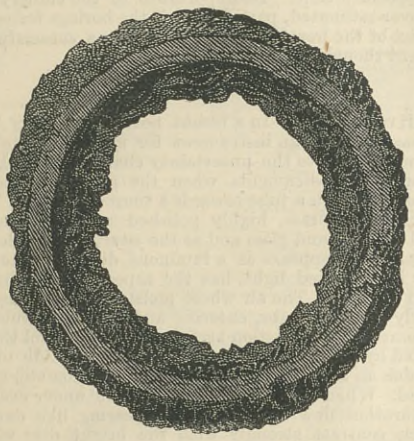
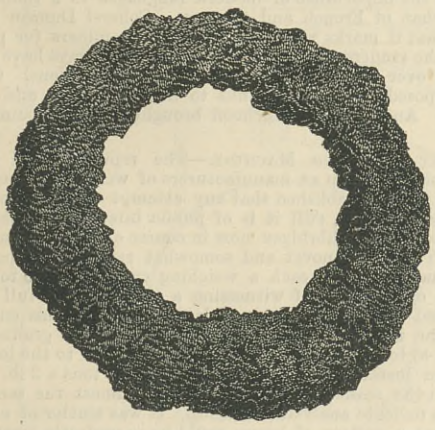
FIRE-BOXES FOR EXCESSIVE TEMPERATURES.

THAT very remarkable craft, the Polyphemus, is fitted with boilers of the locomotive type, and they have given a great deal of trouble both from priming and leaking. It has been found up to the present almost impossible to keep the tubes tight in the fire-box tube plates; and the Government has recently carried out a series of experiments in order to arrive at some solution of the difficulty. There is a close analogy between her boilers and those fitted to torpedo vessels, and the boilers of four first-class torpedo boats were used for trial. According to a semi-official report which has been made public in the *Times*, these trials have extended over a number of weeks, and are now concluded, after each craft has been practically proved to death. The Lightning's tubes were fixed in the usual way, with the bead outside, but strengthened by eight stay tubes; No. 3 had the tubes screwed into the fire-box ends, the thread being of a peculiar kind; No. 11 had the tubes expanded into a groove in the middle of the tube plate and feruled; while No. 12 had the tubes expanded through the plate and strengthened by long steel ferules. No. 3 was also fitted with circulating tubes for the purpose of bringing the water from the cooler parts of the boiler to the furnace end, where the leakages occurred. The conditions of trial were that the boilers were to be pressed under way at



TUBE END CLINKER, TUBE PLATE SIDE.

120 lb. to the square inch for twenty minutes, the air pressure in the closed stokeholes to be equal to 5in. of water. Steam was then reduced in less than twenty minutes to 20 lb. for the purpose of testing the results of the contraction. The trials were continued over six days in the Solent, steam being pressed and reduced three times successively during each trial. No. 11 gave out the first day. After having her tubes re-expanded she entered a second time into the competition, but was again placed *hors de combat*. It was then determined to take her out of the running; but, in accordance with instructions from the Admiralty, she was subsequently fitted with circulating tubes, and underwent a third trial. As the results were not satisfactory she was then withdrawn. On the third day the Lightning had a mishap to her steering gear, while No. 12 sustained an accident to the slides of her fan engine. The Lightning was next put out of the competition, and the trials were limited to Nos. 3 and 12, the ultimate victory remaining with the former and the screwed tubes. She passed through the whole of the six ordeals satisfactorily, the others requiring their tubes to be re-expanded and attended to after each day's run.



TUBE END CLINKER, FIRE-BOX SIDE.

It may appear a little surprising to locomotive engineers that so much trouble should arise. They will say, and with truth, that the tubes of locomotive boilers seldom if ever leak; but in truth, there is very little similarity between the conditions under which the two boilers are worked. In another page we have given particulars of the trial of the largest torpedo boat yet built, which ran on Tuesday at full speed, indicating about 620-horse power for three hours. Her engines were at work without once stopping for five hours, and when running at the slowest made about 280 revolutions per minute; at full speed they made 440. The stroke is 16in., so that the piston speed at the latter velocity was nearly 1300ft. per minute. Not the slightest trouble was caused by the engines; but it is very doubtful if the full speed trial could have been continued for another hour, and this for a very curious reason. It is strange, but nevertheless true, that the presence of a trace of iron in the coal used appears to be the proximate cause of this fact. The grate surface is 25 square feet, and coal is burned on it at the rate of 25 cwt. per hour. In other words, the rate of combustion is nominally 1 cwt. per square foot of grate per hour. The fan maintains a pressure of 6in. of water, or nearly 0·25 lb. per square inch, or 36 lb. per square foot in the stoke-hole. But 36 lb. is the pressure attained by the wind in great storms. Under the influence of so prodigious a draught, large quantities of burning cinders are swept up the chimneys, and those standing aft when the boat is running at full speed have to endure a fiery hail which must be experienced before its terrors can be realised. From the tops of the funnels rise two flames, visible even in daylight; and, as the funnels are short, competent to scorch the faces of those who go too near. After a run of a couple of hours, some four or five cwt. of cinders, about as large as hazel nuts, can be taken out of the smoke-box. It is impossible to fire while the blast is full on, and three men are always in the fire-room. One slows down the fan, while another opens the fire-door with a rod provided for the purpose, and the third shovels on coal, the door being shut while the shovel is being filled. If the fan were not slowed down, all the dust and small lumps of coal would be blown off the shovel and projected against the tube plate, with the result that the tube orifices would very soon be closed up. Even as it is, rings collect round the tubes, one of which rings we illustrate full size in the accompanying engraving. One view is from the tube plate side, the place where the end of the tube came being clearly indicated; the other is from the fire-box side. It will be seen that the ring has reduced the area through the tube nearly one-half. The following is an analysis of a similar ring:—

Iron	15·12
Alumina	38·18
Silica	30·28
Lime	0·20
Sulphur	0·0
Oxygen	6·48
Carbonic acid	0·92
	100·00

Thus it will be seen that this clinker is essentially a silicate of alumina with iron, and for some reason not fully understood the iron appears to be the cause of its formation. At least the rings do not form to anything like the same extent with coal quite free from iron. The proximate cause of the clinker is no doubt that dust particles are driven with tremendous velocity against the tube plate and stick there, and, as we have said, in time the tubes would become entirely stopped up, and no steam could be got.

It will be seen from the foregoing that the heat in a torpedo boat fire-box is much more intense than that in a locomotive fire-box; indeed, it can hardly be less than that of a steel-melting furnace, and the tube plate is very sorely tried. It may be asked why is not a brick bridge put in as in locomotives, which would catch all the clinker and save the tube plate. There is a bridge, but the fire-box, it must be remembered, is very shallow, and the bridge can only protect a few of the lower tubes. The bars are not 1ft. below the level of the lowest row of tubes. All the conditions, therefore, are very unfavourable to the boiler.

Mr. Yarrow, of the firm of Yarrow and Co., Poplar, carried out some time ago a series of experiments with nearly the same object as those made recently by the Government, and he succeeded completely in getting over the difficulty, and keeping his boilers tight. He arrived at some curious results. He took, for example, a template or paper "rubbing" of a tube plate before steam was got up; then steam was raised to a pressure of 120 lb., kept up for a while and allowed to fall; when the boiler was cold another template was taken, but this would not fit the first. Then centre punch marks were made at various places in the tube plate, the distance between them was accurately measured, steam got up and allowed to fall, and the distances re-measured. In all cases they were increased, thus one vertical dimension was 18in. to begin with; it became 18$\frac{3}{8}$in. Another, a horizontal dimension, was 18in., it became 18$\frac{1}{4}$in. In a word, the whole tube-plate $\frac{7}{8}$in. thick, seemed to have expanded. To what this is due it is not very easy to say, but it is probably owing to the circumstance that the sides become dilated, and that from the nature of their form they cannot readily contract again and hold the tube-plate—which is after all little but a mesh work or net—out at the edges and so it stretches. Be this as it may, the result of the stretching is to set the tubes leaking. Mr. Yarrow tried various expedients to impart rigidity to the plates, but in vain; and at last he adopted the opposite principle. Instead of fighting with the tube-plate he let it have its own way, and by providing very simple arrangements, the nature of which we do not feel justified in explaining in detail, he has, as we have said, got over all his difficulties, and makes boilers which will not leak.

We do not wish to assert that the Government should do in the case of the Polyphemus precisely what Mr. Yarrow has done; but we do wish to assert that if they want to get tight tubes they must not rely on screwing or feruling, or any other device of the kind. These will all fail under the test of continuous steaming for any length of time. They must give the tube plate full liberty to contract and expand as it pleases all round, and if they insist on having stays among the tubes, which are quite unnecessary, then let them be of phosphor bronze, which has nearly the same coefficient of expansion as brass. If iron stays are used, the brass tubes, heated by the gas passing through them while the iron stay is still cold, will "walk out" of the tube plates, or if held too tightly at the ends, they will bend. So long as comparatively moderate temperatures have to be dealt with, there is no difficulty in making sound boilers; but when we have to deal with furnaces actually burning some 95 lb. of coal per square foot per hour, matters are altered. Locomotives rarely burn as much as 70 lb. of coal per foot of grate per hour, and the draught seldom exceeds 3in. of water; but even of locomotives it has long been known that the tube plates must be left to themselves, if the tubes are to remain tight.

THE ROYAL AGRICULTURAL SHOW AT READING.

THE forty-fourth show of the Royal Agricultural Society opens at Reading on July 10th, and the implement department only will be opened to inspection by the public on the previous Saturday. In all departments the entries are on a very satisfactory scale, and considerably in excess of the last few years, as much as 13,017ft. run having been taken by 358 exhibitors, who will display their productions on 391 stands. The following tabular statement clearly shows the space allotted in the three general divisions of the implement yard at Reading and at the two previous shows:—

Description of shedding.	Reading, 1882.	Derby, 1881.	Carlisle, 1880.
	Feet.	Feet.	Feet.
Ordinary	9,326	9,138	6,662
Machinery in motion	2,289	2,102	2,060
Side sheds	1,402	1,511	1,059
Total	13,017	12,751	9,781
Number of stands ...	391	377	270

The trials specially assigned to this year are of steam-draining machinery, cream separators, milking machines, straw compressing and binding machines, and apparatus for hay and corn drying, arranged in the following classes:—

Class I.—The most efficient and economical apparatus for excavating field drains, the gold medal.

Class II.—The best cream separator driven by mechanical power, the gold medal.

Class III.—The best cream separator, driven by manual or horse-power, the gold medal.

Class IV.—The best milking machine, to be tested during six consecutive months of the spring and summer of 1883, £50.

Class V.—The most efficient portable straw compressing and binding machine, to be worked in conjunction with a threshing machine, £25.

Class VI.—The most efficient and economical method of drying hay or corn crops artificially, either before or after being stacked, £105.

Two entries were made in Class I., but have since been withdrawn. In Classes II. and III. there are ten machines entered by three exhibitors, and two of these have been withdrawn from the competition; in Classes IV. and V. there is one entry in each; and in Class VI. twelve methods entered by nine different exhibitors. The chief interest centres in the hay and corn drying trials, which will commence on the morning of Tuesday next, near the Whitley Manor Farm, Reading, where 97 acres of meadow grass have been reserved for the trials, in addition to a considerable quantity of rye grass. The Agricultural and Horticultural Association make two entries, one being a portable and the other a fixed system of drying in the stack. Like several other competing inventions, these exhibits are based upon Mr. Neilson's invention, to which we refer at length on another page, the improvements effected in this case having been patented by Mr. E. O. Greening and Mr. Barker, whose object has been to produce a system capable of being adopted by agriculturists, whether farming on a large or small scale In regard to the fan itself, the mechanism presents some points of novelty, as all straps and nearly all spur wheels are dispensed with, thus enabling the whole to be turned by a single shaft carrying one large driving wheel, by which the fan is whirled round at a very high velocity by small friction pulleys. The driving wheel itself revolves at a very rapid rate, being impelled by a modification of the "sun-and-planet" motion, and the result of the combination is to obtain for the small fan a velocity equal to between 2000 and 3000 revolutions per minute, while the labourers only require to turn the handles at the rate of about 50 per minute. The system is provided with a thermometer marked with the points where the fan must be used for hay and for corn-drying respectively, and especially where danger of firing threatens. The fixed system does not differ greatly from the portable one, but in the latter the fan is larger, although supplied at a lower charge. The following considerations are put forward by Mr. Greening as the reasons upon which the system is based:—"It is evident that the plan as worked out by Mr. Neilson would be too costly for most agriculturists. I do not refer simply to the laying down of underground pipes in a permanent stackyard with all the arrangement of separate dampers and a fixed fan driven by an engine, but to the necessity involved of carting all hay and corn from the field however distant, and stacking them in the place where the drying system is fixed. Most farmers now probably erect their stacks at points most convenient for each. Some farmers have no steam engine. Others could not ensure having one available every day for an hour or so during the fortnight sometimes required to cure wet stacks. Very few have stackyards so conveniently arranged that underground pipes could with certainty be placed to reach each stack in a direct line or lines, or even without a good many bends and turns. And in some cases the pipes would not when laid be free from danger of disarrangement by overground pressure. In other cases the pipes could not well be carried to a point where a fixed fan could be conveniently worked by the steam engine." The price of the portable system is £14 for an exhaust fan on wheels. The system is applicable to single stacks, whether in stack-yard or in the field, and can be worked by hand power. The price of the fixed system is £7 for the exhaust fan, and this system is applicable to stacks in rows, the fan to be worked by steam, horse-power, or water motor. In both cases these figures do not include

the cost of air pipes, centre air chamber arrangement, and thermometer and sliding valves.

