ready for rivetting, and the requisite rivets, including 50 per cent. extra, sent with the work. Half the number of purlins of each kind required for end lengths in the various buildings are to be punched right-handed and half left-handed, similar to the window bars shown on drawings, in order that each row of purlins may break joint on the rafters with the adjacent row. The whole of the girders and trusses are to be put together in position with bolts and nuts, and the purlins and window sills bolted to them, to test the accuracy of the work.

The conditions of contract and character of the work are as usual in these specifications. Tenders, addressed to the Secretary of State for India in Council, with the words "Tender for Ironwork for Roofing, &c.," on the envelope, must be delivered at the India-office, Whitehall, London, S.W., before 2 p.m. on Wednesday, 1st June, 1887. If delivered by hand, they are to be placed in a box provided for that purpose in the Store Department.

THE ROLLING CONTACT OF BODIES.[1]

THE lecturer commenced by stating that when two solid bodies roll upon each other, points on the surface of one successively come into contact with corresponding points in the surface of the other in a way which differs essentially from that which occurs in sliding contact, and it is the nature of this rolling contact that he proposed to discuss in an experimental manner.

In the first place, it would be well to understand clearly the nature of the relative motion of the two points which come into contact when the surfaces are such that no appreciable distortion of them takes place, and for this purpose one of the two bodies must be at rest. These may respectively be taken as the plane surface of the ground, and a circular disc rolling upon it. An approximate representation of this motion is given by the end of the spokes of a wheel without its tire. In this case it is seen that a point of the rolling body, when it is just coming into contact with the fixed surface, does so in a direction at right angles to the surface at rest, and also leaves it in the same direction. This action is very similar in kind to that which occurs with the continuous circle formed by the tire. The path of a point in the rim can be drawn in a way visible to the audience by means of a piece of apparatus consisting of two circular glass plates held together by a hollow brass spindle, in which slides an arm carrying a brush. The brush traces the well-known cycloid, of which the only portion now to be considered is that where it directly approaches the surface beneath. This part is perpendicular to that surface, and when epicycloids are drawn, by rolling the disc upon the arc of a circle, the same fact is brought out. One body may, however, not merely roll upon another, and a normal pressure be exerted, but they may exert a tangential force upon each other. It is convenient to keep these two cases separate: examples of them being respectively the wheels of a railway carriage and those of the locomotive that draws it along. It is to be noted that the object in the former case is to permit one body to move relatively to another without permitting sliding contact of their surfaces, whilst in the latter case, in addition to this, the object is to obtain such motion. There are, however, many cases in which it is merely the motion of a body about one point which is required, such as when motion is transmitted from the edge of one rotating disc to another, and then this distinction still more closely holds, as the normal pressure is only obtained so as to ensure the necessary tangential resistance. Thus the effects of rolling motion may be classed as being:—(1) To allow the relative motion of one body to another with which it is in contact without permitting relative motion of that part of their surfaces in actual contact. (2) To obtain the relative motion of such parts of the surfaces of bodies as are not in contact by means of statical contact of the parts which are.

The lecturer then proceeded to discuss, first, the cases in which there was very little resistance to the motion of rolling, and also those in which there was almost perfect development of one surface upon the other, and an account was given of some experiments in which it was found that with two brass discs rolling upon each other the error was only 1 in 300,000, when the best conditions were obtained. The exact nature of the resistance which always occurs, however small it may be, was then dealt with at considerable length by means of diagrams and models, and some remarkable experiments upon the rolling of bodies were exhibited.

In conclusion, the nature of the action which occurs when a rolling body is acted upon by a force obliquely to its plane of rotation was discussed, and the creep of one surface over the other in these circumstances was clearly demonstrated by means of special apparatus.

[1] Abstract of lecture delivered at the Royal Institution by Professor Hele Shaw, M. Inst. C.E., on April 29th.

TENDERS.

CORPORATION OF LEICESTER.

FOR the construction of about 790 lineal yards of 12in. stoneware pipe sewers, together with manholes, lampholes, and other works in connection therewith, in the Wesh Leigh and Ash Leigh-roads. Drawings, specification, and quantities by J. Gordon, M. Inst. C.E., borough surveyor:—

	£	s.	d.
S. and E. Bentley, London (accepted)	343	3	3
A. Turner and Sons, Bilston	377	15	9
Jas. Dickson, St. Albans	389	14	4
Hy. Black, Barrow-on-Soar	391	5	6
Jno. Smith, Belgrave, Leicester	404	0	2
Innes and Wood, Birmingham	500	11	0

DEATH OF A WELL-KNOWN ENGINEER.—An engineer, well known in the Midlands, has just died in America—Mr. Samuel Green, who up to 1863 resided at Clay Cross. He was the son of Timothy Green, an engineer employed in making the Clay Cross Tunnel, and was one of the first engine tenters employed by the Clay Cross Company. Early in life the deceased was a weigher of coal and ironstone with the Clay Cross firm, and remained in that occupation until he went to America, where he entered the service of Messrs. Wilbraham, engineers—who were also natives of Derbyshire. On the 4th inst., he died suddenly from heart disease.

THE INSTITUTION OF CIVIL ENGINEERS.—On Wednesday night Mr. Eward Woods held a *conversazione* in the South Kensington Museum. Although the issue of invitations was restricted, so that the company was more select than numerous, about 3500 were present. Universal satisfaction was expressed at the return of the Institution to what has now come to be regarded as the normal locality for these annual *réunions*. Their great advantage is that they bring friends and acquaintances together under very pleasant conditions, and with surroundings eminently qualified to give contentment of mind and body, who perhaps meet only once a year. When the *conversazione* was held in the Exhibition, nothing of the kind was possible. The place was too big, the crowd was too vast, for anything like pleasant social intercourse. We congratulate Mr. Woods on the success of an entertainment with which every one was pleased; and a word of recognition is due to the indefatigable secretary, Mr. Forrest, on whom a great deal of very hard organising work devolved.

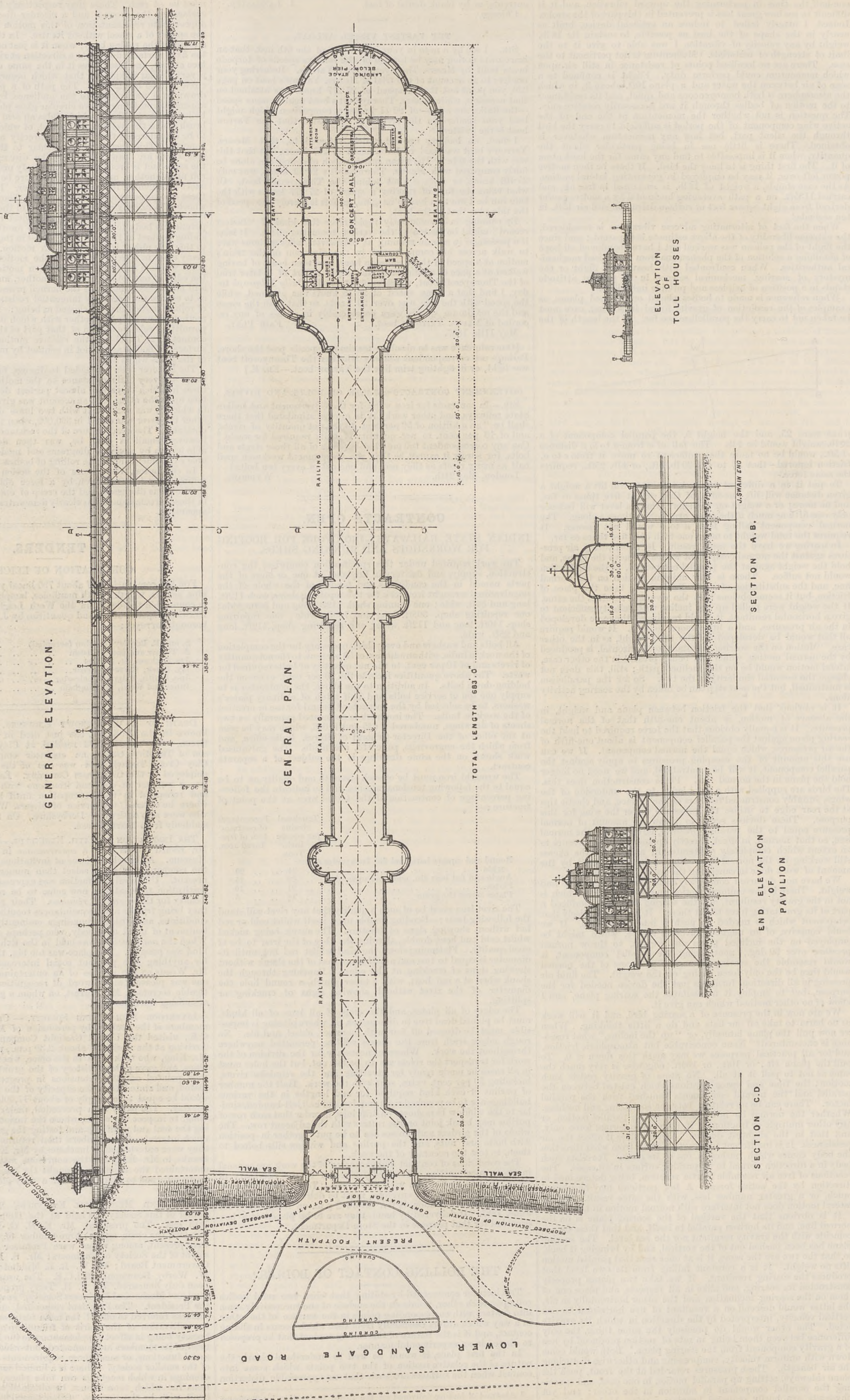
LIVERPOOL ENGINEERING SOCIETY.—On Saturday last the members of the Society, by permission of Mr. W. King, M. Inst. C.E., visited the United Gaslight Company's works at Linacre. Arriving at the works at about 2.30 p.m., the party were met by Mr. King, who took them to the office, where he showed them the plans, and gave a short history of the growth of the works. He then pointed out the extensions in progress and those contemplated, and stated that the capacity of the works when completed would be equal to a supply of about 17,000,000 cubic feet of gas per day. The party then proceeded, under the guidance of Mr. King, to inspect the works, where the various operations of retorting the coal and purifying and testing the gas were examined with much interest. The members then returned to the office, where they were entertained to luncheon by Mr. King. A hearty vote of thanks to Mr. King for the courteous manner in which he had entertained the members brought the visit to a close, and the party returned to Liverpool after a very pleasant and interesting excursion.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—The annual dinner of this Society was held at the Holborn Restaurant on the 18th inst. The president, Mr. E. H. G. Brewster, A.M.I.C.E., occupied the chair, and a large number of members and visitors were present, among whom were Professor Henry Robinson, president of the Society of Engineers; Mr. S. H. Terry, of the Local Government Board; Mr. W. R. E. Middleton, M.I.C.E.; and Mr. W. Worby Beaumont, M.I.C.E. The usual loyal toasts having been duly honoured, Mr. S. H. Terry proposed, "Success to the Civil and Mechanical Engineers Society," coupled with the health of the President. The President responded, and in the course of his remarks referred to one of the main features of the Society, viz., the cultivation of the spirit of friendship amongst engineers, the Society being in effect supplementary to the Institution with which most of its members are connected, but which cannot perform the social functions, or meet those requirements which are the duties of the smaller society. There is a limited number of weeks and of evenings in which meetings can take place, and papers and questions for which time cannot be obtained at the Institution are dealt with by the Society. Other toasts followed, with music in the intervals, and a very pleasant evening was passed.

NEW PROMENADE PIER, FOLKESTONE.

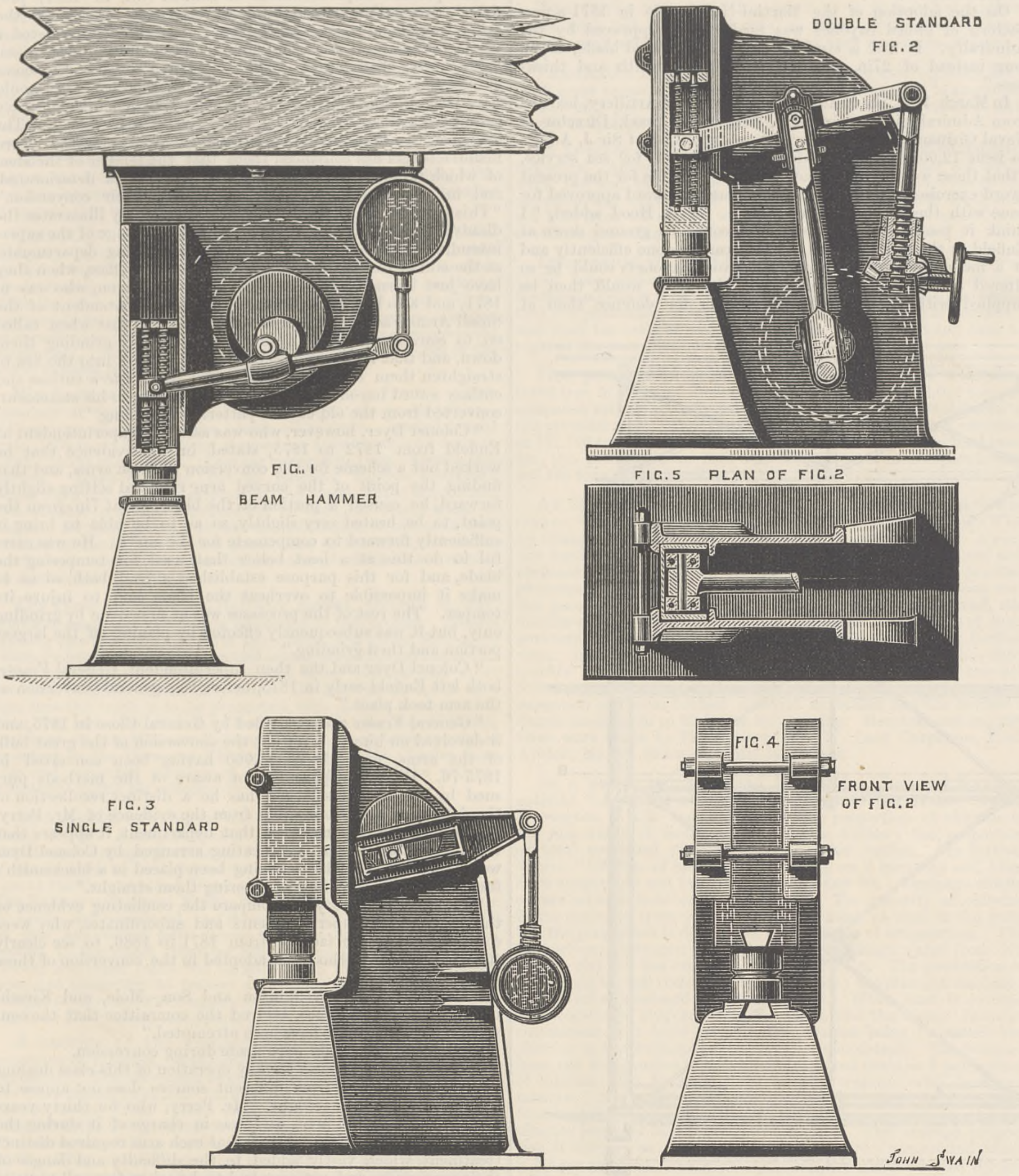
MR. M. N. RIDLEY, A.M.I.C.E., WESTMINSTER, ENGINEER.

(For description see page 418.)



POWER HAMMERS.

MESSRS. WILD AND CO., CHADDERTON, ENGINEERS.



WILD'S POWER HAMMERS.

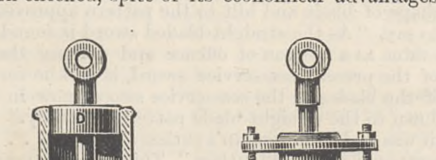
THESE hammers have been designed to meet a long and much-felt want, viz., a hammer which shall be economical in working, perfectly under control, strong, simple, durable, and low in price. It is well known that steam hammers consume a great deal more steam than is accounted for in the work done, and in consequence engineers have been constantly on the lookout for something to replace steam hammers, and at the same time be more economical and perfectly under control in every sense.

Fig. 1 represents a side view of beam hammer specially designed for coppersmiths and similar trades, where it is desirable to have a large clearance and so be able to planish a large sheet of metal. The hammer head is chambered out with an opening left on one side, and through this chamber there are four round bars passed vertically, and on these bars there are a pair of blocks free to slide up or down, and to these blocks is connected the end of a lever, as shown in plan, Fig. 2. Above and below these sliding blocks spiral springs are placed on the bars, with about ½in. of clearance between the spring and the blocks; and it will be seen that these springs will form an excellent elastic connection between the head and lever. In the centre of the lever there is a sliding block or sleeve, to which is coupled the crank pin, which may be made movable or fixed as desired. To the outer end of the lever a screwed rod is connected by means of a pin; and engaging in the screw there is a revolving nut, which is rotated by means of a bevel wheel cast on it, gearing in a similar wheel actuated by the hand wheel. Now it will be quite clear that by setting the crank pin, any length of stroke between maximum and minimum can be obtained, according to the work to be done, and also by raising or lowering the lever end by means of the screw, a light or heavy blow can be given. Fig. 3 is similar in construction, but is arranged to stand on the floor, and all the main frame and anvil is cast in one piece; and instead of employing a round bar for a lever, a lever with a slot in it is employed instead, but the action is just the same. Fig. 2 is designed for the heavier class of hammers, and is driven by a crank-shaft from below, and the stroke is varied by moving the upper end of the connecting rod. The intensity of the blow is regulated in the same manner as in Figs. 1 and 3. The advantage of this arrangement is that the hammer load can be raised or lowered to suit the thickness of the metal operated upon; and if, in forging, a piece of iron has to be reduced from 3in. to 1in., the head can be set for the larger size, and then can follow down as the iron is reduced, and always be giving elastic and sound blows. These hammers, as will be seen, are belt driven, and can be driven by either gas, steam, or water power, and all that is needed is a belt and a pulley on the main shaft, and then we have a machine equal in usefulness to a steam hammer, far more economical, and perfectly within the power of the workman to do as he likes with it. These hammers require very little power for driving in proportion to the weight, are very compact and strong, nor have they any complicated parts about them which are likely to get out of order.

Messrs. Wild have also designed a new and improved method of cushioning power-hammer heads by means of air. Some people who have had experience with spring-cushioned hammer heads do not like them because of the liability of the springs to break; and in consequence they prefer an air cushion, which may be applied when desired to any of these hammers. A lever is also attached, when desired, for varying the intensity of the blows, by foot, and so dispensing with an attendant. These hammers are made by Messrs. John Wild and Co., Middleton Junction, Chadderton.

CARRE'S BOILING-WATER PUMP.

THE difficulty in pumping very hot water into steam generators is generally known. Injectors do not draw, and the ordinary pumps, even when placed close to the supply-tank, are exposed to numerous obstructions, in spite of the precautions observed in working them. Feeding with very hot water has been much checked, spite of its economical advantages, and as



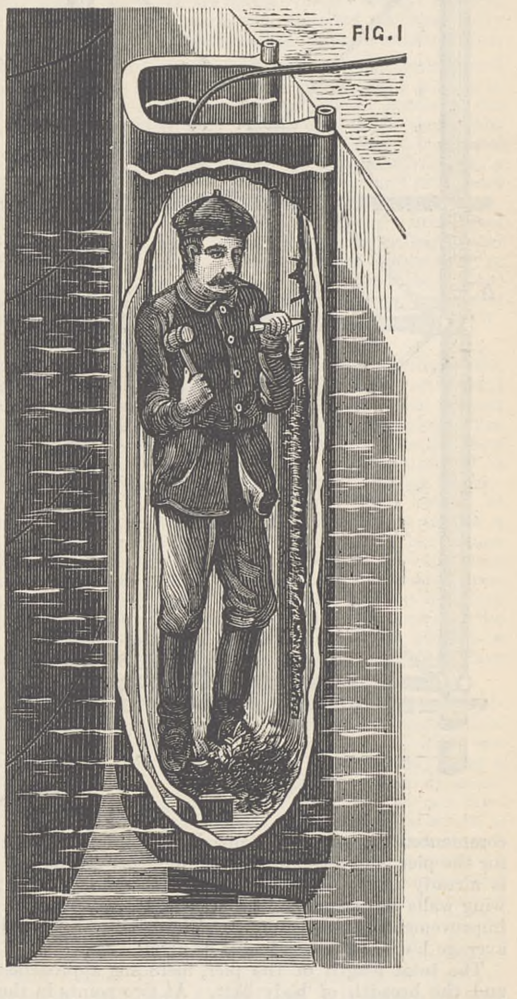
a means of diminishing incrustations because of this. Of course the water may pass through a heater after leaving the feed-pump, but preliminary boiling causes the deposition of the lime, which is less soluble by heat than cold.

The apparatus shown in the annexed engraving (Figs. 1 and 2) is put forward as solving the problem; it has for some little time been applied to several generators, and has worked with success. The apparatus is composed of a cylindrical barrel A, enclosing another barrel c, in which the piston D works. The openings c permit the boiling water which fills the annular space to pass below the piston when it is is near the top of its course. The air below and the steam spread freely into the upper part of the barrel A. On its descent the water is driven back as soon as the piston has passed the openings c^1. The disc D^1, Fig. 2, forms a guide. By the pipe B the pump communicates with the tank of boiling water, in which the water level should be maintained a little above B. When the pump has to work horizontally, or when the feeding-tank is at such a height as to fill the pump, it is necessary to guide the rod, as shown in Fig. 2. To enable the air to escape, the tube G is added, and to this a pipe is affixed, which rises a little above the level of the water in the tank. This pump, says *Le Génie Civil*, is simple, and works with great regularity, and will be appreciated in dye-works as well as for feeding purposes, in sugar factories and chemical works, wherever liquids heated to boiling point have to be raised to greater or less elevations.

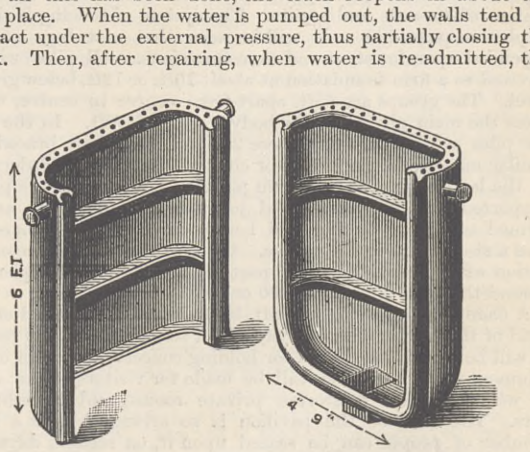
REPAIRING TANKS AND RESERVOIRS.

THE accompanying engravings illustrate a method of repairing reservoirs and tanks. The apparatus consists of a portable coffer dam. One is shown as applied to the treatment of a crack in one of the gas-holder tanks of the Consolidated Gas Company of New York. The apparatus, which we copy from the *Scientific American*, was constructed and used at the suggestion and under the superintendence of the engineer of the company, Mr. William T. Lees.

When such a tank wall breaks, the rupture, as a rule, is vertical, and runs down nearly to the bottom, a distance of 20ft. to



35ft. It is usually of sufficient extent only to cause a loss of water, not enough to exhaust the tank in spite of all efforts. The general way of mending such is to pump out the water, cut the brick away for a foot or two in width, and rebuild the space. Then the tank is filled again. Sometimes, after all this has been done, the crack reopens in about the same place. When the water is pumped out, the walls tend to contract under the external pressure, thus partially closing the break. Then, after repairing, when water is re-admitted, the



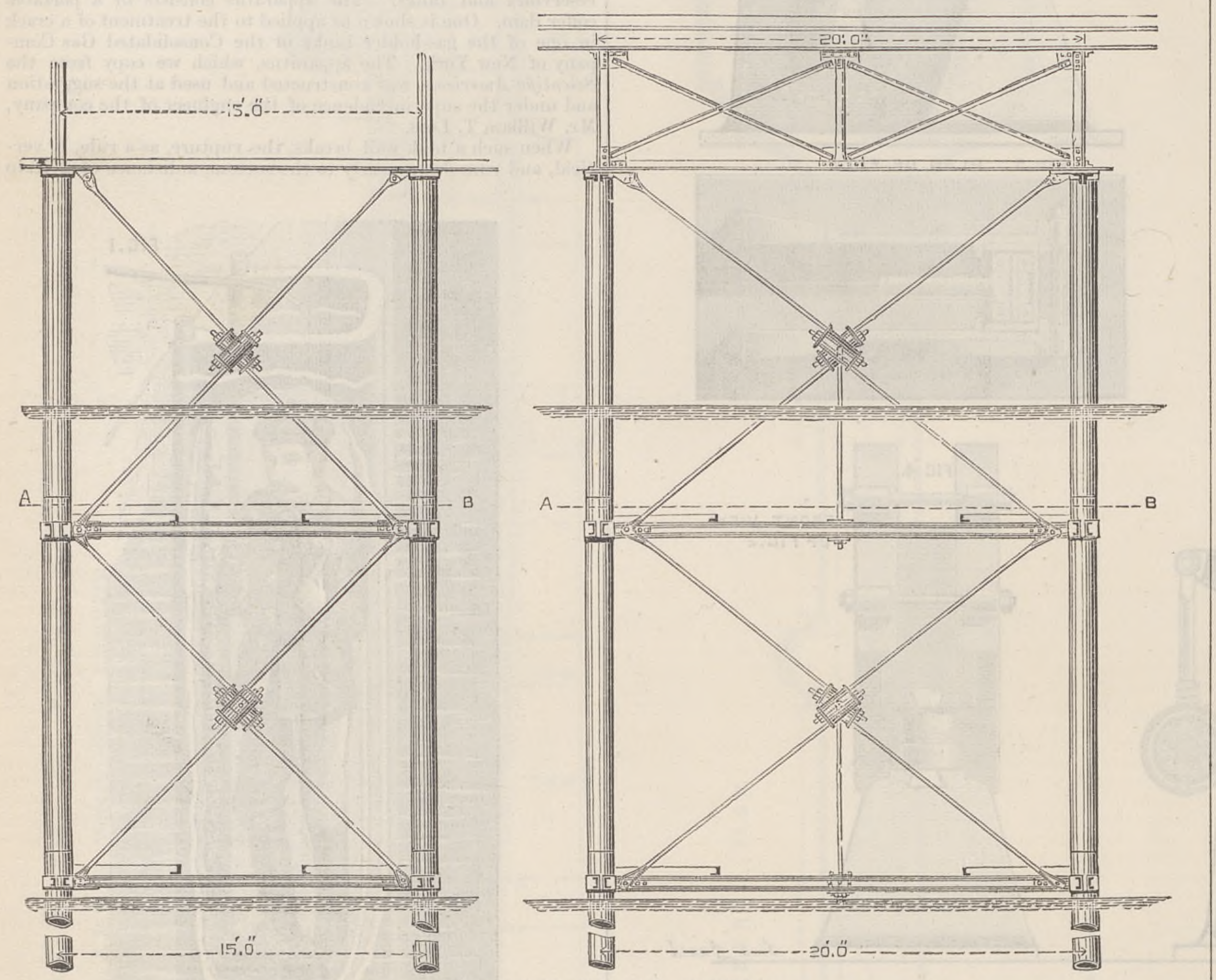
hydraulic pressure, re-establishing the balance, makes the walls assume their old position, and the crack opens as before.

The tank referred to is about 170ft. in diameter and 70ft. deep. A cast iron coffer-dam of U-shaped section was constructed in sections, 6ft. long and 4ft. 9in. in width. Flanges, faced off and perforated for bolts, were provided at the top of the lower section, and at the top and bottom of the others, for attaching them together. The bottom section was closed at the base, and had a small downward extension or well to facilitate pumping. Studs or lugs were provided by which to lift the whole. A semicircular groove was carried around the edge designed to come against the sides of the tank. A 2in. india-rubber hose, with ¾in. aperture, was provided to act as packing.

THE Italian Government has decided not to grant a subvention to the work of tunnelling the Simplon, which may, it is said, have the effect of causing the project to be abandoned.

THE NEW PROMENADE PIER AND PAVILION AT FOLKESTONE.

ON Saturday, the 7th inst., the ceremony of laying the foundation stone for the Folkestone pier was performed by Viscountess Folkestone. The pier, which is being contructed for the Folkestone Pier and Lift Company, will add materially to the attractions of Folkestone, which already possesses attractions superior to many fashionable sea-side resorts, but it has no pier. The site of the new pier which we illustrate is at about the centre of the best part of the town, and immediately below the fashionable cliff promenade known as the Lees. The communications from the Lees to the pier consist of a passenger lift and several footpaths. The lower Sandgate road also connects the pier directly with the town of Folkestone, also with Sandgate and Hythe. As will be seen upon the plan —p. 416—the approach to the pier is a semicircular carriage drive and footpaths leading from the lower Sandgate road. The entrance to the pier is provided with two toll-houses, connected together by a covered way or verandah, and ornamented with a clock tower, as shown by p. 416, which also shows the entrance gates and turnstiles. Along the lower cliff, where the pier proper



ELEVATIONS OF PILE BRACING.

commences, there is a substantial sea wall forming the abutment for the pier, and a retaining wall on either side of it. This wall is already nearly complete, and will when finished, with its wing walls and trimmed and planted slopes, form an important improvement to the sea front. The height of the wall from the average level of the beach will be about 12ft.

The total length of the pier, including approaches, is 683ft., and the breadth of body 31ft. At two points in the length of the pier it is widened to nearly 60ft. by means of recesses, as shown on the plan. The head of the pier is 104ft. in width, and 180ft. in length. The substructure is, as shown by the side and end elevations on page 416 and above, composed of groups or clusters of cast iron piles, 12in. diameter, spaced 15ft. and 20ft. apart, and well braced with a double system of tie-rods and struts. The system of bracing is shown in plan on page 420. It will be seen that cast lugs are not depended upon for strut and tie connections. All piles will be screwed to a firm foundation at about 10ft. or 12ft. below ground level. The groups are 65ft. apart from centre to centre, which gives the main girders in the body a span of 50ft. In the head the piles are spaced everywhere 20ft. apart, and are braced in a similar manner to the groups or clusters. The main girders are of the lattice type, as shown on p. 420. The deck of the pier is supported by transverse rolled joists, spaced 5ft. apart, and is formed of $2\frac{1}{2}$in. planking laid longitudinally, and cambered to give a rise of 4in. in the centre. Comfortable seating accommodation will be provided along part of the body of the pier and around the head for about 1200 or 1400 people.

A commodious pavilion, 100ft. by 60ft., will be erected on the head of the pier, and will be capable of seating about 700 people. It will be suitably arranged for holding concerts and other entertainments, and provision will be made for visitors in the shape of well-appointed lavatories, private rooms, and refreshment bars. The roof of the pavilion is so arranged that a large number of people can be seated upon it, on regatta days and other special occasions. On page 420 is a transverse section of the pavilion. A landing stage of unique construction will be provided at the head of the pier, which will be available in all states of the tide for the landing and embarking of passengers from steamers and pleasure boats of all descriptions. We hope to publish further descriptions of this landing stage later on. The engineer of the pier is Mr. M. Noel Ridley, A.M.I.C.E., Westminster; and the contractors are Messrs. Heenan and Froude, of Manchester.

A SCHEME for the drainage of the river Cillies, in County Fermanagh, has been started. The Cillies is a large river rising at the lakes of Carrick and Bunnahone, and running through a large portion of Fermanagh before it empties into Lough Erne. The inundations from this river cause yearly immense destruction of crops, and consequently the farmers on either side of it are endeavouring to get relief by drainage. With this object they have solicited the local M.P.'s to use their power in Parliament to secure a portion of the £50,000 to be expended on drainage in Ireland for the relief of the people of Fermanagh in the drainage of this river.

THE REPORT OF THE COMMITTEE ON SWORD BAYONETS.

THE report of the Committee on Sword Bayonets may thus be summarised :—

On the adoption of the Martini-Henry rifle in 1871 a new pattern of sword bayonet was made, and "approved by the Admiralty. It had a straight instead of curved blade, $25\frac{1}{2}$in. long instead of 27in., and of much less breadth and thickness."

In March, 1871, Sir J. Adye, then Director of Artillery, learned from Admiral Sir Arthur Hood, then Capt. Hood, Director of Naval Ordnance, that in answer to a suggestion of Sir J. Adye's to issue 12,000 surplus Snider sword bayonets for sea service, "that these weapons were not nearly so suitable for the present sword exercise as the cutlass handled straight sword approved for issue with the Martini-Henry Rifle." Sir A. Hood added, "I think it possible that those in store could be ground down at Enfield to the new pattern. If this can be done efficiently and at a moderate expense, the 12,000 sword bayonets could be so altered and issued as required, and the Navy would then be supplied with a more efficient weapon for defence than at present." "Will you give the necessary directions that, if it can be done efficiently, one of the present pattern is to be altered accordingly, and sent to the Admiralty for examination."

"On the 25th April, 1871, Colonel Dixon, then Superintendent of the Small Arms Factory, Enfield, sent a cutlass sword bayonet to Sir J. Adye for the approval of the Admiralty, after having it ground down." "Sir J. Adye then directed Colonel Dixon to call on Captain Hood and discuss the question. On the 5th May, 1871, Colonel Dixon reported to Sir J. Adye that he had taken the papers to Captain Hood."

"On the 15th May, 1871, Captain Hood wrote to Sir J. Adye that he should object to receive the 12,000 surplus sword bayonets unaltered; that one had been ground down at Enfield to the Martini-Henry pattern, and he says: 'It has been well tried in the Excellent, and is considered to be quite equal to the approved pattern. Therefore I am prepared to accept the 12,000 sword bayonets, provided that they are altered both in shape of blade and hilt to the pattern approved.'" He goes on to say, "As the straight-bladed sword is found to be of far more value as a weapon of offence and defence than is the pattern of the present sea-service sword, it will be very advantageous if the blades of the sea-service swords now in store be ground down to the straight-blade pattern generally."

Again it was said "the seaman's cutlass altered . . . . is a more efficient weapon than the old cutlass." The patterns were approved by the Surveyor-General of Ordnance, Sir H. Storks, on July 10th, 1871. Little work was performed until September, 1874, when —in answer to an inquiry from Admiral Boys—Colonel Fraser, then Superintendent of Enfield, wrote on October 22nd, that if the Naval authorities "still approved of the altered sword bayonet, some in store had better be altered."

On 29th September, 1874, Sir J. Adye was informed by Colonel Fraser that the 15,000 arms could be converted for £6000. The pattern was then again shown to Captain Boys, then Director of Naval Ordnance, who observed that it was well-considered in 1871, and that the conversion should be carried out as quickly as possible.