Messrs. R. A. Lister and Co., of Dursley, enter their new patent exhaust fan, which is also on Neilson's system. It can be worked by two men, or is suitable for driving with horse-gear or steam or water power. The fan is composed wholly of iron. is mounted on four wheels, and can be drawn about with ease.

Mr. Jas. Coultas, of Spittlegate, Grantham, is also one of the competitors, with his patented apparatus for drying in the stack. It is mounted on travelling wheels and shafts suitable for moving from stack to stack or otherwise. The system consists of a powerful exhaust fan driven at a high rate of speed by steam, horse gear, or hand power, the prices varying from £7 10s. to £18.

Mr. W. A. Gibbs' well-known hay dryer has not been entered by himself, but by Mr. W. W. Champion, the manager of the Reading sewage farm, who has for some time past been making experiments with it in combination with one of Gibbs' stack drying fans; this combined system being found very effective in drying grass grown by sewage irrigation. Mr. Gibbs, however, will appear as a competitor at Reading, having entered a hand-power fan and another to be worked by steam. These fans are rough, but strong and effective machines, constructed to enable farmers to fully test the plan of stack cooling at a small outlay, the prices being fixed at £7 and £8 respectively. Suction power for six or eight stacks *seriatim* can be carried from stack to stack, fixed and unfixed in a minute, and worked by one or two men. One of the fans has a rigger instead of handles and spur-wheel gear, so as to be worked from a horse gear or steam engine. The other competitors are Mr. C. D. Phillips, of Newport; Mr. Bamlett, of Thirsk; Messrs. Robey and Co., Lincoln; and Mr. C. Kite and Co., Chalton-street, Euston-road.

The trials of cream separators will also commence in earnest on Tuesday next, and on the preceding day there will be preliminary runs with water by exhibitors to enable everything to be got into perfect working order. According to the programme as at present arranged the horse and manual power machines will be submitted to trial on Tuesday, the steam power machines on Wednesday, Thursday being allotted to final trials if such should prove to be necessary. The following are the points of merit determined for the guidance of the judges:—

Power required to work separator Quantity of milk per hour dealt with Price of machine	 30
Lowness of speed	10
Completeness of separation as determined by analysis and general efficiency	30
Simplicity of construction	15
Power of adjustment for varying percentage of separation	15
	100

The duration of each trial is fixed at one hour. The separators in each class will be tested simultaneously. They will all be worked by the same shaft, the speed of which will be kept as nearly as possible at 150 revolutions per minute, the exact speed being indicated by a speed indicator, and duly noted at regular intervals during the trials. It is estimated that 1700 gallons of milk will be required in order to make an efficient rest of the competing machines. The skim-milk and cream delivered by the machines will be weighed separately; and the chemist to the Royal Agricultural Society will analyse the skim milk from each machine, for this purpose taking such samples as he may deem necessary. The judges will note the time that elapses in the case of each machine between the time of starting and the time when complete separation commences to take place. The imperfectly separated milk will be put back into the supply vats of each machine. The rate of working at intervals during the run will be ascertained by noting the time in which a given measure is filled. All the machines will cease working on fresh milk at the same time, and the time required to finish their charges will be noted. Should any machine leave more than 4 per cent. of butter fat in the skim milk it will be considered out of the competition.

The trials of the straw-compressing and binding machine will take place, in all probability, towards the latter end of next week.

BOILERS OF THE S.V. VESTAL.

THE Trinity House has recently asked for tenders for new boilers for their yacht, the Vestal. We append a copy of the specification for the new boilers, and drawings of the boilers will be found on page 467. The work comprised in this specification is the finding of all material and labour in disconnecting and removing the present boilers, funnels, and mountings, from on board the Trinity House s.v. Vestal, and in the construction of a pair of new multitubular marine boilers, of 160 nominal horse-power collectively, to work at a pressure of 25 lb. per square inch, including a new and complete set of mountings; also new funnels, funnel casings and coamings as hereinafter described; the whole being fitted up, fixed complete for sea, and set to work on board the Vestal, to the satisfaction of the engineer-in-chief of the Trinity House. The whole of the work is to be fitted up in a complete and substantial manner, and to be of the very best quality of material and workmanship; and any details of work not shown on the drawings, or described in the specification, are to be carried out in accordance with similar details in the present boilers, or as shall be directed, without any extra charge. The old boilers—which are fitted with brass tubes—funnels, and all mountings are to become the property of the contractor. The vessel will be delivered to the contractor at any approved port in the United Kingdom, for a period of five weeks, for the removal of the old boilers and for the reception of the new ones, after they have been proved and inspected. All shipwright's work will be executed by the Trinity House at their expense. The whole of the work herein specified is to be carefully executed in accordance with this specification, and with the drawings Nos. 5671 and 5672. The pipe connections between the engines and new boilers are to be made by the contractor for the new boilers, who will be held responsible for placing them truly in position, so that they connect properly with the various pipes, &c. The work is to be fitted together and executed complete, so far as possible, in a proper workshop on the contractor's premises. Due notice is to be given to the corporation when the work is ready for inspection; and after the same has been approved by the engineer-in-chief, the whole is to be thoroughly cleansed and freed from rust. In this state it is to be thoroughly coated with boiled linseed oil, and afterwards to receive two good coats of pure red and white lead mixed, or approved anti-corrosion paint. The different parts are to be figured or marked, and, upon the contractor's receiving a written order, the boilers are to be transferred to the vessel and completed on board; after which they will be tried under steam on the river Thames or elsewhere, to the satisfaction of the engineer-in-chief. All working drawings are to be submitted for approval before the works are commenced.

The patterns, previous to being cast from, are to be submitted for approval, and such of the work as may appear to be of a doubtful quality is, when required, to be subjected, at the expense of the contractor, to such proof as shall be considered sufficient by the engineer. Any defective parts are to be made good, and the whole is to be completed in the best and most workmanlike manner. The whole of the plating—except those portions specified to be of Low Moor—to be manufactured of fine fibrous iron, of approved quality, to bear a tensile strain of not less than 22 tons per square inch of original area, lengthways, with a contraction at fracture of not less than 10 per cent. of original area, and 20 tons crossways, with a contraction of 5 per cent. at fracture of original area. The cast iron is to be of the best tough grey metal, of approved quality. The iron and gun-metal castings are to be run solid, free from sand, air holes, and other defects and blemishes, and to be neat, clean, smooth, and true. The gun-metal is to be in the proportion of 16 parts of copper to 2·75 parts of tin, and ·25 parts of zinc, or other approved mixture; the copper, tin, and zinc to be of the best and approved quality. The threads of the screws, and of the screw bolts and stays, are to be cut true to Whitworth's standard, and, where required, to be provided with proper nuts and washers. The portions of the plating where exposed to the action of the fire, viz., the whole of the furnaces, the whole of the combustion chamber at the back of the furnaces, both tube plates, the uptakes, the whole of the steam chests on tops of boilers, the furnace fronts and water space pockets, are to be of Low Moor iron. The edges of all plates are to be planed. The furnace plates are to be in one plate as shown, and to be carefully bent to a true radius. All rivet holes about the furnaces, combustion chambers, and bent surfaces are to be drilled, the plates are to be taken apart after drilling, the burr cleaned off, and the holes slightly countersunk from the outside. No drifting will be allowed. The plating to be of the following thicknesses, viz.:—Sides, back, and crown of shell, furnaces, combustion chamber, sides, and crown of steam chest, furnace fronts, and bottom plates of water spaces, $\frac{7}{16}$in.; uptake and smoke box, $\frac{1}{2}$in.; front and back tube plates, $\frac{5}{8}$in.; smoke-box doors, $\frac{5}{16}$in.; inner and outer shields on smoke-box doors, $\frac{1}{4}$in.; ash-pit plates, $\frac{3}{8}$in.; funnels for two-thirds their length, $\frac{1}{4}$in.; upper remaining third, $\frac{5}{16}$in.; hoods and casings round funnels, $\frac{5}{16}$in. The manhole in the crown of the steam chest to be stiffened round its edge by a welded ring 2$\frac{1}{4}$in. × $\frac{3}{4}$in. The doors for all man and mud holes are to be formed of two $\frac{7}{16}$in. plates, rivetted together, and secured by two strong wrought iron dogs in the case of the larger holes, and one only in the case of the smaller. The boilers are to be single rivetted throughout. The laps of the $\frac{7}{16}$in. plates are to be rivetted with $\frac{3}{4}$in. rivets, having a pitch of 1$\frac{7}{8}$in. The laps of the $\frac{1}{2}$in. plates are to be rivetted with $\frac{3}{4}$in. rivets, having a pitch of 1$\frac{7}{8}$in. The laps of the $\frac{5}{8}$in. plates are to be rivetted with $\frac{7}{8}$in. rivets, having a pitch of 2$\frac{1}{8}$in. All rivets are to be of Low Moor iron.

All stays and angle irons are to be made of Low Moor or Bowling scrap iron. The stays in the furnaces and combustion chambers are to be chased with a fine thread and tapped into both plates, with nuts and washers on the outer ends; on the inner ends the thread is to be turned off and the end rivetted over to form a substantial head. All other stays are to be of the form and dimensions shown on the drawing.

Each boiler to have 414 solid drawn brass tubes, 2$\frac{1}{2}$in. external diameter, No. 11 b.w.g. thick, and sixteen iron stay tubes $\frac{1}{4}$in. thick. The brass tubes to be expanded into the front tube-plate and feruled with steel or malleable cast iron ferules in back tube-plate. The iron stay tubes to be screwed into both tube-plates and rivetted over at ends.

The furnace doors and door frames to be of wrought iron $\frac{1}{2}$in. thick, and of the form and dimensions shown on the drawing. Wrought iron ash-pit doors $\frac{5}{16}$in. thick to be fitted as shown. The ash-pit plates are to be carried on angle irons shown, and stiffened with angle irons as may be directed; to be fitted so as to form a neat finish with stokehole floor-plates, and to be easily removable for access to the bilges. A complete set of cast iron fire-bars is to be provided and fixed in each boiler. The fire-bars are to be supported at the front end on strong cast iron dead plates attached to the furnace door frames as shown; at the back they are to be supported on cast iron carriers bolted to the back plates of the combustion chambers, and the mid-bearers are to be of the form and dimensions shown on the drawing. Each boiler is to be provided with a new and complete set of mountings in accordance with drawing No. 5672. Adams's spring safety valves—two valves to each boiler, with easing gear to each valve—copper waste steam pipe, and copper drain pipes complete. Each safety valve to be 4$\frac{3}{8}$in. diameter. Waste steam pipes to be 6$\frac{1}{2}$in. diameter, and 11 B.W.G. thick. Drain pipes to be $\frac{3}{4}$in. bore; one drain pipe from each safety valve. One gun-metal steam whistle, 6in. diameter, and one steam pressure gauge—Bourdon's own make—is to be fitted to each boiler. All mountings to be of the best materials and workmanship, and complete with all necessary pipes and connections. All steam cocks to be asbestos packed. Each funnel is to be 27ft. high, and 3ft. 8in. internal diameter, to be flush rivetted with internal single butt straps; the plates to be of the thicknesses herein-before specified. Each funnel to be fitted with bands, shackles, &c., as shown on drawing No. 5672. The funnels when finished are to present a perfectly smooth external surface, and to be oiled and painted as specified for the boilers.

The boilers, when finished, with their mountings attached, and before being painted or placed on board the vessel, are to be tested with cold water to a pressure of 50 lb. per square inch, under which pressure they must be perfectly free from leaks. When placed on board, they are to be solidly bedded on cast iron blocks; to be firmly blocked to the keelsons both fore and aft and athwart ships, and to be completed in every way ready for sea.

The boilers, including the steam dome or chest, are to be covered with two thicknesses of treble felt, and lagged with wood 1in. thick. The lagging to be thoroughly seasoned, tongued, and grooved. The end of the lagging to be protected from fire with sheet iron or lead, tucked under and turned back, and secured with copper nails.

The actual weight of boilers is to be furnished by the contractor when the work is completed.

THE NEW HULL AND BARNSLEY RAILWAY.