The report adds, "This completes the official history of the conversion of the 32,066 cutlasses and 50,511 sword bayonets, in all 82,577 arms, and shows how they were passed into the service."

On 30th May, 1871, Colonel Dixon reported the cost of conversion to be about 7s. to 8s., and that there would be a saving of about 7s. on the cost of the new sword bayonet. Mr. Nepean, Director of Army Contracts, stated that the actual cost of conversion proved to be 9s. $9\frac{1}{2}$d.; while, deducting 3s. $0\frac{1}{2}$d. for the scabbard, the first cost of the weapons when new was 10s. $8\frac{1}{2}$d.. The cost of converting the cutlass—as distinct from the cutlass sword bayonet—was estimated at 2s., and then on 15th July at 1s.; whereas the actual cost has been 2s. $1\frac{1}{2}$d. The cost when new was from 4s. 6d. to 7s.

On 15th June, 1871, Colonel Dixon sent to Sir J. Adye three naval swords, viz., (1) A new cutlass sword bayonet for the Martini-Henry rifle; (9) an altered Snider sword bayonet; (3) an altered cutlass.

On 3rd July, 1871, Captain Hood approved generally, suggesting some slight alterations of the guard and fastening, adding, "It is very desirable that the sea-service swords in store should be altered accordingly."

The present Superintendent of Enfield (*i.e.*, in 1887) produced two cutlass sword bayonets of a new design of the same length and weight as the 1871 pattern, which resisted a vertical pressure of 78 lb. and 80 lb. before deflection, the metal being better distributed. The Committee remark, "It seems extraordinary that so weak a pattern as that of 1871 should have been designed for use as a bayonet, and that it should have been accepted as efficient by the Naval Authorities." "The evidence the Committee have received from practical sword manufacturers has convinced them that the temper of the steel of which these arms were made was in all cases deteriorated, and in some instances destroyed during their conversion." "This point in the history of these arms strongly illustrates the disadvantages which arise from the periodical change of the superintending and other officers of the manufacturing departments, at the end of five years, or some other term of office, when they have just learned their business. General Dixon, who was in 1871, and who had been for many years superintendent of the Small Arms Factory, informed the Committee that when called on to convert these arms, he did so by simply grinding them down, and that he never dreamt of putting them into the fire to straighten them by hammering; thus the *Pattern* cutlass and cutlass sword bayonet of 1871 were, according to his statement, converted from the old curved pattern by grinding."

"Colonel Dyer, however, who was assistant superintendent at Enfield from 1872 to 1875, stated in his evidence that he worked out a scheme for the conversion of these arms, and that finding the point of the curved arm required setting slightly forward, he caused a portion of the blade, about 7in. from the point, to be heated very slightly, so as to be able to bring it sufficiently forward to compensate for the curve. He was careful to do this at a heat below that used for tempering the blade, and for this purpose established a lead bath, so as to make it impossible to overheat the blade and to injure its temper. The rest of the processes was at first done by grinding only, but it was subsequently effected by planing off the largest portion and then grinding."

"Colonel Dyer and the then superintendent, General Fraser, both left Enfield early in 1875, before the general conversion of the arm took place."

"General Fraser was succeeded by General Close in 1875, and it devolved on him to carry out the conversion of the great bulk of the arms, upwards of 35,000 having been converted in 1875-76. He was apparently not aware of the methods pursued by his predecessors, nor has he a distinct recollection of the details of the process, but from the evidence of Mr. Perry, who was practical manager of that department, it appears that the precautions against overheating arranged by Colonel Dyer were not taken, the blades having been placed in a blacksmith's forge to heat them before hammering them straight."

"It is only necessary to compare the conflicting evidence of the officers, both superintendents and subordinates, who were connected with the factory from 1871 to 1886, to see clearly that no uniform method was adopted in the conversion of these arms."

"Messrs. Latham—Wilkinson and Son—Mole, and Kirschbaum, who gave evidence, assured the committee that the conversion ought never to have been attempted."

6. No tests for carbon were made during conversion.

7. The delicacy needed for any operation of this class dealing with arms obtained from different sources does not appear to have been taken into account. Mr. Perry, who for thirty years managed this department, and was in charge of it during the whole of the conversions, stated that each arm required distinct treatment, which vastly added to the difficulty and danger of their conversion, and yet men had to be taken from all parts of the country and taught sword-making at Enfield.

(8) The tests, instead of being submitted to a mixed committee of military and naval officers, were determined by General Dixon and his subordinates, basing it on the precedent of previous tests. "It is now evident that they were wholly inadequate."

The Committee doubt if every arm was fully subjected even to the tests adopted.

"On re-testing, 2600 have failed out of 4398 (nearly 60 per cent.) up to February 8th, 1887, but as the test is not the same as that by which they were first passed (being a more severe one), no direct inference as to whether the grinders did or did not do their duty can be fairly drawn. The inefficiency of the arm is, however, clearly established by this re-test."

The Committee are impressed with the difficulty of determining what the exact test of efficiency should be. They are of opinion that for a weapon to be used in thrusting, it should at least be considerably in excess of the full pressure that a man can exert against a hard substance, such as a bone, pouch, or buckle, and that the arm should stand such a pressure without taking a permanent set."

"This would be best tested by the vertical lever press now in use at Enfield. . . . The act of springing round a curved block will no doubt prove the elasticity of the whole blade; while striking on a block of wood with full force back and edge, and striking each side on the flat, is well calculated to detect flaws in the metal."

(9) On the question of saving put by Sir John Adye, the superintendents fell into a mistake, including the scabbard in the original cost of arm.

The Committee consider "the conversion of these cutlasses and cutlass sword-bayonets was a most unwise step."

They have no reason to doubt the efficiency of any supplied to the Navy prior to 1871, but "they believe that the converted cutlasses and cutlass sword-bayonets, pattern 1871, with which the Navy is now for the most part armed, are absolutely inefficient, untrustworthy, and unfit for service."

The Committee has had abundant evidence that the arms are badly designed, the metal in them being unskilfully distributed; that they are inherently too weak to stand the vertical strain which thrusting weapons should endure without bending, and that for want of proper temper they are too soft for efficient service."

The report is signed by—

H. HUSSEY VIVIAN, J. RUSTON, F. DUNCAN, Col. R.A., T. BRAND, Capt. R.N., E. A. WOOD, Col., Inspector of Auxiliary Cavalry.

A SERIOUS explosion of coal gas occurred on Wednesday evening on board the German steamer J. H. Nieman, of Bremen, lying in Penarth Docks, Cardiff. The vessel was loaded ready for sea. Both fore and main hatches were battened down. The explosion originated in the fore hold and extended to the main hold. The decks forward were completely wrecked, and the fore winch blown to pieces. One of the crew was severely injured and burnt, and was conveyed to the Hamadryad, hospital ship.

RAILWAY MATTERS.

THE railway from Hornsby to Hawkesbury River, fifteen miles in length, and a portion of the line between Brisbane and Sydney, was opened on April 7th.

A REUTER's telegram from New York states that the Pennsylvania Railroad Co. contemplates boring a tunnel beneath the Hudson River, in order to reach the centre of New York city.

IN 1882 much interest was excited in commercial circles, particularly among wagon and coal companies, by the new policy of the Midland Railway Company acquiring the private wagons. This policy has been very vigorously pursued, with the result that the letters "M. R." meet the eye at almost every turn when the traveller is on the rails. The circular issued by the Midland Company to the traders upon their line was dated February 13th, 1882, and it is interesting to know that up to May 24th, 1887, the number of wagons thus bought reaches the enormous total of 47,000.

CANADIANS are glad to hear that the Grand Trunk Company is about to double its tracks. It is said, with the volume of business now going over the road, nothing but the most careful management can prevent disastrous and costly accidents. With the track doubled, the efficiency of the Grand Trunk will be enormously increased. The passenger and mail service can then be expedited at little cost, and the freight business can be increased indefinitely. There was the substantial increase of £283,891 in the traffic receipts for the past half-year.

WE have received the following telegram from a correspondent at the Burlington, U.S.A., freight car brake trials:—"Carpenter electro-air brake beaten all records. Loaded freight train 1300 tons, 2000ft. long, stopped at twenty miles an hour in 140ft.; thirty miles, 386ft. Last car released in 1 sec. Graduation perfect. Loose coupling, but no bumps. Figures accurate." These trials are of great interest in the States, but it is questionable whether continuous brakes will be used on freight trains in England for many years. Before the publication of our next issue we shall no doubt receive full particulars of the trials and of the results with other well-known brakes, some of which do not require an electric attachment.

THE Dore and Chinley Railway moves, though slowly. Sheffield people are very much interested in this project. Besides opening up a beautiful district of Derbyshire, and giving Steelopolis another accessible recreation ground among the hills, it will afford an alternative route to Manchester, and bring Buxton and other favourite localities within easy reach. It may be accepted as a sign that the work is to be proceeded with a little more quickly from the fact that Mr. A. Charles, assistant to Mr. Williams, secretary of the Midland Railway Company, has been appointed secretary to the Dore and Chinley Company. Mr. Charles is an able and respected member of the Midland staff, who will undoubtedly justify his selection for the office.

AT a special meeting of the council of the Railway and Canal Traders' Association, held at the offices of the Association, Eastcheap-buildings, Eastcheap, London, E.C., on the 23rd inst., it was decided to hold the annual general meeting of the Association at the Cannon-street Hotel on Monday, 13th June, at 2.30 p.m. The Railway and Canal Traffic Bill, as sent down from the House of Lords, was considered, and it was resolved:—"That the Council of this Association fully concur with Sir Bernhard Samuelson's motion to the effect 'that no Bill for the better regulation of railway and canal traffic will be satisfactory which does not afford adequate protection to traders and agriculturists against undue charges for terminals and against undue preferences,' and will give the same their heartiest support."

A SECTION of the Indian native press is against the extension of railways, on the ground that they only benefit British capitalists. The *Bangabasi* says:—"The English merchants wish the Government to extend railways on its own responsibility, and borrow money from British capitalists. Their desire would be satisfied if the Government would borrow forty crores of rupees. They have raised the question of the welfare of both England and India. They wish to prove that the natives of India will be benefitted by the extension of railways, and that the English people will also be benefitted by it. We have already shown that the English people only will be benefitted. We wonder at the argument set forth with a view to betray the natives of India and the Indian Government. The extension of railways will increase the sale of English goods. There is no necessity for raising the question of the welfare of the natives of India. Our Government will not do any good to the natives, even if it has the desire to do so. It must undertake work which will do good to the English people. So the railways will be extended. It is idle to talk of the welfare of the natives of India."

IN a report made by U.S. Consul-General Hanna, of Buenos Ayres, in the Argentine Republic, there is contained the following information about new railroads in that country:—"Vast railroad charters have been sanctioned by the present Congress, notably among them those granted to the Buenos Ayres and Pacific and the Transcontinental Railway companies, the former 1200 miles in length and the latter 1500 miles in length. The Buenos Ayres and Pacific line, on the thirty-fourth parallel, now completed and operated to Mendoza, runs through the Uspallate Pass and terminates at Valparaiso, in Chili. The Transcontinental road is to be constructed on the thirty-eighth parallel. It is already built and in operation from Buenos Ayres to Bahia Blanca, on the Atlantic, and from there runs westward to Talcahuano, crossing the mountains by the Colorado Pass, to Antuco, on the Pacific slope. Both of these roads are to be constructed with English capital, upon an agreed basis of cost per mile, with a guarantee of 6 per cent. on the part of the Argentine Government, covering a period of twenty years. Little or no American capital has hitherto found its way here, though the recent organisation in New York of a reputable and powerful syndicate, with 20,000,000 dols. capital, gives assurance that our people are now ready to compete in the field for the rich results, hitherto unchallenged, borne off by European corporations."

THE Darjeeling Railway, which is of 2ft. gauge, climbs the lower slopes of the Himalayas and connects the great plain of Bengal with the mountain sanitarium, Darjeeling. The line rises 6919ft. in 40¼ miles, an average rise of nearly 172ft. per mile. In this distance 16½ miles are on a continuous average grade of 182ft. per mile. As originally laid out, 12 miles of the road—much of which followed a highway—was laid out with grades of 264ft. per mile, and curves of 43ft. radius, but the worst gradient is now 188ft. per mile, and with four exceptions, the worst curves are now 70ft. radius. The cost of the whole line, 51 miles long, has been 2,800,000 rupees, which at the present rate of exchange, is about equal to 19,100 dols. per mile. As this includes rolling stock, and 44 miles of the whole line are in the mountains, this figure is very moderate. The last dividend paid was at the rate of 17 per cent. per annum. The locomotives have 10in. by 14in. cylinders and weigh 24,600 lb. in working order, with tank containing 390 gallons of water. It is proposed to use twin engines, coupled back to back. The freight cars weigh 2000 lb. and carry 8000 lb. The passenger cars vary in weight from 900 lb. to 2400 lb., the diameter of the wheels being 18in. The line has four loops or spirals and five reverses or switchbacks. The maximum super-elevation of the outer rail is 2¾in. The traffic for over five years was worked round a curve of 42·6ft. radius, extending over more than a half circle, on a gradient of 165ft. per mile. The *Railroad Gazette* observes: "Such a combination of narrow gauge, steep gradients, sharp curves, small cars, and big dividends is probably unique, and does great credit to the engineer, Mr. Prestage, and those who assisted him in this enterprise."

NOTES AND MEMORANDA.

THE six healthiest places in England and Wales last week were Wolverhampton, Leicester, Sunderland, Halifax, Birkenhead, and Leeds.

THE Derby was run this year at a somewhat higher speed than last year. The time, as taken by Benson's chronograph, was 2 min. 43 sec. The time last year was 2 min. 45⅗ sec.

THE deaths registered during the week ending May 21st in 28 great towns of England and Wales corresponded to an annual rate of 20·3 per 1000 of the aggregate population, which is estimated at 9,245,099 persons in the middle of the year.

IN London 2483 births and 1536 deaths were registered last week. Allowance made for increase of population, the births were 184 and the deaths 65 below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 18·3, 18·9, and 17·3 in the three preceding weeks, rose to 19·0.

THE production of pig iron in Belgium during 1886 was 17,567 tons under that of the previous year. The principal decrease occurs in forge iron, which would point to the conclusion that the production of manufactured iron in Belgium is declining, and that too without any compensating increase—at any rate, as regards the year 1886—in the quantity of steel turned out.

THE provisional return of the production of manufactured iron in Belgium during 1886 gives a total of 470,022 tons, as compared with an actually ascertained production of 469,249 tons in the previous year. The production of rails and plates is returned at 112,700 tons, as against 103,087 tons in 1885. Of merchant iron, &c., the production in 1886 was 357,322 tons, as compared with 366,162 tons in the previous year.

AT the last meeting of the Physical Society a paper was read on "The Production of Sudden Changes in the Tension of a Wire by Change of Temperature" by R. H. M. Bosanquet, M.A. A very fine hard drawn platinum wire, four or five feet long, was used as a suspension for a ballistic galvanometer, and exhibited peculiar phenomena. The steel needles were replaced by brass ones, and the peculiarities investigated. When the room was warmed, the needles swung round nearly 70 deg. for a few degrees rise of temperature, and remained in about the same position for further rises. If it was now cooled a few degrees—3 or 4 deg. Fah.—they quickly returned to their initial position. The author has not found a complete explanation, but believes it to be due to unequal expansion and loose contact amongst molecules, and has devised a simple mechanism to illustrate his meaning. Remarks and suggestions were made by Prof. Perry, Mr. W. Lant Carpenter, Prof. Ayrton, Mr. W. Shaw, and Mr. Bosanquet.

In a paper recently read before the Chemical Society, entitled "A Contribution to the Study of Well Water," by R. Warington, F.R.S., the author gives the proportion of chlorine in the rain water at Rothamsted as 2 per million; the proportion of total combined nitrogen about 0·7 per million. He further says:—"Of 31in. of rain, annually falling on a bare clay soil, 17in. have evaporated and 14in. percolated below 5ft. Drainage chiefly occurs between October and February. The quantity of chlorine in the drainage from 5ft. of soil is the same as that in the rain, but the proportion is doubled in consequence of evaporation. The proportion of nitrogen as nitrates in the drainage water from 5ft. of bare clay soil has averaged 10·7 per million. The production of nitrates in the soil is chiefly during summer; the principal discharge of nitrates as drainage is in the autumn. When land is covered with vegetation evaporation is increased, and the winter drainage commences at a later period. Evaporation being increased, the chlorine in the drainage water may also be increased. The drainage from the Rothamsted unmanured wheat land contains 6 per million of chlorine; the drainage from the plot manured with farmyard manure, 7·3 per million. While vegetation is active no nitrates are found in the drainage water from the unmanured wheat; the nitrates reappear in autumn, after harvest. The average proportion of nitrogen as nitrates in the drainage from unmanured wheat is 3·4 per million; from wheat receiving farmyard manure, 5·8 per million."

AT the meeting of the Physical Society on May 14th a paper was read on a modification of a method of Maxwell for measuring the co-efficient of self-induction, by E. C. Rimington. The method referred to is given in Maxwell's "Electricity and Magnetism," Section 778, vol. ii., and is called, "Comparison of the electro-static capacity of a condenser with the electro-magnetic capacity of a coil." The apparatus used consists of a Wheatstone's bridge having the coil in one, and the condenser as a shunt to, the opposite arm. In order that no deflection may be produced, either for steady or unsteady currents, a troublesome double adjustment of the resistances is necessary, and to obviate this the modification was devised. It consists in placing the condenser as a shunt to only part of the arm, and this part can be varied by sliding contacts without altering the whole resistance of the arm. An ordinary resistance balance for steady currents is first obtained, and the sliders are then adjusted until no deflection is produced on breaking the battery circuit. Under these circumstances it is shown that $L = K r^2 \frac{D}{B}$, where K is the capacity of the condenser, r the resistance between the sliders, and D and B the resistances of the arms in which the coil and condenser are placed. The conditions of maximum sensibility are investigated, and also those under which a telephone may replace the galvanometer. In the latter it is shown that the only possible solution is when $r = B$—*i.e.*, Maxwell's arrangement. The author believes his modification would be made much more sensitive by adopting the "cumulative" method used by Professors Ayrton and Perry in their secohmmeter, and in his case neither the speed nor the "lead" need be known.

LAPLACE has based his theory of capillarity on the assumption that there is a force of attraction between the particles of a liquid which decreases very rapidly with the distance, becoming insensible at a certain small distance known as the radius of molecular attraction. From this it follows that the molecular forces acting on a particle are in equilibrium so long as the distance of the particle from the liquid surface exceeds the above, but that if it is less, they have a resultant inwards, and consequently an expenditure of work is required to transfer liquid from the interior to the surface. Adopting Clausius' theory of evaporation, and assuming that the particles of a liquid do not differ from those of its vapour, it is shown—*Jour. Chem. Soc.*—that in the case of a plane surface the work done in moving a particle from the interior to the surface is equal to that required to transfer it from the surface into the vapour above it. This work is equivalent to the heat required for the process. If the density of the liquid were uniform up to the boundary between it and its vapour, the equation $p_2 - p_1 = \rho A$ would give the relation between p_2, the pressure in the interior, p_1 the pressure at the surface, ρ the density, and A the mechanical equivalent of the latent heat of evaporation of the liquid, a relation which in the case of ether gives for p_2, 2574 atmospheres! Assuming that the density is a linear function of the pressure, a similar though somewhat smaller result is obtained, as well as a value of $p_2 = 2728$ atmospheres for carbon bisulphide. It is important, however, to mark that the above results are based on the assumption that no work is expended on the molecule itself in transferring it from the liquid to the vapour. The author also explains on this theory the fact, first noticed by Sir W. Thomson, that the pressure of saturated vapour is less in the presence of a concave liquid surface, and greater in the presence of a convex, that when the surface is plane.

MISCELLANEA.

IN Greater London last week 3196 births and 1848 deaths were registered, corresponding to annual rates of 30·8 and 17·8 per 1000 of the population.

THE suspension bridge over the Rhone between Beaucaire and Tarascon broke down on Wednesday evening while a traction engine was passing over it. The driver was killed.

THE members of the North Staffordshire Mining Institute visited last week the extensive Codnor Park Ironworks, near Alfreton, belonging to the Butterley Company. The works were all the more interesting, since to their ironmaking plant the company has recently added a complete plant for the production of Siemens-Martin steel of the highest class. Covering about fifty-five acres of land, the works comprise three blast furnaces and nearly fifty puddling furnaces, and there are engaged fifty steam engines and over 120 boilers.

A MEETING of the executive appointed by the Birmingham committee to consider the question of an improved waterway between Birmingham and the Bristol Channel, was held at Birmingham a few days ago, when a draft statement of the cost of the new work on the Worcester and Birmingham section was presented by the engineer, Mr. Keeling. This showed that the outlay would not at all exceed the estimate of £600,000, and that full consideration had been given to the difficulties likely to be encountered on the part of the canal running into the borough of Birmingham.

MESSRS. MORRISON AND MASON, Glasgow, the new contractors for the Thirlmere Waterworks, have ordered from Messrs. Thomas Larmuth and Co., Salford, Manchester, entirely new rock boring machinery, consisting of the patent Hirnant rock drills, rock drill carriages, &c. It would seem from this that they intend to push the work forward. Messrs. Morrison and Mason have Larmuth's machinery working in the Mugdock Tunnel on the Loch Katrine works for the Corporation of Glasgow, and we are informed that Messrs. Larmuth are making for Mr. George Lawson, contractor, Rutherglen, the machinery required on the Kilty Tunnel, Loch Katrine works. This is the second tunnel on these works.

THE Hotel Victoria, a magnificent building, commenced in 1883, and forming the latest addition to the splendid edifices in Northumberland-avenue, as well as to the palatial hotels of the metropolis, is now completed, and will be opened to the public within the next few days. The building, which is close to the Hotel Métropole, consists of nine floors, beside the basement, rising to a height of 122ft., with a frontage of 300ft., is of Portland stone, and the general character of the elevation may be described as chaste, almost inclining to severity. The Grand Salle à Mangé is in extreme length upwards of 100ft. by some 60ft. wide, thus affording accommodation for about three hundred guests. Messrs. Maple and Co. have used some 30,000 yards, or 17 miles of carpets for the various requirements of the Hotel. The architects are Messrs. Isaacs and Florence, of Verulam-buildings, and the builders Messrs. J. W. Hobbs and Co., of Croydon.

WITH regard to the strike in the Bolton engineering trade, there are some negotiations in progress with a view to a settlement of the dispute, but it is very doubtful whether in their present shape they will lead to any satisfactory issue. The employers are in no mood to depart to any material extent from the position they have taken up, and the course of action which is being pursued on the opposite side is not calculated to lead to a conciliatory feeling. During Tuesday night a number of windows were broken at Messrs. Wood's foundry, and it was found necessary to station a detachment of police on the premises. A number of Scotchmen who have been brought over by Messrs. Wood to take the place of the men on strike have also been boycotted by sympathisers with the strike hands, and they have found the greatest difficulty in obtaining lodgings. In the interests of both the men and the employers, it is, however, to be hoped that the dispute will not be allowed to develope elements of disorder, which cannot fail to leave bitter recollections behind them.

MR. ADAMS, of Hill of Beath, is opening out a a new colliery in the Dalbeath Estate, in the neighbourhood of Dunfermline. Two coupled engines are being erected on the pit bank, which are expected to wind from 1000 to 1200 tons of coals per day from a depth of 150 to 180 fathoms. The first engines are 28in. cylinder, with a 14ft. diameter winding drum, and the second pair are 24in. with a 12ft. drum. Pumping machinery is being erected which is calculated as sufficient to raise a ton of water to the surface at each stroke, the two cylinders of the great pump measuring respectively 84in. and 54in. in diameter. The engines have a 13ft. stroke, and a plunger 24in. in diameter. A crab guaranteed to lift 30 tons is being erected near the pumping engine. Messrs. Grant and Ritchie, of Kilmarnock, are supplying the machinery, and the steam will be obtained from a range of large double-flued boilers constructed by Messrs. William Wilson and Co., of the Lilybank Works, Glasgow. The machinery, &c., is to cost £10,000, and it is calculated that Mr. Adams will spend about £30,000 altogether in opening up the coal seams, which are valuable, and extend over about 150 acres.

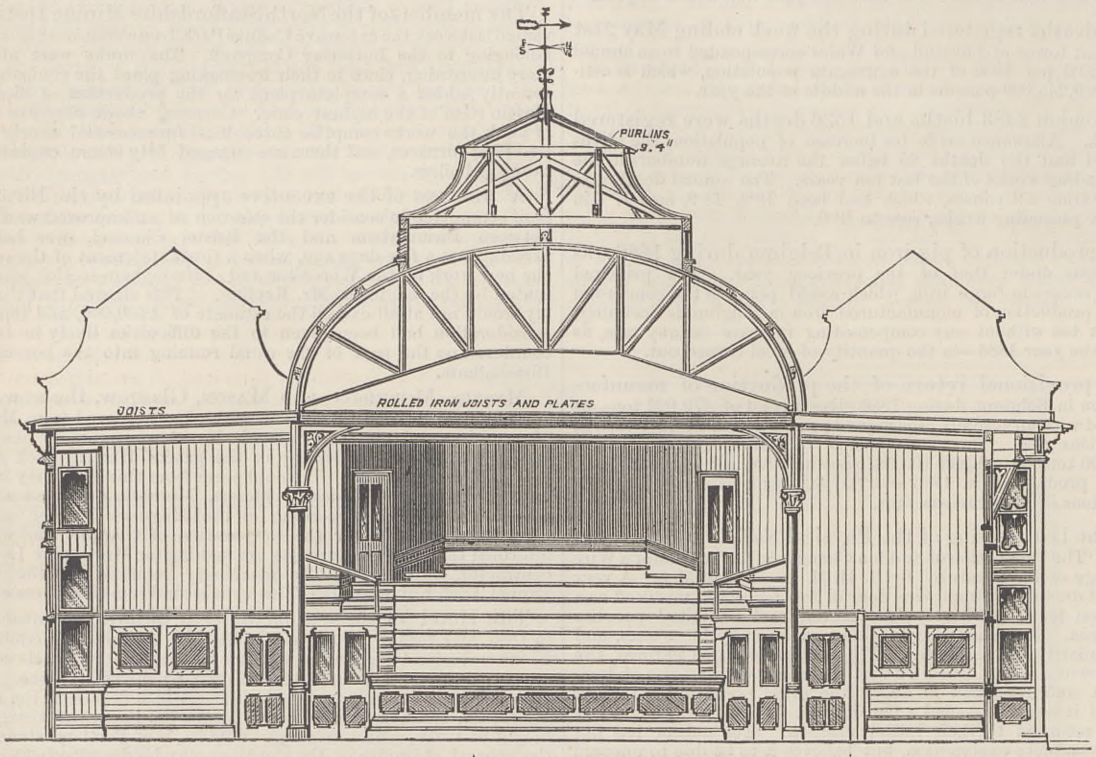
WHEN aluminium bronze is made by a simple mixing of ingredients it is brittle, and does not acquire its best qualities until after having been cast several times. After three or four meltings it reaches a maximum, at which point it may be melted several times without sensible change. As it cools rapidly, large castings require some care to prevent cracking, so numerous runners and a large feeding-head should be employed. The 10 per cent. bronze fuses at about the temperature of brass containing 33 per cent. zinc, and the 5 per cent. melts at a somewhat higher temperature. The former should be poured as cool as possible to produce sharp castings, and should be kept covered with charcoal up to the moment of pouring. Considerable care must be taken in the preparations of "risers," so that the metal will free itself of impurities. The metal can conveniently be freed from slag, or other impurities, when pouring into the mould, by the following method:—A supplementary pot, or crucible, with a hole in its bottom, is secured over the pouring-gate of the mould. This hole is first plugged up by a carbon or iron rod heated to redness, and the pot is filled with the melted metal before the plug is withdrawn. This allows the oxide and slag to rise to the surface, and admits only pure metal to the mould. It also prevents the oxidation that a stream of metal would suffer in pouring through the air to the "pouring-gate," as is often practised.

A SUCCESSFUL series of sanitary demonstrations to the medical profession have just been held in the Parkes Museum, 74a, Margaret-street, W. The first of the series was given by Prof. W. H. Corfield, M.A., M.D., in which he referred chiefly to the defects in sanitary appliances, and bad materials, and workmanship, pointing out the dangers that arise from them. The second was given by Mr. Rogers Field, B.A., M. Inst. C.E. In the course of his demonstration he dealt chiefly with house-drainage, and pointed out the necessity for giving particular attention to all the details of sanitary arrangements as well as to the general principles. For if the details were improperly carried out, it might render the drainage bad and dangerous to health, although the principles on which it was based might be correct. He gave a description illustrated by diagrams of the drainage of the Museum, which has been specially arranged by the Council to illustrate the principles of house drainage, and is so constructed as to be open to inspection. The closing demonstration of the series was given on Monday, 16th May, by Mr. Percival Gordon Smith, of the Local Government Board, and related principally to the construction and ventilation of houses. He exhibited several recent improvements and adaptations, and also mentioned several methods of dealing with the house refuse and sewage. The demonstrations, which have been largely illustrated by models and specimens in the Museum, have been much appreciated, there being a large attendance of the medical profession on each occasion.

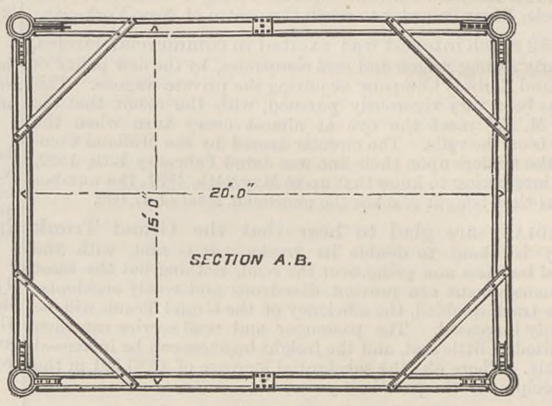
NEW PROMENADE PIER, FOLKESTONE.

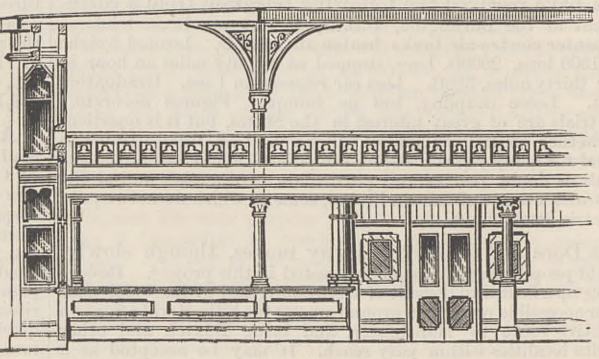
MR. M. N. RIDLEY, A.M.I.C.E., WESTMINSTER, ENGINEER.

(*For description see page 418.*)

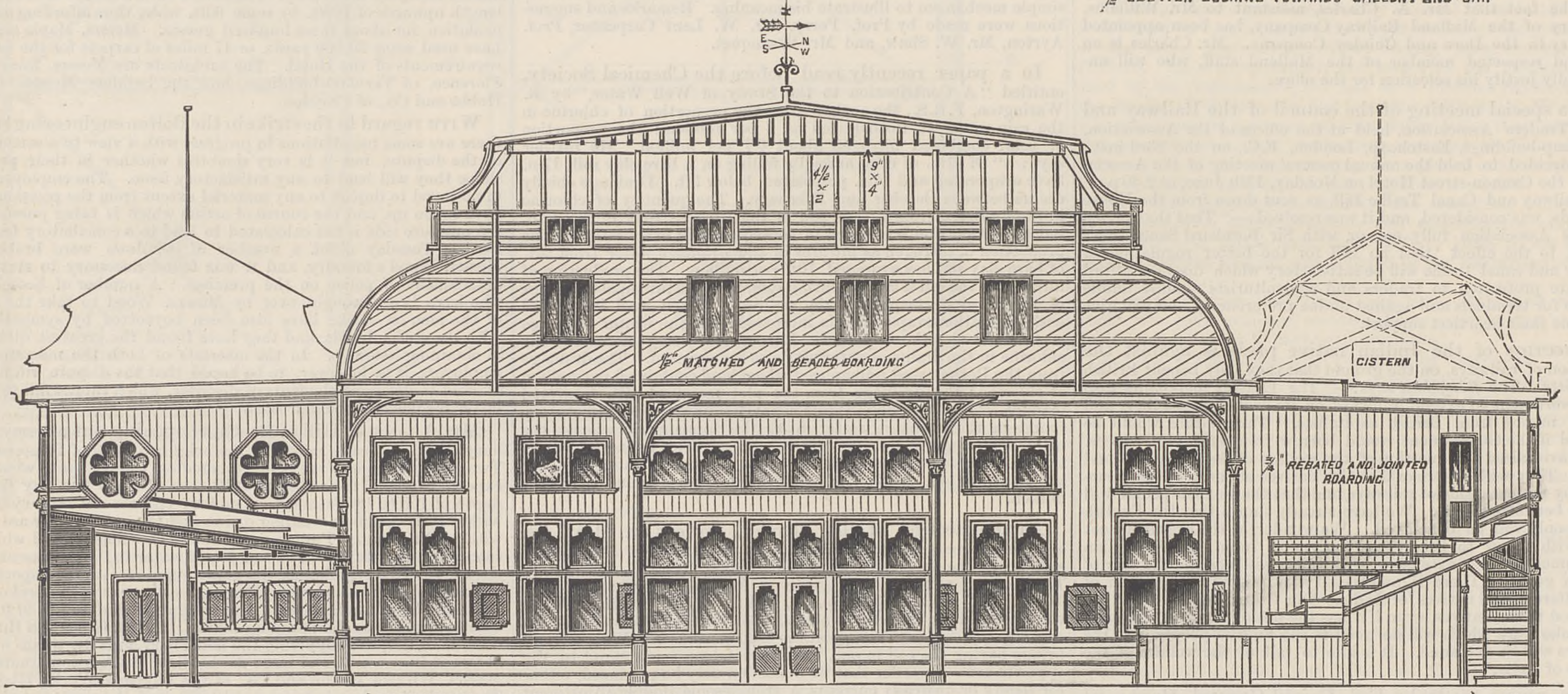


SECTION THRO' HALL LOOKING TOWARDS ORCHESTRA



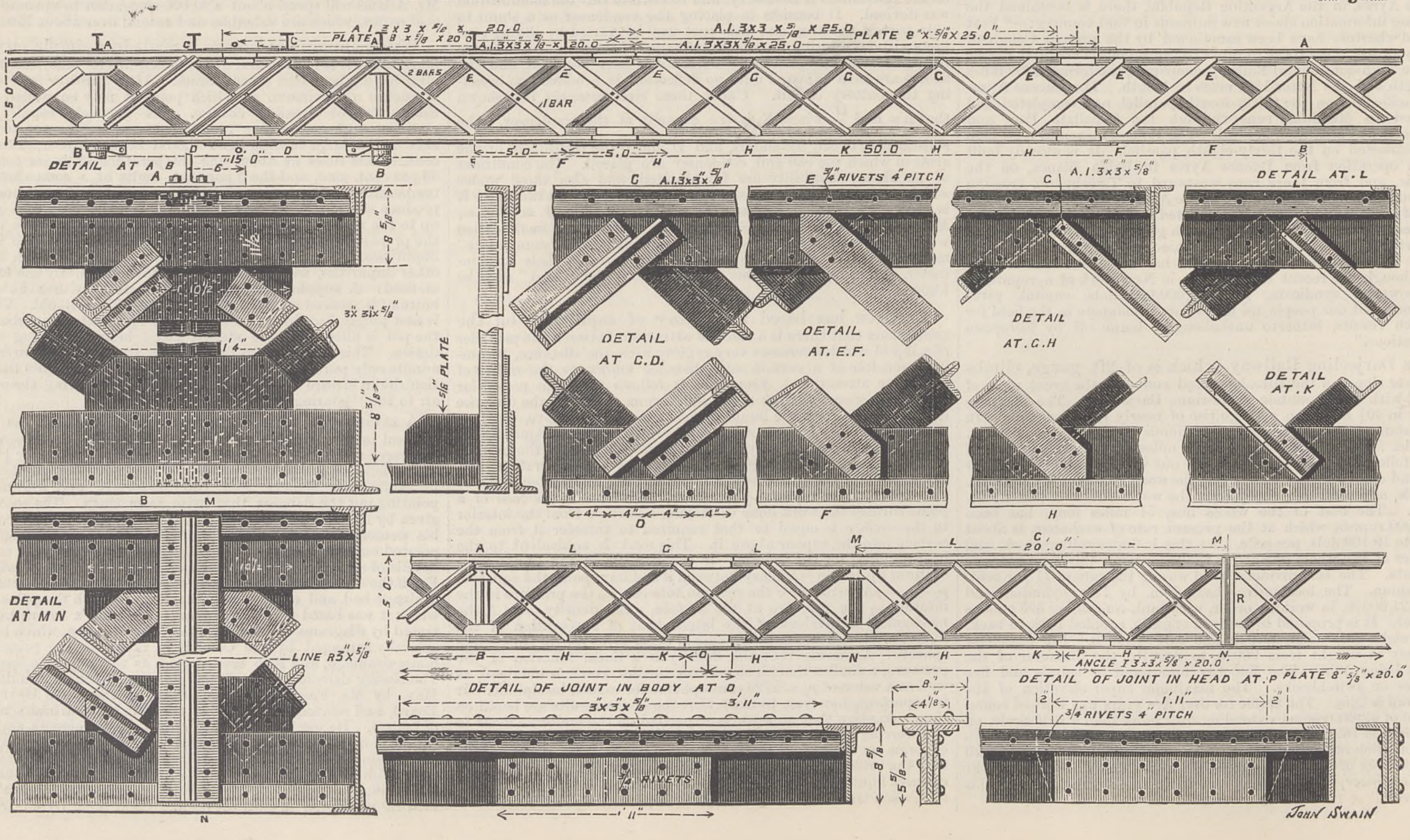


½ SECTION LOOKING TOWARDS BALCONY AND BAR



LONGITUDINAL SECTION OF CONCERT HALL

JOHN SWAIN



FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31 *Beekman-street.*

CONTENTS.

THE ENGINEER, May 27th, 1887.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

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

F. H. TROW.—*We have seen circular rapping and dowell plates in use, but do not know whether they have been an article of manufacture.*

F. WALKER.—*Chiefly because in the opinion of some engineers the contraction of area is more accurately measurable than the elongation, because when expressed in terms per cent. it is more independent of the length of the test piece.*

IRON BAND STANDS.

(To the Editor of The Engineer.)

SIR,—Can any reader oblige me with names of makers of iron band stands—I mean a stand for a complete band? W. S. C.

May 20th.

MAGNESIA BRICKS.

(To the Editor of The Engineer.)

SIR,—Can you or any of your readers oblige me with the address of a maker of magnesia bricks, such as are used in the basic process?

May 24th. C. H.

HOFFMAN KILNS.

(To the Editor of The Engineer.)

SIR,—I venture to ask whether any correspondent can refer me to a gentleman who would professionally give full details of Hoffman's circular lime kilns (*Ringöfen*). CALCIUM.

Hampstead, May 22nd.

PETROLEUM BOILERS.

(To the Editor of The Engineer.)

SIR,—Can any of your readers give the address of the maker of a steam generating boiler burning petroleum, size about 6-horse power; where any such are working, and the cost per horse-power? R. P.

May 25th.

COST OF STEAM.

(To the Editor of The Engineer.)

SIR,—Can any of your readers give information of what it costs to produce steam from coals and water, with the plant and labour necessary to work all? The district of the country should be named, as coals, water, and labour, &c., we know, vary in price in the various parts.

May 23rd. CLYDE.

CEMENT NOT SETTING.

(To the Editor of The Engineer.)

SIR,—Will any reader explain the causes which lead to cement not setting? I have met with several cases in which cement, taken not only out of the same bag, but when gauged off the same board, has not set in outside work. In one, the end of a house was coated nearly 1in. thick to render it weather-proof. Much of this crumbled off; the remainder became as hard as iron. The cement was all out of the same lot, and the gauging and wetting were the same. Is there anything in the working or the cement to explain such failures? PETROS.

GRUSON TURRETS.

(To the Editor of The Engineer.)

SIR,—In the address of the President of the Mechanical Engineers' Institution, as given in last week's issue of your paper, it is stated incidentally that at Elswick much larger turrets are being constructed for the Italian Government, to carry a pair of 120-ton guns—which may be read as if these turrets were being made by the Elswick firm; whereas, as a matter of fact, these large turrets are being made by the well-known "Gruson Works" of Buckau-Magdeburg, in their chilled cast iron armour, which has stood so severe a trial at Spezia last year, with eminent success. You would much oblige by inserting this explanation in your next issue.

G. C. WARDEN AND CO.,
Representatives of the "Gruson Works," Buckau-Magdeburg.

Queen-street, Cheapside, London, May 24th.

SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

Half-yearly (including double numbers)	£0 14s. 6d.
Yearly (including two double numbers)	£1 9s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made. THE ENGINEER *is registered for transmission abroad.*

A complete set of THE ENGINEER *can be had on application.*

Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

Remittance by Post-office order.—Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Hawaiian Islands, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, Mauritius, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

Remittance by Bill on London.—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Sandwich Isles, £2 5s.

ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office order in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

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

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, May 31st, no meeting, it being Whitsun Tuesday.

GEOLOGISTS' ASSOCIATION.—Friday, June 3rd, at 8 p.m. Paper to be read:—"On the Formation of Agates," by W. J. Abbott.

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.—The Home Counties District Meeting will be held at Portsmouth on Saturday, June 4th. Members will assemble at Waterloo Station and take tickets at the Main Line Booking-office for the 9.30 a.m. train. Arriving at Portsmouth—town station—the members will proceed to the Council Chamber, High-street, where, at 12.15, Mr. Boulnois will read a short paper descriptive of the drainage works of Portsmouth, recently carried out by Sir Frederick Bramwell. A visit will then be made to the works, at one o'clock; return to the town, visiting the Town Hall works to be shortly described by Mr. Boulnois.

THE ENGINEER.

MAY 27, 1887.

DEFECTIVE WEAPONS.

WE publish elsewhere, in a slightly abbreviated form, the history of the conversion of the cutlasses and cutlass sword bayonets as put forward by the Committee appointed to inquire into the matter. We admit that the whole story is unsatisfactory, abundantly illustrating the need for reform in our ordnance department. We are brought to certain very decided conclusions from facts in the evidence. A sword bayonet is at all times a bad substitute for the old triangular weapon. It appears that a sword bayonet has at last been made of the weight and length of that adopted for the service, which is capable of resisting a vertical pressure of 80 lb. before bending. This seems regarded as a successful achievement. The old triangular bayonet bears 320 lb. "vertical," that is, longitudinal, pressure. On this subject the Royal Commission, under Judge James Fitz-James Stephen, sitting at the same time as the Committee, speaks in a way that deserves to be given verbatim:—

"Lord Wolseley told us that throughout the whole of the Indian Mutiny he knew of no more than half-a-dozen cases in which wounds were given by the bayonet. When a charge of bayonets takes place the usual practice has been for the party which has the weakest nerves of the two to run away, and the weapon has thus been used rather for the purpose of intimidation than for the purpose of actual fighting. The Arabs in Africa were the first enemy encountered for a long series of years by the British army, who fought hand to hand with swords and spears, and in fighting with whom the bayonet was actually used. A certain number of bayonets were no doubt bent in these conflicts; others were struck by bullets, and others in various ways, by other rough usage, were injured in the course of the extremely violent hand-to-hand combats which took place on those occasions. General Buller particularly told us that he considered the complaints with regard to bayonets had been greatly exaggerated.

"We learn with some surprise from Colonel Arbuthnot that notwithstanding the unfavourable experience which had been gained with respect to the use of the sword bayonet, it is now proposed to withdraw the triangular bayonet from the service, to attach to the Enfield-Martini rifle a new pattern of sword bayonet, which is also to be used for the purpose of chopping wood. We hope that great caution will be exercised in making this change. Lord Wolseley told us that though he preferred the sword bayonet because of its usefulness as a chopper, he would keep a certain number of triangular bayonets in store to fight with barbarians who might be expected not to run away from sword bayonets. To have one bayonet for use and one for show seems an odd arrangement. This confirms the opinion we have already expressed as to the necessity for adding the council already described to the office either of the Secretary of State or of the Master of Ordnance, if appointed."

In asking for a cutlass sword bayonet, then, the Admiralty are responsible for demanding an article which is, under the most favourable conditions, a weak substitute for a triangular bayonet, a weapon of perhaps 80 lb., or at most 100 lb. strength, as compared with 320 lb. General Dixon is responsible for submitting the particular pattern adopted, and, so far as we can see, is responsible for the tests adopted as sufficient to ensure a serviceable arm—that is, supposing that a sword or cutlass sword bayonet can be held to be serviceable; but he does not approve of the process of conversion, afterwards followed. After submitting the pattern, his responsibility became shared in a measure by the naval authorities. This we know is disclaimed by them. They contend that the trial made of the weapon on board the Excellent only extended to its convenience in handling at drill.

Successive superintendents might not certainly understand this, although General Dixon appears to take this view, for the following reasons:—Weapons successively made to the same exact dimensions and pattern are asked for, in order to be tried. The only possible difference between the successive arms sent is that of quality. There would be no more need to send one after another of identical dimensions, if size and shape were all that was in question, than to send a sample of every batch that is made now. Do the naval authorities really contend that the words, "It has been well tried in the Excellent, and is considered to be quite equal to the approved pattern," only meant "The Excellent officers have carefully measured the two blades, and find them identical in dimensions?" It would be playing the fool with stores to submit such a question to the Excellent. Surely the officers would not wish us to regard their reports as only amounting to so trivial a statement.

We next come to the actual carrying out of the work. General Dixon was gone before it began. General Fraser and Colonel Dyer appear to have done the early part of the work. General Dixon states positively that he altered the shape of the blade by grinding only. The Committee, however, furnish a drawing of one blade laid over the other, showing that the old pattern cannot be made to cover the new one, and that the weapon had to be straightened. Either General Dixon must have operated on an abnormal blade that somehow was found in the service, which appears extraordinary or impossible, or the blade was worked and straightened without his knowledge, which seems more probable, however serious the supposition; or lastly, General Dixon forgot what took place, and argued from subsequent experience and habits of mind.

When General Fraser with Colonel Dyer commenced operations, they found the question already settled by high authority, and only had to consider the best means of carrying it out. Even at this stage it would not have been natural to raise the question. They certainly could say, "General Dixon's tests are not sufficient. The Excellent officers are mistaken in thinking the converted arm 'equal to the approved pattern.' It is weaker. Instead of being merely an indifferent article, such as the Navy have always preferred, of about 80 lb. or 100 lb. stiffness, it is a really weak weapon, inferior to any in the hands of foreign navies, except the Greek naval cutlass." The blade cannot be straightened without destroying or injuring its temper." This would have been plain speaking and unpleasant, but it would have been true, and so far as we know General Fraser is a man who has never hesitated to say a true thing because it was disagreeable; but why should General Fraser suspect the evil? He found that a conversion had been approved and tests laid down, and the only information to be got would be from the manager, Mr. Perry, who presumably knew what he had done under General Dixon and continued it. We have before now pointed out the impossibility of a superintendent coming fresh to a department, and maintaining his opinion on details of processes of manufacture in the teeth of the permanent manager, backed as he must be by the men, whose future prospects depend on him much more than on a temporary superintendent. Colonel Dyer appears to have bestowed considerable attention to the process of conversion. He employed a lead bath to secure a lower temperature than could be looked for in a smith's fire. To suppose that the lead bath was necessarily at 600 deg. is a mistake, and without a pyrometer of some kind the temperature could not be known; but undoubtedly the lead bath was a help as to uniformity, especially if unskilled men were employed. Mr. Perry states, however, that the lead bath was not used, so that he apparently did not know of its use. Admiralty experiments have since shown that to bend steel at blue heat is the sure way to tear it asunder. Probably a higher temperature than Colonel Dyer contemplated was commonly employed. The cutlasses passed their test, which was a weak one. "They were sprung over a bridge 3⅝in. high, and struck edge and back on a block of wood. They were also troughed and gauged." Following General Dixon's tests and directions conducted by the same manager with an arm whose pattern had been a matter of repeated discussion by the highest authorities, it was almost inevitable that successive superintendents would raise no question, and as years went on, and use seemed to endorse the soundness of the decision, it was less and less likely that a doubt should arise. The cutlass-sword-bayonets apparently chopped wood for Lord Wolseley. They drilled on board the Excellent, and they served to frighten fairly civilised people. They passed the tests at Enfield. They saved 11½d. each in the estimates. Everyone was pleased with them until savages were met with who, as the Royal Commission expresses it, were extremely violent. Then it was darkly hinted that some bayonets or sword-bayonets behaved badly. Of this, however, there seems to be no definite evidence. Subsequent events make us fear that if the naval cutlass-bayonets were actually used in hand-to-hand struggle, that they may indeed have behaved badly. It is, however, to the naval officers of the fleet that we owe the discovery of the terrible state of things existing. Captains Fitz Roy, Luxmore, Rawson, and Cleveland give evidence as to this. The *impromptu* tests to which the weapons were put are not at all to be objected to, but we think highly commended for the purpose in view—the discovery of untrustworthy weapons generally. Nevertheless, the best blade can be pressed down till it bends or breaks, and to govern manufacture, certain and regular tests must be insisted on. Captain Rawson naturally considered that bayonets that bent permanently in a lunge at a 4in. cushion of canvas and oakum were worthless; so were those which could be permanently bent by the grasp of the fingers. Eventually the whole question came up in a formidable shape, one of the most extraordinary features of the case being that the arms are issued blunt, and naval officers appear to have a bad conscience if they grind them, which it appears renders them very weak. Captain Luxmore resents the imputation of having done so. Yet they say they must be ground before use in action.

What conclusion are we to draw? Primarily we heartily endorse the opinion expressed both by the Special

Committee on the sword-bayonets, and that expressed by Judge Fitz-James Stephen's Royal Commission, that the evil of the five years' system is illustrated by this story. Here is the main mischief. On the whole the men concerned do not flinch from their responsibility. General Dixon especially takes more, we think, than he need have done. Had he remained at Enfield, he must have become aware that re-heating besides grinding was necessary, and this he would apparently have objected to. On the five years' system General Fraser, who has spent the principal years of his service in manufacturing shells, comes to Enfield, and out of perhaps £100,000 worth of work on the year, finds £1000 devoted to a process of which he can have no experience. From the manager he learns the established system, and established tests are carefully observed. There is nothing to raise his suspicion. A man who had made swords and bayonets all his life might have an eye so trained as to take fright at the dimensions of the blade, or he might question the soundness of the process of conversion, but such men cannot exist on the five years' system.

It is easy now to obtain a condemnation of a process that is known to have given bad results, but the experience needed to speak beforehand is a peculiarly special one. To stand bending well, a blade must be not only symmetrical in distribution of metal, but its crushing and tensile strength must be fairly matched. A bent blade may get a permanent set, because the side under tension stretches. It may equally yield because the side under compression sets up. This explains how a permanent set may occur in a blade where steel may appear of high quality in one respect. It is, however, impossible to discuss so cramped a question here further than to point out that special experience is needed, and this is the one thing that is absolutely impossible on the five years' system. Hence we hold that General Fraser, Colonel Dyer, General Close, and Colonel Arbuthnot surely canot be blamed. General Close, for example, can fairly plead that he did excellent service based on his general scientific and practical knowledge as a manufacturer. In a short time he found means to strengthen and greatly improve the triangular bayonet and land service sword bayonet. To expect him to guess by intuition that a weapon devised by his predecessors was 20 lb. less stiff than contemplated, or that the tests and methods of manufacture he finds are untrustworthy, is to expect impossibilities. It may be wondered, then, why we have not specially indicated Mr. Perry, the manager, as the one to whom the fault attaches. We would at once say that it is not reasonable to lay much responsibility on one in a subordinate position. He gets little credit for what his department achieves, and he should get little blame. The superintendent may very well look to the manager as responsible to him, but it is ridiculous to ask Parliament to recognise that the supply of arms to the country fails because an artisan who has risen to a position entailing a salary of perhaps £500 per annum, fails to furnish a series of superintendents with the connecting links necessary to give continuity to a dislocated, unbusiness-like system.

THE CONTROL OF THE LONDON WATER SUPPLY.

THREE years have elapsed since an officer of the Royal Engineers wrote a concise and able treatise on "London Water." The work was described on the title page as, "A Review of the Present Condition and Suggested Improvements of the Metropolitan Water Supply." The book, small and unpretending in its form, attracted but little notice at the time. But circumstances have since invested it with peculiar importance, its author having recently received the appointment rendered vacant by the death of Colonel Sir Francis Bolton, who had held the post of Water Examiner under the Metropolis Water Act of 1871 from the date when the Act came into operation. The induction of General A. de Courcy Scott to this responsible office naturally excites curiosity as to the views with which he is likely to be governed in the fulfilment of his duties, and inasmuch as he has "written a book" on the subject to which his duties relate, it is equally natural that this should be looked upon as affording a clue to the predilections of the new Examiner. Still, it must be remembered that an outside observer, having only a partial view of the facts, is in a very different position from an authority who is able to command information, and who can survey his especial topic from more than one standpoint. General Scott is now gaining an experience which he had not before, and it is quite likely that much to which he gave expression in his irresponsible days of imperfect knowledge will be considerably modified now that he enjoys better opportunities of gaining information. It is to his periodical reports to the Local Government Board that we shall have to look for the more matured views which may be supposed to govern his official action. His duties are indeed limited in their scope, and simple in their character; but the opinions which he may express in his official reports will carry peculiar weight, and may have considerable influence on the future history of the London water supply. It may not follow that any great changes will be brought to pass, but it will be a valuable result if extravagant theories are corrected by the test of ascertained facts, and unreasonable demands are made to merge in practicable and useful measures.

It cannot be said that General Scott has entered on his duties with any prepossession in favour of the system by which the greater part of London is at present supplied with water. We find him saying in 1884, "Instinct with the masses, and reading and reflection in the case of the educated, are rapidly leading to a consensus of opinion regarding the entire unsuitability of rivers draining thickly populated valleys for use as sources of water supply." Water polluted by town drainage is, of course, unsuitable for drinking purposes. But is this characteristic of the Metropolitan water supply? The towns above the intakes of the London water companies are strictly prohibited from discharging sewage into the stream. The law is being enforced, and any exception which remains will not be allowed to continue. The practical test is found in the quality of water as supplied to the consumer. General Scott's latest report has reference to the Metropolitan water supply for March. Therein he describes at some length the composition and management of the filter-beds belonging to the seven companies who take water from the Thames or the Lea. He then states, "Whatever may be the improvements in the process of filtration which a study of the question may produce, there is not wanting valuable testimony to the general efficiency of the means already in use for the purpose." Dr. E. Frankland, who cannot be suspected of any undue bias in favour of the existing supply, is quoted by General Scott as stating in his last annual report that "the high efficiency of treatment, and consequent general improvement in the quality of the river portion of the Metropolitan water supply, which has been conspicuous for several years past, has been more than maintained during 1886." Dr. Percy Frankland, the son of the foregoing, has tested the supply by means of Dr. Koch's gelatine plate process, and has demonstrated the extraordinary efficiency of the plan of filtration adopted by the companies. General Scott refers to the fact that the observations thus made show that the micro-organisms in the Thames and the Lea during the past year were intercepted by the filter beds to the extent of 97·6 per cent. in the case of the former river, and 96·5 per cent. in the case of the latter. These micro-organisms, detected by means of cultivation in suitable media, are not the "moving organisms" of which Dr. E. Frankland has sometimes spoken, but of which none were seen in 1886, so far as the Metropolitan supply was concerned. The cultivated organisms are more minute than those which are the subjects of direct observation. There is also the assurance that all microbes are not mischievous, though science has not yet found it practicable to distinguish between the pathogenic microbes and those which are harmless. If the germs of zymotic disease are living organisms, they are doubtless incapable of escaping observation under the Koch process, though their identity may not be established, and they "pass in the crowd." But while we have no proof that they are there at all, there is the observed fact that the "crowd" itself is extremely limited. In March last the filter-beds intercepted 98·1 per cent. of the micro-organisms in the Thames supply, and 99·2 per cent. of those in the supply taken from the Lea.

General Scott gives attention to the argument that the companies "are now committed, under legislative sanction, to certain sources of supply and certain intakes, and that it is practically out of their power to vary them." This, however, he considers to be "only true in a modified sense," and he goes on to show that the purity of the supply will be greatly influenced by the use of means and appliances already within reach. A good situation for the intakes, a sufficient extent of impounding and settling reservoirs, and an adequate provision of well-constructed and properly managed filter beds, are recognised as tending to improve the character of the water before it passes into the mains. The greater the admixture of deep-well water with the supply, and the more rigidly the flood-water of the rivers is excluded from the reservoirs, the less will be the proportion of organic carbon in the water received by the consumer. Fltration will scarcely touch the organic carbon, but while it fails in this respect, it will directly deal with the micro-organisms. Hence the value of the bacteriological test, and the point is one on which General Scott is very explicit. The results may vary from time to time; but the average obtained over an extended period "will apparently be a measure of the efficiency of the treatment of the water, the standing resources, and the acquired advantages of individual companies." General Scott states that the engineers of the several companies watch the bacteriological results "with interest, and are each laudably anxious that those in particular with which they are individually concerned should be as favourable as possible." With the prospect that this mode of testing the purity of the supply "will improve in power and efficacy," it forms a welcome adjunct to the labours of the analyst, and is welcomed as such by General Scott.

Within the last few days an interesting contribution to this subject has appeared in the form of a paper read at the Parkes Museum of Hygiene, by Major Lamorock Flower, the Sanitary Engineer of the Lea Conservancy Board. In this dissertation Major Flower treats of the entire basin of the Lea, and shows how effectually the process of pollution has been stopped in that part of the river which is connected more or less with the water supply of the metropolis. While the Thames furnishes half the water supply of London, the Lea gives rather more than one-third, springs and wells completing the total. From the Lea is drawn the main supply of the New River and East London Companies, and, of course, there is a general idea that the river is none of the purest. Its head waters are wholesome enough, consisting of springs in the lower chalk near Luton. If Acts of Parliament and lawsuits could do the river any good, the Lea ought to be a model stream. It was the first river in England that enjoyed the protection of a Conservancy Board, and the water rights connected with it have been carefully guarded. It is not a big river, and the law specifies that the navigation is to have precedence of the water supply. Whatever happens, London must not drink the river dry. Certainly the people of the metropolis are not particularly disposed to imbibe such water as may be found below Tottenham, though there is a great improvement in that section of the stream. There, as at Canning Town, the sewage has lately been treated effectually by means of Hanson's sulphurous powder. The Lea and Bow Creek have thus been robbed of their terrors, and it is to be hoped the improvement will be maintained. In the course of his paper, Major Flower recites the various measures adopted to prevent pollution to the Lea and its tributaries. The list of towns is extensive, and the modes of purification are various; but the general result is satisfactory. We are told, "There is practically no pollution above the New River intake." With respect to the East London Company, we gather from the description which Major Flower gives of the works executed in recent years, that the company have succeeded in intercepting "all sewage likely to pollute the water above their intake." He also refers in terms of approbation to the operations carried on by the company for the purpose of increasing the supply taken from the underground waters of the chalk. Major Flower would like to have the entire sewage of the Lea Valley carried away seaward in one gigantic outfall sewer; but taking the case as it stands, we perceive how much can be done by judicious and persistent effort on ordinary lines. Despite all the difficulties which may be supposed to beset the conservancy of the river, the water supply furnished by the East London Company, tested according to the latest scientific methods, gives no indication of unwholesome admixture.

There are now half-a-dozen chemists and a Government Water Examiner watching over the water supply of London, and if anything goes wrong the fact is not likely to escape notice. At the same time the guardianship is none too strict, seeing that the health and comfort of five millions of people are concerned in the question. There are passages in General Scott's *brochure* of 1884 which advocate extensive and vital alterations in the system of the Metropolitan Water Supply, including a change of source and of management. But these matters lie, as yet, a long way off, and it is evident that the new Water Examiner is earnestly resolved to make the best use of existing means. Nevertheless there is something significant in the fact that a man such as General Scott, who has committed to writing proposals for condemning the present river supply and buying off the existing companies, should be appointed by the Government as the Water Examiner of the Metropolis. The permanent officials of the Local Government Board and the Home-office have very possibly made their voices heard in this matter, and look upon General Scott, rightly or wrongly, as the precursor of a change which shall place the water supply in other hands than those which now possess it. Even some who stand higher than permanent officials may have entertained the same idea, and exercised their influence accordingly.

THE TRAFFIC OF THE SUEZ CANAL.

AN official return just issued by the Suez Canal Company shows such a diminution of traffic to and from the East by this route, that it will be interesting to consider the conditions which may be deemed to be operative in causing the falling-off. Before attempting to do this, however, it will be desirable to quote the leading figures of the return. That these are very highly suggestive will, we think, be generally admitted; and if the considerations we can advance possess weight, there would appear to be a necessity for the Company to reconsider the scale of dues, or to take such other steps as may tend to mitigate the effects of the competition which, as it seems to us, is causing and is likely, unless checked, still further to cause, much loss to the revenue of the Company. The return demonstrates that during last year, as compared with that previous to it, there was a consider able falling-off in tonnage passing through the Canal, and consequently an equivalent reduction in the transit receipts. The number of vessels was less by 524, the net tonnage showed a decrease of 568,097 tons, and the transit receipts a decrease of 5,680,049f., the same rate of dues being levied in both years. The transit receipts for 1884 amounted to 62,378,115f.; for 1885, to 62,207,439f.; and for 1886, to 56,527,390f. Thus for two consecutive years there has been an annual decrease which although but trifling during the first of them, became very marked and serious during the second.

It would scarcely seem warrantable to presume that this decrease is to be attributed to any reduction in the general volume of Eastern trade. Indeed the returns from our colonies in the East, as well as those from all countries with which Europeans carry on trade in that hemisphere, go to prove the contrary. As many vessels, if not more, left European ports for the eastward during 1886 as did so during 1884, while their aggregate tonnage was larger in the later year. There must therefore, it would seem, have been a divergence of route adopted, and it must be of interest to determine the causes which have led to that adoption. Now there is but one alternative route to that by the Suez Canal, and that is by the Cape of Good Hope. If there is any degree of parity in the bulk of the trade from European ports during 1886 when compared with 1884, and the Suez Canal returns show that it is not securing its former proportion of that bulk, it must follow of course that the long sea route is obtaining the increased balance of the traffic. It is a fact worth noting that the decreased figures which represent the Suez Canal traffic occur simultaneously with, and bear some relative proportion to, the advance made with the triple compound engine. It was only during 1884 that this system received any extended trial, and during 1885 it had very considerable extension. But during last year, the results of the two previous years having fully demonstrated the economy of triple expansion, every steamship owner that was in a position to do so hastened to adopt it, a very large number of existing vessels having their engines modified, while but comparatively few new steamers were launched the engines of which were not on the new principle.

The very important saving of coal effected by this change has tended greatly, we should say, towards increasing the flow of our Eastern trade *viâ* the Cape of Good Hope. Steamers bound for Australia and the Eastern ports generally have, with but few exceptions, hitherto been necessitated to call in at the Cape to fill up with coal. A call of that kind is at no time without expense, and it of course entails delay, which further adds to the cost of a voyage. Then, again, the necessity prevents the ships from following the quickest course, which lies some 300 to 400 miles south of the Cape. These delays and cost are avoided in the case of steamers which are capable of steaming their entire journey without putting in for coal; and it may be said, we think, that this advantage has perhaps been secured to the majority of our steamships by the introduction of the triple-expansion engine. There seems to be a parallelism of occurrence between the adoption of engines of that type and the reduction in the traffic of the Suez Canal, and the fact cannot but be noteworthy when considering the causes operating towards that reduction. Now, proceeding further upon this basis, we find, if our argument has any material degree of soundness, that the cost of working steamships by the Cape route has been reduced by the several savings above mentioned, while that route is quite on a parity in respect of coal saving with steamers which adopt that by the Suez Canal. From this we may deduce that the fees charged for transit by the Canal are so high as to now outbalance the advantages it offers of a lesser mileage. It is cheaper, under the modified conditions which have become established during the last three years, to send a steamer by the long sea route than to send it by the shorter passage, weighted as the latter is with the heavy fees charged for transit through the Canal; and we may predict, if such a conclusion may be held to be established, that we shall, unless steps are taken which may check such a result, see the tonnage using the Suez route still further annually decreasing. This, as it appears to us, can only be stayed by the reduction of the transit fees to the point at which the balance of economy may be re-established in favour of the shorter passage. The fees on a 3000-ton ship now represent the cost of nearly that weight of coal in England.

The cause we have stated must prove operative in another way in inclining the balance of advantage towards the Cape route. Everything which brings the duration of the two journeys more nearly level will induce a preference by passengers for the latter method of reaching their destination. By the Cape they avoid the great heat of the Red Sea so much dreaded by a large proportion of them, and the curiosity to see the numerous places at which our mail steamers call on their voyages palls after one or two experiences. Both our passenger and cargo traffic may therefore be expected to become more and more diverted from the Canal route as high speed can be economically attained by the ocean route, and it behoves the Suez Canal directors to take the fact into their serious consideration. We note by the return under reference that Great Britain during the year just passed owned 77 per cent. of the whole tonnage using the Canal. France had 8¼ per cent., Holland 4 per cent., and Germany 3·69 per cent.

EFFECTS OF MINING RENTS AND ROYALTIES UPON THE IRON TRADE.

On Monday evening last Mr. Haigh, of Barnsley, delivered an address in the presence of a large number of miners and the officials of the Yorkshire Miners' Association at Barnsley, on mining rents and royalties, and their effects on trade. The speaker reviewed the law relating to mining rents and royalties in Germany, France, and Belgium, pointing out that the low mining rents and royalties enabled them to compete successfully, and outstep our own ironmasters. He expressed a strong opinion that they were for the most part able to compete successfully with British manufacturers owing to the easy rate at which they could produce coal and iron ore. Turning to the manufacture of pig iron, he said the iron and coal trades had been depressed for more than twelve years, the consequence being our other trades generally have not been prosperous. When the iron trade was depressed it did not consume near so much coal or coke; that to a great extent accounted for the depressed state of the coal trade. Whilst as a nation we were almost the sole makers of iron and steel, and had no foreign competitors, we could supply our home trade and other countries without feeling the effect of these royalties and charges quite so much; but the moment we are face to face with a foreigner in the markets of the world, who has very small rents and royalty charges to pay—and even these charges go into the national exchequer to assist in meeting the expenses of the State—we are run out of the foreign markets, and even driven from our own. They were surprised when they saw it stated that Belgium had received an order to supply one of their own railway or tramway companies with 100,000 tons of steel rails, or that a contract has gone across the water for the supply of ten locomotives, or they learnt that the British Government were sending thousands of tons of Belgian rails to make railways in India. The girders of St. Enoch's Railway Station, Glasgow, were brought from Belgium, and they also knew that the iron used in the construction of the Court-house Station in their own town was of foreign manufacture. Not very long ago one of their ironmasters—Maclellan—who owned eight furnaces, had four of them standing at that very time he was importing iron girders from Belgium and Germany with his name on in prominent letters, which were used in the construction of the municipal buildings, and were paid for out of the pockets of the ratepayers of one of our large cities. The speaker pointed out that rents and royalties had to be paid, not only on coal, but also on ironstone and lime; and that being so, when these were added together they made a total of 6s. 6d. per ton on every ton of pig iron smelted in Great Britain. In Germany the like royalties are 6d., in France 8d., and in Belgium about 1s. 3d. per ton. In the manufacture of steel a further expenditure of mineral product was necessary in the shape of coke. On the average it took nearly two tons of coal to make one ton of coke; two to three tons of coke are required to convert the requisite quantity of iron into steel, which brings the amount paid in rents and royalties on the minerals used in the manufacture of a ton of steel in our own country to not less than 9s. 6d.. whilst the like royalties are in Belgium 1s. 9d., France 1s., and in Germany 9d. Thus finding that on the minerals used in the manufacture of each ton in Great Britain more is paid than in Belgium by 5s. 3d. for pig iron and 7s. 9d. for steel, in France 5s. 10d. on pig iron and 8s. 6d. on steel, and in Germany 6s. on pig iron and 8s. 9d. on steel. The speaker did not explain how it was that in spite of all this the Belgian workman works for starvation wages, and that for equal quality English iron is cheaper than Belgian.

OUR STEAMSHIPS.