ON Monday last the works committee of this line paid their first visit, and inspected what may be called the South Yorkshire portion of the undertaking, the construction of which is in a very forward state. The party, who were conveyed by the Midland from Hull to Cudwarth, included Mr. J. Fisher, J.P., deputy chairman of the company, the mayor of Hull, and five other members of the committee, as well as the accountant and engineer of the company. They were met by Mr. Larry, of Cudwarth, agent to the contractors, and Mr. Purdon, the resident engineer of that section of the line. Although only about sixteen months has elapsed since the first plot of land was placed in the hands of the contractors near Brierley, great progress is being made, and owing to the depressed state of the coal trade, and the existing rates charged by the existing railway companies, many colliery owners are looking with great interest to the opening of the line. It is somewhat singular that a lengthy and important dispute, in which three large collieries have been engaged since last February, was mutually arranged on the very day the line was inspected. It will be remembered that the Midland Company withdrew the ledger accounts from the Carlton Main, Monk Bretton, and Moughton Main Collieries, and have compelled them to pay cash for all coal they have sent away up to Monday. The new Hull and Barnsley line ends at Cudwarth, near to the three collieries named, and the bank to connect the line with the Midland is tapped right up. The permanent way is laid along a good portion of the line, and the visitors were able to ride over part of it in their own wagons. What is known as the No. 6 section which leads up to Brierley tunnel was minutely examined. The cutting, which is about a mile in length, is principally formed of rock and shale, and about half the work has been done. The excavation at the mouth of the Brierley tunnel is fully 60ft. deep. The tunnel itself will be 650 yards in length, of which 220 yards has already been excavated. Three shafts are sunk from the surface, and although much water was met with all three were down in August last. The party descended one of the shafts and made a minute inspection of the tunnel, which has a horseshoe arch, and not a flying arch coming down to the rail level. The party next proceeded to Hemsworth, where there is another large tunnel, which village the line passes about half a mile to the south. Carriages were procured, and the party then drove to South Kirby, where the deepest colliery in Yorkshire is being opened out near to the new line. Here luncheon was taken, and a move was then made to Upton cross roads, where the line is in a forward state, a considerable portion being ballasted ready for the permanent way. Here a cutting has to be made through the magnesian limestone for a distance of a quarter of a mile. On reaching the South Kirby tunnel, which is about 1222 yards in length, they found about a third of the work had been done. Here five shafts have been sunk, and the party also descended one of these and inspected the tunnel which opens out to the eastern face. The party were then conveyed on an engine to Willow Bridge, and driving to Heck on the Doncaster and Selby line, then took the train at Selby for Hull, greatly pleased with all they had seen. There can be no doubt but this section of the new line will be ready for opening before the specified time. Its importance to the colliery interests cannot be over-estimated, particularly if the borings for coal in the Selby district of the new line turn out to be as successful as they are at present thought to be.

A NEW HYGROMETER.—In a recent note to the Paris Academy, M. Crova has described an instrument for measuring the moisture of the air not subject to the uncertainty characterising the indications of previous instruments when the air is agitated. The observer looks through a tube towards a source of light. This tube is of nickel-plated brass, highly polished within, closed at the further end with ground glass and at the nearer with a lens. The ground glass plate appears as a luminous disc, and the polished interior, by its reflected light, has the aspect of a bright annular space round the disc. The air whose moisture is to be ascertained passes slowly along the tube, entering and leaving by tubulures at the ends connected by a suction arrangement. To cool the tube, it is surrounded by a metallic sleeve filled with sulphide of carbon, through which an air current is passed. A thermometer is inserted in this liquid. When the temperature of the air under examination reaches saturation dew is deposited, appearing like dark brown spots, which contrast strongly with the bright disc when seen directly. A gradual rise of temperature makes these disappear, and thus, by repeated appearances and disappearances, the dew-point may be estimated with an approximation of one-tenth of a degree.

OXFORD MILITARY COLLEGE.—The annual speech day of this institution, which prepares candidates for Woolwich, Sandhurst, home and Indian Civil Service, took place on the 21st inst. Lord Waveney, in the absence of H.R.H. the Duke of Connaught, who wrote to express his regret at not being able to attend, gave away the prizes to the successful competitors for military proficiency. Letters of regret were read from Lords Hertford and Jersey, Colonel Sir Robert Loyd-Lindsay, Bishop Claughton, and many others. His lordship was seconded by General Burnaby, M.P., and Colonel F. Duncan, R.A. The proceedings were opened by an inspection of the students on parade. After the riding, sword, lance, and carbine exercises had been gone through, the reports from the governor, General Desborough, on the military studies, and the disciplinarian, Colonel Macartney, were then read. The sword of honour, given annually by Colonel Sir Robert Loyd-Lindsay to the student passing highest from this College into Sandhurst or Woolwich, was awarded to Mr. Reade, and another sword, given by Lord Waveney for military proficiency, to Mr. Hibbert. His lordship then addressed the students at some length, touching upon some of the most important duties and requirements of a soldier. "I am likewise glad to find," said he, "that the head master of this College lays so much stress upon the study of modern languages, the importance of which cannot well be overrated now-a-days." He complimented the students upon the able manner in which the various military exercises had been performed. General Burnaby, M.P., agreed in what his lordship had said about the importance of modern languages to a soldier, particularly that of French and German. Colonel Duncan said he was sure that if marks were given by the examiners for physical training, the students from this College would always have a great advantage over those coming from other institutions. General Lorry proposed a vote of thanks to Lord Waveney and to the chairman. An excellent luncheon brought the proceedings to a close.

A GREAT WEIGHING MACHINE.—The reputation of Messrs. Henry Pooley and Son as manufacturers of weighing apparatus is already so firmly established that any attempt to enhance it may be regarded as futile, still it is of public interest to make some reference to two weighbridges now in course of completion by the firm which are of a novel and somewhat remarkable character. The two machines have each a weighing capacity of 80 tons, and we had an opportunity of witnessing a test with the full load of 80 tons piled upon the weighing platform. With this enormous load on, the indicator was sensitive to the lowest graduation—indeed, at 40 tons, when a single pound was added to the load, the weigh-beam instantly indicated it, and with 80 tons a 2 lb. weight would turn the scale as readily, and with almost the same precision, as a delicate analytical balance. It was matter of no small surprise that a system of levers could be so perfectly arranged as to accurately balance a huge load of 80 tons in suspension with such apparent ease, but the test assumed somewhat of the marvellous when the scale turned so readily with a weight which represented only the 100,000th part of the load. It is but an example of the perfection to which applied mechanics have of late years been brought by British enterprise and skill, and in this special class of machines by Messrs. Pooley in particular. The kind of machine referred to is what is known as their self-contained railway wagon weighbridge, and we understand the present examples are for use at some large English marine engineering works. The self-contained iron box, which is intended to do away with a masonry foundation, is constructed of massive iron girders, framed together, whilst the levers, roadway girders, and platform are equally strong and substantial. The knife-edged centres and their corresponding bearings are of steel, properly hardened. They are unusually long, having each a 10in. bearing throughout. The fulcra or sustaining links are solid forgings, each representing about 2 cwt. of metal. These, as well as the whole of the parts, have been made by Messrs. Pooley at their Liverpool works. We understand the total weight of the machinery is about 30 tons. In addition to these this firm have many specimens of weighing apparatus in course of manufacture, amongst others a set of eight table weighing machines for balancing locomotive engines, which are just being completed for one of the leading railway companies. They also recently made for India an enormous machine for weighing jute, with platform 23ft. square, forming, in fact, a large weighing floor.—*Liverpool Journal of Commerce.*

BOILERS FOR THE TRINITY HOUSE YACHT VESTAL.

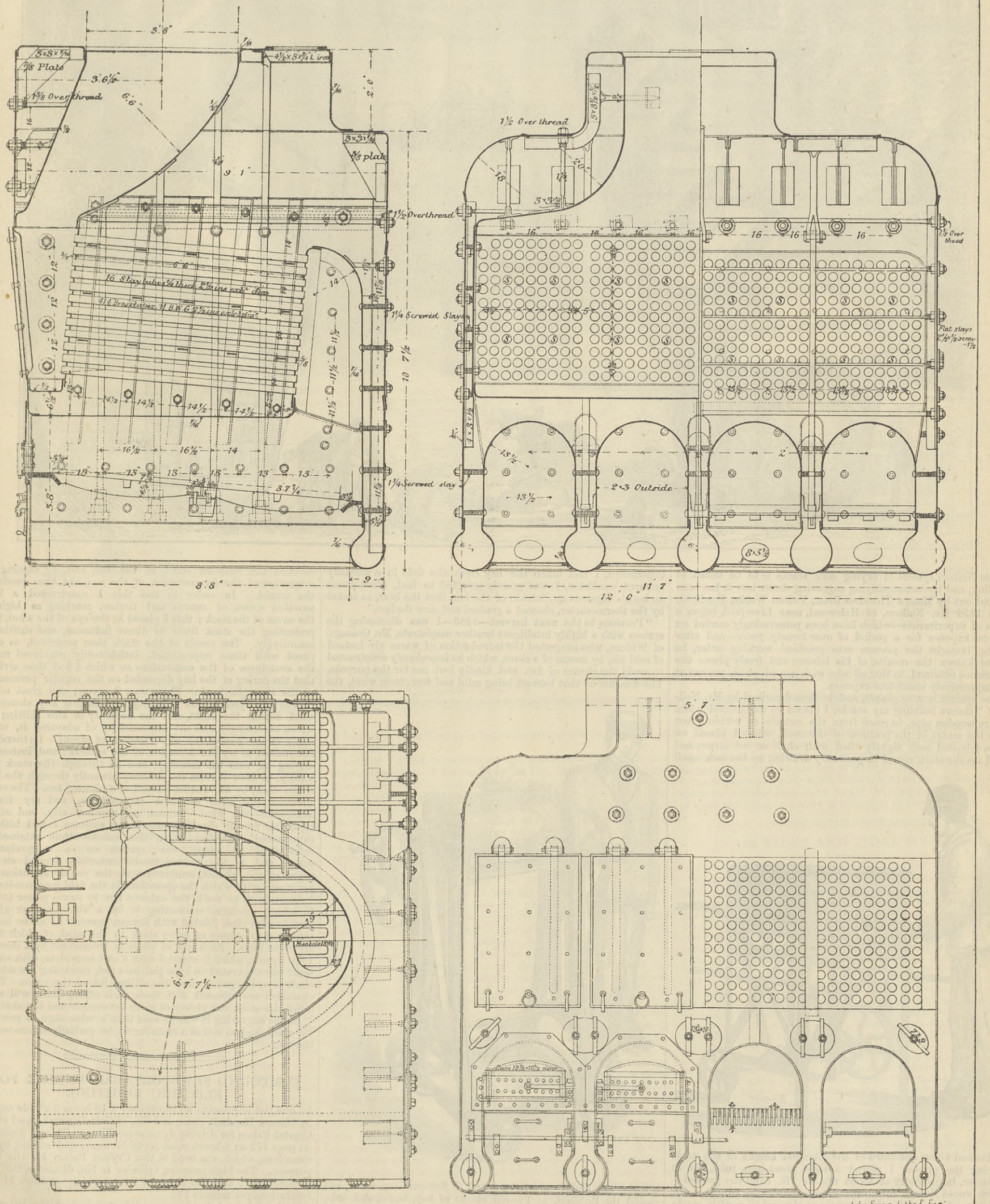
(For specification see page 466.)

Heating & Grate Surface in one Boiler.

430 tubes. 5' 6" long, 2½ ext.r dia.r	1547-87 □
Furnaces	123-50 □
Combustion Chamber	135-27 □
Total	1806-64 □

Grate Surface 64 □'

Working Pressure 25lbs.



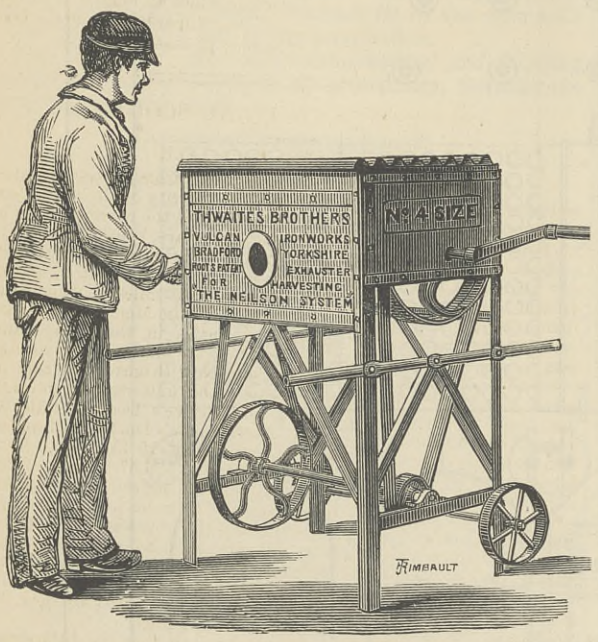
NEILSON'S SYSTEM OF DRYING CORN.

MESSRS. THWAITES BROS., BRADFORD, ENGINEERS.

The Neilson system of drying corn stacks is to be tested at Reading, and the accompanying engraving shows how it has been worked out by Messrs. Thwaites Bros., Vulcan Works, Bradford.

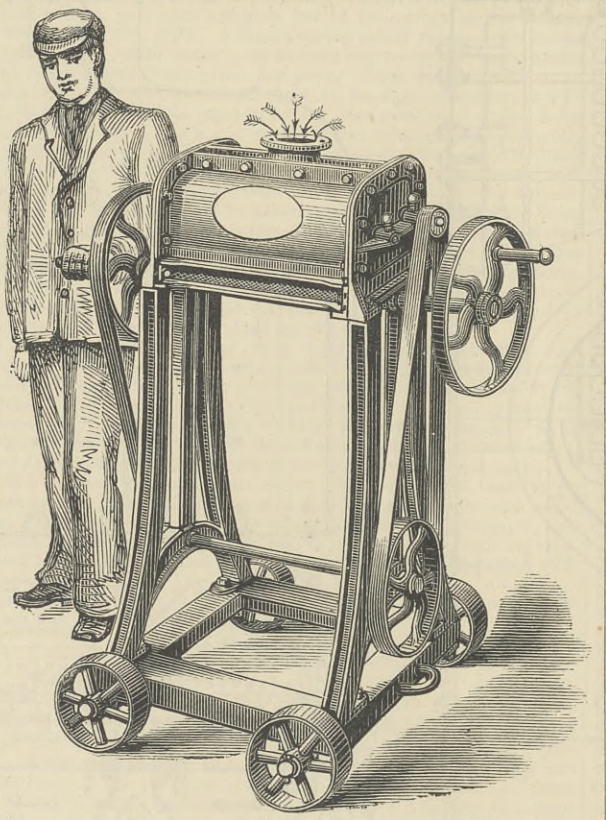
In 1856 Mr. Neilson, of Halewood, near Liverpool, began a series of experiments—which have been perseveringly carried on at great expense for a period of over twenty years—and after having brought the process into practical working order, he makes known the results of his labours and freely places the experience obtained, so that all who wish can adopt his process at a comparatively small first expense.

The system is very simple, and is thus described by Mr. Neilson : "Before building my stacks, I placed on the ground a 9in. square wooden pipe, to reach from the outside to within a foot from the centre of the position of the stack, where I placed on end a 4-bushel sack tightly filled with chaff or cut straw, and build up the stack round it, gradually drawing up the sack until



it attained about one-third of the intended height of the stack. During the process I placed a light sheet-iron tube, 2in. in diameter, horizontally at about 6ft. or 7ft. from the ground—which would sink to about 4ft. or 5ft.—so as to admit of the insertion of a common thermometer at the end of a stick, reaching from the outside of the stack to within 1ft. of the sack, so as to ascertain the heat of the interior ; the stack was then built up to its intended height. To the outside opening of the 9in. wooden pipe I then connected, by air-tight arrangement, the mouth of a common winnowing fan, and commenced driving in air. While in operation during the day, I noticed no difference in the heat of the stack ; but the following morning, after a night's rest, it had risen to between 80 and 90 deg. As, for the sake of experiment, I had taken the hay from the field in a partially uncured condition, I was greatly gratified to find, after about an hour's vigorous application of the fan, that the heat, as tested by the thermometer, showed a gradual and slow decline."

"Previous to the next harvest—1863—I was discussing the system with a highly intelligent brother magistrate, Mr. Gossage, of Widnes, who suggested the introduction of warm air instead of cold air, by means of a stove, which he ingeniously constructed to avoid the chance of fire, and kindly lent me for the purpose. The weather at that harvest being mild and free from wind, the



success was highly satisfactory, and I flattered myself I had passed the Rubicon, as I cured stacks of hay, beans, and oats. Again, however, I was disappointed, and reappearance of mould in different places, in subsequent years, convinced me it was owing to some cause I had not discovered, independent of the operations in the field, and attributable to some failure in the working of the fan. After much reflection on the state of the weather during the previous harvests, and the prevalence of the westerly winds, and the appearance of the mould chiefly on the west side of the stacks, I was induced to think that the action of the wind had checked the outward effect of the fan, and, by causing the stagnation of the fermentation of the sap, had thus produced the mould. In order to test this I constructed a light movable screen of canvas and timber, reaching as high as the eaves of the stack ; this I placed in the eye of the wind, thus protecting the stack from its direct influence, and shifting it accordingly. The result of the stack thus protected, as compared with those unprotected, satisfactorily convinced me of the soundness of the conclusions at which I had thus arrived, that the curing of the hay depended on the regular permeation of the atmospheric air. There was, however, one great objection to this system—the necessity of watching any change of wind during the night, and the necessity of also shifting the screen accordingly, and the impossibility of adapting it, under those circumstances, to any number of stacks. I, therefore, determined to try the inversion of the system ; and, instead of driving air into the chimney, and so through the stack outwardly, to draw it from the chimney inwardly through the bulk of the stack, by an exhaust instead of a blowing fan. The result answered my most sanguine expectations, and my former antagonist—the wind—became my greatest ally, and amply repaid me for the disappointment and expense I had hitherto experienced. Satisfied with the success thus attained, I determined to adopt the system on a comprehensive scale ; and, as the success would materially depend on the power of the exhaust, combined with the proper attention and judgment with which the operations in the field were conducted, I determined to work the exhaust fan by steam power from a thrashing machine, connecting it by a 9in. diameter glazed earthenware pipe, jointed with Roman cement so as to be air-tight and to operate on every stack in the yard, of which there are three rows. Each row of pipes is intersected by a chamber 12in. square, which is covered with a cast iron plate, with an air-tight valve operated on by a ½in. iron rod, extending outside the stack so as to open or close the sliding lid of the valve. These chambers are situated 25ft. from each other, which will allow a full-size stack and plenty of room between it and the next."

In the engraving it will be seen that a wire cage is put into the stack, and so makes a chamber to be partially exhausted by the fan.

COMPOUND SEMI-PORTABLE ENGINE FOR ELECTRIC LIGHTING.

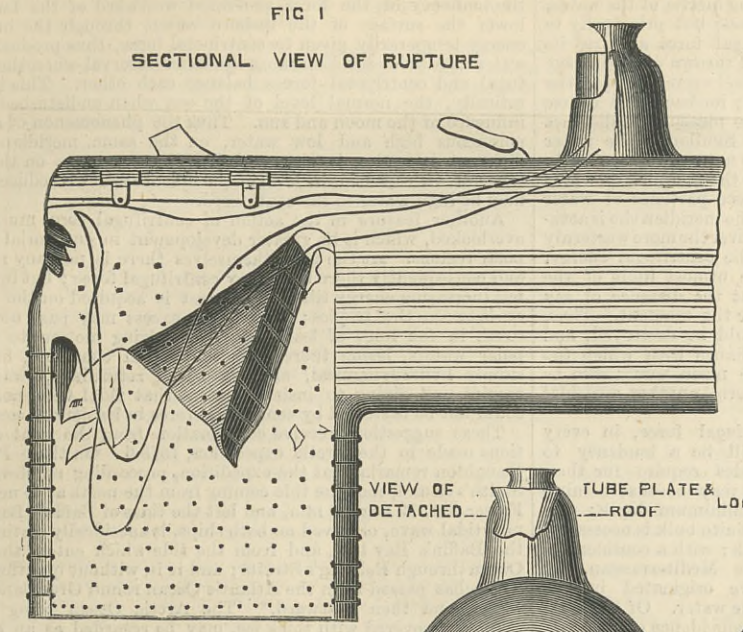
In our last impression we illustrated a 16-horse portable engine, by Messrs. Marshall, Sons, and Co., of Gainsborough, used at the Crystal Palace for driving dynamo machines. We now illustrate, on page 472 an 8-horse semi-portable compound engine, by the same firm, which was used at the Crystal Palace for the same purpose. The high-pressure cylinder is 5in. diameter, the low-pressure 9in., and the stroke 12in.; working pressure 140 lb., revolutions per minute 180.

Both high and low-pressure cylinders are steam jacketted. The steam chests are placed outside so as to give ready access to the slide valves, and the stop valve can be examined by taking off its covers. The high-pressure cylinder is fitted with Hartnell's patent automatic expansion valve gear. The boiler shell is made of steel. The fire-box is of Bowling iron. The greatest care and attention have been bestowed on the design of this engine so as to render it in every way suitable for electric lighting.

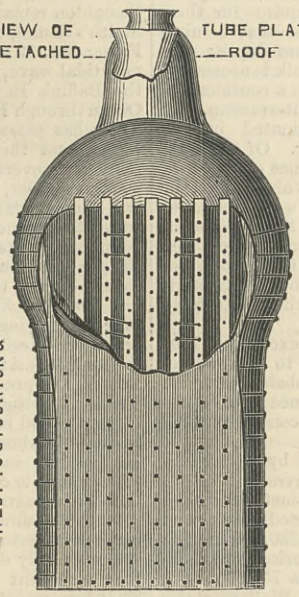
BOILER EXPLOSION ON THE NORTH-EASTERN RAILWAY.

FIG 1

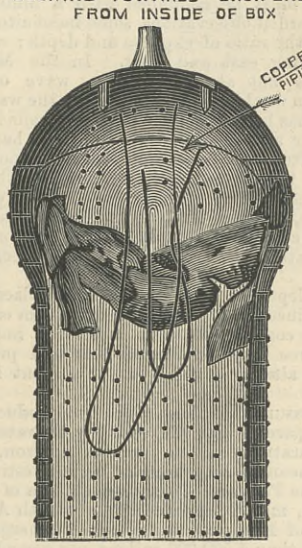
SECTIONAL VIEW OF RUPTURE



VIEW OF DETACHED TUBE PLATE & ROOF



LOOKING TOWARDS BACK END FROM INSIDE OF BOX



GENERAL CONSTRUCTION OF BOILER

SECTIONAL ELEVATION

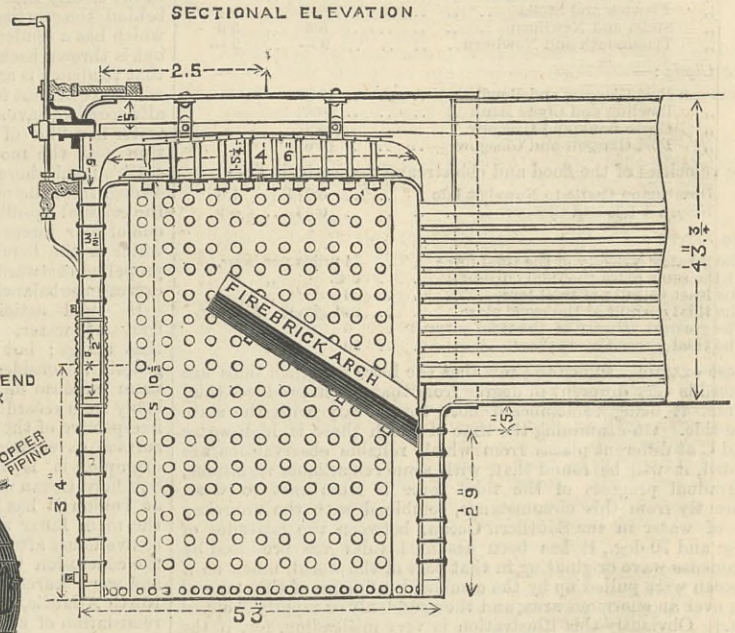
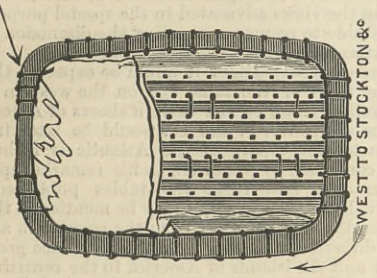


FIG. 2

SECTIONAL PLAN OF RUPTURE



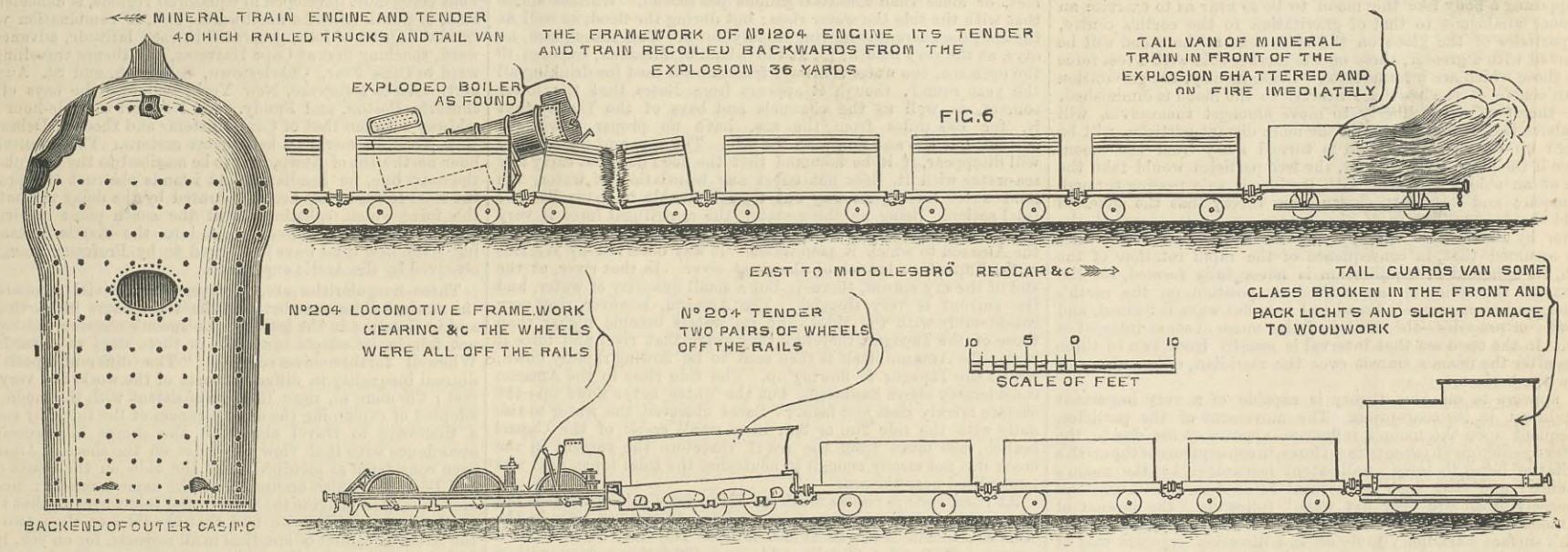
MINERAL TRAIN ENGINE AND TENDER 40 HIGH RAILED TRUCKS AND TAIL VAN

THE FRAMEWORK OF N°1204 ENGINE ITS TENDER AND TRAIN RECOILED BACKWARDS FROM THE EXPLOSION 36 YARDS

TAIL VAN OF MINERAL TRAIN IN FRONT OF THE EXPLOSION SHATTERED AND ON FIRE IMEDIATELY

EXPLODED BOILER AS FOUND

FIG.6



BACK END OF OUTER CASING

AT about 4.30 p.m., on the 26th December, 1881, while No. 204 goods engine and tender, attached to a train of three wagons and a brake van, was drawing up behind a mineral train on the up mineral line at Thornaby Ironworks junction, about half-a-mile east of South Stockton station, on the North-Eastern Railway, the fire-box of the boiler exploded, and the boiler and fire-box were thrown forward and deposited on the fifth and sixth vehicles from the rear of the mineral train, striking, as it passed, and setting fire to the brake van of this train. All the engine wheels and four wheels of the tender were knocked off the rails, and the whole of the goods train recoiled about 36 yards. The accompanying engravings explain themselves. The driver and fireman of the goods train and the guard of the mineral train were killed on the spot, and the guard of the goods train and a wagon inspector in the van of the mineral train received fatal injuries, from the effects of which they died shortly afterwards.