As we have previously given in THE ENGINEER an article on the dwindling in the number and tonnage of steamships for a number of months, it may be of interest to show that the latest official report indicates a change in this respect. Confining our attention first to the steamer fleet of the United Kingdom, we find that in April there were twenty-five iron steamships added to the registry, and thirteen only were removed therefrom. There were also five wooden steamers added, and three removed, so that in both classes there was a numerical gain in the month. The tonnage statistics, however, are the most important, and if they are looked at, we find that the iron steamers added aggregated 17,999 tons net register, whilst those removed were of 11,136 tons register. The wooden steamers were of small tonnage, those added to the register being 69 tons in the total, and those removed only 32 tons. In the month, then, it appears that there was a net increase of fourteen steamers, and that the addition to the tonnage was more than 6800 tons. The colonial registers show the following results for the month:—Two iron and four wooden steamers added to the registry, and five and four respectively removed. The tonnage statistics are—iron added, 672 tons; removed, 1116 tons; wood added, 37 tons; removed, 149 tons. But even allowing for the fall in the tonnage of the colonial steam fleet, the month reveals a large increase both in numbers and in tonnage. The gain is scarcely so apparent in the steam power—the additions aggregate 3992-horse power, and the removals were 3086-horse power. One of the most noticeable features in the additions for the month to the register for the United Kingdom is the fact that eight out of the twenty-five steamers are over 1100 tons each net register, and that six out of the remainder are less than 100 tons each net register. As to the material of the vessels still classed as "iron steamers," it is noticeable that sixteen out of the twenty-five were built of steel. There is a subsidiary table which has some interest at the present time, namely, that showing the numbers and tonnage of the vessels sold to and bought from foreigners. Five steamers were registered in the United Kingdom and the Colonies in the month which were bought from foreigners, but all except one were built in the United Kingdom. That exception was a wooden steamer built at Newbury, United States of America, in 1863, which was transferred to Montreal. The total net tonnage of these vessels was rather over 4100. On the other hand, we sold to foreigners in the month six steamers of about 4600 tons, and all of these were British built, except one small wooden steamer which was sold from Adelaide to Swanport, if that can be called a loss, for it was a sale to a Colonial Government, but it, of course, necessitated the removal from the register. It is thus clear that there has been in the month—first, an addition to the total steam tonnage of the United Kingdom, after allowance is made for its loss and for that of the Colonies; and secondly, that the gain is not by purchase, but, despite a sale, slightly in excess of that of the tonnage purchased. Of course, there is to set against that gain as far as our total carrying power is concerned, a considerable loss in the number and tonnage of our sailing fleet, but as far as the month is concerned, there would be a gain on the balance.

LITERATURE.

Dynamics for Beginners. By the Rev. J. B. LOCK, M.A. London and New York: Macmillan and Co. 1887.

MR. LOCK is a Senior Fellow and lecturer on mathematics and physics in the University of Cambridge, and he has succeeded in producing one of the most unsatisfactory treatises on dynamics of the multitude which now exists. It is not that the book is inaccurate, for as a matter of course it is not. That is to say, the sums so far as we have tested them worked properly, and the formulæ are, with very trifling exceptions, printed correctly. In this respect the book is a great improvement on the first edition of Mr. Lock's Arithmetic. The defect of the book lies in its method. Some cause, the precise nature of which we are unable to ascertain, prompts men to write treatises on dynamics, and as all that can be said on the subject has been said and written a hundred times already, it follows that each fresh author is harder pushed than his predecessor to say something new, or rather, to say old things in a new way. The favourite method of doing this at present consists in coining strange words and attaching great importance to them, as though they enunciated new and mighty truths. Mr. Lock has invented two new words, and on these the whole book turns. Indeed, it requires no great stretch of the imagination to fancy that, having invented the words, the book was written on purpose to put them fairly before the world. "We choose as our unit the velocity of a point which uniformly passes over the distance 1 foot in the interval 1 second. We shall call this unit velocity a velo." This, then, is the first of the new words. "We shall choose as our unit acceleration the acceleration of a point which, moving with uniformly increasing velocity, has velocity increased by 1 velo in the course of each second; we shall call this unit acceleration a celo. Thus a celo is (a foot per second) per second." This, then, is the second of the new words.

The reader will not be slow to trace the happy effect which a combination of the two produces—velocelo, from which violincello is deduced as a natural consequence. Speaking very plainly, "velo" and "celo" are neither more nor less than scientific slang, and nothing is easier than to suggest new words of a similar character by the dozen. The advantage of using the word "celo," instead of a foot per second, is, we suppose, that it shortens matters a little. Carrying out this system, we may write for "horse-power" the word "hosp," and say that the engines of the Etruria exert 12,000 "hosps." Again, the effect of gravity acting for one second on a falling body imparts to it a velocity of 32·2ft. per second. Why not take a quantity of matter representing 1 lb., acted on for one second by gravity, and establish a unit, which we may call a "gravy." It is true that this suggests Mrs. Todgers, but this may be excused. Is there any reason why the British unit of heat should not be called a "onener?" That is, in a condensed form, 1 lb. of water raised 1 deg. Fah. See how convenient it would be to write, "the thermal efficiency of hydrogen burned in oxygen is 64,000 oneners," and so on. The only objection which may be urged to all this is that as every writer can adopt any name he pleases for a unit, without regard to anyone else's wishes, there may be a slight tendency to confusion. It will not do to urge that the harmony and good feeling which exists among men who write books about dynamics is so well marked that it is enough for one man to invent a new name for a unit, and the whole scientific world will follow him in admiration. Experience, we fear, teaches a different lesson; and in a very few years, if the example set by Mr. Lock is followed, someone will have to publish a dictionary of scientific slang, without which the unfortunate student will make little way. Thus, for instance, last year, Professor D. H. Marshall, of King's University, Kingston, published a book on dynamics, in which he uses the word "tach" to mean unit velocity of one centimetre per second. He has no special name for the unit of acceleration, but the unit of momentum he calls a "gramtach," and the unit rate of doing work a "dyntach." The unit pressure-intensity of one degree per square centimetre he calls a "prem." Professor R. H. Smith suggests that names for the units might be formed systematically by the addition to the ordinary name for the quantity of the invariable affix "on," which is the root part of the word "one." Thus as unit names he would employ "velociton" or "velon;" "acceleron" or "accelon;" "momenton;" "presson;" "tenson," &c. &c. For the sake of uniformity he would change "radian" into "radion." Fortunately, engineers are not concerned in these professorial divertisements.

It is very difficult to read even a little book like this of Mr. Lock's, to say nothing of larger works, without wondering what good purpose it is intended to serve. Whole pages, for example, are devoted to the consideration of the action of gravity. Now it so happens that six simple formulæ suffice to solve every problem which can present itself to the engineer. As, for example, given the height from which a body falls, its velocity will be eight times the square root of that height. A stone is dropped down a well: to ascertain its depth, square the number of seconds, and multiply by 16·1. The result is the depth in feet, and so on. The student ought to learn these things as he learned his multiplication table. Again, for other cases of accelerated or retarded motion, eight more rules suffice to solve nearly all questions. As for example: Wanted, the foot-pounds of work stored in a body moving with a given velocity, then $\frac{M\,v^2}{64} = W$, where M is the weight of the body in pounds or tons, v its velocity in feet per second, and $64 = 2\,g$. The young engineer who has these fourteen rules stowed in his memory will really be as well equipped for work in the office, or the shops, or the field as a man who has read and fairly mastered the whole of the principles laid down in some of the larger treatises on dynamics. If the pages and pages of matter written on dynamics are practically useless to the engineer, we may well ask to whom can they be of use? If only there was time enough available to spend in acquiring information of the kind, well and good. It would, for example, be desirable that an engineer should have a competent knowledge of the classics, but as a matter of fact, there is so much to be learned about so many things, that there is no time to acquire a competent knowledge of all; and in nothing is the judgment of a teacher better shown than in rejecting the useless. Mr. Wren was one of the first to perceive this, and much of his success has been due to the skill with which he taught just what was wanted for a particular purpose—no less and no more.

Mr. Lock, like many other writers on dynamics, is hazy in some of his definitions. Take, for example, Newton's third law. This law means, simply stated, that action and reaction are equal and opposite. That is to say, every force is balanced by one equal and opposite. It is also stated that motion is caused by force. These things being so, the intelligent student naturally asks, "How is it that if a force is *always* balanced by an equal and counterpoising force, motion results?" He may search most text books on dynamics from cover to cover without finding the answer. Mr. Lock tells his readers that "when two equal and opposite forces act upon the same point, the work done by one of the forces is equal and opposite to the work done by the other." The word "when" here implies an alternative. It assumes that circumstances may exist under which two opposite forces are not equal. But this would be a flat contradiction of Newton's third law, which is that every force is at all times balanced by a precisely equal and opposite force. Now, Mr. Lock states, as we have seen, that the *work* done by each of the opposing forces is the same; but if that be the case how can a force produce motion? The student will seek in vain for a line of explanation which may help him to solve this problem.

Mr. Lock gives what is practically a new definition of heat. "Heat is the kinetic energy of the minute particles of a substance." Is it? A few pages earlier in the book Mr. Lock defines kinetic energy as the "capacity for doing work which a mass has by virtue of its mass velocity." Combining the two propositions, we find, according to our author, that heat is, after all, only a capacity for performing work. This statement possesses the merit of simplicity, but we fear it has nothing else to recommend it.

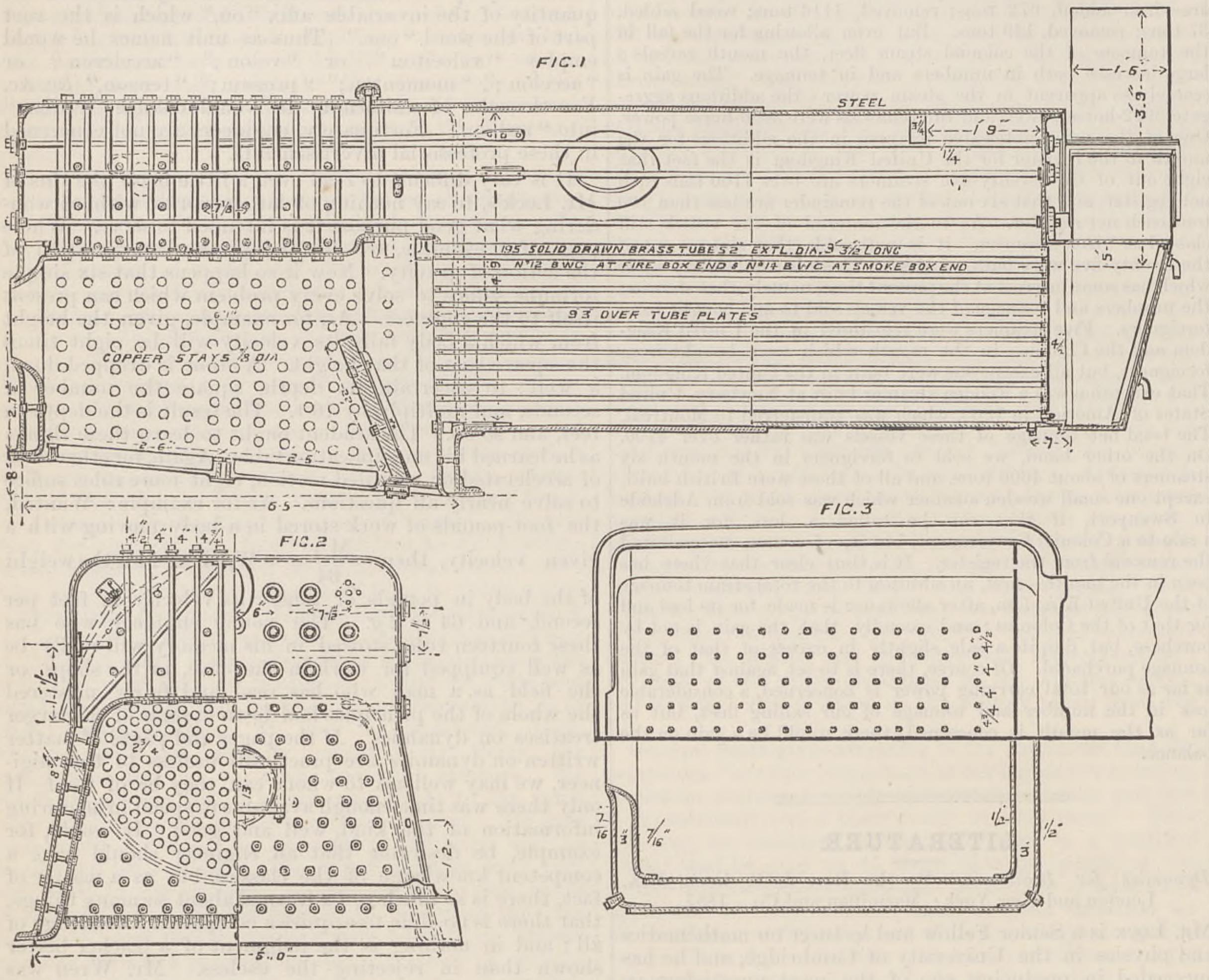
In another place we are told that there "are several forms of energy, of which two chiefly concern us in dynamics, viz., potential energy and kinetic energy." Two or three pages further on we are told,—"A steam engine does work. It is supplied with the energy of heat obtained from the combustion of the coal, in which coal is stored the energy radiated from the sun countless ages ago." Certainly Mr. Lock does not hesitate to draw large draughts on the credulity of his readers. May we venture to ask how he knows that there is any energy stored in coal other than that proper to the quantity of heat concomitant with its sensible temperature while it lies in the bunker? Is the stored energy potential or is it kinetic? How is it that he does not see that the energy utilised is the kinetic energy of the oxygen gas?

We need not continue. All that is said by Mr. Lock worth saying has been already infinitely better said by Professor Oliver Lodge, who has produced the best small text-book of dynamics yet written. To Mr. Lock we award the honour of inventing the names velo and celo; and this will, we hope, go far to reconcile him to our criticism.

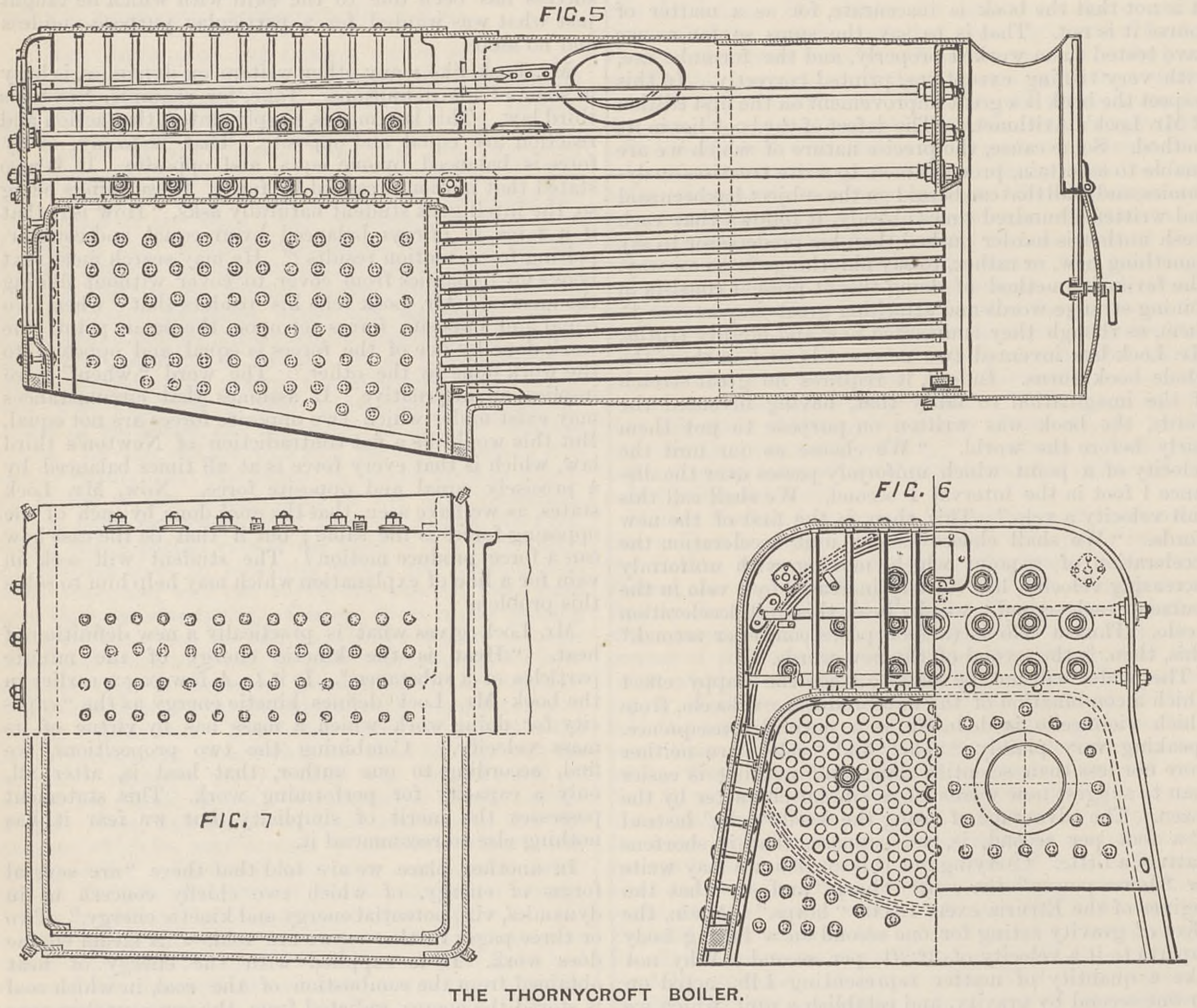
TORPEDO BOAT CASUALTIES.

WE told our readers in our last impression the story of the explosion of a boiler on board a torpedo boat. At the time we went to press our information was scant. Official, and, we may add prudent, reticence interfered to prevent anything like a detailed statement of the truth. Since we wrote the facts have become public; and they are far more serious and important than appeared at first sight. The Admiralty wisely determined to test a flotilla of torpedo boats purchased for the Navy at various times. The test was different from anything made before. Hitherto boats have been tried as weapons of attack and defence. Their sea-going qualities up to a certain point have been made the subject of experiment; but nothing was really known concerning their powers of endurance when steaming at full speed in charge of naval engineers. Now it is obvious that in case of actual war our torpedo boats might be called on to steam long distances in order to repel a threatened attack, and it is also clear that under such circumstances they would be called upon to go from place to place as fast as they could go. In was decided for these reasons that the boats of the flotilla should race over a distance of about 100 miles. The special correspondent of the *Army and Navy Gazette*, who accompanied the flotilla, thus describes what took place:—

Thursday morning broke fine and clear, but owing to the northerly wind of the night previous, there was a heavy swell on until well into the afternoon. The flotilla formed in six divisions, and weighed by division, 10 min. between each division, which, on getting under weigh, formed in single column line ahead, and made a preliminary canter at full speed. Each boat was four boats' lengths from the next ahead, and the strictest orders were given that under no circumstances whatever were the boats racing to close this distance. As they passed through the hole in the breakwater, time was taken for each boat by an officer belonging to the Seahorse, who was stationed there in a steam pinnace for the purpose. Our course lay between the Race and the Bill of Portland, and then W. by N. $\frac{1}{2}$ N. for the Orestone Rock. It at once became apparent that all our calculations as to the fastest type were at fault, for the Yarrow boats developed superior speeds to the rest, although from their bottle-nose snouts the way these boats took in water throwing the spray in a cloud over their stems, they must have been decidedly moist and unpleasant to their crews. The second division had barely started before No. 27—Thornycroft—Lieut. Coxon, returned with hot bearings. We were now struggling past the Bill, and the sensation crept over me—as I clung to the hand-rail, the speed of the boat and her motion rising over the swell and rolling from side to side, making it nasty work to hold on—that if anything happened to the box of boilers just behind me, the *Army and Navy Gazette* would be without "copy" from No. ** next week. Moreover as the lieutenant in charge assured me, there was just a chance that we might break down and get swamped. As I was thinking of these things, we saw No. 41—Thornycroft—Lieut. Colmore, rendered incapable, having broken something in her engines, and a moment later No. 50—Thornycroft—Lieut. Greville, drew out of the line for a similar reason. Leaving these boats tossing in the trough of the sea in a very unenviable condition, we struggled on to the Rock, close to which the lamentable catastrophe occurred on board No. 47—Thornycroft—Lieut. Tower, the exact cause of which does not appear to be certain, although I expect that the crowns of her furnaces came down from lowness of water in her boilers. Such an accident nearly happened in No. 57—Thornycroft—Lieut. Harford, where the men rushed on deck, and I understand it was solely owing to the presence of mind of her artificer, that another disaster was prevented. No 42—Thornycroft—Lieut. Armstrong, was put out of action by defects developing in the engine-room, and No. 55—Thornycroft—Lieutenant Carey, also came to grief. Thus out of the twenty-two boats, seven, all of them Thornycrofts, came to grief, and another, No. 45, Lieutenant Thursby, lost a blade of her screw. The remaining boats finished the course, the first three being No. 31—Yarrow—commanded by Mr. Dawe, gunner, Lieutenant Hewitt not having turned up in time; No. 35—White—Lieutenant Hamilton; and No. 46—Thornycroft—Lieutenant Grant. The times were as follows:—No. 31, 5 hours 10 min. 15 sec.; No. 35, 5 hours 10 min. 20 sec.; No. 46, 5 hours 15 min. Thus there were only five seconds between the first and second boats. The Rattlesnake's time was not taken, as no sooner did Captain Long hear of the accident to No. 47 than he transferred his flag to the Seahorse, and sent the "catcher" to tow the disabled boat to Devonport. The Seahorse then cruised about picking up the disabled boats, and taking four of them in tow, started for Portland. However, somewhere off the Bill the hawser made fast to Nos. 41 and 50 parted, and those craft went adrift. Very wisely, the captain left them to their fate, as the night was dark, and a collision might have resulted if attempts had been made to take them in tow again. I hear these two boats had a most unpleasant time of it, but they used their electric lights to show passing ships their position, and soon after 1 a.m. the Seahorse found them by this means, and skilfully passing a hawser to No. 41, towed them into harbour.



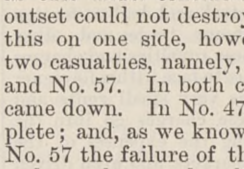
THE YARROW BOILER



THE THORNYCROFT BOILER.

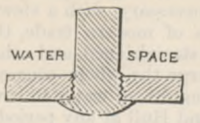
Opinions differ as to the value of torpedo boats, but it is certain that no maritime Power could be without them; and the fact that, out of twenty-four British boats, no fewer than eight were rendered *hors de combat* as soon as they were worked under conditions which might—and probably would—obtain any or every day if we were at war, is extremely serious. The failures we have recorded possess a national importance. It is a noteworthy fact that all the boats which broke down were by the same firm. There were four boats by Messrs. Yarrow and Co., three boats by White, of Cowes, the remaining seventeen were by Thornycroft. If we refuse to class the failure of a propeller as a breakdown because the boat was still able to proceed, though at reduced speed, we find that the casualties to the boats of the Chiswick firm came to over 41 per cent. If out of 100 torpedo boats forty-one are to become unserviceable within an hour after they proceed to sea, confidence in the utility of such craft will be weakened. It may be urged—and has already been urged to some purpose—that the failures were due to the incompetence of the men in charge. If this were wholly true it would imply a very serious indictment of the Admiralty; we refuse, however to believe it. While we admit that had more care been exercised in the stokeholes it is possible that no breakdown would have occurred, we hold that any system of design or construction which renders boilers and engines dependent for their safe working on exceptional skill and vigilance, must be defective. Whatever the probable shortcomings of the crews in charge could possibly have been, we think the man cause of the failures must be sought and found in the machinery of the boats, and even in the boats themselves, and we fancy, before we have done, that our readers will be of the same opinion. As we know nothing yet of the nature of the failures which took place in the engine or boiler rooms of Nos. 27, 41, 50, 42, and 55, we can say little about them. No. 27 had hot bearings; but they must have been very hot indeed to stop the boat. The bearings in a torpedo-boat engine are so comparatively small and light, and the appliances for cooling so perfect, that, as is known from experience, a very hot bearing can be cooled in a very few minutes; and in a long race, such as this under consideration, five minutes' delay at the outset could not destroy the chances of a boat. Putting this on one side, however, we may confine ourselves to two casualties, namely, the failure of the boilers in No. 47 and No. 57. In both cases the crowns of the fire-boxes came down. In No. 47 the failure was sudden and complete; and, as we know, lives were lost. In the case of No. 57 the failure of the crown plate was not so sudden and complete, and no lives were lost; although the risk incurred was awful. Why did the furnace crowns come down? The first reply that will suggest itself to an engineer is that they came down because the boilers were short of water. On this point, however, there is a great deal to be said; and in order that our readers may comprehend the whole matter, we give here two sets of drawings—Figs. 1, 2, and 3—showing the system of construction adopted by Messrs. Yarrow and Co., and Figs. 5, 6, and 7, that used by Messrs. Thornycroft and Co.

At first sight there does not seem to be much difference between them, but there is a difference—a most essential difference in detail. It will be seen that in neither boiler are bridge stays used. The tops of the inside and outside fire-boxes are secured to each other by stays. It will also be seen by Fig. 8 that the stays used by Messrs. Yarrow have large heads jumped up out of the solid and forged to shape; that under these heads is a screw thread; that the opposite ends or points are also screwed. The stays are turned down between the threads, so that the threads stand up. These bolts are then screwed hard into place from the inside, and large square nuts are then screwed on the ends projecting on top of the fire-box shell. In locomotive work the crown stay bolts always have heads or nuts inside the fire-box on the crown stays.



Turning now to Mr. Thornycroft's boiler, it will be seen by Fig. 4 that he dispenses with nuts and heads. His stays are screwed, just as Mr. Yarrow's are, but there the resemblance ceases. The ends of the stays are rivetted over—the crown stays thus resembling the side stays. This we regard as an essentially weak system of construction, and to it we believe the failure of the boilers in 47 and 57 was partly due. The system of rivetting over cold answers well enough in a side stay which is not more than 6in. or 7in. long over all; but the crown stays are over 2ft. long, and rivetting up cold has a very great tendency to do more harm to the screw thread in the $\frac{7}{16}$in crown plate than anything else, for it is next to impossible properly to hold up a bar 2ft. long to the rivetting hammer. It may be urged that a screwed and rivetted stay is just as strong as a screwed stay with head and nut. This we deny. That it may be quite strong enough under ordinary circumstances is one thing; that it is strong enough for torpedo boat boilers does not at all follow as a legitimate consequence. It will not do to assume that, because such a system of construction may give good results in a locomotive boiler, it must do so in a torpedo boat boiler. It has been urged that the crown plates came down in No. 47 and No. 57 because the plates were overheated from shortness of water. This we concede at once, but it does not follow that the men in charge were to blame. As a matter of fact, the crowns of the fire-boxes in torpedo boats are often left uncovered by water for some little time. When running before a sea, the boat will get on the back of a wave travelling at nearly her own pace, and she will run with her head down and her stern up until she has outpaced the wave. During this time the crown of the fire-box may have no "solid water" on it; but besides this, torpedo boats are so lively and jump about so much that in a heavy sea the crown plates are sure every now and then to get left dry, or nearly so, for a few seconds, unless the water is kept high in the glass. If there are large nuts inside the box, these serve to keep cool considerable areas of metal just round the screw threads. It is well known that it is practically impossible to make a nut red hot if the stay remains cool, because the stay serves to convey away heat in a way very clearly set forth by Peclet, Wye Williams, and others. Every engineer will concede, we think, that if the top of a Yarrow box became overheated, it would be likely to come down between the stays in pockets; but it is evident that it must be made very hot indeed before the heads could be forced off the stays or drawn right through the plate. It is, we think, incontestable that the Yarrow system must be stronger than the Thornycroft system. A leak might be started by the crown plate cracking, but its total disruption is to the last degree unlikely. It must not be forgotten, however, that these are the first failures of Thornycroft boilers that have taken place, and that the old Lightning has given no trouble and has been very hard worked. But the Lightning has been managed by men of great experience.

FIG. 4.



We have little doubt that Messrs. Thornycroft's other failures have been due to the desire to make the machinery of their boats as light as possible. It is a matter of interest to know that the Yarrow boats of the same dimensions weigh nearly seven tons more than the Thornycroft boats. Of this 3½ tons go to the hull and 3½ tons to the engines and boiler. For example, it will be seen by Fig. 1 that Messrs. Yarrow and Co. raise the forward end of the internal fire-box. They thus get room for more tubes without raising the crown plate as a whole. The small portion actually raised being near the mid-length of the boiler, where the water level is not much affected by pitching, it is always covered. But the result of adopting this system of construction is that the boiler holds an extra half-ton of water. Messrs. Thornycroft's engines are speeded higher than Messrs. Yarrow's, the pitch of the screws being finer; and this we hold to be objectionable. Nothing can exceed the skill with which the Thornycroft engines have been designed and made; but facts are too strong for them and the advocates of high-speed engines. Those who hold that we may yet have 40-knot passenger steamers may draw an instructive lesson from the torpedo boat race of May, 1887. The consolatory feature of the whole affair is that the boats of Messrs. Yarrow and Mr. White did their work without a hitch or difficulty of any kind, and it is not to be supposed that their engine-room staffs were better than those of the Thornycroft boats.

STEAMSHIP EFFICIENCY.

BY the courtesy of Mr. W. Stroudley, locomotive superintendent of the London, Brighton, and South Coast Railway, we are enabled to lay before our readers a valuable statement concerning the performance of two paddle steamers, plying between New Haven and Dieppe. The engravings on the next page illustrate their paddle wheels. A good deal of information of a somewhat similar kind exists with regard to screw steamers, but very little is available concerning paddle boats.

These experiments, recorded here, were carried out under the supervision of Mr. R. Scott, one of the engineers set apart for the duty, and Mr. Buckwell, in the steamships Normandy and Brittany. They were told off for this purpose, with a sufficient number of assistants, so that particulars might be taken with the greatest possible accuracy. The accompanying particulars of these vessels will enable our readers to appreciate the conditions under which these trials were made:—

Length on load water line...	230ft.
Breadth, moulded	27ft. 6in.
Mean draught	7ft. 10in.
Displacement	740 tons
Area of immersed midship section	203 square feet
Diameter of paddle wheels, measured to centre of axis of floats	17ft.
No. of floats in each wheel	9
Dimensions of floats	3ft. 7½in. × 9ft. 6in.

There are three floats immersed on each wheel, giving an area of 206·64 square feet. The inner end of the float is 12in. from the side of the ship. The floats are curved to a radius of 8ft. 6in., and have flanges 4in. deep at each end. These paddle-wheels have been designed by Mr. Stroudley. A boat of similar dimensions, fitted with oscillating engines and ordinary feathering floats, did not give a good result. Then the Brighton and Victoria were built on an improved design, and were fitted with

Particulars of Coal Tests on Board S.S. Normandy during Passage from Dieppe to Newhaven on 6th May, 1884.

Condition of vessel's bottom ... Clean
Draught ... 7ft. 6in. fore, 8ft. 3in. aft
Weight of cargo ... 28 tons
State if vessel had any list to port or starboard, and to what degree ... Nil.
Flood or ebb sailing ... Neap ebb
Booked time of starting from harbour ... 11 a.m.
Actual time of starting from harbour ... 11.42 a.m.
Actual time of passing pierhead going out ... 11.52 a.m } h. m.
Actual time of passing pierhead coming in ... 4.40 p.m. } 4 48
Actual time of arrival at harbour... ... 4.43 p.m.
Time detained on passage ... 15 min.
Cause of detention ... Waiting for water
Particulars of sails used, and time ... Nil
Height of barometer at starting ... 30·02
Direction of wind ... W.N.W., light
State of weather ... Fine
State of sea ... Smooth
Height of water in boilers on passing pierhead going out ... 4½in. fore, 3½in. aft
Height of water in boilers on passing pierhead coming in ... 7in. fore, 7in. aft
No. of revolutions before passing pierhead ... 60
No. of revolutions from pier to pier ... 8730
No. of revolutions after passing pierhead ... 66
Total No. of revolutions ... 8856
State change, if any, in opening of main stop valve ... Nil
State change, if any, in degree of expansion ... 60 and 65 per cent.
State change, if any, in opening of throttle valve ... ⅝ and ¾
State what feed-water, if any, was supplied ... Auxiliary ⅛ open for 20 min.
Description of coal on trial ... Stephenson Clarke's Merthyr
Coal used for lighting up and raising steam in the boilers to 50 lb. per square inch ... 2 tons
Coal used on passage ... 5 tons 12 cwt.
Consumption of fuel per hour ... 23·33 cwt.
Condition of fire-grate ... Very good
Weight of ashes remaining at end of passage ... 18 cwt. 2 qr. 26 lb.
Proportion of ashes to total fuel consumed ... 12·33 per cent.
Amount of smoke ... Very little and light
State if steam blast was used, and how long ... Nil
Depth of fire on bars at end of passage ... 2½in. fore, 2in. aft
Distance pierhead to pierhead ... 64¾ knots.
Distance travelled by paddle-wheel ... 76·69 knots
Amount of slip of paddle-wheel ... 18·44 per cent.
Mean indicated horse-power ... 1232·14

N.B.—Diagrams to be taken from each cylinder simultaneously, if possible, every half hour.

The undermentioned Particulars to be taken every half-hour during the Passage.

Time.	12.20	12.50	1.20	1.50	2.20	2.50	3.20	3.50	4.20
No. of revolutions per minute by actual counting ...	34	36	32	32	31	31	30	31	29
Temperature of feed-water ... ...deg.	117	127	118	128	112	113	116	128	123
Temperature of gases in uptake ... ...deg.	835	785	670	825	700	750	785	770	750
Vacuum in uptake	No gauges.								
Vacuum in ash-pit									
Vacuum in flame-box									
Vacuum in condenser ... ... in.	26	25½	26	25½	26½	27	27	25½	26
Steam pressure	98	97	110	85	87	80	80	75	70
Point of cut-off by valve motion ... ...per cent.	65	60	60	65	65	65	65	65	65

REMARKS.—Stephenson Clarke's Merthyr coal. This coal was discharged direct from ship into barge and put on board unscreened. It is of the same superior quality as previously reported. During the outward and return trips, dampers were kept partly closed during the greater part of the passage, a sufficient quantity of steam being easily obtained. There is a very small percentage of clinker in the ash remaining, neither rake nor pricker being used during either of the passages.

To W. Stroudley, Esq., Brighton. (Signed) R. SCOTT, Engineer.

Particulars of Coal Tests on Board S.S. Normandy during Passage from Newhaven to Dieppe on 14th May, 1884.