Goods engine No. 204 was built at the Darlington shops in 1880, and commenced running in March, 1880 ; since which time, up to the 26th December, it had run 48,849 miles. The copper fire-box was of the usual form, the internal dimensions being 5ft. 10½in. high by 4ft. 5in. long by 3ft. 4in. wide. It was constructed of copper-plates ½in. thick, and was stayed in the usual way with ⅞in. copper bolts, 4½in. from centre at the ends and sides, the roof being supported by seven crown stays, 4¾in. from centre to centre, there being ten wrought iron bolts, 1in. in diameter and 4½in. from centre to centre, in each crown stay, these crown stays again being supported by hanging stays attached to the outer shell of the fire-box. A fusible plug was screwed into the centre of the roof of the fire-box. The fire-box was provided with a brick arch, by means of which the flames would be projected towards the top of the fire-box over the fire door before entering the tubes. The lock safety valves were set to a steam pressure of 155 lb., and the spring balance safety valves to a steam pressure of 140 lb. These had been last cleaned, examined, and tested on the 3rd December last. The fire-box was fitted with only one water gauge of the usual form ; this had been thoroughly examined on the 22nd December, and had been seen to be in proper working order on the morning of the 26th December. The horizontal tube of the water gauge entered the outer fire-box about 1in. below the top of the copper fire-box, but the lower socket of the vertical tube was so fixed that no water would be visible in the vertical tube unless there was about 1½in. of water above the level of the top of the copper fire-box. The difierence of level between the underside of the top of the boiler and the upper side of the roof of the copper fire-box was about 13in. The boiler had not been tested since the engine commenced running, but on the 4th February, 1880, it had been submitted to a hydraulic test of 200 lb. pressure to the square inch.

Colonel Yolland, reporting on the accident, says that from a careful inspection of the exploded fire-box, and from a consideration of the foregoing evidence, he has formed the conclusion that the explosion of the copper fire-box of engine No. 204 was probably occasioned by the crown of the fire-box having become overheated from want of water, and when thus weakened, having been unable to resist the pressure caused by the sudden creation of steam upon water being admitted into the boiler just as the engine was drawing up behind a mineral train at Thornaby junction.

The reasons which have led him to this conclusion are :—(1) The appearance of scorching on the copper-plate on the inside of the fire-box near the place of the fracture, which was at the top of the fire-box, over the fire-hole door, where the flames are projected—owing to the brick arch—before entering the tubes ; this same appearance being also visible on the adjacent bolt heads and nuts of the roof stays. (2) The fact of the driver having been seen to use the regulator just before the explosion. (3) The fact that the engine had been only about twenty-one months in use, and that the copper fire-box and stays were generally in good condition, the construction of the fire-box being of the usual type. Whether the want of water was attributable to carelessness on the part of the deceased driver, or to some defect in the water gauge having misled him as to the height of the water, it is impossible now to say. According to the evidence the gauge appears to have been properly examined on the 22nd December, and to have been observed to be in working order on the morning of the explosion. It is certainly most desirable that duplicate water gauges should be fixed to all boilers. The difference of level between the top of the boiler and the crown of the copper fire-box, amounting only to about 13in., was certainly small in the case of this engine, and would of course quickly allow the crown of the fire-box to become uncovered without very constant attention. He was not aware of the greatest difference of level which exists, but he knew that some locomotive engineers kept down the crown of the fire-box 20in. below the top of the boiler, and that 15in. to 18in. is a common difference of level. So small a difference as 13in. should as far as possible be avoided. The failure of the lead plug—which had been removed from the fire-box by order of the locomotive superintendent soon after the explosion—to melt when the crown of the fire-box became heated appears to have been owing to the bottom surface of the lead having become covered with a hard incrustation. Some locomotive engineers think these plugs perfectly untrustworthy ; others on the contrary use them, but have them very frequently renewed.

The plug in the present instance had not been renewed for four or five months, the boiler smith stating that there was no regular time for renewal. He concludes by saying there can be no grave objection to the use of these plugs, and if their renewal is made peremptory at short intervals when an engine is in the sheds for overhauling, there would be comparatively little fear of their not being in a state of efficiency in case of need.

ON TIDES AND TIDAL SCOUR.*

BY MR. JOSEPH BOULT, C.E.

THAT the force producing tides is different from that observed in tidal currents is very obvious when the velocity of the tidal force in different places is compared with that of the currents. As in most places contiguous to tidal water there are, speaking broadly, tides twice in every twenty-four hours, the tidal force must run over the circumference of the globe in that period—that is, on the equator—approximately at the rate of 1000 miles in the hour. From observations made by Mr. Rendel, in the Mersey, it appears the tidal force moves at varying velocities in that river, and that the velocities vary with the state of the tide between springs and neaps. Between Formby Point and New Brighton the rate of the so-called head of the wave appears to be uniformly 24 miles in the hour ; between New Brighton and Prince's Dock, 12 miles at springs, and 6·22 miles at neaps ; from Prince's Dock to Ellesmere Port the rates are respectively 27 miles and 15·43 miles ; from Ellesmere Port to Runcorn 28 miles and 26·67 miles ; from Runcorn to Fidler's Ferry, 12·5 miles and 6 miles ; from Fidler's ferry to Warrington, 7·5 miles and 6·76 miles ; the average rates from Formby Point to Warrington, 16·7 miles and 11·4 miles. As is well known, the greatest velocity of tidal streams in the Mersey does not exceed 7 miles in the hour, the average being much less. As the number of observations taken by Mr. Rendel's directions were extremely limited, the results quoted are open to correction, but for the present purpose they suffice.

On referring to other rivers, it will be seen that the differences in the rate of tidal force and tidal current are very great. In the Thames they appear as follows :—

	Head of wave S.	Head of wave N.
Between Deptford and London Bridge	15·6	15·6
,, London Bridge and Battersea	9·73	14·6
,, St. Katherine's Docks and Battersea Bridge	9·	8·28
,, Battersea Bridge and Putney Bridge	18·	6·
,, Putney Bridge and Kew Bridge	22·5	17 nearly
,, Kew Bridge and Teddington Lock	6·6	4·6
The average between Deptford and Battersea	11·7	15·
The average between Battersea Bridge and Teddington Lock	10·7	7·4

*A Paper read before the Liverpool Engineering Society.

The rate of the tidal current between London Bridge and Putney Bridge at flood appears to be two miles per hour.*

In the Tyne the velocities of the head of the wave are reported as follows:—

	Head of wave S.	Head of wave N.
Between Tynemouth Haven and Prior's Stone	2	2
,, Prior's Stone and Ballast Office	2·95	2·95
,, Ballast Office and Howdon	10	5
,, Howdon and Bill Point	9 +	7·4
,, Bill Point and Old Quay	9 —	11·8
,, Old Quay and Elswick	9·74	—
,, Elswick and Stella	—	—
,, Stella and Newburn	5·6	5·6
,, Tynemouth and Newburn	9 —	9 —

In the Clyde:—

Between Port Glasgow and Bowling	12·28
,, Bowling and Clyde Bank	6·63
,, Clyde Bank and Glasgow	16·37
,, Port Glasgow and Glasgow	10·67

The velocities of the flood and ebb streams respectively as—

Dumbarton Castle to Newshot Isle	0·91 F	1·6
Newshot Isle and Glasgow	0·43	0·9

In the Severn:—

The greatest velocity of the tidal force	74 miles per hour.
At the same place the tidal current	4·43 ,,
The least velocity of tidal force	6 ,,
The tidal current at the same place	not given.
The greatest velocity of the tidal current	6 ,,
The tidal force at same place	10 ,,

These examples suffice to show that the force by which tides are produced is very different in degree from that which produces tidal currents, it being remembered both forces vary with the state of the tide. On examining the time at which there is high-water F and C at different places from which reliable observations are recorded, it will be found that, with some remarkable variations, the gradual progress of the tidal force is from east to west. Apparently from this circumstance, combined with the unbroken mass of water in the Southern Ocean, between the latitudes of 30 deg. and 70 deg., it has been assumed tides are produced by an immense wave originating in that part of the world, much as if the ocean were pulled up by the combined influence of the sun and moon over an enormous area, and then suddenly or rapidly dropped again.† Obviously this illustration is very misleading, for, if the ocean were so raised, and suddenly dropped, the wave would move concentrically in ever widening rings of diminishing altitude, as is seen when a stone is dropped into a pond, and the general advance in a westernly direction only would be impossible. The equilibrium theory of the genesis of tides which has hitherto been accepted as correct has been pronounced by such authorities as Professors Whewell and Sir William Thomson to be inadequate for explaining various phenomena, but I am not aware that any modification of that theory or any other hypothesis has been generally adopted. A globe insulated from all external influence is assumed to acquire its form through three balanced forces, namely, the cohesion of its particles amongst themselves, centripetal force, or gravitation to the centre of the globe, and centrifugal force, and it is further assumed if the equilibrium of these forces be disturbed, the shape of the globe will be modified.

Supposing a body like the moon to be so near as to exercise an influence analogous to that of gravitation to the earth's centre, the particles of the globe on the side next to the moon will be attracted with a greater, those on the further side with a less force than those which are intermediate. Consequently, the gravitation to the centre of the particles nearest to the moon is diminished, and, therefore, if at liberty to move amongst themselves, will rise above the general level, and the more distant particles will be heaped up on the side which is turned away from the moon. Hence if the globe were at rest, the free particles would take the form of an oblong spheroid with its longer axis passing through the moon; and it may be shown from theory that the spheroid would be in equilibrium if the longer semi-axis exceeded the shorter by about 58in. In applying this illustration to the tides it is assumed that, in consequence of the rapid rotation of the earth, its spheroid of equilibrium is never fully formed, for the vertex of the spheroid has shifted its position on the earth's surface, and an immensely broad and very flat wave is formed, and follows—or precedes—the motion of the moon at some interval of time. In the open sea that interval is usually from two to three hours after the moon's transit over the meridian, either above or below the horizon.

It appears to me this theory is capable of a very important amendment in its conception. The movement of the particles, consequent upon the moon's influence, appears to me due to the greater freedom given to centrifugal force, in consequence of the earth's gravitation being to some small extent neutralised by the moon's influence; and that such centrifugal force does not cause "an immensely broad and very flat wave" following "the motion of the moon," but imparts to all the free or fluid particles on the earth's surface a tendency to fly off in a direction opposite that of the earth's rotation, just as mud flies backward off a carriage wheel; this centrifugal tendency operating on every meridian in turn, its effects being visible at some interval after the moon's transit above or below the horizon.

Allowing for the fact that the sun's influence is much less than the moon's, the phenomena of solar tides are identical, but they are not perceptible apart from the lunar tides. When the two sets of tides coincide in time and place, which they do when the sun and moon are in opposition or conjunction, the result appears in what are known as spring tides; when the sun and moon occupy intermediate positions, and are neither in conjunction nor in opposition, then the solar high water coincides with the lunar low water, or the reverse, and the result appears in the neap tides. Other changes in the relation of sun and moon are indicated in the varying levels of the tides, the result of what is termed their priming and lagging, as the sun is westward or eastward of the moon. Obviously these variations of the tide depend upon the extent to which the earth's gravitation is modified by the influence of the moon and sun, and the extent to which the earth's centrifugal force is freed from the restraint imposed by that gravitation through which the original theoretical equilibrium is constantly changed.