Condition of vessel's bottom ... Clean
Draught ... 7ft. 7in. fore, 7ft. 8in. aft
Weight of cargo ... Nil
State if vessel had any list to port or starboard, and to what degree ... Nil
Flood or ebb sailing ... Spring flood
Booked time of starting from harbour ... 10.5 a.m.
Actual time of starting from harbour ... 10.5 a.m.
Actual time of passing pierhead going out ... 10.10 a.m. } h. m.
Actual time of passing pierhead coming in ... 2.8 p.m. } 3 58
Actual time of arrival at harbour ... 2.12 p.m.
Time detained on passage ... Nil
Cause of detention ... Nil
Particulars of sails used, and time ... Nil
Height of barometer at starting ... 30·5
Direction of wind ... W.S.W., fresh
State of weather ... Breezy
State of sea ... Choppy
Height of water in boilers on passing pierhead going out ... 1½in. fore, 1½in. aft
Height of water in boilers on passing pierhead coming in ... 4½in. fore, 4½in. aft
No. of revolutions before passing pierhead ... 70
No. of revolutions from pier to pier ... 9520
No. of revolutions after passing pierhead ... 55
Total No. of revolutions ... 9645
State change, if any, in opening of main stop valve ... Nil
State change, if any, in degree of expansion ... Nil
State change, if any, in opening of throttle valve ... ⅞in. and full
State what feed-water, if any, was supplied ... Auxiliary ¼ open for 20 min.
Description of coal on trial ... S. Clarke's Merthyr
Coal used for lighting up and raising steam in the boiler to 50 lb. per square inch ... 2 tons
Coal used on passage ... 7 tons
Consumption of fuel per hour ... 35·35 cwt.
Condition of fire-grate ... Very good
Weight of ashes remaining at end of passage ... 1 ton 7 cwt. 3 qr. 14 lb.
Proportion of ashes to total fuel consumed ... 15·49 per cent.
Amount of smoke ... Very little and light
State if steam blast was used, and how long ... ⅛ open for 1 hour
Depth of fire on bars at end of passage ... 2in. fore, 2in. aft
Distance pierhead to pierhead ... 64¾ knots
Distance travelled by paddle-wheel ... 82·05 knots
Amount of slip of paddle-wheel ... 26·72 per cent.
Mean indicated horse-power ... 2068 59

N.B.—Diagrams to be taken from each cylinder simultaneously, if possible, every half-hour.

The undermentioned Particulars to be taken every half-hour during the Passage.

Time.	10.40	11.10	11.40	12.10	12.40	1.10	1.40
No. of revolutions per minute, by actual counting ...	38	44	38	38	41	40	38
Temperature of feed-water ... ...deg.	132	126	122	132	139	138	130
Temperature of gases in uptake... ... ...deg.	1080	1050	1050	1050	1025	1050	1110
Vacuum in uptake	No gauge						
Vacuum in ash-pit							
Vacuum in flame-box							
Vacuum in condenser ... ... in.	25	26	26	25	24½	24½	25
Steam pressure	105	110	98	100	100	100	90
Point of cut-off by valve motion ... ...per cent.	65	65	65	65	65	65	65

REMARKS.—S. Clarke's Merthyr coal, taken from stack in coalyard. This coal still maintains the same qualieties as previously reported.

To W. Stroudley, Esq., Brighton. (Signed) R. SCOTT, Engineer.

Particulars of Coal Tests on Board S.S. Normandy during Passage from Dieppe to Newhaven on 23rd May, 1884.

Condition of vessel's bottom ... Thoroughly clean
Draught ... 7ft. 7in., fore, 8ft. aft
Weight of cargo ... 17 tons
State if vessel had any list to port or starboard, and to what degree ... Nil.
Flood or ebb sailing ... Spring ebb
Booked time of starting from harbour ... 11.40 a.m.
Actual time of starting from harbour ... 11.34 a.m.
Actual time of passing pierhead going out ... 11.41 a.m. } h. m.
Actual time of passing pierhead coming in ... 5.55 p.m. } 6 14
Actual time of arrival at harbour ... 6.2 p.m.
Time detained on passage ... 1 hour 45 min.
Cause of detention ... Waiting for water
Particulars of sails used, and time ... Nil.
Height of barometer at starting ... 30·61
Direction of wind ... E., light
State of weather ... Fine
State of sea ... Smooth
Height of water in boilers on passing pierhead going out ... 2½in. fore, 1½in. aft
Height of water in boilers on passing pierhead coming in ... 2in. fore, 7in. aft
No. of revolutions before passing pierhead ... 56
No. of revolutions from pier to pier ... 8267
No. of revolutions after passing pierhead ... 64
Total No. of revolutions ... 8387
State change, if any, in opening of main stop valve ... Nil
State change, if any, in degree of expansion ... 65, 70, & 75 per cent.
State change, if any, in opening of throttle valve ... ½ and ⅝
State what feed-water, if any, was supplied ... Nil
Description of coal on trial ... Tredegar steam coal
Coal used for lighting up and raising steam in the boilers to 50 lb. per square inch ... 2 tons 4 cwt.
Coal used on passage ... 3 tons 19 cwt.
Consumption of fuel per hour ... 12·64 cwt.
Condition of fire-grate ... Very good
Weight of ashes remaining at end of passage ... 1 ton 12 lb.
Proportion of ashes to total fuel consumed ... 16·3 per cent.
Amount of smoke ... Very little, and light
State if steam blast was used, and how long ... Nil
Depth of fire on bars at end of passage ... 2½in. fore, 1½in. aft
Distance pierhead to pierhead ... 64¾ knots
Distance travelled by paddle-wheel ... 72·12 knots
Amount of slip of paddle-wheel ... 11·38 per cent.
Mean indicated horse-power ... 1003·54

N.B.—Diagrams to be taken from each cylinder simultaneously, if possible, every half-hour.

The undermentioned Particulars to be taken every half-hour during the Passage.

Time.	12.10	12.40	1.10	1.40	2.10	2.40	3.10	3.40	4.10
No. of revolutions per minute, by actual counting ...	29½	31	32	28	29	29	32	32	29½
Temperature of feed-water ... ...deg.	140	121	141	111	125	125	122	128	122
Temperature of gases in uptake ... ...deg.	1025	1000	990	980	925	945	1000	970	930
Vacuum in uptake	No gauges.								
Vacuum in ash-pit									
Vacuum in flame-box									
Vacuum in condenser ... ... in.	24	25½	24	27	26	25	26	25	25½
Steam pressure	67	65	70	80	75	78	65	65	70
Point of cut-off by valve motion ... ... per cent.	65	65	65	70	75	75	75	70	65

REMARKS.—As far as can be judged from ebb sailings, the Tredegar steam coal appears to be of good quality, the amount of clinker in the ash remaining is exceedingly small.

To W. Stroudley, Esq., Brighton. (Signed) R. SCOTT, Engineer.

Mr. Stroudley's patent floats, and attained a speed of over 17 knots as the mean of four runs between the Cloch and Cumbrae lights on the Clyde.

The Normandy and Brittany, afterwards built, were made 10ft. longer, and with more boiler power and higher pressure. They performed over eighteen knots on the same ground. The Netherlands Company were having the Princess Elizabeth and other boats built at Messrs. Elder's at the time, and they adopted the Stroudley curved float, with the result that they attained a speed of two knots per hour in excess of the contract. A considerable number of paddle vessels have been since fitted with these floats, all of which performed in a very satisfactory manner. The South-Western Company has also adopted these in its Jersey boats, and has effected considerable increase in the speed. With deep floats on a wheel of small diameter there is a great amount of back water when the float is entering, and also when leaving, and it is impossible to put a straight float into the water without this action. The result is that they lift the water and force it so as to fill the paddle-box; whereas in the Normandy, when running at 45 or 46 revolutions per minute, one could stand inside the paddle-box with a mackintosh on, the water being only a very fine spray, the wheels leaving the sea perfectly clear and free, at very little above the water line. The lever arms on the floats are 2ft. in length, and the excentric is placed 15in. forward of the main shaft and 2in. below its level. 3 hrs. 42 min. is the fastest run with passengers and cargo that has been absolutely tabulated, but taking the time from Newhaven to Dieppe, from the paddle-shaft passing the pierhead at each place, the run was made in 3 hrs. 38 min. The engines of the Normandy and Brittany are compound, working with a high boiler pressure. The cylinders are placed at an angle, the high-pressure nearly horizontal over and to the starboard side of the low-pressure cylinder. Each engine drives a separate crank, the cranks being coupled at right angles by a drag link. It will be noticed that the slip rapidly increases with the speed, which is the reverse of what takes place with the screw propeller.

Particulars of Coal Tests on Board S.S. Brittany during Passage from Newhaven to Dieppe on 27th June, 1884.

Condition of vessel's bottom	Clean
Draught	7ft. 10in. fore, 7ft. 9in. aft
Weight of cargo	
State if vessel had any list to port or starboard and to what degree	Nil
Flood or ebb sailing	Spring flood
Booked time of starting from harbour	10.5 a.m.
Actual time of starting from harbour	10.9 a.m.
Actual time of passing pierhead going out	10.17 a.m. } h. m.
Actual time of passing pierhead coming in	1.59 p.m. } 3 42
Actual time of arrival at harbour	2.12 p.m.
Time detained on passage	Nil
Cause of detention	Nil
Particulars of sails used and time	Nil
Height of barometer at starting	30·65
Direction of wind	E., light
State of weather	Fine
State of sea	Calm
Height of water in boilers on passing pierhead going out	2in. fore, 2in. aft
Height of water in boilers on passing pierhead coming in	3in. fore, 3in. aft
No. of revolutions before passing pierhead	84
No. of revolutions from pier to pier	9343
No. of revolutions after passing pierhead	56
Total No. of revolutions	9483
State change, if any, in opening of main stop valve	Nil
State change, if any, in degree of expansion	Nil
State change, if any, in opening of throttle valve	Nil
State what feed-water, if any, was supplied	Nil
Description of coal on trial	Stephenson Clarke's Merthyr
Coal used for lighting up and raising steam in the boilers to 50 lb. per square inch	1 ton 18 cwt.
Coal used on passage	8 tons 13 cwt.
Consumption of fuel per hour	46·76 cwt.
Condition of fire-grate	Good
Weight of ashes remaining at end of passage	1 ton 8 cwt. 1 qr. 16 lb.
Proportion of ashes to total fuel consumed	13·31 per cent.
Amount of smoke	Very little and light
State if steam blast was used, and how long	¾ open for 3 h. 40 min.
Depth of fire on bars at end of passage	2in. fore, 2in. aft
Distance pierhead to pierhead	64¾ knots
Distance travelled by paddle-wheel	82·07 knots
Amount of slip of paddle-wheel	26·75 per cent.
Mean indicated horse-power	2132·41

N.B.—Diagrams to be taken from each cylinder simultaneously, if possible, every half-hour.

The undermentioned Particulars to be taken every half-hour during the Passage.

Time.	10.45 a.m.	11.15 a.m.	11.45 a.m.	12.15 p.m.	12.45 p.m.	1.15 p.m.	1.45 p.m.
No. of revolutions per minute, by actual counting ...	40	42	40	44	43	42	42
Temperature of feed-water ... ...deg.	150	145	148	154	150	148	146
Temperature of gases in uptake... ...deg.	1350	1400	1350	1400	1425	1400	1350
Vacuum in uptake ... ... in.	¼	¼	¼	¼	⅜	¼	¼
Vacuum in ash-pit ... ... in.	⅛	¼	¼	¼	⅜	¼	¼
Vacuum in flame-box ... ... in.	¼	½	½	½	½	½	½
Vacuum in condenser ... ... in.	23	23	23	21½	23	23	23
Steam pressure	93	95	95	102	98	100	95
Point of cut-off by valve motion ... ...per cent.	65	65	65	65	65	65	65

Remarks.—Stephenson Clarke's Merthyr coal, ex-ship Commerce. Discharged direct from ship into barge, and put on board screened, and is of the same quality as previously reported. The freight brought by the Commerce appears to be much better as regards the size of coal, the percentage of small being much less than has been the case with any previous supplies brought by sea.

To W. Stroudley, Esq., Brighton. (Signed) R. A. Scott, Engineer.

Particulars of Coal Tests on Board S.S. Brittany during Passage from Dieppe to Newhaven on 24th July, 1884.

Condition of vessel's bottom	Clean
Draught	7ft. 11in. fore, 8ft. 5in. aft
Weight of cargo	59 tons
State if vessel had any list to port or starboard, and to what degree	2 deg. to starboard
Flood or ebb sailing	Spring flood
Booked time of starting from harbour	10.25 a.m.
Actual time of starting from harbour	10.21 a.m.
Actual time of passing pierhead going out	10.28 a.m. } h. m.
Actual time of passing pierhead coming in	3.3 p.m. } 4 35
Actual time of arrival at harbour	3.9 p.m.
Time detained on passage	Nil
Cause of detention	Nil
Particulars of sails used, and time	Nil
Height of barometer at starting	30·36
Direction of wind	W.N.W., strong
State of weather	Rainy
State of sea	Choppy head sea
Height of water in boilers on passing pierhead going out	3in. fore, 2½in. aft
Height of water in boilers on passing pierhead coming in	2½in. fore, 2in. aft
No. of revolutions before passing pierhead	64
No. of revolutions from pier to pier	9237
No. of revolutions after passing pierhead	76
Total No. of revolutions	9377
State change, if any, in opening of main stop valve	Nil
State change, if any, in degree of expansion	65 per cent.
State change, if any, in opening of throttle valve	Nil
State what feed-water, if any, was supplied	Nil
Description of coal on trial	Duffryn, Rhymney, Merthyr
Coal used for lighting up and raising steam in the boiler to 50 lb. per square inch	2 tons
Coal used on passage	10 tons 4 cwt.
Consumption of fuel per hour	44·51 cwt.
Condition of fire-grate	Good
Weight of ashes remaining at end of passage	1 ton 12 cwt. 3 qr. 22 lb.
Proportion of ashes to total fuel consumed	13·4 per cent.
Amount of smoke	Moderate; dark
State if steam blast was used, and how long	½ open; 4½ hours
Depth of fire on bars at end of passage	2in. fore, 1½in. aft
Distance pierhead to pierhead	64¾ knots
Distance travelled by paddle-wheel	81·14 knots
Amount of slip of paddle-wheel	25·31 per cent.
Mean indicated horse-power	1844·36

N.B.—Diagrams to be taken from each cylinder simultaneously, if possible, every half-hour.

The undermentioned Particulars to be taken every half-hour during the Passage.

Time.	11.0 a.m.	11.30 a.m.	12.0 p.m.	12.30 p.m.	1.0 p.m.	1.30 p.m.	2.0 p.m.	2.30 p.m.
No. of revolutions per minute, by actual counting	34	34	33½	36	36	34	34	33
Temperature of feed-water ... ...deg.	136	140	140	140	143	132	140	136
Temperature of gases in uptake ... ...deg.	1100	1150	1200	1150	1150	1175	1200	1225
Vacuum in uptake ... ... in.	⅜	⅜	⅜	⅜	⅜	¼	¼	¼
Vacuum in ash-pit ... ... in.	⅜	⅜	¼	⅜	⅜	¼	¼	¼
Vacuum in flame-box ... ... in.	½	½	½	½	½	⅜	½	½
Vacuum in condenser ... ... in.	24	24	23½	23½	23½	23½	24½	23½
Steam pressure	95	97	98	102	100	100	95	98
Point of cut-off by valve motion ... ...per cent.	65	65	65	65	65	65	65	65

Remarks.—With Scotch coal it would be more suitable for the boats. The consumption is somewhat less than with Stephenson Clarke's Merthyr coal.

To W. Stroudley, Esq., Brighton. (Signed) R. A. Scott.

THE TRENT NAVIGATION SCHEME.

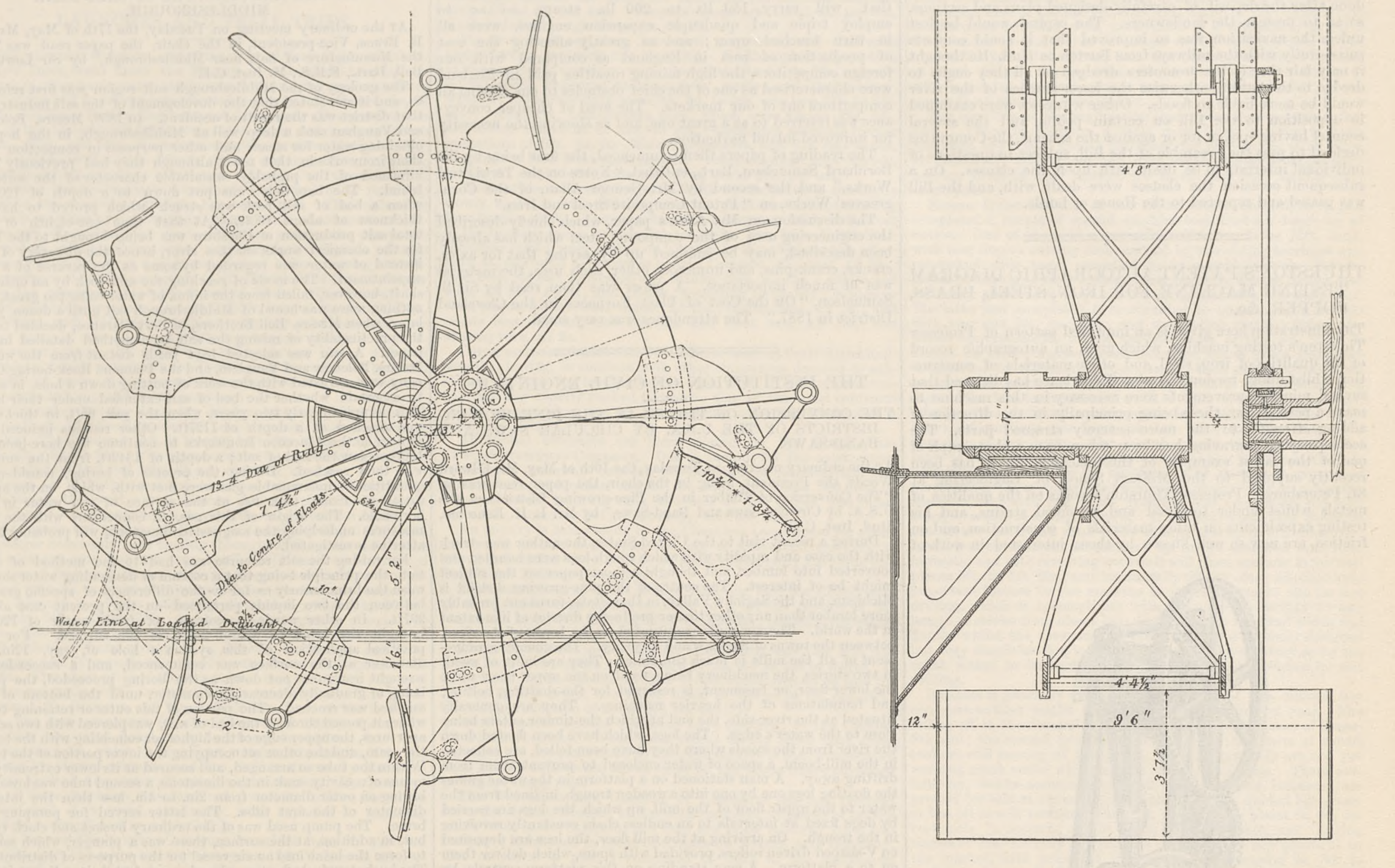
While the Manchester Ship Canal project is hanging fire—dependent upon the subscription of the amount upon which the commencement of the work depends—another internal canal scheme of equal importance within its less extensive limits has come before Parliament and received the sanction of one House, and is full of promise as a genuine and actual undertaking. Very few preliminary remarks are necessary to explain the object and effects of the Bill for the improvement and maintenance of the river Trent from Wilden Ferry, in Derbyshire and Leicestershire, or one of them, to the river Humber in the county of Lincoln, which has received the sanction of a Select Committee of the House of Lords. As far back as 1700 powers were granted to Lord Paget to make the river Trent navigable to Burton-on-Trent. Between that time and the present many efforts have been made to improve the carrying capacity of this, one of the main waterways of the country, and the river is now navigable up to a place known as Derwent Mouth, where communication with the Mersey system begins by means of a canal belonging to the North Staffordshire Railway Company, and this canal presents the only available means of transporting traffic by water between Burton-on-Trent and Hull. According to a statement put forward in the early part of the present session, "The capital and the powers of the present Trent Navigation Company are quite inadequate to provide efficient accommodation for the traffic for which the Trent will form when improved a most effective means of transport, and it is therefore enough to dissolve the present company, incorporate a new navigation company with increased capital and powers. The capital as at present proposed to be raised is £350,000, divided into 30,000 £10 shares. The navigation of the Trent below Gainsborough and the outfall of the river into the Humber is greatly impeded by shoals and shifting sands, and it is necessary, with a view of adapting the river to the requirements of modern trade, that the channel shall be dragged, deepened, straightened, and otherwise improved. The proposal is to enlarge the whole course of the river, so as to enable vessels drawing 6ft. of water to cover the entire course between Liverpool and Hull at any period of the year. As soon as this is accomplished, the company will by the scheme have powers to demand the tolls and duties provided by the Act of 1858." This being the scheme, the Bill for carrying it out came before a Select Committee of the House of Lords, the Earl of Jersey presiding, and the general scope of the measure and the nature of the opposition were explained by Mr. Pember, Q.C., in these terms:—The Bill (he said) was one to provide for the improvement and maintenance of the navigation of the river Trent from Wilden Ferry to Gainsborough, and out of a long string of opponents who had originally presented petitions against the measure, only three were left. The promoters of the Bill were gentlemen very largely interested in the district, and quite capable of carrying out any undertaking they might enter into. What an improved navigation would do was this. They proposed to bring the whole of the traffic they could get on to the river from Burton; and in doing so they would first of all tap Derby, because there was the Derby Canal there, and coming down they also came past Nottingham, with all the great trade there was at Nottingham, with all the great colliery district just opening out so largely, first of all up the Erewash Canal, then up the Nottingham Canal, and away to the Crompton Canal, running up as far as Pinxton, right away into South Derbyshire, and then beyond, from Pinxton, running up towards Belper, into the whole of the industrial part of Derbyshire, giving the whole of that the advantage of a proper access by means of the Trent to Hull and Grimsby, and the whole of the industrial undertakings and the great docks and shipping ports in Hull and Grimsby, and also, of course, to Goole, if necessary, and thereby bringing them all into direct communication with sea-going places. Not only so, but by means of a canal beyond Burton, the Trent and Mersey Canal, which went right away through the whole of the Staffordshire district, until it got into the Mersey by means of the Bridgewater Canal at Runcorn, and that was in communication with all the great canal systems, the Rochdale Canal—in fact, it was impossible to say what part of the great industrial portions of the northern and north-midland of England would not be put in direct communication with the eastern ports by a proper suitable inland navigation if once the Trent was put into an efficient position physically to carry the traffic. Mr. Pember described the different Acts which had been passed relating to the navigation of the Trent, and having referred to the provisions contained therein, he proceeded to deal with the petitions which had been lodged against the present Bill. Alluding to the petition of the riparian owners and to their statement that the deepening of the channel of the river would be disastrous to the banks, he said they contended that by diverting the stream into mid-channel it would be beneficial rather than injurious to the interests of the landowners. The petitioners said:—"We apprehend that the injury to the banks already caused by the use of steam tugs will be seriously increased by the employment of larger steamers, such as are intended to be used, and, moreover, as regards the Newark branch of the river, your petitioners are advised that no powers at present exist for the use of steam tugs or steam power thereon, and they object to such powers being granted." The petitioners were quite under a misapprehension with regard to that, because a legal decision had been given that steam tugs could be used. Then, with regard to the other matter, as to using larger steamers than at present, he thought they should have sufficient evidence before their lordships to show that there was a right, so far as regards steamers of the size which would be able to come up the river, and of the draught. It would be for their lordships to hear what they had to say on the matter, but the Trent was fairly wide, and in some places very wide, and when the river was deepened he thought they would have little to apprehend from the wash of steamers. Of course, in any place where there had been a very great washing away of the banks, it was quite possible some mischief might happen; but if there was any special place where anything was suggested which was not a fanciful injury, they must consider how they could manage to do as little injury as possible, and all their powers were on the principle that they must carry out all their works, doing as little damage as might be. If they did not, they were liable to an action. If they did as little damage as might be, they were then still liable to pay compensation under the Lands Clauses Act, and their 1858 Act. Therefore so far as that was concerned, he thought they did not want any special provision or protection in the Bill. As regarded the use of steam tugs on the Newark branch of the river, he would presently put in the shorthand writer's notes of the judgment of the Queen's Bench Division in that matter. It was perfectly clear that there was a right to use steam tugs. If there was such a right, and if that was involved in the grant of the original navigation, it was difficult to see why improving an existing system of navigation entitled the landowners to special compensation, which never was granted under the old Bill. There was a very strong set of petitions in favour of this Bill. They had a petition from the Corporation of Nottingham; from the Corporation of Derby; the Corporation of Burton-on-Trent; the Corporation of Newark-on-Trent; the Derby Canal Company; the Derby Chamber of Commerce; the Proprietors of the Leicester Navigation; the Proprietors of the Erewash Navigation; the Colliery Owners' Association of Nottingham, Leicestershire, and Derbyshire; the South Staffordshire Ironmasters' Association; the Proprietors of the Soar Navigation, and four hundred and eighty inhabitants of Gainsborough as against a couple of hundred who petitioned against them. During the early stages of the Bill numerous local bodies and individuals were strongly opposed to the Bill; but as time went on, and they realised more clearly the true position, they withdrew their objections, until—as Mr. Pember said—there were only three real opponents left.

Evidence being taken in support of the scheme, Mr. E. M. Hutton Riddell, a Newark banker, gave a brief history of the old Trent Navigation Company, of which he had been chairman for fifteen years, and he explained that the old company was dissolved by an Act of Parliament in 1884, and new powers were given to the company incorporated by that Act. The attempt made to raise capital was, however, half-hearted, in consequence of overtures which were made to the company by the Corporation of Nottingham. The Corporation went so far as to introduce a Bill in the Session of 1885, for the purpose of acquiring the navigation. The measure was abandoned, but the action of the Corporation to some extent paralysed the efforts of the company. In the course of cross-examination, Mr. Riddell stated that the object of the promoters was to make

FEATHERING PADDLE WHEELS S.S. NORMANDY AND BRITTANY.

MR. W. STROUDLEY, BRIGHTON, ENGINEER.

(*For description see page 425.*)



a thoroughly good waterway. The Bill would enable them to provide steam-tugs, and to make such charges as seemed to them to be reasonable. The old company were carriers, and they proposed to take over the old company's powers, and to construct vessels for the purposes of their business. They had no intention of dealing in commodities as traders, or of conducting any business except in connection with navigation. It would be competent when the Act was passed for anyone to put tugs on the river, and he knew people who were taking steps to do so. It would not be compulsory on them to use the company's tugs in the same way that it was compulsory on people to use the railway companies' engines on railways. As to capital, they contemplated raising £175,000, and the prospectus they had issued mentioned that figure. This included the sum of £42,500, which was to be allotted in fully paid-up shares as part of the purchase money of the old concern. A little over £80,000 had been subscribed, making a total exceeding £122,000, and leaving them only about £40,000 more to raise. They were to pay the old company £30,000 in cash, but the purchase they were making would represent a very valuable property. The works, freeholds, and plant they were acquiring had been valued at something like £100,000. The details would be laid before them by other witnesses. He had no doubt the property represented the value they had given for it or more. He had received so many assurances from substantial persons that he had no doubt whatever the further capital which was required would be raised. . . .

Other witnesses, including Mr. W. N. Nicholson, a director of the Trent Navigation Company, Mr. Samble, of Burton-on-Trent, Mr. Salt, M.P., and Mr. Barnes, M.P., having been examined in support of the Bill, Mr. Henry Mills, F.G.S., civil engineer, was examined. He said his firm were engineers to a good many noblemen, each of whom had consented to his saying that he supported the Bill. They were in want of a good navigation, and felt confident that if the scheme now proposed was adopted it would of necessity be a great benefit to the district where the collieries were situated. He agreed with what Mr. Barnes had said. Large ironworks had been removed from this district to Whitehaven, which had been a great loss to the neighbourhood. They had been removed to avoid the expense of transit to the sea. A great quantity of timber came to the colliery districts, and at present it came by railway. The navigation was almost valueless on account of the condition of the river. Witness pointed out five canals which ran through the colliery districts, and said the feelings of the owners of collieries and ironworks was that the navigation of the Trent, carried on in the way proposed would be a great advantage to them. There were large coalfields along almost the whole line of the river Trent. If the Trent was improved, no doubt the canals would be. The Nottingham Canal belonged to the Great Northern Railway. The Duke of Rutland used the Grantham Canal to bring coal to Belvoir. The Trent navigation was naturally the key to all the smaller canals running into it.

To illustrate the commercial effects of the project, Mr. R. P. Cafferata, a plaster manufacturer at Newark, was examined. He stated that his output averaged about 33,000 tons a year, and had done for the last three years. He had to compete with carriage from France, and it had taken about 7900 tons a year from him. The freight from France to London was 4s. per ton, and railway rate from Newark to the Thames was 9s. 2d. The French plaster came from Rouen by boats. If the navigation were improved, he could compete with the French, and could get the whole of the trade back to-morrow. He was also a brick manufacturer, and his kilns were adjacent to his works. At one time he did a considerable trade with London in bricks, but the cost of carriage was prohibitive. If he had water carriage, he could regain the whole of the brick trade which he had lost. He intended having his own vessels if this scheme were carried into effect.

Mr. Rofe, C.E., engineer to the Trent Navigation Company, gave evidence as to the different Acts which had been passed in reference to the river. If the traffic, he said, was to be fully conducted, it was necessary to dredge the river and to have more capital at their disposal, as proposed in the present Bill. He believed the amount they proposed to raise would be sufficient for their purposes. The riparian owners thought the dredging would injure their banks, but he did not think it would do anything of the kind. They had done considerable dredging on the river, and in one place on Lord Carnarvon's property at Stoke, where they had made a section and removed a shoal, notwithstanding it had had two heavy floods through it, it had maintained its position. Where a proper channel was dredged, it had the effect of improving the banks. The banks for a considerable distance had been greatly neglected for many years past. They were in the most deplorable state at the parts where the company did no dredging and no towing. There was nothing in the geological formation of the bed of the river to prevent dredging; on the contrary, it could be effectually and economically carried out. Dredging would improve the flow of water, mitigate the floods, and materially assist the drainage.

Cross-examined by Mr. Bidder: He said he had been connected with the company for some years. In 1845 the revenue of the company from tolls was £8000, in 1850 £4711, in 1855 £3111, in 1860 £4862, in 1870 £4261, in 1875 £3469, in 1886 £2980. In 1835 they had their largest toll. These were gross tolls. The dividend on £26,000 was about £1300, so take that from £2986 left a fair amount for working expenses. That would be a period, however, when they would be expending a large sum in dredging. He was associated with the 1884 Bill. They were now proposing to dredge the river deeper and to put in larger locks. They were going to deal with the same navigation, but to treat it in a different manner. He was not the advising engineer of this Bill, but he was the engineer to the company.

Among other experts and eminent men called in support of the Bill were the following:—Mr. Robert Robinson, civil engineer, Darlington, said he had inspected the river Trent and the Trent and Mersey Canal. The Tees was a river with which he was perfectly familiar. Its banks were similar to those of the Trent, and damage was done to the banks by the floods in a similar way to that done to the banks of the Trent. There was no traffic on part of the Tees, and he did not attribute the mischief to the banks of a river in any sense to the traffic upon it. It was not likely that any result of consequence to the banks would follow the use of steam tugs.

Mr. T. Hawksley, said his firm were responsible for the engineering portion of the scheme now before the Committee. He was well acquainted with the river Trent, and had recently made a careful investigation of it. He considered the proposed improvement essential, if the river was to be converted into one suitable to the navigation requirements of the present day. It was not proposed to alter existing weirs, nor to erect new ones. It was intended to substitute larger locks, so as to enable a steam tug to go through with a train of barges at only one alteration of the locking. The result of this Bill, if passed, would be to enable the company to do that which the old company failed to do from want of means. The efforts which had already been made had resulted in restoring some of the traffic. The Bill sought no powers to increase the number of weirs, and the water would not be higher than the present level, probably rather below it. There was no reason, therefore, to apprehend increased flooding. It would take ten million cubic feet of water to raise the level "lake" or floodlands between Gainsborough and Dunham Bridge, and the proposed works, if made, would only bring down a million and a half of cubic feet of water per hour. That would only raise the level of the "lake" above Gainsborough to the extent of three-eighths of an inch, and this estimate was made without taking into account certain moderating influences which, in his opinion, would altogether remove that three-eighths of an inch. In fact, the company's works would not increase the height of the floods at Gainsborough to any appreciable extent. As to the allegation that material taken out of the river would be an appropriation of property, they were prepared to give compensation to landowners in respect of materials taken out of a profitable nature. The clause settled with the Duke of Newcastle, who stood with respect to his banks and the bed of the river in the same position as other riparian owners, was one which he would advise should be made applicable to them all. In his opinion they would not by their works raise the flood level at all. They would spread the flood over a longer period by bringing some of the water down quicker, and so there would be less come down at the maximum height. The maximum amount coming down at any given moment would be less than it now was. The works they proposed to do would tend to the protection of the banks. The injury which was now done to them was not by any water brought down for the purposes of navigation, but by the floods.

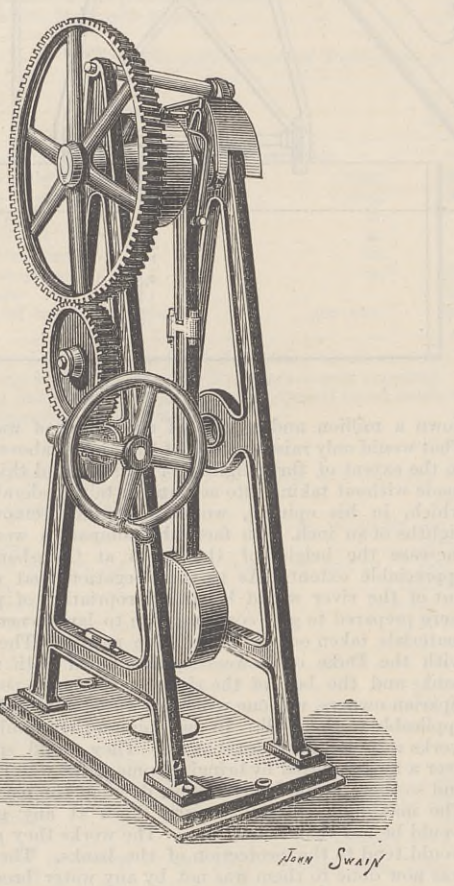
Sir Frederick Bramwell, briefly examined, expressed the view that the proposed works would not injure anyone, and that, on the contrary the more rapid discharge of the water would mitigate rather than increase the intensity of the floods at Gainsborough.

Mr. J. Abernethy said the effect of deepening and improving the channel would not be to raise the summer level—quite the reverse. It must be remembered that this was to a great extent a canalised river. There were five weirs across it. They proposed to remove certain shoals which existed between these weirs, and the effect of that would be to lower the summer level proportionately, and the flood level also. This was the inevitable result. Neither in the way of floods or summer level could the works possibly do any harm. The effect would not be very appreciable, but so far as it extended it would ameliorate the floods. The deepening of the channel in the centre of the river would have the effect of diminishing the wash upon the banks, and there would be a longer foreshore, over which the wave would extend. During floods the damage to the banks would be less. As the deepest portions of the river would be in the centre instead of as at present being irregular, and sometimes running close to the side with great velocity, the erosion on the banks would be lessened. The works would not raise the flood level at Gainsborough. The flood water would reach that town a little earlier than at present, instead of being heaped up and thrown down suddenly. In his opinion, therefore, Gainsborough would be benefitted. Witness was just now engaged for the Government in reporting upon the navigation in Ireland. The effect of removing shoals in the Irish rivers had been to lower the surface level during floods. He did not anticipate any difficulty in dredging this river.

On behalf of the opponents of the Bill, Mr. Rundle, C.E., consulting engineer to the Doncaster Corporation, said he believed that the effect of the proposed works would be to bring down the water to Gainsborough with greater rapidity and cause the floods there to rise to a higher level. The works would, in fact, increase the liability of Gainsborough to floods. One result would be to necessitate the barrier wall constructed on the Lea Marsh being strengthened and probably raised. It had already given way, with the result that Gainsborough was flooded. He thought therefore that it was only reasonable to ask that where damage was caused by these works the Local Board should receive the necessary compensation. Mr. W. H. Wilsted, C.E., of Hull, expressed the conviction that Gainsborough would suffer for the increase of water, and Mr. Leader Williams, C.E., engineer of the Manchester Ship Canal, expressed the opinion that the bed of it had long been rising owing to neglect, and that for an improved navigation they ought to deepen it so as to permit of vessels drawing 6ft. to navigate the river. To obtain this, necessary works would be required low down the Trent in the shape of movable sluices, and these could only be done after the deposit of carefully-designed plans and sections, so as to protect the landowners. The capital would be lost unless the navigation was so improved that it could compete successfully with the railways from Burton to Hull. He thought it only fair that if the promoters dredged at all they ought to dredge to the outfall, otherwise the lower reaches of the river would be more liable to floods. Other witnesses were examined in opposition to the Bill on certain points, and the several counsel having spoken for or against the scheme, the Committee decided to pass the preamble of the Bill, subject to questions of individual interests to be dealt with upon the clauses. On a subsequent occasion the clauses were dealt with, and the Bill was passed and reported to the House of Lords.

THURSTON'S PATENT AUTOGRAPHIC DIAGRAM TESTING MACHINE, FOR IRON, STEEL, BRASS, COPPER, &c.

THE illustration here given is an improved pattern of Professor Thurston's testing machine, which gives an autographic record of the qualities of iron, steel, and other materials of construction whilst under torsional strain. Experience has dictated that several minor improvements were necessary in this machine to make a perfect test, these being principally in the direction of adding strength to the more severely strained parts. The accompanying engraving has been taken from a photograph of one of the latest examples of this machine, which has been recently supplied to the Military School of Engineering at St. Petersburg. Professor Thurston's works on the qualities of metals whilst under torsional and tensional strains, and his testing experiments on other materials of construction, and on friction, are now so well known by those interested in work of



this description that we need not here give any account of his valuable researches in this direction. One of the first examples of the machine under notice, made by Messrs. W. H. Bailey and Co., of the Albion Works, Salford, Manchester, was noticed in our issue of September 18th, 1877. The one now illustrated, however, will convey a far better idea of its utility and application. We understand that Messrs. Bailey have an active department engaged in machines for an immense variety of testing purposes, in connection with which this enterprising firm has recently issued an exhaustive catalogue of testing machines and instruments, and no doubt many of our readers will avail themselves of the useful information afforded by its publication.

THE IRON AND STEEL INSTITUTE.

THE spring meeting of the Iron and Steel Institute commenced yesterday at the Institution of Civil Engineers, Mr. Daniel Adamson taking the chair as president. After the reading of the report of the Council for 1886, and presentation of the Bessemer medal to Mr. James Riley for his important services in the metallurgy of steel. Mr. Adamson read his inaugural address. In this he firstly referred to the mechanical and physical properties of iron 99·92 per cent. pure, and traced the difference in these properties as the quantity of usual alloying materials or impurities increased or varied, the effect of various temperatures on irons and modern steels, as first made known by himself to the Institute in 1878, and more recently further investigated; the modifying influence of various other causes was also dealt with, and the inference drawn that there need not, taking all these many things into account, be any wonder at "cannon bursting, nor at Cabinet Ministers making unwise speeches in Parliament when they attempt to discuss a subject of such a refined technical character." Passing on to the discussion of the questions involved in a selection of steels best suited for guns, and for various structural uses, and advocating more scientific knowledge of characteristics and applications, though not in the most scientifically exact phraseology, Mr. Adams urged the adoption of steels of higher tensile strength for bridges. In this he will meet strong though qualified support, but the makers and users of ploughs will not, perhaps, be so ready to endorse the proposed application of 60-ton steel in the construction of this old implement, as there may be difference of opinion as to the value of a plough of half the present weight for cutting furrows, say, 9in. by 14in. The use of mild welding steels for boilers, the selection of irons for founding uses, the increase in the weight of rails for our main fast lines, from 80lb. to 100lb., as advocated by Mr. C. P. Sandberg, the further use of cast steel, the use of boilers that will carry 150 lb. to 200 lb. steam, so as to employ triple and quadruple expansion engines, were all in turn touched upon; and as greatly affecting the cost of production of iron in England as compared with our foreign competitors, the high mining royalties paid in England were characterised as one of the chief obstacles to our driving all competitors out of our markets. The need of cheaper conveyance was referred to as a great one, and as showing the necessity for improved inland navigation.

The reading of papers then commenced, the first being by Sir Bernhard Samuelson, Bart., entitled, "Notes on the Terni Steel Works," and the second by Mr. George Allan, of the Corngreaves' Works, on "Patent Composite Steel and Iron."

The discussion on Mr. Allen's paper, which chiefly described the engineering uses of the compound steel which has already been described, may be summed up by saying that for axles, cranks, crank-pins, and numerous other such uses, the material was of much importance. A paper was then read by Sir B. Samuelson, "On the Cost of Blast Furnaces in the Cleveland District in 1887." The attendance was very small.

THE INSTITUTION OF CIVIL ENGINEERS.

THE CONVERSION OF TIMBER IN THE PINE-GROWING DISTRICTS OF THE U.S.A. BY CIRCULAR SAWS AND BAND-SAWS.

AT the ordinary meeting on Tuesday, the 10th of May, Mr. Edward Woods, the President, being in the chair, the paper read was on "The Conversion of Timber in the Pine-growing Districts of the U.S.A. by Circular Saws and Band-Saws," by Mr. L. H. Ransome, Stud. Inst. C.E.

During a recent visit to the United States, the author was struck with the ease and rapidity with which rough logs were handled and converted into lumber, and thought a short paper on the subject might be of interest. The centre of the pine-growing district is Michigan, and the Saginaw Valley, in that State, turns out probably more lumber than any other timber-producing district of like extent in the world. The saw-mills are situated on the banks of the river, between the towns of Saginaw and Bay City. The general arrangement of all the mills is much the same. They are built of wood, in two stories, the machinery being fixed on the upper floor, while the lower floor, or basement, is reserved for the shafting, belting, and foundations of the heavier machines. They are generally situated at the river-side, the end at which the timber enters being close to the water's edge. The logs, which have been floated down the river from the woods where they have been felled, are collected in the mill-boom, a space of water enclosed to prevent them from drifting away. A man stationed on a platform in the water guides the floating logs one by one into a wooden trough, inclined from the water to the upper floor of the mill, up which the logs are carried by dogs fixed at intervals to an endless chain constantly revolving in the trough. On arriving at the mill floor, the logs are deposited on V-shaped driven rollers, provided with spurs, which deliver them on to a platform. A man standing on this platform controls, by means of a lever, a steam log-flipper, with an incline towards the carriage of the circular or band-saw, as the case may be. The logs are held in position while being fixed by an ingenious machine commonly known as a "steam-nigger." Several methods of feed are employed in these mills; but the usual plan consists of a steam-cylinder fixed immediately below the floor-line, and corresponding in length with the travelling carriage. In addition to the large circular saws or band-saws, a vertical frame, or gang-saw, is employed for cutting the slabbed logs into boards of any required thickness.

In order the better to appreciate the respective merits of circular saws and band-saws, the construction of both machines was described, as well as of the mode of treating the saws in each case, their relative advantages being considered under the following heads:—(1) Rapidity of production. (2) Quality of work. (3) Power consumed. (4) Waste of wood.

As regards rapidity of production, the circular saw has at present a decided advantage, producing on an average in white pine 50,000 square feet of lumber, 1in. thick, in a day of ten hours, while the band-saw in the same time turns out on an average about 35,000ft. It should, however, be borne in mind that the circular saw, having been in use for so many years, has probably reached its utmost limit of production, while, on the other hand, the band-saw, having been but recently introduced for this purpose, is capable of considerable further development. This assumption is confirmed by the fact that a band-saw mill of the most improved construction has been known to produce as much as 52,000ft. in a day of ten hours, the product of one hundred and two logs.

As regards quality of work, the advantage is undoubtedly on the side of the band-saw, for whereas it is practically impossible to run a large circular saw at a high velocity without a certain amount of vibration, which naturally produces a somewhat rough surface, a band-saw, being packed immediately above and below the cut, passes through the log in a straight line; and moreover, as the teeth of a band-saw are considerably finer than those of a circular saw, they produce a smoother surface.

It is unfortunate that, owing to the question of power being so little considered in America, and to the fact that the application of the band-saw for logs is comparatively new, no authentic tests as to the power required by the latter machine have as yet been made with the indicator; but by comparing the engines usually employed to drive both the band and circular mills, an approximate idea on this point may be arrived at. To drive a circular mill with a 6ft. saw, an engine with a cylinder 18in. in diameter, a piston-travel of 500ft. per minute, and an average pressure on the piston of 40 lb. to the square inch, is generally employed. Such an engine developes 154 indicated horse-power. To drive a full-sized band mill, an engine with a cylinder 12in. in diameter, working under similar conditions as to piston-speed and average pressure, is recommended. This would develope about 68 indicated horse-power, or considerably less than one-half that required to drive a circular mill.

The last, but certainly not the least, important point is the question of waste of wood; and here again the band-saw gives by far the best results. The amount of wood lost in sawdust per cut by a circular saw is $\frac{5}{16}$in.; therefore, when producing boards 1in. thick, the waste is 24 per cent. A band-saw at most wastes $\frac{1}{8}$in. per cut, or, when cutting 1in. boards, 11 per cent. Again, to make a board cut by a circular saw, when planed on both sides, hold up to $\frac{7}{8}$in., it must be cut 1in. thick; *i.e.*, $\frac{1}{16}$in. must be allowed on each side for planing; while, on the other hand, owing to the superior cutting of the band-saw, it is only necessary to allow $\frac{1}{32}$in. on each side for planing, showing an additional saving of $\frac{1}{16}$in. per cut. This gives a total saving of $\frac{1}{4}$in. per cut by the use of the band-saw.

The foregoing calculations apply to timber of such a size as can be converted by a circular saw 6ft. in diameter; but for larger logs it is necessary to employ an overhead saw, and as the tracks of the two blades never exactly coincide, the boards thus sawn show a joint, which necessitates a still further waste of wood. This objection does not apply to the band mill, which will saw through logs of any diameter.

It is thus evident that for the conversion of pine logs, the balance of advantage lies distinctly with the band-saw; and if this is so in the case of comparatively small and cheap timber, it is certain that for the more valuable descriptions of hard woods, which frequently run to very large sizes, these advantages would be enormously increased; and it is not too much to say that the band-saw will, in a few years, be universally employed in preference to any other machine for the wholesale conversion of timber.

ON THE MANUFACTURE OF SALT NEAR MIDDLESBROUGH.

AT the ordinary meeting on Tuesday, the 17th of May, Mr. G. B. Bruce, Vice-president, in the chair, the paper read was "On the Manufacture of Salt near Middlesbrough," by Sir Lowthian Bell, Bart., F.R.S., M. Inst. C.E.

The geology of the Middlesbrough salt region was first referred to, and it was stated that the development of the salt industry in that district was the result of accident. In 1859, Messrs. Bolckow and Vaughan sank a deep well at Middlesbrough, in the hope of obtaining water for steam and other purposes in connection with their ironworks in that town, although they had previously been informed of the probably unsuitable character of the water if found. The bore-hole was put down to a depth of 1200ft., when a bed of salt rock was struck which proved to have a thickness of about 100ft. At that time one-eighth of the total salt production of Cheshire was being brought to the Tyne for the chemical works on that river, hence the discovery of salt instead of water was regarded by some as the reverse of a disappointment. The mode of reaching the salt rock by an ordinary shaft, however, failed from the influx of water being too great, and nothing more was heard of Middlesbrough salt until a dozen years later, when Messrs. Bell Brothers, of Port Clarence, decided to try the practicability of raising the salt by a method detailed in the paper. A site was selected 1314 yards distant from the well of Messrs. Bolckow and Vaughan, and the Diamond Rock-boring Company was entrusted with the work of putting down a hole, in order to ascertain whether the bed of salt extended under their land. This occupied nearly two years, when the salt, 65ft. in thickness, was reached at a depth of 1127ft. Other reasons induced the owners of the Clarence Ironworks to continue the bore-hole for 150ft. below the bed of salt; a depth of 1342ft. from the surface was then reached. During the process of boring, considerable quantities of inflammable gas were met with, which, on the application of flame, took fire at the surface of the water in the bore-hole. The origin of this gas, in connection with the coal measures underlying the magnesian limestone, will probably hereafter be investigated.

For raising the salt recourse was had to the method of solution, the principle being that a column of descending water should raise the brine nearly as far as the differences of specific gravity between the two liquids permitted—in the present case about 997ft. In other words, a column of fresh water of 1200ft brought the brine to within 203ft. of the surface. For the practical application of this system a hole of, say, 12in. in diameter at the surface was commenced, and a succession of wrought iron tubes put down as the boring proceeded, the pipes being of gradually decreasing diameter, until the bottom of the salt bed was reached. The portion of this outer or retaining tube, where it passed through the bed of salt, was pierced with two sets of apertures, the upper edge of the higher set coinciding with the top of the seam, and the other set occupying the lower portion of the tube. Within the tube so arranged, and secured at its lower extremity by means of a cavity sunk in the limestone, a second tube was lowered, having an outer diameter from 2in. to 4in. less than the interior diameter of the first tube. The latter served for pumping the brine. The pump used was of the ordinary bucket and clack type, but, in addition, at the surface, there was a plunger, which served to force the brine into an air vessel for the purposes of distribution. The bucket and clack were placed some feet below the point to which the brine was raised by the column of fresh water descending in the annulus formed between the two tubes. In commencing work, water was let down the annulus until the cavity formed in the salt became sufficiently large to admit of a few hours' pumping of concentrated brine. On the machinery being set in motion, the stronger brine was first drawn, which, from its greater specific gravity, occupied the lower portion of the cavity. As the brine was raised fresh water flowed down. The solvent power of the newly-admitted water was of course greater than that of water partially saturated, and being also lighter it occupied the upper portion of the excavated space. The combined effect was to give the cavity the form of an inverted cone. The mode of extraction thus possessed the disadvantage of removing the greatest quantity of the mineral where it was most wanted for supporting the roof, and had given rise to occasional accidents to the pipes underground. These were referred to in detail, and the question was started as to possible legal complications arising hereafter from new bore-holes put down in close proximity to the dividing line of different properties, the pumping of brine formed under the conditions described presenting an altogether different aspect from the pumping of water, or natural brine.

The second part of the paper referred to the uses to which the brine was applied, the chief one being the manufacture of common salt. For this purpose the brine, as delivered from the wells, was run into a large reservoir, where any earthy matter held in suspension was allowed to settle. The clear solution was then run into pans 60ft. long by 20ft. wide by 2ft. deep. Heat was applied at one end by the combustion of small coal, beyond which longitudinal walls, serving to support the pan and to distribute the heat, conducted the products of combustion to the further extremity, where they escaped into the chimney at a temperature of 500 deg. to 700 deg. Fah. On the surface of the heated brine, kept at 196 deg. Fah., minute cubical crystals speedily formed. On the upper surface of these other small cubes of salt arranged themselves in such a way that, in course of time, a hollow inverted pyramid of crystallised salt was formed. This ultimately sank to the bottom where other small crystals united with it, so that the shape became frequently completely cubical. Every second day the salt was "fished" out and laid on drainers to permit the adhering brine to run back into the pans. For the production of table salt the boiling was carried on much more rapidly, and at a higher temperature, than for salt intended for soda manufacturers. The crystals were very minute, and adhered together by the solidification of the brine, effected by exposure on heated flues. For fishery purposes the crystals were preferred very coarse in size. These were obtained by evaporating brine more slowly and at a still lower temperature than when salt for soda-makers was required. At the Clarence Works experiments had been made in utilising surplus gas from the adjacent blast furnaces, instead of fuel, under the evaporating pans, the furnaces supplying more gas than was needed for heating air and raising steam for iron-making. By means of this waste heat, from 200 to 300 tons of salt per week were now obtained.

The paper concluded with some particulars of the soda industry. The well-known sulphuric acid process of Leblanc had stood its ground for three-quarters of a century in spite of various disadvantages, and various modes of utilising the bye-products having been from time to time introduced, it had until recent years seemed too firmly established to fear any rivals. About seven years ago, however, Mr. Solvay, of Brussels, revived in a practical form the ammonia process, patented forty years ago by Messrs. Hemming and Dyar, but using brine instead of salt, and us avoiding the cost of evaporation. This process consisted of forcing into the brine currents of carbonic acid and ammoniacal gases in such proportions as to generate bicarbonate of ammonia, which, reacting on the salt o the brine, gave bicarbonate of soda and chloride of ammonium. The bicarbonate was placed in a reverberatory furnace, where the heat drove off the water and one equivalent of carbonic acid, leaving the alkali as a monocarbonate. Near Middlesbrough the only branch of industry established in connection with its salt trade was the manufacture of soda by an ammonia process, invented by Mr. Schlœsing, of Paris. The works were carried on in connection with the Clarence Saltworks. It was believed that the total quantity of dry soda produced by the two ammonia processes, Solvay's and Schlœsing's, in this country was something under 100,000 tons per annum, but this make was considerably exceeded on the Continent.

LAUNCHES AND TRIAL TRIPS.

THE steamer, Shannon, one of the City of Cork Steamship Company's liners, went down the Mersey on her official trial trip on Monday, after having new machinery fitted to her and extensive alterations and improvements effected to her hull by Messrs. David Rollo and Sons, Fulton Engineworks, Liverpool. The new engines are of the three-crank triple expansion type, and have cylinders 21½in., 36in., and 58in. diameter respectively, with a stroke of 36in. The engines are of a very simple, strong, and open design, having ordinary double excentric valve gear, with all the valves placed in line above the crank-shaft; combined steam and hand reversing gear on the revolving principle has been fitted. The condensing water is supplied by a centrifugal pump, while there are two complete sets of duplicate air, feed, and bilge pumps; the pumps are worked by an independent set of triple expansion engines. Steam is supplied by two large double-ended steel boilers, having a working pressure of 155 lb. per square inch. The whole of the machinery is to the requirements of the Board of Trade. The Shannon is a vessel of 882 tons gross register, she is 251ft. between perpendiculars, 28-2 beam, and 17½ft. depth of hold. On her trial yesterday her mean draught was 12-3, and, with her engines running 81 revolutions per minute, the speed was 13¼ knots per hour. This was considered highly satisfactory. The whole of the contract has been carried out under the personal supervision of Mr. G. A. Calvert, the company's superintendent engineer.

On Saturday last the steam-tug Jubilee, built by Messrs. Steward and Latham, Blackwall, made her trial trip with most satisfactory results. The Jubilee is 71ft. in length, 14ft. 6in. beam, and 8ft. 6in. in depth. She is fitted with compound surface condensing engines, with cylinders 14·5 and 28in. diam., and 22in. stroke.

Messrs. A. M'Millan and Son launched from their dockyard at Dumbarton, the steel screw steamer Albania, sister to the Ionia and Thrace, both launched a few weeks since from the dockyard. These vessels are to form additions to the Greek Royal Mail and Passenger Steamship Line trading throughout the coasts of Greece and adjacent seas, and are very handsomely fitted up for a large number of first and second-class passengers, and are to be furnished with all modern improvements for comfort and economy. The Albania is of the following dimensions:—Length, 265ft.; breadth, 34ft.; depth 21ft.; tonnage gross register, about 1500 tons. The machinery, which is on the triple expansion type of 1700 indicated horse-power, is by Messrs. D. Rowan and Son, Glasgow, and is capable of propelling the vessel at a speed of 13 knots. The shell of the Albania is the first on which the new electro-magnetic drill, invented and introduced by Mr. F. J. Rowan, C.E., Glasgow, and Mr. J. M'Millan, jun., of the builders' firm, has been employed for the purpose of boring instead of punching the rivet holes in hulls of vessels, boilers, &c. The drilling machine, which is of a light weight, attaches itself to the plating by electro-magnets, and the drill is driven by electrical energy applied to a motor of suitable construction. By the adoption of these machines it is rendered practical to bore the whole of the shell of a vessel, producing work superior to anything hitherto accomplished in shipbuilding.

The Barrow Shipbuilding Company launched from its yard on the 25th inst. the screw steamer Grangense for Messrs. R. Singlehurst and Co., Liverpool. Her dimensions are 180ft. by 26ft. breadth moulded, by 11ft. depth of hold, and she is intended to carry about 300 tons deadweight and steam 10 knots at sea loaded. She will be schooner rigged with two-pole masts. She is built of steel and will be eligible for the 100 A class in Lloyd's Registry of shipping. The ship will be propelled by triple expansion engines of 500 indicated horse-power with a working pressure of 150 lb. per square inch. The vessel will be completed in a few weeks, when she will be ready to go to her station in South America. On the same day the builders also launched for the Metropolitan Board of Works, the twin screw steamer Bazalgette, 230ft. in length by 38ft. beam by 13ft. 10in. depth of hold, and capable of carrying 1000 tons deadweight. She is built of steel, will be classed 100 A.1 in Lloyd's Register. The vessel will be propelled by twin screw triple expansion engines, 15in., 22in., and 33in. diameter by 24in. stroke, with a working pressure of 150 lb. per square inch and capable of steaming 10 knots a hour. This steamer is the first of a series of similar vessels intended to be built to the order of the Metropolitan Board of Works for the purpose of conveying London sewage sludge from the outfalls in the river Thames out to sea.

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

(*From our own Correspondent.*)

THERE is slightly more activity at the finished ironworks this week in consequence of makers working off orders which are required before the Whitsuntide holidays begin. Such work being completed, makers anticipate nothing doing during the whole of next week. In some exceptional cases, however, operations will be resumed on Tuesday night or Wednesday.

The close of the month operates to deter much new business coming out, and influenced by recent events, ironmasters show rather more determination than before to refuse profitless orders.

Prices cannot be said to be improved. A moderate demand is experienced for medium and common bars, but the market is somewhat prejudiced by the slackness of Australian inquiries. Marked bars remain at £7, and second-class qualities at £6; medium sorts are £5 5s. to £5 10s., while common are £4 15s. to £5.

In the sheet branch the earliest restarts will be made after the holidays because of the desire which shippers express for the speedy execution of contracts. Sheets, singles, are £5 17s. 6d. upwards; doubles, £6 to £6 2s. 6d.; and trebles, £7 easy, all with local delivery. Galvanised sheets are quoted £9 17s. 6d. to £10 for 24 gauge, delivered Liverpool, but occasionally contracts are accepted at £9 15s.

Makers of thin sheets for stamping and working-up purposes generally report quite an active business on account of country consumers, and also for the United States, Canada, Australia, Sweden, Denmark, Norway, Russia, and Italy. Messrs. E. P. and W. Baldwin are meeting with an enlarged sale for their terne, lead, and tinned sheets in particular. Their present prices are:—Severn singles, £10; Wilden B., £11; and B.B., £12. Upon doubles and extra 20s. to 30s. per ton is quoted, and upon lattens a yet further 20s. to 30s. Charcoal sheets are £15; best charcoal, £18; and extra qualities, £21. Messrs. Jno. Knight and Co. quote:—The "Cookley K" brand of tinned sheets, 26s.; Cookley S.S., 24s.; "Cookley," 23s.; black "Dibdale," 8s.; "K.B.C.," 9s.; "Crown," 10s. 10d.; "C.S.S" charcoal, 14s. 10d.; "Knight's charcoal," 18s. 10d., all per box at the works.

The quotations of Knight's Crown bars are £7; plough bars, £9; and charcoal bars, £15, also at the works.

The new Russian and Canadian tariffs were much discussed by ironmasters this—Thursday—afternoon in Birmingham. The sheet makers, alike ordinary and best, are most affected. A large business is done with Russia in common black roofing sheets, while Canada and Russia also take best thin sheets in considerable lots. The common sheet makers have most to fear, since Russia can more easily supply herself with these than with best sheets. As to the Canadian business, best sheet makers anticipate increased overland competition by the United States.

Importations continue of steel and iron produced in Scotland. Steel sheets or plates, from ¼in. thick down to 20 w.g., the Scotch people are delivering here at under £7 per ton, after paying a carriage of 15s. per ton; and wide iron gas strip, from 10in. up to 20in., they are sending in at under £6 per ton. Narrow gas strips from local makers are about £4 15s. to £5 per ton, and bedstead strip £5 to £7 per ton. Coopers' hoops are about £5 per ton, while builders' rough hoops are £4 15s.

Pig iron does not show increased movement, and deliveries under former contracts are curtailed. Northampton pigs, which at the quarterly meetings were quoted at 38s. 6d. to 39s., are now selling at 36s. delivered to consumers' works; and Derbyshires', which at the earlier date were 39s. 6d. to 40s. are now 37s. to 38s. easy. Similarly, Lincolnshire pigs, which were 42s. to 42s. 6d., are to-day abundant at 39s. to 40s.; hematites maintain former quotations of 52s. 6d. for Welsh forge sorts, and 57s. 6d. to 60s. nominal for best West-coast brands. Local all-mine pigs are 50s. to 52s. 6d., and cinder sorts something under 20s. per ton.

Work at the mills and forges in North Staffordshire is coming in slowly, and it is with difficulty that the plant can be kept running four turns a week. The export demand keeps up fairly well, most of the business being on colonial account. Bars from North Staffordshire works were quoted on 'Change in Birmingham this afternoon at, delivered Liverpool or equal: Common, £5; best, £5 10s.; best best, £6 5s.; horseshoe and turning iron, £5 15s.; angles and tees, £5 15s., £6 5s., and £6 15s., according to quality; bridge or tank plates, £6 5s.; best boiler, £6 15s.; double best, £7 5s.; and treble best, £9 5s.; best channel and rivet iron, £7 15s.; and fencing wire, £7 5s.

Constructive engineers note with satisfaction that the Midland Railway Co., having, in common with other companies, decided to substitute bridges for level crossings, the work of bridge construction is being rapidly pushed forward. One of the latest contracts in this respect given out by the company is for the erection of a bridge at Bulwell.

Additional contracts are being placed by the Birmingham Central Tramways Company. One of them is for the construction of a cable tramway between the borough of Birmingham and Handsworth, and others are for the supply of about 500 tons of Bessemer steel tramway rails, 350 tons of slot beams, and other materials, including points, crossings, and the like.

An inquiry is being made by the Cheshunt Local Board for about 1300 tons of cast iron pipes, ranging in diameter from 12in. to 36in., and similar work is likewise being required by the Oude and Rohilkund Railway Company.

The ironworkers at Great Bridge, believing that the sliding scale of the Liability Corporation is unfair to a certain portion of the workmen, have, at a meeting held on Monday, passed a resolution in favour of the sliding scale of 1886.

The rivet workers in the Rowley, Blackheath, and Old Hill districts have given notice for a return to the old 4s. list of wages. It is declared by the operatives that rivets which used to be paid for at the 4s. list prices are being made as low as 2s. 6d. per cwt., showing a reduction of about 37½ per cent.

More cases of serious rattening have occurred in the Cradley Heath chain trade. What gives colour to the belief that these outrages are not committed by the chainmakers is the circumstance that smiths' bellows are slit at some of the shops where advanced prices are being paid.

The Wolverhampton Chamber of Commerce has just received from the British Minister at Madrid a complete collection of native-made locks in use in Spain, and they are to be followed by a collection of locks used in Spain and made in France and Germany. The collection is mainly composed of locks of the commonest description; but some imitations of French patterns are very good work.

NOTES FROM LANCASHIRE.

From our own Correspondent.)

Manchester.—The condition of trade in the iron and allied branches of industry in this district still presents no improved aspect upon what I have had previously to report, except that perhaps the collapse of one of the oldest iron-making concerns in the district has tended to emphasise the conviction which has been steadily growing of late, that prices have already passed the lowest point at which it is possible that iron, even under the most favourable conditions, can be made at anything like a legitimate return to the producer; and this has brought forward some of the hesitating buyers who have been waiting for still lower prices. Business, however, that is forced forward under such conditions does not represent any real improvement in trade. The main element for an improvement in trade is still wanting. There is no real increase of actual requirements amongst the users of iron in the district; and although no doubt the work in hand, taking it all through the various branches of industry, represents a very considerable consumption of iron, there is still the fact that this consumption is considerably below even the present restricted production, and this excess of iron over requirements must of necessity continue to keep down prices. With regard to the export trade, the increased Canadian tariffs will of course tend to check business in this direction, and they have given rise to some bitter comments on the hostile action which our Colonies take with regard to what it is here regarded should be a mutual free commercial intercourse between the Mother Country, and the various colonial Possessions. Further than this the almost prohibitory tariffs which have been put in force by nearly every country where British industrial enterprise has become a competitor are becoming a very sore point whenever the prospects of trade are discussed, with the result that in many cases a very severe strain is being put upon free trade principles which have hitherto been held without question. In what I have stated I am of course only reflecting the tone of conversation which is very prevalent upon 'Change, but there seems to be a growing feeling that there is a want of reciprocity in our commercial relations with other countries which can scarcely be regarded as a satisfactory consummation of our free trade policy.

There was a fairly good attendance on the Manchester iron market on Tuesday, with rather more business coming forward from buyers, who had been holding back in the expectation of lower prices; but there was no really increased weight of actual requirements. For pig iron there was a fair amount of inquiry, and transactions to a moderate extent were reported, but this was chiefly due to hesitating buyers coming into the market under the apprehension that the recent failure in the iron trade might tend to stiffen prices; and to a certain extent these apprehensions were justified, as some of the Lincolnshire makers were holding out for a slight advance upon the prices that would have been taken a week or so back. Generally, however, where higher prices were asked, the effect was to check business, and there was no eagerness to buy except at low figures. For Lancashire brands of pig iron quotations remain nominally at 38s. 6d. to 39s., less 2½, delivered equal to Manchester, but at these figures local makers are doing little or nothing. For Lincolnshire iron, makers are asking 36s. 6d. and 37s. for forge to 37s. 6d. and 38s. for foundry, less 2½, delivered equal to Manchester, and at about the minimum figures moderate transactions are reported. In outside brands offering here Scotch iron remains the weak point in the market, and in this underselling is going on quite as keenly as ever, with prices apparently tending still lower, but in Middlesbrough iron the tone is firm, and for the best-named brands of foundry makers hold to 43s. 4d., net cash, for delivery equal to Manchester, although there are some ordinary g.m.b.'s to be got at about 1s. per ton under this figure.

In hematites some considerable buying is reported to have been going on recently, both for home requirements and for shipment, and prices are showing more firmness; makers of the best brands are holding for about 53s., less 2½, for No. 3 foundry, delivered into the Manchester district. The business doing here is, however, still only small, and there are sellers prepared to take under the above figure.

The manufactured iron trade remains about stationary, both as regards prices and demand; but if trade is not actually any worse, there is an absence of any prospect of improvement, which gives a depressed tone to the market, and with many of the makers only indifferently supplied with work there is a disposition to cut a little under quoted rates to secure actual specifications. The quoted list prices for delivery into the Manchester district remain at about £5 per ton for bars, £5 5s. for hoops, and £6 5s. to £6 10s. per ton for sheets, but in many cases about 1s. 3d. per ton under these figures is being taken.

The condition of the engineering trades remains very unsatisfactory. There is, perhaps, a little more work stirring in some branches, but it is so keenly competed for that it has to be taken at excessively low figures, and it is very exceptional where engineering firms in this district are more than very indifferently employed.

Messrs. Hulse and Co., of the Bidsal Works, Salford, have just completed a couple of special machine tools that are deserving of notice. One of these is a powerful self-acting lathe 75ft. long, with four duplex cutting tools, carried by two sliding carriages and compound slide rests, propelled by twin guide screws. Several lathes of this type have already been made by Messrs. Hulse, and for heavy steel work they are becoming almost a standard tool. The lathe just completed is constructed to operate upon objects 60ft. long and 5ft. diameter, and the sliding carriage being propelled simultaneously at the opposite sides of the bed, there is almost an entire absence of cross-strains, whilst great steadiness is imparted to the cutting operations. Each sliding carriage can be traversed in either direction independently of the other, and each of the four tools will take a cut of 1½in. deep over a ¼in. feed, which, at the ordinary cutting speed for steel, is equal to about 5 cwt. of cuttings per hour, or ten tons for the four tools per day of ten hours. The second special tool just completed may be described as a large universal milling machine, which is certainly remarkable for the multiplicity of work it is capable of performing. It is constructed somewhat on the type of a planing machine, viz., with bed, table, uprights, and cross slide, but with a large vertical revolving spindle. It will drill a hole 3½in. diameter out of the solid, and afterwards enlarge this up to 5in. diameter; it will mill exterior curved surfaces up to 3ft. diameter and 10in. in depth, and with revolving cutters it will plane surfaces in vertical planes 6ft. by 1ft. 6in., and horizontally 6ft. by 3ft. Another very important feature in the machine is its arrangement also for slot drilling, which it accomplishes with the greatest facility to any length of stroke from about 1½in. to 6ft. by any required width and depth, whilst the reversing of the stroke by a specially designed but very simple motion is effected with as much accuracy as by the crank action to be found in machines expressly designed for slot drilling.

Business is generally quiet in the coal trade of this district, but not more so than might be expected for the time of year. The falling off in the demand is felt chiefly in the best classes of house-fire coal; the second qualities and the commoner sorts of round coal are still moving off fairly well, and pits generally are not yet working much under what may be termed full time. There are, however, stocks accumulating, and these in some instances are pressed for sale at under current rates; but the quoted list prices at the pit mouth remain unchanged, and average about 8s. 6d. for best coals, 7s. seconds, and 5s. to 5s. 9d. for common coal. Engine classes of fuel are only in moderate demand, and are plentiful in the market, with prices at the pit mouth averaging 4s. 3d. to 4s. 9d. for burgy, 3s. 6d. to 3s. 9d. for best slack, and about 2s. 6d. per ton for the common sorts.