When the moon is on the equator, at the time of her transit, the action of tidal force may be assumed as parallel to the meridian; as the moon passes into north or south declination, her influence will be greater on one side of the equator than on the other, varying with her distance north or south; as the extreme range of declination is an are of nearly 60 deg., representing, from position, one-third of the earth's periphery, her influence in the region of his extreme northern declination will be very much greater than at the same distance south of the equator; and two results may follow:—(1) The amount of centrifugal force liberated will be greater in the northern than in the southern hemisphere, and consequently the tidal elevation be greater; (2) that part of the force which is in the northern hemisphere may be somewhat in advance of the southern part, and consequently the line of motion will not be parallel to the meridian, but more or less oblique, according to the amount of declination; from which conditions two tendencies arise:—(1) That the motion of the tidal force will be conoidal, that is, revolving round the part which moves more slowly; (2) that the water raised to the greater altitude will flow downwards. Thus the height and progress of the force may be subjected to irregularities, irrespective of the local and temporary incidents to which attention will now be directed.

Though gravity is said to be a force which is transmitted, not during any interval of time, but instantaneously, its velocity, according to Laplace, being, if not infinite, at least fifty millions of times greater than that of light, yet the greatest and least tides do not happen exactly at the times of new and full moon, but at least two or three days after, even in places directly exposed to the ocean. These variations are no doubt to be ascribed in part to the irregular form and depth of the ocean, the inertia of the water, friction, atmospheric pressure, and other causes, but principally to the time which elapses before the centrifugal force acquires its greatest strength and momentum. The mud thrown off a carriage wheel does not quit the tire at its highest level vertically over the axle, otherwise the mud would fly upwards; its backward course shows clearly that it leaves the tire at some measurable distance behind the vertical radius of the wheel. Similarly, the water which has a tendency to leave the earth does not rise to the zenith, but is thrown backward, that is, westward of the meridian on which that tendency is acquired. Consequently those particles of water which are nearest to the moon, that is, are on the meridian she is actually crossing, have a tendency to fly backwards over the more westernly water in a film of thickness varying with the centrifugal energy, thin near the moon, and thickening to the utmost limit of the earth's hemisphere nearest to her—that is, at the distance of say 45 deg. from the meridian on which she is for the moment. Thus, the original equilibrium of three forces would be destroyed, and one of four forces take its place; in compliance with which the water in the hemisphere furthest from the moon would also be propelled eastward of her meridian, and form another cycloidal excrescence balancing that first formed.

If tidal action is referable to centrifugal force, in every body of water, however small there will be a tendency to that action; but probalby, perceptible tides require for their genesis a considerable bulk of water. It may be that a minimum expanse must be combined with a minimum depth; probably from recorded observations, some indefinite bulk is necessary, irrespective of the ratio of expanse and depth; with a considerable surface extending east and west. In the Mediterranean, for example, it is not at all likely a wave originated in the Southern Ocean would give any motion to the water. Of the tides at Toulon it has been observed that the coincidence of phase of the main lunar and solar semi-diurnal tides, happening some four or five hours after the time of new and full moon, would point to the conclusion they were wholly generated in the Mediterranean, and were scarcely, if at all, influenced by any action from the North Atlantic, through the Straits of Gibraltar, the amount of retardation of coincidence of phase for those components amounting on the western coast of Europe to between thirty and forty hours.*

The great depth of this sea, in some places exceeding 1000 fathoms, combined with its great length from east to west, makes its mass very considerable. It seems not improbable as much centrifugal force may be liberated as will produce the effects observed; the absence of tides in the Levant is consistent with such an origin.

From the assumption that tides are produced by centrifugal action, it is apparent that the quantity of water removed by the tides is comparatively trivial. In the Amazon, sometimes called the Mediterranean of America, the basin is estimated to contain, exclusive of the Para and Tocantins, an area of 2,330,000 English miles; that is, more than one-third of South America, and equal to two-thirds of Europe. The average discharge is 750,000 cubic feet, or more than 4,500,000 gallons per second. Wallace states that with the tide the water rises; but during the flood, as well as the ebb, the current is moving rapidly down. This takes place, he says, at the very mouth, for at the island of Mexiana, exposed to the open sea, the water is always fresh, and is used for drinking all the year round; though it appears from Bates that the lower courses, as well as the channels and bays of the Delta—that is, for 150 miles from the sea, have no proper downward current, but ebb and flow with the tide. The apparent discrepancy will disappear, if it be assumed that the flood does not carry any sea-water with it, does not effect any translation of water, the land water forcing its way out though unable to neutralise the tidal action. Being on the equator, the centrifugal force is very great. Some idea of its strength is suggested by the distance up the Amazon to which it penetrates. It was observed by Wallace in the Tapagóz, a branch of the great river. In that river, at the end of the dry season, there is but a small quantity of water, and the current is very sluggish. The Amazon, however, rises very considerably with the tides, and its waters become higher than those of the Tapagóz, therefore they enter that river and force it back; the Amazon itself is then seen to be flowing rapidly down, whilst the Tapagóz is flowing up. The tide rises in the Amazon considerably above Santarem, but the water never flows up; the surface merely rises and falls.† Bates observed the water to rise daily with the tide 2in. or 3in. in a small creek of the Cupari branch, 530 miles from the sea;‡ therefore the current in the creek was not strong enough to neutralise the tidal force, as it was neutralised near the sea.

At Para, springs rise as much as 11ft., yet a tidal current is not perceptible. It is said there are no fewer than seven tides in the Amazon, within a length of 600 miles. The Gulf Stream has a course of 3000 miles, 60 miles wide and 100 fathoms deep, with a velocity varying from 5 miles an hour to only 10 miles a day, unbroken by tidal ebb or flow.

There is a large space of still water in the Irish Sea, between Carlingford and the Isle of Man, where occurs the phenomenon of water rising and falling without any perceptible stream. This space of still water is marked by a bottom of blue mud, the surface probably of a deposit of blue clay, an unfailing indication of the absence of disturbance, since probably it is largely impregnated with vegetable matter, from which its colour is derived, and characteristic of riparian deposits. The stream by which the mud is conveyed to this spot must, therefore, be very gentle.

The maximum elevation of a lunar tide is estimated to be 5ft., that of a solar tide 2ft. The sum of those figures represents the highest springs, and their difference the lowest neaps. The elevation of 7ft. above the surface of the ocean is but the infinitesimal part of the earth's diameter of nearly 8000 miles, and has a much smaller ratio to the moon's distance of 237,000 miles, or thirty diameters. The ratio of the centrifugal force, released by the influence of the moon and sun, to the earth's centripetal force, must also be very small, and to produce the effects assigned to it may be conceived as acting hydrodynamically like an hydraulic ram; that is, the centrifugal force is, as it were, in a closed vessel full of water, the top of which is, in a degree, elastic. When the force is too weak to expand the cover the water is confined, and under pressure; as the force is increased the cover is expanded, but when the expansion reaches the limit of elasticity the water is completely bound, and great force may be transmitted through its agency. For the elastic cover or web, acting on the surface of the water, substitute elastic gravitation acting upon every particle of water, it is obvious the effect is similar, and pressure applied at one end of the vessel of water will rapidly produce effect at the other end, whatever the distance, if the channel be unobstructed.

This conception of the resistance offered by centripetal to centrifugal force appears identical with that of "the practical rigidity conferred by rotation" on frictionless particles, which has been proposed, almost simultaneously, by General Barnard and Sir William Thomson. But they assume "an infinitely rigid envelope," instead of one partially elastic, which appears to me to represent the action of gravitation; the phrase "*indefinitely* rigid envelope" would appear to be unexceptionable.

Continents and islands, some of varied outline, occasion interruption and deviation in the course of centrifugal force. It is not likely any appreciable force is released from land, because of the cohesion of its particles, and its density is very much more than that of water with, say, twice the specific gravity. Land surface, therefore, does not present the undulating motion so characteristic of tidal water. So, likewise, it is to be observed that, on the western side of land, the inshore water will not be raised by the passage of centrifugal force from the eastward; and the tendency of the force generated westward of the land is to lower the surface of the inshore water, through the increased energy temporarily given to centripetal force, thus producing low water; half-tide level marking the brief interval when the centrifugal and centripetal forces balance each other. This is, theoretically, the normal level of the sea when undisturbed by the influence of the moon and sun. Thus the phenomenon of contemporaneous high and low water, on the same meridian but in different latitudes, is observable in the ocean, as on the West Coast of Africa, when the level of the inshore water is reduced, there may be high water to the southward.

Another feature in the action of centrifugal force must not be overlooked, which is its greater development in equatorial than in polar regions. At the poles themselves there is not any rotation, and consequently there is not any centrifugal force; but its genesis has increasing energy till the greatest is acquired on the equator or between the tropics; thence the excess may pass north and south in the lines of least resistance, giving motion to circumpolar waters, losing therein its centrifugal character, becoming simply hydrodynamical, and, as such, returning towards the tropics, and giving to inshore waters that tidal influence which could not be bestowed by centrifugal force in its normal course.

These suggestions receive confirmation from the tidal observations made in the Arctic expedition, 1875-6. On these Professor Haughton remarks that the expedition, proceeding northwards up Smith's Sound, met the tide coming from the north at or near Cape Frazer, lat. 79 deg. 40 min, and left the tides of Baffin's Bay. The new tidal wave, observed on both ships, is specifically distinct from the Baffin's Bay tide, and from the tide which enters the Arctic Ocean through Behring's Straits; and it is, without question, a tide which has passed from the Atlantic Ocean round Greenland northwards, and then westward.* The Arctic Ocean being for the most part covered with thick ice, may be regarded as an accumulating chamber, into which the tidal forces from the North Pacific and North Atlantic are combined under pressure, and issue southwards to produce the tides of North-Western Europe. It would be inappropriate here to enter more at length into the discussion of the general question of the genesis of tides; those who wish to do so are referred to a paper on the subject in the *British Architect and Northern Engineer* for August 1st and 8th, 1879; but preparatory to applying the views advocated to the special purpose of this paper, it is desirable to resume so much of the discussion as relates to the North Atlantic.

From the preceding suggestions it would be expected that in the North Atlantic tides of the same age on the western shores of Europe would follow those on the eastern shores of America; that is, that the time of H. W., F. and C., would be later in Europe, because the easternmost part of the Atlantic is inshore. This anticipation is confirmed by Whewell, in his remarks upon simultaneous observations, and from the tables published by the Admiralty annually. First of all, it may be mentioned that on the coast of America the tide advances from the equator in a northerly and westerly direction, resulting from the resistance presented by that continent and the islands of America to the centrifugal force. That being most developed in equatorial regions, is deflected off the coast of South America northwards, and, in combination with the various degrees of force generated in each latitude, advances westward, touching first at Cape Hatteras, and thence travelling southward to Cape Fear, Charlestown, Savannah, and St. Augustine; northward to Delaware, New York, and into the bays of Massachusetts, Boston, and Fundy. At Newport the tide-hour is about midway between that of Cape Hatteras and those of Delaware and New York, its meridian being more eastern. The lateness of the hour northward of Newport is to be ascribed to the irregularities of the coast line, for headlands and islands obstruct the progress of the tidal force, as has been illustrated by the delay in that part of the force which, splitting off at the south point of Greenland, travels along the eastern coast into the Arctic Ocean, forming "the new tidal wave" referred to by Professor Haughton as observed by the Arctic expedition.

Those irregularities are, however, very trivial compared with the marked differences between the tidal hours in North America and in Europe; in the latter "the moon's crossing the equator is not felt in its effects until two or three days afterwards." Dr. Whewell further observes (27), "The different epoch of the diurnal inequality in different parts of the world is a very curious fact; the more so, since it is inconsistent with the mode hitherto adopted of explaining the circumstances of the tides, by conceiving a tide-wave to travel along all the shores in succession. In accordance with that view the tides on the shore of America had been considered as identical with the tide on the coasts of Spain and Portugal, which occurs about the same moment; nor does it appear easy to imagine the form of the tide-waves so that this shall not be the case. Yet we find that the tides on these two sides of the Atlantic cannot be identical in all respects, for on 9th, 10th, and 11th June, when the diurnal inequality was great in America, it was nothing in the west of Europe; and on the 18th and 19th, when this inequality had vanished in America, it was great in Europe. It would seem as if the tidal phenomena on this side of the Atlantic corresponded to an epoch two or three days later than the same phenomena in America; and we may, perhaps, add, that different kinds of phenomena do not appear to travel at the same rate. Thus the equilibrium theory, though it may explain the general form of the inequalities, cannot give their epochs and amounts by any possible adjustment of constants. I may add, he says, that the notion of the progress of the tide-wave from south to north in the Atlantic is still further involved in difficulties by its appearing at the Cape of Good Hope, that the diurnal inequality showed itself most clearly on 17th, 18th, and 19th June, that is as late as in Spain and Portugal."†

Just as the lateness of the tides on the western shores of Europe appears due to the time occupied by the return of the tidal force from the east of North America, after its northern deflection, so the similar lateness on the west coast of South Africa may be due to the return of the motor from the east coast of South America. There is much complexity in the tidal action off the west coast of South America, arising probably from the combined influence of the two deflections, caused by the east coast of Africa and the east coast of South America; and uncertainty as to the distribution of land and water in antarctic regions precludes the possibility of a satisfactory explanation.

(*To be continued.*)

THE EXPORT DUTY ON SILVER.—The announcement made exclusively a few weeks since by the *Engineering and Mining Journal* that the Mexican export duty on silver was to be repealed has proved correct. It is reported now in press despatches from Washington that the Mexican Minister has received official information from the State Department of his country that Congress has repealed the duty. It is stated that this measure is intended to encourage the investment of American capital in Mexican mines. This statement will be received with some satisfaction, and will reassure those who may have felt some hesitation, owing to the growing hostile feeling manifested by a portion of the Mexican press. An additional gross income of 4 per cent. per annum will be a valuable aid to Mexican enterprises; and if the Government can succeed in increasing the security of property at the rate which it has accomplished during the last few years, the proprietors of Mexican mines will be saved additional heavy amounts.

---

* *Manual of Practical Hydrology.* By Nathaniel Beardmore, Civil Engineer. Waterlow and Sons. 1862.

† Beardmore, op. cit., p. 223.

* Report Tidal Committee, Brit. Assoc., 1872, pp. 356-7.

† "Narrative of Travels on the Amazon and Rio Negro." By Alfred Wallace, Sect. Physical Geography.

‡ "The Nauralist on the Amazon." II., 132.

* "Narrative of a Voyage to the Polar Sea during 1875-6." By Captain Sir George Nares. London, 1878. pp. 356-7 and 376.

† Phil. Trans. 1836, pp. 289, 341.

RAILWAY MATTERS.

THE Great Eastern Railway Company commences a daily service of its steamers between Harwich and Antwerp with July. The insufficient quay accommodation at the latter port has prevented the company from doing this sooner.

IT is stated that the London, Brighton, and South Coast Railway stands third among English railways in the number of train miles run by its engines annually, while in the amount of net earning upon each £100 of capital spent on rolling stock and plant it is second in the list.

THE Midland Railway Company is driving a second tunnel by the side of that near Haverstock-hill, for keeping the goods and passenger traffic perfectly separate as far as St. Albans, and thus accelerating its through passenger trains. The distance from London to Manchester is now done in 4¾ hours, to Bradford in 5, and to Glasgow and Edinburgh in 10½ hours each.

THE old Colony, U.S., Railroad people claim to carry in one of their trains running to Plymouth and wayside stations the largest number on the round trip of any train out of Boston. From 1200 to 1400 passengers are carried daily by this train. Boston has such thickly settled suburbs that the local trains on the roads entering it are no small part of their revenue.

A SELECT COMMITTEE of the House of Lords has passed a Bill, which has already received the sanction of the House of Commons, reviving the powers originally granted in 1866, and amended by an Act of 1871, authorising the construction of a railway under the Mersey between Liverpool and Birkenhead, and extending the time for the completion of the line until August, 1885. The total length of the proposed tunnel from shaft to shaft is exactly one mile, a fourth part of which has already been constructed.

THE Scotch express, due at King's-cross at 10.50 on Monday night, was thrown off the line by an accident to the engine at Walton Junction, near Peterborough, while travelling at a speed of about fifty miles an hour. There were fortunately few passengers in the train, and none of them are reported to be seriously hurt. Among the number was Mr. Jos. Dodds, M.P., who was, however, able to continue his journey to London. It is surprising that the results of the accident were not more disastrous, bearing in mind the great speed and the violence of the sudden stoppage.

IN reporting upon the causes of a collision which occurred on the 15th ultimo, at Barton station, on the Manchester, Sheffield, and Lincolnshire Railway, when a mixed train from New Holland to Barton came into collision with the stop blocks, Major Marindin says:—"If the driver's statement be correct"—and he previously says he is inclined to believe the driver and gives reasons for this—"this case furnishes a strong argument in favour of the automatic action of brakes, for the driver would not have been able to run, after the brake pipe had become disconnected, depending upon a useless machine to stop the train in a case of emergency."

THE Wrexham, Mold, and Connahs Quay Bill, which has been under the consideration of a select committee of the House of Lords, presided over by Lord Cottesloe, was passed on the 22nd inst. A few weeks ago the Bill came before a committee of which Lord Methuen was the chairman, and was rejected; but on its recommitment it received the support of Mr. Gladstone, whose Hawarden collieries it proposes to serve, the Duke of Westminster, who is an extensive colliery owner in North Wales, and Mr. Osborne Morgan, all of whom have given evidence during the week. The petitioner against the Bill was the Great Western Railway Company, which contended that it supplied sufficient facilities for the carriage of the mineral products of the district.

THE ironmasters and manufacturers of the Wolverhampton district are expecting much benefit from the projected railway from Wolverhampton to Craven Arms—a distance of some forty miles. The line will supply a link in the railway system of the district by which the Midlands will be put into direct communication with Central and South Wales. Such communication has long been needed, and is becoming more and more wanted, because of the growing importance of the trade of South Wales, and especially of the port and harbour of Milford Haven. On Tuesday a meeting of the supporters of the scheme was held in London and a provisional committee was appointed to promote the line. Among the members of the committee are the Lord-Lieut. of Staffordshire, and representatives for the Earl of Dudley and the Duke of Cleveland.

A MASSACHUSETTS paper states that the Railroad Commissioners have received at their offices, in Pemberton-square, an instrument, by Dr. Thomson, of Philadelphia, which is in use for the detection of colour-blindness upon the Pennsylvanian Railroad. The invention suggested itself to Dr. Thomson from the fact that the number of *employés* upon the Pennsylvania system of railroads comprised upwards of 35,000 persons, scattered over more than 2500 miles; and as the number of trained ophthalmic surgeons was limited, it was desirable to find a system which would enable the facts to be collected by any intelligent *employé* in the company's service in such a form as to enable decisions to be justly made by scientific experts, although personally absent from the examination. The instruments used consist of two flat sticks, about 2ft. in length and 1in. in width, fastened by a hinge at one end and connected by a button at the other. Between them, and concealed from view, are forty white buttons, having the figures from 1 to 40 upon them, attached to the stick by small wire hooks, which permit of easy removal or change of position. To the shanks of these buttons are attached forty skeins of coloured wool. The test skeins are separate, and three in number—light green, rose or purple, and red. These skeins are shown to the persons examined in turn, and they are directed to select from the stick the colours which will match them. When the examination is made the instrument is closed to conceal the number, and test greens being shown, the person examined is directed to select ten tints from the stick; and when this is done the figures are recorded by the clerk, and the selections thus made can be identified at any future time. After a protracted experience upon several thousand *employés* of the Pennsylvania Railroad, that company has adopted the invention, and it will be used for examinations hereafter.

ON the 10th of February a boiler exploded on the Great-Eastern Railway near Bury St. Edmunds. The locomotive was shunting wagons at the time. It was an eight-wheeled engine, with a four-wheeled leading bogie, coupled driving and trailing wheels, and six-wheeled tender. It was made by the Vulcan Foundry Company, and began running in July, 1865, and was supplied with a new boiler and fire-box in December, 1876, after having run about 204,000 miles. The new boiler was made at Stratford Works, of Yorkshire iron $\frac{5}{16}$in. thick, the fire-box of copper $\frac{7}{8}$in. thick, except the tube plate which was ½in. thick. It was submitted to a hydraulic test of 240 lb. to the square inch, and commenced running on the 28th December, 1876, and had run up to the date of explosion 161,015 miles. Major-General Hutchinson, in reporting to the Board of Trade, states that there is but little reason to doubt that the explosion was owing to the defective condition of the copper stays in the right side of the fire-box. Three of these stays, a little below the centre of the box and near the tube plate, were found to have had old fractures; and it was at this spot that most probably the mischief first commenced by the steam pressure here first bulging the copper-plate, then stripping it away from the greater part of the rest of the stays, and breaking fourteen, and then tearing the side plate from the back plate more or less along the angle in which the side and back plates meet. The surfaces of fractures showed very little symptons of corrosion, certainly nothing to warrant the opinion that the explosion was due to corrosion. There is not the least reason to suppose that there was any excess of steam pressure above that authorised, viz., 140 lb., at which pressure the safety valves—which had not been, it was stated, in any way meddled with after the explosion—began to ease off when tested.

NOTES AND MEMORANDA.

A NEW arrangement of filter removing calcareous deposits from water, in which the water is passed through a succession of filters, worked in series, filled with sawdust, impregnated with magnesia, has been described. Salts of magnesia thus replace those of calcium, and, being more soluble, form no scale in boilers.

VALUE of exports per head of the population in the Australian Colonies:—New South Wales, £21 11s. 2½d.; Victoria, £18 15s. 3d.; South Australia, £21 1s. 7½d.; Queensland, £15 10s. 8½d.; Tasmania, £13 6s. 1¾d.; Western Australia, £17 4s. ½d.; New Zealand, £13 7s. 10½d. General average, £18 5s. 6¾d.

MR. B. BRAUNER has redetermined the atomic weight of didymium, and gives 145·4 as the correct number for a purer sample, instead of 146·6 as previously arrived at; but his experiments suggest the possibility that didymium is like cerium, a compound which may be split up into at least two elements, the atomic weight of one being under 145·4, and the other over 146·6.

THE value of imports per head of the population in the Australian Colonies during the year 1881 has been given as follows:—New South Wales, £19 7s. 5½d.; Victoria, £17 2s. 4½d.; South Australia, £21 2s. 2d.; Queensland, £13 18s. 2d.; Tasmania, £12 1s. 0½d.; Western Australia, £12 3s. 9d.; New Zealand, £12 19s. 10d.; general average, £16 17s. 0¾d.

OXYGENATED water, or peroxide of hydrogen, discovered by Thénard in 1818, is obtained by the action of sulphuric or hydrochloric acid on the bioxide of barium; and it is only during the last few years that it has been prepared commercially under sufficiently favourable conditions to come into general use. Its properties render it specially suitable for the bleaching of animal substances, such as wool, feathers, ivory, &c., which must be previously freed from grease or other impurities.

A REPORT is published in the *Comptes Rendus* on a memoir of M. Bouquet de la Grye, entitled, "Study on Waves of Long Period in the Phenomena of Tides." In this memoir the author extends the work of Laplace. It is also proved that the greatest elevation of the water at Brest occurs, not with west, but with south winds. The density of the water, *Nature* says, is found to explain the unexpected fact revealed by Bourdaloue, that the mean level of the ocean at Brest is higher by 1·02m. than that of the Mediterranean at Marseilles. From 1834 to 1878 the mean level of the ocean has sunk at Brest, or the ground has risen; the fact subsists, after allowing for variation of temperature and saltness. The relative rise of ground has been about 1mm. a year.

THE following recipe for a cheap and simple non-conducting covering for steam pipes has been given by the *Boston Journal of Commerce*. Four parts of coal ashes, sifted through a riddle of four meshes to the inch, one part calcined plaster, one part flour, one part fire-clay. Mix the ashes and fire clay together to the thickness of thin mortar, in a mortar trough; mix the calcined plaster and flour together dry, and add to it the ashes and clay as you want to use it; put it on the pipes in two coats, according to the size of the pipes. For a 6in. pipe, put the first coat about 1¼in. thick; the second coat should be about ½in. thick. Afterward, finish with hard finish, same as applied to plastering in a room. It takes the above about two hours and a-half to set on a hot pipe.

PROFESSOR H. M. PAUL has communicated to the Seismological Society of Japan some notes on the effect of railway trains in transmitting vibrations through the ground. A box, holding about 20 lb. of mercury thickened by amalgamation with tin, was placed upon a heavy plank screwed to the top of a post sunk 4½ft. into the ground. Images reflected in the surface of the mercury were observed by a telescope, as in meridian observations. An express train passing at a distance of one-third of a mile, set the surface of the mercury in confused vibration for two or three minutes. The experimenter, *Nature* says, also found that a one-horse vehicle passing along a gravelled road 400ft. or 500ft. distant caused a temporary agitation of the mercury whenever the wheels struck a small stone.

INSTEAD of the methods of testing and comparing hardness at present in use, Dr. Herz, of Berlin, has sought a more absolute method, and he has confined himself, on account of the complexity of the question, to the consideration of isotropic elastic substances. In these the hardness may be determined by the pressure which must be exerted on a round mass to exceed the limit of elastic resistance. In the case of plate-glass, *e.g.*, it was found by experiment that, at a pressure of 136 kilogrammes per square millimetre, the limit was passed, and a circular crack was produced; 136, accordingly, expresses the degree of hardness of the glass. Every isotropic body which has its limit of elasticity exceeded under greater or less pressure is, respectively, harder or less hard. The advantage of this method lies in the fact that no second substance is needed, but only two specimens of the substance examined.

THE following formula has been deduced for the conductivity of annealed iron and steel wire, in which F is the conductivity, pure copper being 100, m the resistance of the wire in Ohms, l the length of the wire in metres, a its absolute weight in grammes, and s its specific gravity: $F = 1{\cdot}5594 \frac{l^2 \times s}{a \times m}$. The following are average values from a number of tests:—Wrought iron from Lancashire works, carbon, 0·04 to 0·08; conductivity, 15·75 to 15·17; open hearth steel, carbon, 0·04 to 0·08; conductivity, 14·97 to 14·17; Siemens-Martin steel, carbon, 0·08 to 0·15; conductivity, 14·17 to 13·76; Martin steel, carbon, 0·15 to 0·25; conductivity, 13·76 to 13·02; Bessemer steel, 0·25 to 0·40; conductivity, 13·02 to 12·50; Bessemer steel, carbon, 0·60; conductivity, 11·85; Bessemer steel, carbon, 0·80; conductivity, 10·66.