For shipment there is a tolerably good demand, but prices rule low, steam coal delivered at the high-level, Liverpool, or the Garston Docks, being obtainable at about 6s. 9d. to 7s. per ton.

Barrow.—The demand for hematite pig iron is quiet, and there is not much business in the immediate future, if the present inquiry is any criterion. But there is no secret as to the fact that buyers would readily purchase large deliveries for forward delivery if they could be booked at lower prices than those which are asked by makers. It is significant that the demand for iron in the Glasgow and other markets has improved to such an extent as to lead to an increase in quotations up to 43s. 6d. per ton, being fully 2s. over the selling price of a few weeks ago. The business doing with second-hand dealers is also at fuller prices, and it is worthy of note that there is less margin between the prices quoted by makers and that at which second-hand dealers have been doing business than has been the case for some time past. The probability is that a considerable number of orders will be booked during the earlier part of the summer season for delivery during the latter part of the summer and the autumn months, There is a good demand for Bessemer pig iron on the part of steel makers, who are very busily employed, and who are experiencing a good demand for steel rails especially. There is also a good inquiry for blooms, billets, and bars, and orders are well held. Rails are quoted at from £4 1s. 3d. to £4 5s. per ton net f.o.b., and blooms at £3 15s. to £3 17s. 6d., while billets are quoted at £3 18s. to £3 19s. per ton net. There is a guaranteed activity in the steel trade throughout the season, and even the merchant steel and in the steel shipbuilding material department there are hopes of improved trade. The demand for finished iron is quiet, and sales remain at an unremunerative price. The shipbuilding trade has received no new impetus. Orders are offering, but up to the present none have definitely been placed. It is considered probable that some new contracts will be booked shortly, not only in the shipbuilding, but in the marine engineering departments. Iron ore is in fair but not brisk demand. The native samples are quoted at 8s. 6d. to 11s. per ton net at mines. Last week a sale by auction in West Cumberland of Spanish ore of ordinary quality realised 9s. 6d. per ton. The coal and coke trades are steady, and no variation in demand can be noted. Shipping is fairly employed, and some very heavy parcels have to be delivered during the season to America and the colonies. The proposed alterations in the tariffs of Canada will not affect this district materially.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THERE is again some interest excited by steel making at Woolwich. A correspondent in one of the Sheffield newspapers puts the case bluntly thus:—"Are Sheffield artisans in future to be idle? If not, they will with all their heart and soul protest against Government steel making at Woolwich. Every ton of steel made at Woolwich robs the working men of Sheffield of their livelihood, and costs the taxpayers of England double what it ought to do." This correspondent makes charges against the Government management which it might be indiscreet to repeat. The *gravamen* of the charge is that the Woolwich officials "are now making several thousand tons of steel yearly where steel was never made previously, and as this promises to increase and replace enormously other materials, they want to introduce it at the expense of Sheffield, and only await higher sanction to carry into effect these contemplated enlargements." The correspondent adds: "Complete plans and plant are already arranged for pending the needful sanction, and then the three or four Sheffield manufacturers who have already expended vast sums to meet these requirements will be dispensed with, and so will the workmen.

Reduction of employment at several district collieries is being arranged for. Quotations for coal are still at winter prices, the leading company selling at 14s. per ton for best Silkstone; thin seam, 12s. 6d.; brazels, 11s. 3d.; nuts, 10s. 10d.; brights, 10s. 10d.; common coal, 9s. 7d. Engine coal is making 7s. 11d. per ton. The summer prices come into operation on June 1st.

Saw-making is a trade which is carried on in Sheffield and in the

Hallamshire district to a large extent, A keen competitor in the United States is Mr. Disston, of "Keystone" works fame, and at one time it was feared Disston would sweep the board. Of late years, however, the saw trade has signally revived here, and it is again in many establishments quite a flourishing industry. A very large business is done in circular saws for log-cutting, great quantities of them being sent to the timber districts of the States. Some observations made by Mr. L. H. Ransome, in one of the most important of these localities—Michigan—have excited much interest here, particularly among the firms who make a speciality of circular and band saws. He has come to the conclusion that the circular saw is certain to be superseded by the band saw for log cutting. Up to the present date it has been held that the circular saw is the best for rapidity of work, the average daily output—ten hours' work—being 50,000 square feet of 1in. white pine boards, the average output of the band saw for the same period being 35,000ft. Mr. Ransome says this comparison requires qualification. The circular saw, he contends, has reached its utmost limit of production, while the band saw has yet undeveloped powers. For instance, it is urged that a band saw of a special and improved type has been known to cut up 102 logs, producing 52,000 square feet of 1in. lumber in ten hours. In quality of work, it is believed, the band saw has an undoubted advantage, as its finer teeth produce a smoother surface, while it passes through the log in a straight line. The *Sheffield Telegraph*, commenting on the controversy, states that so far as Mr. Ransome has been able to make comparison, he finds that 68 indicated horse-power will drive a full-sized band saw, as against 154-horse power required by a 6ft. circular. In other words, the band saw is worked with less than half the steam power required by the circular saw. In waste the difference between the two saws is ¼in. per cut in favour of the band saw, owing to the smaller quantity of sawdust created by the band saw, and the smoother surface, which does not necessitate so much waste in planing. In the matter of band saws, one Sheffield firm at least is well abreast of the times; and others may note the opinion expressed by Mr. Ransome that the band saw will, in a few years, be universally employed in preference to any other for the splitting of log timber.

Messrs. Moses Eadon and Sons, of the President Works, Sheffield, who are very large manufacturers of saws, write to the Sheffield newspapers to say that band saws have been successfully used in this country for the past twenty-five years for sawing every description of timber, and there are quite a number of saw mills which are, and have been for a long time opening logs with band saws made by them. The firm state that they are constantly manufacturing band saws from ⅛in. to 6in. wide. Messrs. Eadon add that they cannot entirely accept Mr. Ransome's statement that band saws will in a few years be universally employed in preference to circular saws for the conversion of timber. "It is evident," they add, "that band saws have a decided future before them; but circular saws have also advantages for some work that no other saw can possess, and our opinion is that they will not be materially affected."

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE improvement in the Cleveland pig iron trade, which set in at the beginning of last week, still continues. The market held at Middlesbrough on Tuesday last was largely attended, and the tone was one of animation. Buyers once again showed a desire to purchase, and a slight advance in quotations took place. The belief gains ground that before long a higher range of prices will prevail, and consequently consumers are anxious to secure all they can at present rates. Sellers, on the other hand, are somewhat shy, and evince an unwillingness to dispose of large quantities, either for present or forward delivery. At Tuesday's market, consumers had to pay 34s. per ton for No. 3 g.m.b. for prompt delivery, or 3d. more than last week. For delivery over three months the price asked was 34s. 6d. These are merchants' figures. Makers are very firm, 35s. per ton being what they demand for delivery over the next month or two. They will not quote for a longer period in the present state of the market.

Stevenson, Jaques and Co.'s current quotations:—"Acklam hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire," (Cleveland) No. 3, 36s.; "Acklam basic," 36s.; refined iron, 48s. to 63s.; net cash at furnaces.

Warrants show still more improvement than makers' iron. Sales were made on Tuesday at 34s. 6d. per ton for prompt cash and 34s. 7½d. for payment in twenty-one days.

The stock in Messrs. Connal and Co.'s Middlesbrough store is gradually decreasing. The quantity held on the 23rd was 328,593 tons, or 150 tons less than on the 16th inst.

The Middlesbrough shipments of pig iron continue good, 59,680 tons having left the port between the 1st and 23rd inclusive, as against 56,348 tons in April and 46,253 tons in March for corresponding periods.

The outlook in the finished iron trade is slightly more promising. There are several inquiries in circulation, but buyers hesitate to contract, and prices are no better. Common bars and ship plates are quoted at £4 10s. per ton, and angles at £4 7s. 6d., all f.o.t. at makers' works, less 2½ per cent. discount.

The steel trade remains at about the same level, plates being obtainable at £6 5s., and rails at £4 2s. 6d. to £4 5s. at makers' works. Foundries are fairly well supplied with orders for the present. There is nothing new to report as regards the engineering or shipbuilding trades. The price of coal is tending downwards, but coke remains firm, and in good request.

The Northumberland colliers' strike, which has lasted four months, was brought to a close on Tuesday last, practically on the terms offered by the employers at the outset. On the 19th inst. another ballot was taken at the various collieries, to ascertain whether the men would now agree to allow the Wages Committee of their own council of delegates to approach the employers, and make the best terms they could with them for a resumption of work. Exactly the same question had been put over and over again and always answered in the negative. Until they had been beaten down by long continued poverty and suffering, the men would not allow their chosen representatives to use their discretion in the negotiations which took place. They sent them rather as messengers than as representatives, with power only to convey their will and pleasure to the owners, which was a useless waste of time. Suffering has at last taught them what argument could not, viz., that the wages obtainable in any industry must depend on what the sale of the commodity produced, under competition, will afford, and not on what the operatives think they ought to have. As soon as ever the Wages Committee had *carte blanche* to do their best, the matter became a simple and easy one. They met the owners, discussed a great variety of local details, pleaded for the men to the best of their ability, and finally agreed to the 12½ per cent. reduction at hard, and 6¼ per cent. at soft coal collieries. So ends this great struggle. Most of the pit villages, which four months ago were full of happy homes, have now become scenes of misery and destitution. All this has been borne with a quiet, stubborn resignation peculiar to Northumbrians, and worthy of a better cause. It will be years before the effects of the strike pass away, and it is pretty certain that it will take a good deal to make the present generation of colliers undertake another big strike.

Another bore hole has reached the salt. It is the property of the Newcastle Chemical Works Company, and is the eighth hole belonging to the South Durham Salt Works. The American boring process was employed, and occupied only twenty-eight working days. The hole is 8in. diameter and 1096ft. deep.

A curious action has been brought under the Employers Liability Act against the Stockton Malleable Iron Company, by a turner in their employ named Edwards. This man was working a lathe, behind whith was a door in the outer wall. While Edwards was tightening up a nut behind the lathe, a gust of wind blew open the door against him. He lost his balance, and his hand went in among the cog-wheels, whereby he lost three or four fingers. He claimed £234 on the ground that the building and machinery were defective, and that a responsible foreman, a Mr. Pidd, was the last who went through the door, and that he had not properly fastened it. After devoting six hours to the case, the judge summed up. He said there was no contributory negligence on the part of Mr. Pidd, and he rejected the idea that the vibration of the machinery would ever lift the latch out of its place. He gave a verdict for the defendants, but hoped they would not ask for costs.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE Glasgow pig iron market has been somewhat irregular this week, prices of warrants fluctuating considerably, the range for Scotch warrants being generally from 41s. 9d. to 41s. 5d. per ton; Cleveland, 34s. 4½d. to 34s. 6½d.; and Cumberland, 43s. 10½d. to 43s. 7½d. cash. The condition of the Scotch warrant market is not at all very encouraging. Stocks continue to accumulate at the rate of about 2000 tons a week, and the only expectation of an improvement in the market is based upon a possible although not a very probable improvement in the demand from the United States. Warrants are strongly held, and the prices are maintained at a height at which there is little market for the iron, which is thus tossed from one speculative hand to another, and never goes into consumption. The current production of makers is more than sufficient to meet all the requirements of the home consumption and the export demand. The past week's shipments have been small, being 2187 tons coastwise and 4036 abroad; total, 6223 tons, as compared with 12,828 in the corresponding week of 1886. Of the total, 1820 tons went to Italy, 529 to Canada, 400 to the United States, 215 to India, and 230 to Holland. The imports for the week of Cleveland pigs into Scotland have been 6090 tons, being 2000 tons greater than the Scotch foreign exports—a state of things which forcibly indicates the lightness of the trade we are doing at present. There are eighty-one furnaces in blast, against ninety twelve months ago.

The current values of makers' pig iron are as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 48s., No. 3, 44s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. and 46s.; Summerlee, 52s. 6d. and 43s.; Calder, 49s. 6d. and 42s.; Carnbroe, 43s. 6d. and 40s.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 43s. and 39s.; Govan, at Broomielaw, 43s. and 39s.; Shotts, at Leith, 48s. 6d. and 45s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 47s. and 40s. 6d.; Eglinton, 42s. 6d. and 38s. 6d.; Dalmellington, 43s. 6d. and 40s.

Makers of malleable iron are generally quiet, with few fresh orders of consequence offering at the moment. The past week's shipments of iron and steel goods from Glasgow embraced £5500 worth of machinery, £2200 sewing machines, £6500 steel goods, and £37,100 general iron manufactures, the latter embracing £5220 worth of pipes, &c., despatched to Newcastle, New South Wales; £5280 ditto to Canada; and £5080 ditto to Mauritius.

Steel makers are for the most part doing well, although the prices are difficult to maintain.

In the coal trade business has been good, the week's shipments from Glasgow being 21,908 tons; Greenock, 841; Ayr, 8258; Irvine, 1778; Troon, 6970; Burntisland, 15,572; Leith, 1585; Grangemouth, 21,849; Bo'ness, 11,208; Granton, 1985; and Port Glasgow, 160—total, 92,114 tons, as compared with 89,887 tons in the corresponding week of 1886. Prices of all sorts of coal are without material change.

There is little or no trouble with the colliers at present. They are putting out as much coal as is required, and in some places more than can be readily got out of hand.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

SOME time ago I intimated in this column that a resuscitation of the silver lead industries of Cardigan and the North of Wales was likely, and now I learn that good progress is making at Ynyslas, on the Cambrian line, and not far from Aberystwith. The promise there is described as excellent. Old workers in this industry will remember the Van mine, near Llanidloes, which at one time, though sold for £40,000, was estimated at the value of a million sterling. I expect that Mr. Conacher, of the Cambrian Railways, will be ready to meet any emergency if this turns out a lucky hit. This is clearly only the pioneer lode. From the time of Carbery Price and Mackworth the great district has been regarded as a rich field, only requiring capital to develope.

I am glad to find that the North Wales colliers are returning to work. The South Wales colliers are working well, and the run upon the collieries continues.

I have been surprised with the novel names on locomotive coal trucks in the Welsh valleys, showing that, on account of the strike in the north, railways have to go farther afield for coal. The great feeder, the Rhondda Valley, continues well worked, and the Taff Vale line has had a busy time of it, some of the largest totals known having been run down.

Taking the high total of 190,000 tons exported alone from Cardiff a short time ago for foreign destination, I find that this amounted to about a quarter of a mile! Taking the late totals of 10,000,000 tons, foreign and coastwise, exported annually, the fact is a startling one that about 15½ square miles of Wales is every year shipped off to other countries. These countries, I note by the return called for by Sir Hussey Vivian this week, are principally Russia, Sweden, Denmark, Germany, France, Spain, Italy, and Egypt. The "returns" show that from Cardiff alone the value of the coal sent last year was 3¼ million sterling, and the total quantity close upon 7,000,000 tons coal and patent fuel. The Newport total was 1,971,956 tons, Swansea a little under a million. The smallest quantity from a Welsh port was Milford Haven, which sent away 879 tons only.

Coal quotations remain in the old groove, notwithstanding the great demand. House coal is quiet, small steam not much inquired after, and I see large stocking going on in some quarters. Patent fuel shows a slight improvement.

There has been an improvement generally in the steel works. More business is being done of a varied character, rails, blooms, tin bar, and merchant bar. In old rails there is still inquiry in the market, but scrap iron is not much sought after, and the offer of 10s. per ton made by buyers retards the demolition of the old works, a consummation much desired. If prices went up at least half-a-dozen of the old works would be brought to the hammer.

The demand for tin bar shows the state of the sister industry. Tin-plate is certainly brisk, even if prices remain quiet. Last week 70,000 boxes were sent away from Swansea alone, while the quantity sent to stores only amounted to 29,241 boxes. There is now held in Swansea about half the quantity that was in stock at this time last year. Prices are the same as last week, but firmer. Good coke brands fetch 13s. 3d., even wasters are realising 12s. 6d. Siemens command 14s. best brands. Even at these prices sellers are careful, and do not care to commit themselves to contracts for long delivery. The opinion in the trade is that prices must go up. Tin is still moving upward, and increased quotations for tin-plates must follow. I see that charcoals and ternes are beginning to show some movement.

Shipping at Cardiff is showing a better aspect, and the accession of new vessels to the coal fleet is steady and marked. Amongst them is one named after the directing mind in the coal world of Wales, Sir W. T. Lewis, who I am glad to see is back in harness from a long sojourn in Germany, and fully restored to health.

A good deal of iron ore continues to come in, principally from Bilbao. Ebbw Vale and Dowlais are large buyers. Swansea imported 4000 tons iron and steel for tin-plate last week alone.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE heavy blow which has been inflicted upon the iron industry of Silesia does not appear for the moment to have affected the iron market there much. This may probably be accounted for by almost a clean sweep having been made of all forge pig iron to send to Russia before the 13th inst., when the new iron and steel tariff came into force; the number of domestic orders still on the books for rolled iron of all sorts, which keeps the works and mills quite fully employed; and the expectation that the coalition convention with Westphalia will soon become a reality. The financial organs pretend to look lightly on what practical people would call a calamity for a district, by maintaining the illusory notion that, as the Russian iron industry is still very weak, it will be obliged still to import Silesian pig, though the duty be £3 p.t., or 130 to 150 per cent. of the value of the article. But when it is considered that Russia took 22 per cent. of the total of forge pig produced in Silesia, not to reckon other sorts, wrought iron and castings to a very large amount, that Austria is about to raise its duties on iron too—and at present no compensating outlet has been found for this quantity of iron, which must be suddenly thrown into stock, or furnaces must be put out of blast—then the situation can in reality only be looked upon as very serious. Even provided the new law now proposed permitted it, which as devised would not be the case, the plan of removing furnaces and plant into Poland also has its difficulties, for the large works interested in the scheme are so loaded with preference shares and mortgages that new capital is not to be procured in that way, and to form new companies in the present state of political feeling and tension between the two nations would be a hopeless endeavour. Roumania has lately reduced some articles of its iron tariff—for instance, wire manufactures from 10 to 4 Lei, and this seems the only promising new outlet for Silesian iron at present. This again will, of course, react on the coal mines. It is no wonder foreign nations look with such envy on England, where, if one outlet be closed, others can be opened up.

On July 1st next the following new iron tariff comes into operation in Austria:—Sheets under 0·4 mm. thick, 6fl. p. 100 ko., was formerly 5fl.; tin-plates under 0·4 mm. thick, 10fl., was 8; wire under 0·5 mm., 6fl., was 5; wrought iron tubes, 6·50fl., was 5; rivetted tanks and steam boilers, 8·50fl., was 6; sheet iron manufactures coated with zinc or copper, 15fl., was 8·50; bright saws, plane irons, and chisels, 20·50fl., was 10; screws under 5 mm. 20fl., was 10; fine iron wares, 25·50fl., was 15. Metals and metal wares are raised in most cases to about double the former duty, but are not detailed here, as being of less importance to readers of THE ENGINEER.

The Belgian iron market continues very firm, especially as concerns pig iron. Contracts for the second half of the year have been concluded and the furnaces are in full work. Forge pig is noted 42f., and foundry No. 3, 47f., which shows an advance of 4f.p.t. since December. The machine shops have more to do, as a good many orders have come in from abroad, and more are expected with certainty shortly. There is no doubt that this is in a great measure the result of the Belgians having cultivated, and which they are persistently doing still, the plan of establishing miniature exhibitions of their manufactures in different foreign countries and places, which now-a-days seems absolutely required, for the purchasers insist upon not only seeing illustrations, but actually feeling the goods before buying, and we all know how seeing articles tempts purchasers. The Americans understand this thoroughly, even to sending a locomotive or tramcar to be seen and tried before purchase. No doubt English manufacturers would also soon reap the benefit, if they joined in each manufacturing district, and through the aid of the respective Chambers of Commerce got up and sent abroad similar collections of samples, accompanied, however, by a representative suitable in all particulars. The semi-socialistic workmen's strike in South Belgium has not yet apparently affected the iron and coal markets; but if it extends—and it has already assumed a threatening character—it must soon do so, if not checked in time. Here is a problem to solve almost as hopeless as trying to square the circle. Capital does not receive the common interest of the country when laid out in the coal mines, the workmen and their families cannot possibly subsist on a pittance of 1s. 6d. to 2s. 6d. at most a day for ten hours' work in a deep mine, and the price of coal cannot be raised if it is to be disposed of. If economy in plant and working is no further possible, the lookout is a dreary one indeed.

In France the attempt to put up prices has failed, and the tendency is downwards again, with business very quiet. With difficulty 135f. for merchant bar iron has been maintained, while girders are quoted 125f. p.t., and plates are falling in price. The steel works complain of English, Belgian, and German prices spoiling their export trade. Old rails are quoted 70f. p.t., but difficult to be sold at that figure.

There is no improvement to note in the iron or coal markets of Rheinland-Westphalia. Prices in general have been nominally maintained, in consequence of the various conventions. The demand for ores has been unimportant, and there is no material alteration in prices from those last noted. In the pig iron market scarcely any change has occurred. The export of spiegel leaves something to be desired, and prices and domestic demands are unchanged. Forge pig keeps up its price in Westphalia at M. 48, while the best Siegerland brands are to be bought at M. 45·50 p.t.

Foundry pig iron has not been so much called for, but, thanks to the convention, the price has not receded. M. 50·20 was the lowest price tendered for a lot for the Royal Dockyard at Wilhelmshaven, and M. 53·40 the highest, p.t. delivered. In the month of April 314,621 tons of iron were produced; forge and spiegel, 159,617; Bessemer, 36,763; basic, 80,067; and foundry, 38,174 tons. April last year 291,221 tons were made. This year, up to April 30th, 1,200,439 tons have been produced. In rolled iron, both as regards price and sales, the condition of the trade is unaltered, and the mills have sufficient work in hand. Stocks in second hands are almost exhausted, so the convention price soon stands a chance of being realised all round. Some contracts for the third quarter have been made known, but still, as a rule, buyers are backward in placing orders, for they do not seem to put much faith in the convention. This may soon change when they learn the result of the meeting of mill masters held on the 19th inst., when, it is reported, satisfactory arrangements were arrived at. Of plates there is nothing to note. Most of the sheet works are well supplied with orders, and can keep on rolling regularly. Some are rather short of work, and prefer slackening make to stocking, though stocks are very low. The base price remains M. 130 p.t. The wire rod trade, both in Westphalia and Siegerland, is good, and prices are firm, and now it has a better chance, since pig iron has fallen in the latter district. Also the wire works have full employment, which, of course, has its influence irrespective of the export of wire rods, and the demand for wire is good, so the market was not weakened when some makers were induced to lower their prices. It is now noted M. 125 to 130, both in iron and steel, while wire rods cost M. 110 to 112 p.t. In railway material there is nothing new, as prices and demand are unchanged. The machine shops are a little better employed, and for some kinds of castings a somewhat higher price has been obtained.

The lowest tender for coal for the State railways was M. 5·20, and for patent fuel—briquettes—M. 6·60 p.t. The highest tenders were M. 5·80 and 6·70 respectively. The long contracts lately made were for coking coal M. 3·40 to 3·80, and for blast furnace coke M. 6·80 to 7·40 p.t.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Co-operation on a railroad.—President Ashley, of the Toledo, Ann Arbor, and Northern Railroad, has instituted the profit-sharing plan on that railroad, with the approval of the stockholders. All officers and employés, except the president, will participate in the profits after being five years in the employ of the company, and in any year in which a dividend is declared, each person interested will receive a dividend on his salary as if he owned stock to the value of his salary. Any participant disabled on duty so as to be incapacitated for not less than six months will receive a certificate of paid-up stock for an amount equal to his total salary for the previous year. In case of death on active duty, the legal representative will receive a similar certificate equal to five times the amount of salary for the previous year. On retirement after twenty years' continuous employment, the certificate will be for the amount of the last year's salary. This is the first instance in which the profit-sharing system, which has worked very satisfactorily in other cases, has been adopted by a railroad company.

Smelting Montana ores.—The West Duluth Land Co., incorporated by capitalists of New York, San Francisco, Boston, and Duluth, with a capital stock of 2,500,000 dols., will erect extensive works and plant at Duluth, Minn., for the purpose of smelting and refining copper and silver ore from Montana. The great Anaconda copper mine has been sending its ore to Swansea—Wales—to be refined, but in consequence of the heavy cost for freight, and the rivalry with the Calumet and Hecla mine in Michigan, has induced the company to seek better facilities for smelting and reduction, and these facilities will be offered by the new works. Work will begin at once, and by October the works will be ready to turn out twenty tons of refined copper per day. This is a great enterprise, and no expense will be spared to make the works complete, with the best plant obtainable and all improvements.

Iron in New York.—The iron industries along the New York and New Jersey borders are experiencing a decided "boom." Mines in operation are taking in increased forces of labourers, new mines are being opened and abandoned ones reworked. The ores are said to yield a superior quality of steel, for which purpose they are principally used. A large mining property has been purchased near Warwick, N.Y., and Cooper, Hewitt, and Co.—New Jersey Steel and Iron Works—are opening up a number of their mines and shipping large quantities of ore. In connection with this boom there is revived activity in the zinc-producing districts of Franklin and Ogdensburg, N.J.; two companies that had suspended work for some years have resumed operations, and new parties are getting to work on their properties.

Sewerage of San Diego, Cal.—Colonel Geo. E. Waring, the inventor of the "Waring separate system of sewerage," has made his report to the city trustrees of San Diego, Cal., after a long and careful examination of the locality and circumstances. Plans and specifications have been prepared, and proposals are now invited for an enormous amount of work. The work includes 187,050ft. of sewer pipe—from 6in. to 24in. diameter—with Y branches and specials, a large timber sewage reservoir in the harbour, 24in. cast iron pipe from the land to the reservoir, and 30in. pipe thence 600ft. into deep water; the pipe to be put together and culled, floated into position and sunk. Proposals for the sewer work proper will be opened on May 20th; for the reservoir, iron pipe, creosoted lumber, earth filling, &c., on May 27th; and for the brick manholes and flush tank, on June 3rd.

Atchison, Topeka, and Santa Fe Railroad Company.—The annual report of the company is a remarkable and interesting paper, and shows that this already extensive system will adopt an extension policy in accord with the favourable prospects for railroad construction for the current year. Its line to Chicago—the Chicago, Santa Fe and California—is under construction. A new line is projected from Ness City, Kan., to Colorado Springs, Col., a distance of 200 or 300 miles, according to the route; from Kiowa, a terminus of the Southern Kansas line on the Indian Territory line, a line will run across the Indian Territory—crossing the Llano Estacado—and New Mexico, to El Paso, Tex. Various branches and extensions are contemplated which will serve as feeders, and open up new territory in Arizona and New Mexico, besides making a number of connections with other systems.

The New York and Brooklyn Bridge.—The capacity of the cable railroad is overtaxed now during the busy hours, and various plans are contemplated for giving an increased capacity. Trains of three long cars are run at intervals of one and a-half minutes; but though crowded to suffocation, they cannot dispose of the crowds at the depôt. The rush is to New York in the morning, and to Brooklyn in the evening. All the cars now have a side door in the middle, in addition to the end doors; the platforms and approaches are improved, and inclined planes, instead of steps, are being adopted at the exits to facilitate the dispersal of the crowd from the cars. Three plans for increasing the capacity are being considered:—(1) Increasing the platform length and switching tracks to allow of six instead of three car trains, with a central platform for exit and the present side platforms for ingress—trains to start alternately from each track; (2) cable switching instead of by locomotives; (3) a cable railroad on the carriageways. The first plan is recommended to be adopted at one, and the third will probably be necessary before long. The enormous traffic was not realised when the bridge and approaches were designed. All the trains have the Eames vacuum brake, worked by an excentric on one axle of each car, and each brakeman applying the brake to his own car. Extensions of the tracks at the Brooklyn end are being made, and the structure will eventually have a fine centrally located depôt facing a City Hall square. The total receipts for April were 72,665·07 dols., composed as follows: Promenade, 1666·14 dols. (fare, 1c.); carriageways, 5636·28 dols.; railroad, 65,362·65 dols. (fare, 3c., ten tickets for 25c.) The total number of passengers was 2,652,159; promenade, 272,799; railroad, 2,379,360.

New York rapid transit.—In addition to the intramural transit question, which is becoming daily more urgent, the facilities for transit across the East River to Brooklyn, and the North River, Hudson, to Jersey City, are under consideration. A company has been organised to build a great cantilever bridge, for railroad traffic, across the East River, and a joint commission of the corporations of New York and Brooklyn has been appointed to consider the feasibility and necessity of a bridge or tunnel connection across the river from Grand-street, New York, to Broadway, Brooklyn. General Newton, Commissioner of Public Works, New York City, prefers the tunnel project; he suggests two tunnels side by side as preferable to one large one, and would have approaches at right angles, giving access to the up-town and down-town districts. This Commission will report shortly to the State Legislature. The Hudson River tunnel scheme is being revived, and it is said the workings will be pumped out and work started soon. One of the intramural schemes is to build branches from the present elevated roads on the west side to the principal railroad ferries, carrying the tracks across to the ferry houses, and connecting with double-deck ferry boats, with the upper deck on a level with the elevated railroad depôt. It is not stated whether the present ferry boats could be fitted for this purpose without considerable and expensive alterations to the arrangement of the engines, boilers, &c.

NEW COMPANIES.

THE following companies have just been registered:—

Elkington and Company, Limited.

This is the conversion to a company of the business of goldsmiths, silversmiths, &c., carried on by the firm of Elkington and Co. It was registered on the 18th inst., with a capital of £500,000, in £10 shares. The subscribers are:—

	Shares.
*F. Elkington, Wolverley, Worcester	1
*J. B. Elkington, Burry Port, South Wales	1
A. J. Elkington, 28, Cromwell-road, W.	1
*Howard Elkington, Mold, Flint, manufacturer	1
*Hyla Elkington, Selby Oak, Worcester, manufacturer	1
*H. F. Elkington, Selby Oak, Worcester, manufacturer	1
G. M. Elkington, King's Norton, Worcester, manufacturer	1

The number of directors is not to be less than three, nor more than seven; qualification, 100 ordinary shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Hinendelaencina Silver and Gold Mining Company of Spain, Limited.

Upon terms of an agreement of the 9th inst. this company proposes to purchase silver and gold mines situate in the province of Guadalajara, Spain, known as La Esperanza, Buen Deses, and Nuevo, Brazil. It was registered on the 14th inst., with a capital of £60,000, in £4 shares, 7500 of which are A, or £5 per cent. preference shares; the B shares will be allotted to the vendor as fully paid, for purchase consideration. The subscribers are:—

	Shares.
Paul Juncker, Colombe, engineer	50
C. Fonteville, Paris, engineer	50
A. Semadeni, Paris, accountant	10
R. Serrano, Paris, professor	50
N. J. Jowanneaun, Tours, ex-notary	50
S. Freyler, Bordeaux, contractor	5
L. M. J. Alziary, Paris, insurance agent	10

The number of directors is not to be less than five, nor more than ten; the subscribers are to appoint the first, and determine their remuneration; qualification, 50 shares.

International Water and Sewage Purification Company, Limited.

This company was constituted by deed of settlement on the 11th March last, and was registered on the 18th inst. as a limited company, with a capital of £100,000, in £5 shares, 6000 of which are allotted and are fully paid up. Its object is to manufacture materials for the purification of water and other liquids and for gases, and for the precipitation and treatment of sewage and excreta. The subscribers are:—

	Shares.
Marquis de Stacpoole, Galway	600
F. Candy, Bexley, Kent, manufacturer	2428
A. Angell, Southampton, analytical chemist	1888
N. F. Leopold, C.E., 13, Upper Westbourne-terrace	1080
J. D. Chew, Woking, surveyor	1
J. Crew, 34, Finsbury-pavement, land agent	1
W. B. Hallett, Goring, Oxon	1
E. S. Jones, 27, Kildare-terrace, W.	1

The number of directors is not to be less than three, nor more than seven; qualification, £100 shares or £500 stock. The company in general meeting will determine remuneration.

John Rogerson and Company, Limited.

This company proposes to carry on business as iron, steel and chemical manufacturers, colliery owners, farmers, and dealers in stock and farm produce. It was registered on the 12th inst., with a capital of £500,000, in £10 shares. The subscribers are:—

	Shares.
*John Rogerson, J.P., C.E., Croxdale Hall, Durham, steel manufacturer	1
*J. E. Rogerson, Croxdale Hall, Durham, steel manufacturer	1
Mrs. J. Rogerson, Croxdale Hall, Durham	1
*Alexander Downie, Stanhope, Durham, engineer	1
A. S. Stevenson, J.P., Tynemouth, alkali manufacturer	1
J. A. Cowen, Blaydon-on-Tyne, fire-brick manufacturer	1
W. Godden, 34, Old Jewry, solicitor	1

The number of directors is not to be less than three, nor more than five; qualification, 250 shares. The company in general meeting will determine remuneration. Mr. John Rogerson is appointed managing director and chairman for five years, at such remuneration as may be fixed by the directors.

Improved Patent Ivory Company, Limited.

This company was registered on the 17th inst., with a capital of £10,000, in £5 shares, to acquire inventions and any secret process for the manufacture of compositions suitable for the imitation of ivory, wood, and other natural substances. The subscribers are:—

	Shares.
*M. Levy, 292, High Holborn, merchant	1
*A. H. Dean, 160, Fleet-street, publisher	1
G. W. Hunter, 14, Alfred-place, W., major-general	1
J. G. Clemow, 80, Coleman-street, solicitor	1
F. L. Gardner, Buxton House, Chiswick	1
J. Saunders, 14, Pembridge-villas, W.	1
*N. Levy, 162, Westbourne-terrace, stock jobber	1

The number of directors is not to be less than three, nor more than seven; qualification, 20 shares; the first are the subscribers denoted by an asterisk; remuneration, £50 per annum each.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

16th May, 1887.

7136. Bathing Waters, W. Lippert, London.
7137. Air Regulator for Organs, J. W. Gilbert, London.
7138. Sauces, &c., J. H. Payne, London.
7139. Coating Metal Plates with Tin, &c., D. Edwards, R. Lewis, and P. Jones, London.
7140. Gunpowder Case, L. Clark and E. H. Steward, London.
7141. Grinding Mills, H. H. Lake.—(— *Zonca and Bella, Italy.*)
7142. Collapsible Boats, C. Henderson, Glasgow.
7143. Safety Hook and Link, A. R. McCabe, and T. W. and J. Thomson, London.
7144. Obtaining Barometrical Readings, B. A. Collins, London.

17th May, 1887.

7145. Holding Papers, E. B. Bucke, Colchester.
7146. Safety Buckle for Harness, Hon. W. E. Fitz-Maurice, Croydon.
7147. Field Game, F. H. Banks, Birmingham.
7148. Sure-cure Plaisters for Burns, &c., J. H. Goodman, Calcot.
7149. Fenders, W. Bondall and A. Webb, Birmingham.
7150. Machine Measure, W. O. Greener.—(*G. Smith, Trieste.*)
7151. Moulds for Blowing Glass, S. Bunting, Dublin.
7152. Adjustable Standard Bracket, G. Halford, Halifax.
7153. Locks for Receptacles for Coin, F. J. J. Gibbons, Bloxwich.
7154. Hydraulic Lifts, R. Clarke, London.
7155. Rifle Sight Elevators, T. Turner, Sutton Coldfield.
7156. Manufacturing Oil Gas, J. Keith, Glasgow.
7157. Boots and Shoes, H. E. Brown, Dublin.
7158. Covering Cylinders with Card Fillets, N. W., F. W. Thompson, and H. Hoyle, Halifax.
7159. Polish for Leather, &c., H. Dell, Brighton.
7160. Velocipedes, W. Wright, Manchester.
7161. Frames, &c., of Velocipedes, W. C. Burton, Rochdale.
7162. Artist's Palette, F. F. Atkinson, London.
7163. Billiard Scoring Board, J. and S. E. Brindle, Whitehaven.
7164. Thread Winding Machines, J. Booth, London.
7165. Locking the Brakes of Velocipedes, C. Church, London.
7166. Mills for Grinding Flint, &c., W. Boulton, London.
7167. Twist Lace Fabrics, S. Hamel and J. Ward, London.
7168. Life-saving Equipments, H. Swindall, London.
7169. Traction Wheel, H. W. Hyde and G. Myers, London.
7170. Cartridges, &c., T. Bland and O. M. Partridge, London.
7171. Wads, &c., for Explosive Ingredients, T. Bland, London.
7172. Gauges for Steam Boilers, J. Wetter.—(*J. B. Little, Canada.*)
7173. Cue Tips, F. J. Hardy, Upper Norwood.
7174. Extinguishing Lamps, J. Parry, London.
7175. Extinguishing Lamps, J. G. Thompson, London.
7176. Manufacture of Gold, B. J. B. Mills.—(*F. Mallet-Guy, France.*)
7177. Gas, J. W. Corbett and R. D. Hardy, London.
7178. Cement, J. W. Corbett and R. D. Hardy, London.
7179. Refrigerator, M. Stanbrook, London.
7180. Boot and Shoe Lasts, C. W. Evans, London.
7181. Lasting Machines, S. B. Ellithorp, London.
7182. Anemometer, W. M. Walters, London.
7183. Chaff-cutting Machines, T. Lemon, London.
7184. Electric Arc Lamps, W. Mackie, London.
7185. Electro-propulsive Motors, W. H. Akester, London.
7186. Supporting the Roofs of Coal Mines, &c., G. Downing.—(*C. Baily, France.*)
7187. Lasting the Uppers of Boots and Shoes, J. Y. Johnson.—(*The Shoe Lasting Machine Company, United States.*)
7188. Covering Insulated Electrical Conductors, J. Tatham, London.
7189. Secondary Batteries, W. P. Akester, London.
7190. Distilling and Maturing Alcohols, J. Wallace, London.
7191. Connecting Electrical Conductors, A. Binkowski, London.
7192. Fire-resisting Materials, F. M. and D. D. Spence, Manchester.
7193. Tracing the Shape of the Foot, L. Giraudon, London.
7194. Preparing Perforated Sheets for Automatic Musical Instruments, J. Carpentier, London.
7195. Breech Mechanism for Ordnance, T. Nordenfelt, London.
7196. Horse Hoes, F. C. Lake, London.
7197. Holders for Black-lead Pencils, &c., A. J. Boult.—(*W. von Pittler, Germany.*)
7198. Obtaining Aluminium from its Ores, &c., W. A. Baldwin, London.
7199. Gauge Cocks, A. J. Boult.—(*D. H. Roberts and W. D. McRae, Canada.*)
7200. Card Tables, T. A. Nottage, Liverpool.
7201. Printing Music by Hand, J. H. Bennett, Liverpool.
7202. Electric Telegraphs, A. J. Boult.—(*J. F. McLaughlin, United States.*)
7203. Combined Superheaters and Hydrocarbon Burners, C. T. Shoen, London.
7204. Attaching Tires to Bicycle Wheels, H. Fowkes, London.
7205. Self-lighting Lamps, A. J. Boult.—(*W. von Pittler, Germany.*)
7206. Apparatus for Use in Gunnery Practice, J. G. Lorrain, London.
7207. Fasteners for Gloves, H. H. Lake.—(*S. W. Shorey, United States.*)
7208. Dog-carts, H. H. Lake.—(*R. W. Hare and R. Sproud, United States.*)
7209. Covered Buttons, H. H. Lake.—(*W. P. Devine, United States.*)
7210. Carrying Knapsacks upon the Back, A. Sohner, London.
7211. Nail-making, &c., Machines, C. J. Capewell, London.
7212. Automatic Supply of Liquids, F. L. Rawson and E. Brown, London.
7213. Pisciculture, E. Schnell.—(*F. Lugrin and E. du Roveray, Switzerland.*)
7214. Bird Scares, J. E. Surridge, London.
7215. Lighting Ships, D. J. Morgan, London.

18th May, 1887.

7216. Breech-loading Fire-arms, J. D. Dougall, jun. London.
7217. Water-closets, J. Clarkson and S. Wilkinson, London.
7218. Hanging of Pictures Securely, H. Adeane, London.
7219. Cutting Screws, T. M. Bear, J. Blomfield, and G. P. N. Burden, Colchester.
7220. Steam Gear, W. W. Clayton, Leeds.
7221. Pedals of Pianos, H. W. Pohlmann, Halifax.
7222. Ejector Mechanism for Fire-arms, C. O. Ellis and E. W. Wilkinson, Birmingham.
7223. Looms, &c., for Weaving, G. H. Hodgson, Halifax.
7224. Self-fastening Apparatus for Knitting Machines, A. Beyer, Berlin.
7225. Knitting Machines, J. Luddington, Newcastle-on-Tyne.
7226. Preparing Safety Paper for Cheques, R. C. Menzies and C. M. King, Glasgow.
7227. Extinguishers for Oil Lamps, W. H. Pasley, Birmingham.
7228. Portable Tables, F. J. Bramley, Bradford.
7229. Compressed Air Apparatus suitable for Glass-blowing, S. Bunting, Dublin.
7230. System of Heating Boilers or Generating Steam, J. E. Barwick, Kent.
7231. Couplings for Railway Rolling Stock, W. Holland, Manchester.
7232. Economising Beer Cleaner, R. Dixon, Middlesbrough.
7233. Ring Spinning and Doubling Frames, J. Edge, Halifax.
7234. Champion Button Fastener, G. Ball, Birmingham.
7235. Safety Mechanism of Electric Arc Lamps, &c. F. C. Phillips and H. E. Harrison, London.
7236. Construction of Water-pipes Exposed to Frost, J. Warwick, Newcastle-on-Tyne.
7237. Runners and Notches for Umbrellas, W. H. Welshman, Birmingham.
7238. Promoting the Circulation of Air in Main Drains, &c., F. F. Abbey, Huddersfield.
7239. Dissolving Tallow, &c., in Water, F. Vogel, Manchester.
7240. Bedstead Bottoms, T. E. Wale, Birmingham.
7241. Covering Wires for Telegraphic, &c., Purposes, D. Spill, London.
7242. Rods and Poles for Curtains, S. Proctor and G. A. Malster, London.
7243. Cement for Artificial Stone-work, L. G. Knemeyer, London.
7244. Heat Conductors for Baking and Boiling, W. F. Stanley, South Norwood.
7245. Stoppering Bottles, G. H. Jones, London.
7246. Clipping or Shearing Sheep, &c., P. S. Hyslop, Glasgow.
7247. New Motive Power, A. A. Clarke, London.
7248. Watches, J. Robinson, London.
7249. Stopping and Starting Apparatus, W. L. Wise.—(*J. Nordmann, Germany.*)
7250. Concave Slide Spear for Fishing-rods, W. H. Wigley, Cheltenham.
7251. Securing Window-sashes, H. H. Lake.—(*A. H. Crockford, United States.*)
7252. Formers for Plastic Brick Manufacture, J. Gollings and H. Hicks, London.
7253. Incandescent Gas-burners, E. Fahrig, London.
7254. Bottles for Containing Poisons, H. Poths, London.
7255. Fastening for Farm and Park Gates, G. W. Shipton, London.
7256. Ovens, F. M. Mercer, London.
7257. Harness Engines of Open Power Shed Looms, A. Guthrie, Glasgow.
7258. Syphons, E. Putzey, London.
7259. Converting Syrups from Sugar into Mono-saccharates, F. Harm, London.
7260. Rotary Air Propellers, A. J. Boult.—(*C. Enke, Germany.*)
7261. Dental Anodyne, C. T. Arnold.—(*C. W. Arnold, United States.*)
7262. Copying Presses, H. H. Lake.—(*J. H. Currier and J. Thompson, United States.*)
7263. Couplings, H. H. Lake.—(*V. M. Petit-Girard, G. Freydier-Dubieul, and X. Janicot, France.*)
7264. Smoke-consuming Apparatus, R. A. Gibbons, London.
7265. Phonic Reception of Electrical Signals, C. Ader, London.
7266. Closing Bulkheads, J. Rogerson, A. Downie, and J. A. Snowdon, London.
7267. Knitted Fabrics, J. J. Adgate and S. P. Kittle, London.
7268. Obtaining Oxygen, A. Hommel, London.
7269. Mechanical Roundabouts, &c., L. C. Bourgaie, London.

19th May, 1887.

7270. Carbonic Acid Gas, E. W. Parnell and J. Simpson, Liverpool.
7271. Starting of Tram-cars, J. H. Wilson, Tipperary.
7272. Cans for Preserved Fruit, &c., H. Faulder, Manchester.
7273. India-rubber Thread, H. H. Waddington, Manchester.
7274. Artificial Manufacture of Coal, F. V. Hadlow, Buxted.
7275. Automatic Weather-bar, J. Bird, Crewe.
7276. Twine, J. Wilcock and H. N. Bickerton, Ashton-under-Lyne.
7277. Alcoholic Liquids, J. Takamine, Glasgow.
7278. Treating Ores, J. S. MacArthur and R. W. and W. Forrest, Glasgow.
7279. Enamelling Metallic Surfaces, J. D. Watson, Glasgow.
7280. Metal Sheets, &c., W. Orr and P. S. Brown, Glasgow.
7281. Boxes, &c., for Storage of Eggs, E. C. Bower, London.
7282. Malleable Iron, G. Hatton, London.
7283. Mill Furnaces, J. Houlston and M. Croft, London.
7284. Machine for Cleaning Roads, &c., J. Sainty, Norwich.
7285. Cover for Saucepans, J. Muirhead, Bedfordshire.
7286. Furnaces, R. W. Anderson, Liverpool.
7287. Stretching Carpets, J. Borrows, Birmingham.
7288. Checking Passengers' Fares in Omnibuses, A. A. Gleaves, London.
7289. Battering or Raising the Pile of Sealskin, &c., H. Lister, Huddersfield.
7290. Expansion Boxes or Joints, T. E. Mitton, North Birmingham.
7291. Padlocks, J. Bates, Bloxwich.
7292. Conveying Sheets of Paper into Printing, &c., Machines, W. Barker and J. Beall, Newcastle-on-Tyne.
7293. Sleeve or Dress Adjuster, J. Whitehead, Birmingham.
7294. Gas Motor Engines, H. Williams, Stockport.
7295. Cutting Scarf Joints on Leather Bands, W. H. Dorman, Stafford.
7296. Clutch Mechanism, W. Sisson, London.
7297. Carding or Packing Toilet Pins, J. Jackson and P. A. Martin, Birmingham.
7298. Producing Paper Boxes, &c., F. C. Leonardt, Birmingham.
7299. Stop Motions for Twisting Frames, P. Smith, jun., London.
7300. Cruet Frames, C. H. Bingham, Sheffield.
7301. Looms for Cutting Pile Fabrics, J. Oswald, London.
7302. Parcelling Tobacco, G. Wilcox, London.
7303. Double-action Ratchet Screwing Stocks, T. Maiden, London.

7304. Operating the Knives of Machinery, R. L. Donkin, London.
7305. Metallic Fastening for the Leather Tips of Billiard Cues, W. Michalk, London.
7306. Machine for Mixing Dough, D. E. Thomson, Glasgow.
7307. Supporting the Saddles of Bicycles, &c., W. G. Ashford and C. H. Freeman, London.
7308. Labels for the Frames of Umbrellas, W. A. Bindley and W. J. Gell, London.
7309. Portable Sewing Machine, A. W. Leader, London.
7310. Money-boxes, T. Goodman.—(*E. Hammel, Germany.*)
7311. Opening and Closing Casements, R. Livingston, Glasgow.
7312. Match-box, W. Bone, Grantham.
7313. Controlling Telephonic Calls, Impresa Mineraria Italiana and E. H. Furse, London.
7314. Hats, &c., P. Haddan.—(*F. F. Hodges, United States.*)
7315. Field Magnets, S. S. Bromhead.—(*G. Perdretti, Italy.*)
7316. Bellows, W. Cole, London.
7317. Reversible Electric Batteries, J. Kynoch and W. Habgood, London.
7318. Portable Vapour Baths, A. N. Mezzetti and R. Whitlock, London.
7319. Converting Meat, &c., into Pulp, S. Arnaud, London.
7320. Preparation of Fire-resisting Materials, F. M. Spence and D. D. Spence, Manchester.
7321. Studs, &c., L. C. H. Mensing, London.
7322. Wheels of Bicycles, &c., W. Bown and W. Loach, London.
7323. Revolving Slide Valves, R. Thompson, G. Finley, and R. Hewgill, London.
7324. Wrapper for Music, &c., M. S. Bainbrigge, London.
7325. Opening Bottles, L. de M. G. Ferreira and W. Winfield, Ealing.
7326. Traverse Warp Machines, H. Haddan, London.
7327. Stitched Seams, L. Bendix, Liverpool.
7328. Galvanising Sheet Iron, N. S. Burnell, Liverpool.
7329. Boxes for Ointments, &c., J. P. Shields, Liverpool.
7330. Refrigerators, C. Baker, London.
7331. Oil Lamps, J. H. Ross, London.
7332. Cutting Wood, L. Arbey, London.
7333. Preparing Indigo Solutions for Dyeing Purposes, F. E. Schmückert, London.
7334. Supporting Candle Shades, Sir H. C. Malet, London.
7335. Weighing Machines, W. Snelgrove, London.
7336. Electric Switch, A. Slatter, London.

20th May, 1887.

7337. Stamping Holes in Slate, S. Oldershaw and D. Butt, Leicester.
7338. Artifibial Breasts, R. Bruzon, London.
7339. Carriage Seats, W. Wright and C. T. W. Piper, Devenport.
7340. Motive Power, J. Neff, Ontario.
7341. Hinges, H. McKibbin, Belfast.
7342. Pickers, E. Beaumont and R. Gledhill, Huddersfield.
7343. Reflectors, J. Whitehead, Birmingham.
7344 Lamps, J. Morton, Aston.
7345. Grinding Corn, W. Holmes and E. E. Hart, Keighley.
7346. Small-arms, H. Smith, Birmingham.
7347. Gearing, A. Melvin, Glasgow.
7348. Forks, A. E. Stayner and W. Roberts, Sheffield.
7349. Wheels, R. J. Powell and S. Watts, Bath.
7350. Gas-motors, J. Faber, Berlin.
7351. Toy, L. Myers, Birmingham.
7352. Handles, J. Gordon, Birmingham.
7253. Paper Fastener, J. Jackson and P. A. Martin, Birmingham.
7354. Curling Tongs, J. Jackson and P. A. Martin, Birmingham.
7355. Comb, J. Jackson and P. A. Martin, Birmingham.
7356. Lead Glazing, J. Armstrong, London.
7357. Carts, A. Atkinson, Leeds.
7358. Pads, R. C. Madden, London.
7359. Printing, W. J. Slous, London.
7360. Electric Machines, G. C. Fricker, London.
7361. Weight Registering Machines, G. Kirkman, London.
7362. Chairs, W. C. and M. McEwen, London.
7363. Utilising Heat, C. Tellier, London.
7364. Bands, F. H. Maberly, Birmingham.
7365. Straps, G. Tabberner, London.
7366. Fastenings, G. Tabberner, London.
7367. Time Keeping Apparatus, G. W. Parkes, London.
7368. Puddling, R. Chambers, London.
7369. Type Writing Machine, W. P. Thompson.—(*A. Barker, United States.*)
7370. Amalgamators, W. P. Thompson.—(*J. A. Sperry, United States*).
7371. Sieves, J. B. Williams, I. Bradburn, and R. Stubbs, Liverpool.
7372. Blocks, C. Klic and L. Collardon, London.
7373. Sifter, R. Huntbach, Manchester.
7374. Blocks, C. Klic, London.
7375. Tilting Casks, W. Valentine, London.
7376. Varnishes, F. Crane.—(*J. Hale and W. D. Field, United States.*)
7377. Varnishes, F. Crane.—(*J. Hale, United States.*)
7378. Electric Indicators and Bells, W. Mosley and J. Lewis, London.
7379. Calculating Machine, A. P. Eggis, London.
7380. Mutes for Violins, &c., A. N. Mezzetti, London.
7381. Mantelpieces, J. Dudley and J. Hamilton, Derby.
7382. Ornamenting Cigar-cases, &c., R. A. Green, London.
7383. Ships' Boats, C. Henderson, Glasgow.
7384. Water-meter, H. Gardner.—(*W. C. Lowe, France.*)
7385. Combination Blotting Ruler, M. Emanuel, London.
7386. Tram-car with Gas Motor, O. Blessing, London.
7387. Sending Samples by Post, &c., E. Tomlinson, London.
7388. Safety Pins, H. H. Lake.—(*D. A. Carpenter, United S ates.*)
7389. Securing Double Doors, &c., R Fladgate, London.
7390. Magic Lanterns, A. Schanschieff, London.
7391. Liquid Meter, A. Frager and B L. Michel, London.
7392. Purification of Sewage, H. H. Lake.—(*C. Lortzing, United States.*)
7393. Picture Cord Fastener, A. G. Hofstatter, London.
7394. Primary Electric Batteries, J. A. Kingdon, London.
7395. Portable Revolving Hand Tool, H. Wicks, London.

21st May, 1887.

7396. Galvanic Elements, C. M. Pielsticker.—(*F. C. G. Müller, Prussia.*)
7397. Wire Grip, J. Harrison and A. Lilwell, Birmingham.
7398. Cords used in Spinning, &c., W. P. Butchart, Glasgow.
7399. Machinery for Twisting Yarn, C. W. Lancaster, Halifax.
7400. Chandelier, &c., G. Page, jun., London.
7401. Brake for Carriages, &c., C. T. W. Piper, Devonport.
7402. Steam Generators, J. Smith and D. Cowan, London.
7403. Springs for Perambulators, H. J. Lightbown, Manchester.
7404. Manufacture of Hats, &c., T. Rowbotham, Manchester
7405. Projectiles for Rifles, &c., T. Nordenfelt, London.
7406. Machinery for Sizing Yarn, W. Lancaster, Halifax.
7407. Machinery for Beaming Yarn, W. Lancaster, Halifax.
7408. Fan Photo Frame, M. Emanuel, London.
7409. Regenerative Furnace, A. de L. Long and C. Watson, London.
7410. Bearings for Velocipedes, S. Watts and R. J. Powell, Bath.
7411. Manufacture of Cement, A. Busch, London.
7412. Shrinking Woollen Goods, &c., C. H. Hopps, Leeds.
7413. Compound for Rollers, F. Illingworth and W. Atkinson, Bradford.
7414. Mechanical Excavators, G. A. Metcalf, Leeds.
7415. Eyes of Needles, J. S. Tayler and A. Harvey, Great Grimsby.
7416. Printing Permanent Labels on Bottles, T. W. Hogg and P. J. Jackson, Newcastle-on-Tyne.
7417. Cut Pile Fabrics, F. H. Wilke and G. A. J. Schott, Manchester.
7418. Bedsteads and Spring Mattresses, G. Lowry, Barnsley.
7419. Churns, S. Wright, Glasgow.
7420. Forced Combustion in Furnaces, A. McInnes, Glasgow.
7421. Gas Apparatus, J. F. and G. E. Wright, Birmingham.
7422. Picking Apparatus, A. Whiteley, London.
7423. Fastening Handles to Cutlery, H. S. Dungworth and A. Brooke, Sheffield.
7424. Holding Matches, T. Pickup and M. Edmundson, London.
7425. Chamber, &c., Pails, F. Williams and C. Clarke, London.
7426. Preparation of Aluminium, &c., A. C. Henderson.—(*P. L. T. Héroult, France.*)
7427. Horse Clippers, A. McMurray, Glasgow.
7428. Playing on Musical Instruments, F. E. P. Ehrlich, London.
7429. Unloading and Stacking Hay, &c., H. King, London.
7430. Detachable Hub, T. H. B. Hitching, London.
7431. Electric Clocks, A. J. Boult.—(*M. Engelhardt, Germany.*)
7432. Cutting Textile Fabrics, &c., E. Law, Liverpool.
7433. Keys, L. Lenaerts, Liverpool.
7434. Recording Receipts, A. J. Boult.—(*L. Thiele, Germany.*)
7435. Screws, E. de Pass.—(*F. Purbrick, Australia.*)
7436. Switch, A. B. Gill, London.
7437. Lubricators, J. G. G. E. Bischoff, London.
7438. Stone Saws, E. Edwards.—(*L. Mardoux, Belgium.*)
7439. Grinding Spherical Balls, P. Haddan.—(*H. Richardson, United States.*)
7440. Child's Bib, E. F. M. Spies, London.
7441. Grip for Cable Railways, R. S. Belisle and J. Lucas, London.
7442. Atmospheric Gas Burners, T. Littlejohns, London.
7443. Breech-closing Mechanism for Guns, W. Lorens, London.
7444. Indicating the Position of a Train on a Railway, A. F. A. Clepkens, London.
7445. Rear Driving Safety Bicycles, J. Keen, London.
7446. Fire Escape, J. O. Spong, London.
7447. Machine Guns, F. Podger, London.
7448. Sawing Slate, J. P. de Winton, London.
7449. Buttons, D. Wade, London,
7450. Penholder, T. J. McCartney, London.
7451. Automatic Brakes, T. E. Kent and A. Masson, London
7452. Tramway Tickets, L. J. Mars, London.
7453. Submerged Mines, F. A. Velschow, London.
7454. Ornamentation of Woven Fabrics, J. Dopter, London.
7455. Bending or Curving Metal Tubes, E. S. Higgins, London.

23rd May, 1887.

7456. Ball Castors, H. D. Booth and C. Copus, London.
7457. Swimming, J. Pilkington, Manchester.
7458. Stop Valves, E. Morton and J. W. Manley, Stalybridge.
7459. Spittoons, W. E. Noble, Manchester.
7460. Duplex Slab-tilting Apparatus, T. Williamson and W. and H. Neilson, Pollokshields.
7461. Drying Hat Bodies, S. Christy and T. M. Penney, Manchester.
7462. Machines Operated by the Action of a Coin, F. C. Lynde, Manchester.
7463. Solitaires, &c., M. A. H. Rongier, Birmingham.
7464. Phantom Photographic Camera, T. Prescott, Manchester.
7465. Dough-kneading Machines, J. and T. Vicars and J. Vicars, jun., Liverpool.
7466. Filters, T. Nelson, Accrington.
7467. Studs for Bale Ties, J. B. Bradshaw, Sheffield.
7468. Folding Bedstead, G. Taylor, Hyde.
7469. Ship-logs and Current Meters, C. A. A. Capito. —(*P. K. Prytz and G. A. Rung, Denmark.*)
7470. Intercepting and Ejecting Cartridge Cases, I. and R. Bullock, Birmingham.
7471. Air-tight Tins, J. Naylor, Hull.
7472. Self-setting Rabbit, &c., Traps, W. Burgess, Malvern Wells.
7473. Syphon Flushers, F. B. Hill, London.
7474. Tobacco Pipes, A. H. Smith, London.
7475. Spring Curtain Band-holder, K. E. Wilson, Lewisham.
7476. Cleaning, &c., Seed, G. A. Hartington, Rochdale.
7477. Ironing Machines, &c., W. and F. Bash, London.
7478. Closing the Sliding Doors in Bulkheads, W. Shearman and J. G. Galley, London.
7479. Adjustable Hinge for Step Ladders, J. Bunnett, Bradford.
7480. Bronchial Vaporiser, &c., A. Drake and C. Hassam, London.
7481. Tandem Tricycles, B. Green and S. Lee, London.
7482. Coke, R. de Soldenhoff, London.
7483. Cleaning Knives, C. David, London.
7484. Rotary Printing Machines, J. Michaud, London.
7485. Wire Cloth, A. J. Boult.—(*C. A. Sacket, United States.*)
7486. Cooking Ranges, F. Ashwell, London.
7487. Carriage Landau Head Lock, &c., F. Lovett, Brighton.
7488. Stopper for Bottles containing Wines, &c., H. Aumonier, London.
7489. Indicating the Height of Water, W. L. Turner London.
7490. Pianofortes, G. Green and C. Savage, London.
7491. Lamps, M. Davis, London.
7492. Moorings, E. C. G. Thomas, London.
7493. Folding Chairs, J. F. Clasen, London.
7494. Steel, P. C. Gilchrist, London.
7495. Iron, P. C. Gilchrist, London.
7496. Trough Girders for Floors of Bridges, E. Olander, London.
7497. Increasing the Speed of Screw Steamers, H. Lyon, London.
7498. Screw Propellers, W. Bury, London.
7499. Regulating the Supply of Air, C. Birley and J. Sturgeon, London.
7500. Implements for Cultivating Land, D. Greig, London.
7501. Stretching Gelatine-coated Sheets, F. W. Zimmer, London.
7502. Locks, G. R. Boyce, London.
7503. Burners, S. Pardoe, London.
7504. Utilisation of Bye-products, P. G. W. Typke, London.
7505. Locking Device for Paste-board Boxes, A Greiffenhagen, London.
7506. Miners' Lamps, The New Portable Electric Lamp and Power Syndicate Company, D. Urquhart, and B. Nicholson, London.
7507. Wire Ways, H. H. Lake.—(*T. Otto Germany.*)
7508. Stoppering Bottles, J. Lauinger and W. Simon, London.
7509. Rope-gripping Apparatus, H. H. Lake.—(*S. H. Terry, United States.*)

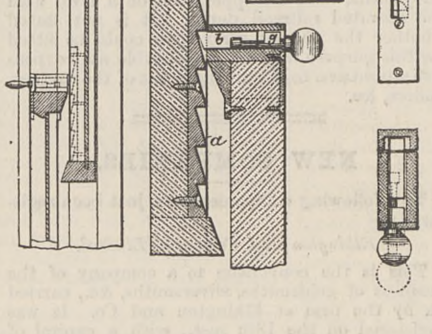
SELECTED AMERICAN PATENTS.

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

360,015. Sash Lock, *D. B. Hart, Passaic, N.J.—Filed August 5th*, 1886.

Claim.—(1) A sash lock consisting of the engaging piece *a*, the bolt *b*, and a suitable case for said bolt, in combination with the key, recessed into said bolt and provided with the bearing *g*, adapted to engage with the inner face of the bolt case to lock the bolt in position when projected, and with the outer face of the case to lock the bolt in position when retracted,

360,015

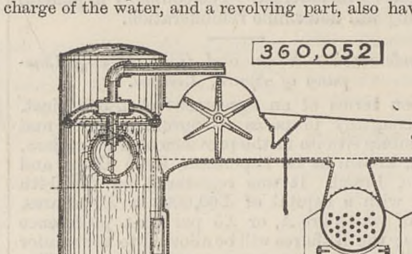


substantially as described (2) In a sash lock, the bolt *b* and a suitable case for the same, in combination with the key provided with the bearing *g*, adapted to engage with the inner face of the case and lock the bolt in position when projected, substantially as described.

360,052. Smoke Condenser, *B. Roberts, Indianapolis, Ind.—Filed November 2nd*, 1886.

Claim.—(1) The combination, with a furnace, of a condenser, a conduit or breech leading from said furnace to said condenser, a suction fan located in said conduit between said furnace and said condenser, and a perforated circular water pipe arranged within said condenser. (2) The combination, in a smoke condenser, of a pipe running around inside the walls of said condenser and provided with fine orifices for the discharge of the water, and a revolving part, also having

360,052

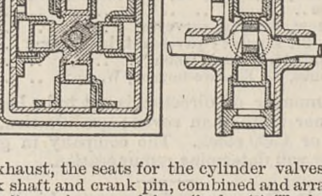


fine orifices, whereby the air in the condenser is thoroughly wet when the device is in operation, substantially as set forth. (3) The combination, in a smoke condenser, of the furnace, the condenser, the breech or conduit leading from said furnace to said condenser, a fan in said breeching, and a damper having an attachment which serves as a continuation of the rear wall of said fan, substantially as set forth.

360,057. Steam Engine, *G. Smith, New York, N.Y.—Filed July 13th*, 1886.

Claim.—(1) In an engine, the piston having two or more connected parts movable back and forth within their respective cylinders, said cylinders being made movable upon their seats and operating as valves, and the crank pin located at the central part of the piston, the parts being combined and arranged to operate substantially in the manner shown and described. (2) In an engine, the piston composed of three or more parts, the corresponding independent cylinders, movable upon their seats, the box containing the channel

360,057

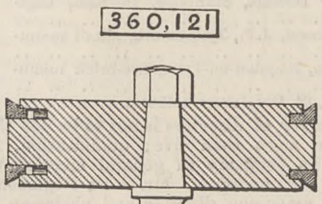


for the exhaust, the seats for the cylinder valves, and the crank shaft and crank pin, combined and arranged substantially as shown and described. (3) The herein-described engine, comprising the crank shaft and crank pin, a piston mounted upon said pin, and having a number of parts surrounding the same and fitted to enter their respective cylinders, the movable cylinders operating as valves, the box containing the steam channels and ports, and the sides or heads, all arranged for operation substantially in the manner and for the purposes set forth.

360,121. Packing-ring for Pistons, *W. W. St. John, Brooklyn, N.Y.—Filed October 29th*, 1886.

Claim.—(1) In a piston, a packing-ring cut at one side only, having its outer side bevelled, so that the

360,121

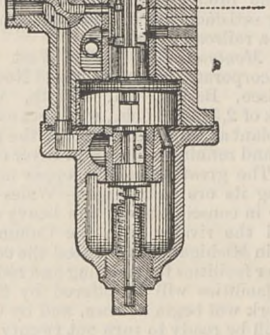


side bearing against the inner surface of the cylinder and the side bearing against the body of the piston shall wear in proportionate degree, substantially as specified. (2) In a piston, a packing-ring cut only at one point and having a cross-section whose vertical side bearing against the piston body is greater in width than the face side bearing against the inner surface of the cylinder, and having its outer upper side bevelled, as shown and for the purpose set forth. (3) In a piston, a packing-ring having a cross-section whose side bearing against the piston-body is of greater width than its face side bearing against the surface of the cylinder, and having its side bevelled, as shown, and provided with a shoulder, as set forth. (4) In pistons, a packing-ring having the side placed toward the piston-body of greater depth than its face side, and its outer side bevelled, in combination with a pin having a head, as and for the purpose specified.

360,070. Fluid Pressure Automatic Brake Mechanism, *G. Westinghouse, jun., Pittsburg, Pa.—Filed November 19th*, 1886.

Claim.—In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake cylinder, a triple valve, and an auxiliary valve device, actuated

360,070

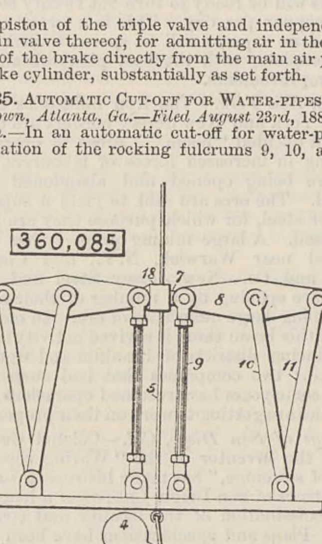


by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air pipe to the brake cylinder, substantially as set forth.

360,085. Automatic Cut-off for Water-pipes, *W. G. Brown, Atlanta, Ga.—Filed August 23rd*, 1886.

Claim.—In an automatic cut-off for water-pipes, a combination of the rocking fulcrums 9, 10, and 11,

360,085

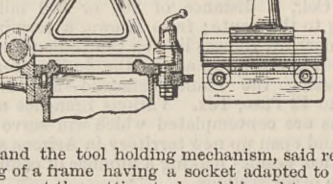


the beam 8, the bolt 7, the loop 18, the bar 5, connected to the lever 3, the weight 4, and the valve, substantially as described, and for the purpose specified.

360,132. Tool Support for Lathes, *J. R. Back, Worcester, Mass.—Filed December 10th*, 1886.

Claim.—In a machine for boring, chucking, or drilling, the combination, with mechanism for holding the work to be bored, and mechanism for holding and presenting a cutting tool to the work, and mechanism for rotating said work, substantially as described, of a tool rest for supporting said cutting tool between the

360,132

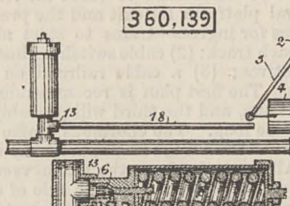


work and the tool holding mechanism, said rest consisting of a frame having a socket adapted to receive and support the cutting tool, and hinged to a carriage longitudinally adjustable on the ways in a line parallel with the axis of said cutting tool, and ways formed on the rigid framework of the machine and adapted to receive said carriage, substantially as described, and for the purpose set forth.

360,139. Cut-off for Water Pipes, *W. G. Browne, Atlanta, Ga.—Filed August 23rd*, 1886.

Claim.—(1) In a cut-off for water pipes, the combination of the compound coil composed of two strips of different metals, 8 and 9, one end of said coil being stationary and the other having a rotary movement, as described, the valve operating plate 7, the rotating valve 6, its stem loosely fitting said operating plate, but turning with it, the spring 17, and the fixed valve seat, all arranged and operating to cause a discharge of water through the pipe 18 by the change in the temperature of the compound coil, substantially as

360,139



set forth. (2) In a cut-off for water pipes, the combination of the compound coil and valve operated b said coil with the pipe 18 and valve 2, lever 3, and vesse 4, to contain water to act as a weight for closing said valve 2, substantially as specified. (3) In an automatic cut-off for water pipes, the combination of the compound coil 8 9, the adjusting plate 10, the plate 7, spring 17, valve 6, the part 13, and vessel 4, attached to a lever 3, having counterbalance 5, arranged, substantially as described, to close the valve 2.