HERR KAYSER has been continuing his researches on "absorption," or condensation of gases on surfaces of solids, and has studied the influence of the adsorbing material. The pressure, *Nature* says, was determined which occurred in the glass vessel when given volumes of gas had been in contact with the solid material. The gases were carbonic acid, sulphurous acid, and ammonia, and these were absorbed in the empty glass vessel by coarse glass powder, and by turnings of brass and wrought iron. The metal turnings were quite clean and unoxidised, and before each experiment they were heated *in vacuo* to about 300 deg., to remove gas. It was found that pressure was greatest, and so absorption least, in the empty vessel. The order of increasing absorption was in general: Empty vessel, iron, brass, and glass powder. By the empty vessel, $S O_2$ was least condensed, $C O_2$ and $N H_3$ about equally. Also on the metallic surfaces, $S O_2$ always gave greater pressure than $N H_3$; between $C O_2$ and $S O_2$ there was hardly any difference. By the glass surfaces, on the other hand, $C O_2$ was comparatively little condensed, $N H_3$ considerably, and $S O_2$ to a large extent.

MR. K. PFARSKI has made a list of the longest bridges at present existing. This statement was made public some time ago, but is worth inserting here for future reference. The lengths are given in metres:—Parkersburg Bridge, 2147; St. Charles Bridge, over the Missouri, 1993; Ohio Bridge, near Louisville, 1615; bridge over the East River, 1500; Delaware Bridge, Philadelphia, 1500; Victoria Bridge, over the St. Lawrence, 1500; New Volga Bridge, near Syssran, 1485; Hollands-Diep Bridge, near Moerdyk, 1479; bridge over the Pongabunda, near Gooty, India, 1130; Dniester Bridge, near Kiew, 1081; Rhine Bridge, near Mainz, 1028; Dnieper Bridge, in Pultawa, Russia, 974; Mississippi Bridge, near Quincy, 972; Missouri Bridge, near Omaha, 850; Weichsel Bridge, near Dirschan, 837; Danube Bridge, near Stadlan, 769; Po Bridge, near Mezzana Corti, 758; Tamar Bridge, near Saltash; 665; Leck Bridge, near Kuilenberg, 665; Mississippi Bridge. near Dubuque, 536; bridge over the Gorai River, India, 529; Britannia Bridge, near Bangor, 464; Saane Bridge, near Freiburg, 382; Theiss Bridge, near Szegedin, 355. The new Volga Bridge, near Syssran, is accordingly the longest in Europe.

MISCELLANEA.

THE Phosphor-Bronze Company, Limited, has been awarded the gold medal for its fine collection of phosphor-bronze specimens at the New Zealand Exhibition.

MR. JOHN WORTON, manager of the Moss Bay Hematite Iron and Steel Company, has been appointed to succeed Mr. E. P. Martin as manager of the Blaenavon Company's works at Blaenavon.

THE *Moniteur de la Flotte* describes a proposal for placing passing ships in communication with existing submarine cables. The projector would float buoys with the necessary connecting wires and apparatus at intervals of a day's journey along the line of the cable, each numbered and properly lighted at night, and he considers that the plan presents but few difficulties and would obviate much anxiety and many dangers.

MESSRS. THOMAS SKINNER AND CO.'S steamer Stirling Castle, with the first of the new season's tea from Hankow, China, arrived in the Albert Docks at 4 a.m. on Thursday, the 22nd inst. She passed the lightship at the mouth of the Yangtse, forty-two miles from Shanghai, at 3.45 a.m. on the 23rd of May, and passed Gravesend on the 22nd at 2 a.m., making the run, including all detentions, in 29 days 22 hours 15 minutes, or steaming time 27 days 23 hours 45 minutes. She began discharging at seven o'clock in the morning, and her teas were early upon the market.

A NEW screw dredger of 800 tons, built and engined by Messrs. Simons and Co., was launched on the 23rd inst. complete from their works at Renfrew. It is named Clyde, and is the property of the Clyde Lighthouse Trust, having been built under the direction of their engineers, Messrs. D. and T. Stevenson, Edinburgh. This is the third dredger this firm have constructed for the river Clyde, and will be the most powerful, being fitted with compound engines of 350-horse power, and it is designed to raise 500 tons per hour from a depth of 35ft. to 40ft. water. On board are steam appliances for head, stern and side movements; also for lifting, lowering, and manœuvring, and throughout the hull and machinery every recent improvement has been adopted.

AN International Exhibition is being organised at Amsterdam, to open in May, next year, and continue open until October. Its object is to bring together the indigenous products of the various colonial possessions of the European countries side by side with articles suitable for exportation to them. Group VII. of the second section includes engines, machinery, tools, and means of transport; and Group VIII., civil engineering, pumps, and mining appliances. The Exhibition is placed under the patronage of the King of Holland and the Dutch Government, and under the honorary presidency of the Colonial Minister. The general commissioner is M. E. Agostini; the president of the executive committee, M. D. Cordes; and the secretary, M. J. Kappeyne Van De Coppello.

THE Fives-Lille Company is employing its full complement of men, viz., 2500, and is tolerably well supplied with orders for the future. It is engaged upon some locomotives for the Northern Railway of France, the finishing of steel cannons, cast at Creusot, for the French Government, girder bridges for Austria, and sugar machinery, both cane and what is usually called beetroot, but is really mangold wurzel, for the colonies. The shops are all parallel with each other, and are mostly provided with travellers. That in the boiler shop consists of a girder, running at one end on a rail attached to the side wall, and supported at the other by a standard on a truck, carrying the engine and boiler, running on the ground level. The works are well supplied with machine tools, though not the most modern. Railway wheels are made by stamping the boss with half the spokes under the hammer, and then hand-welding them to the other half of the spoke and part of the rim, forged in one under the hammer. The curved inside of the rim between the spokes is planed by a rocking arm, the rim being fed in a circular direction. There is a self-acting hammer, called "*marteau à planer le cuivre*," worked by a belt, for planishing copper cylinders, which are self-acted round by a cord.

THE Government of India have recently sanctioned for execution from the grant for Famine Protective Works the completion of the first section of the Gokak Canal in the Belgaum Collectorate. The project for a large canal, with head-works on the Ghatprabha river above the famous falls of Gokak, emanated from Colonel—now Lieut.-General—Walter Scott, R.E., in 1853. A preliminary survey was carried out under his direction, which showed that remarkable facilities existed for leading a canal off from a point about two miles above the falls to irrigate the tract on the left bank of the Ghatprabha river lying between the Ghatprabha and Krishna rivers, and comprising portions of the Gokak and Bagalkot talukas, and of the Mudhol and Jamkhandi native States. The river has a sheer descent of about 160ft. at the fall, and at the spot selected for the canal head the total command is about 200ft. By cutting through a ridge of hills on the left side of the valley, General Scott showed that the canal could be at once brought out with a complete command of the country beyond. Investigations for storage works and for the extension of the canal are in progress. The works are now in charge of Mr. R. B. Joyner, Executive Engineer for Irrigation, under Mr. J. H. E. Hart, Chief Engineer for Irrigation.

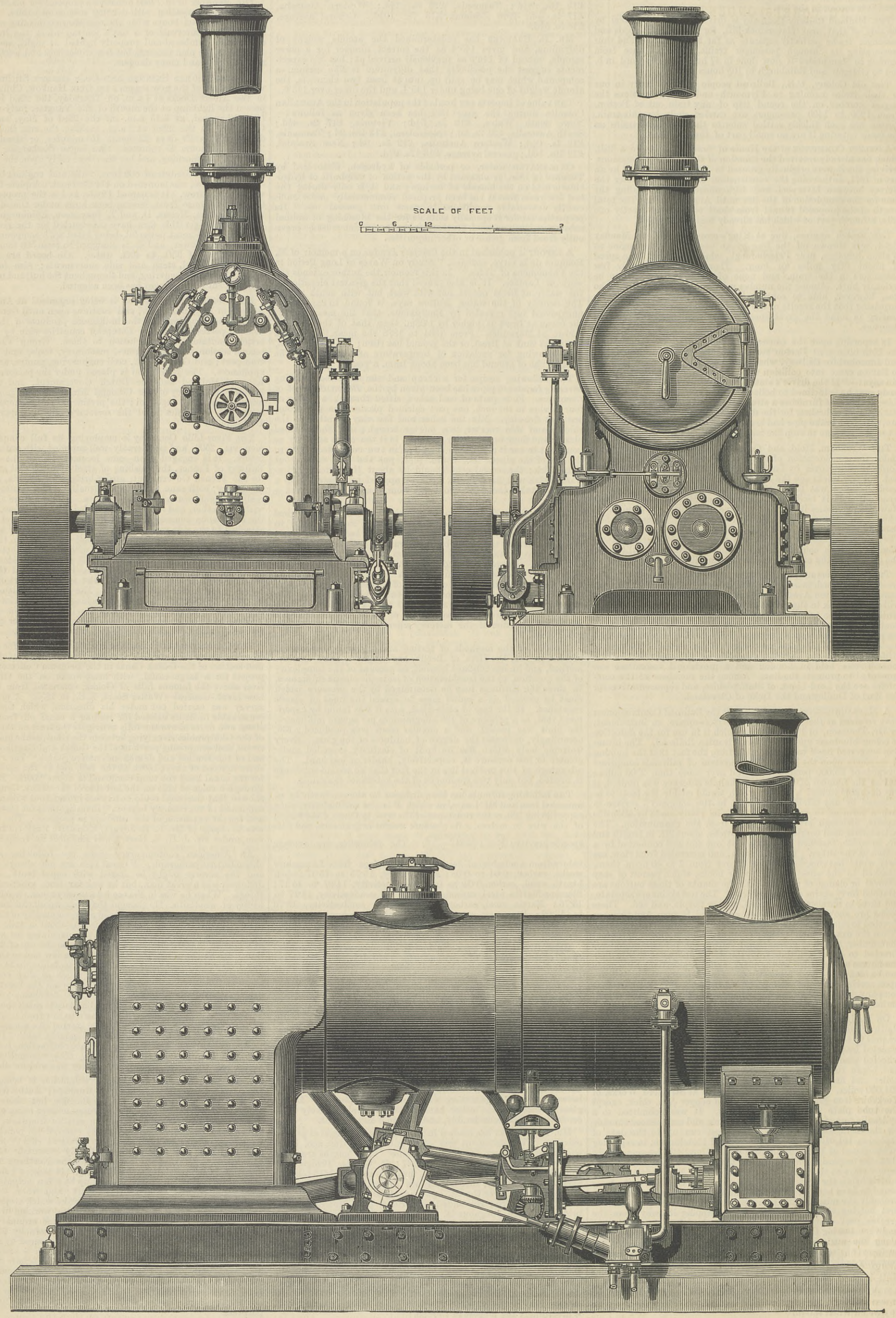
AN American contemporary gives the following somewhat characteristic paragraph:—"Great men are not always practical, and the reverse might be stated with equal truth. Anyhow, Jefferson was a great man, but he was far from practical in some things. When he was in France he was very much struck with the utility of windmills. He thought they were wonderful institutions, and cost so little to run. He owned a large quantity of timber on a mountain much higher than Monticello, about a mile off. He purchased in France a windmill and the machinery for a saw mill at a cost of 13,000 dols., and had it taken to the top of the mountain. He had for a neighbour a bluff old fellow named Cole. One day Cole came to see him, and Jefferson took him up to where he was having the mill built. It was as much as they could do to climb the steep ascent. When Cole recovered the breath he lost getting up the mountain, he said: 'Mr. Jefferson, you have a splendid saw mill, and it is in a splendid place to catch the wind, but how are you going to get the logs up here to saw from?' The author of the 'Declaration of Independence' started like a man suddenly awakened from a delightful dream, and quickly said: 'Hey, Cole, how? What?' And then, relapsing into abstraction, led the way down the mountain toward Monticello. The windmill was never completed, and years after the machinery was sold for old iron."

A SMALL international industrial exhibition is being held at Lille, under the auspices of the Municipal Authorities. The exhibitors are chiefly French and Belgian, but there are two English, viz., Doulton and Minton, ceramic ware being one of the classes. A prominent feature is the artistic ironwork, produced entirely by the hammer, and black, relieved by polished steel, nickel, and copper, which produce an excellent effect; fine scroll-work, flowers, and fruit are marvellously executed. One of the Dandenné perpetual clocks, like that at the Northern Terminus, Brussels, is erected outside the building. It is kept going by the weights being kept constantly wound up by a fan actuated by the ascensional current of an air-tight shaft; and when the weight nears the top of its course it puts on a brake which stops the fan, provision being made for twenty-four hours' working in the event of a temporary cessation of the current. Some original improvements in mechanical drawing appliances are shown by M. Jardez, of Lille. He stretches the paper by a panel secured by iron bars. The left-hand edge of the board is provided with a scale and also with a grooved rod, fixed by pins, on which the square works for dispensing with a true edge. The stock of the T-square has an aperture for adjustment, and the blade is also graduated. There is besides a small rack for hatching regularly. Other novelties are folding iron trestles and some metallised cloth for roofing purposes.

8-HORSE POWER COMPOUND ENGINE.

MESSRS. MARSHALL, SONS, AND CO., GAINSBOROUGH, ENGINEERS.

(*For description see page 468.*)



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.*

TO CORRESPONDENTS.

*** *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.*

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

*** *All letters intended for insertion in* THE ENGINEER, *or containing questions, 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.*

LABOR OMNIA VINCIT.—*The diagrams you enclose are very good. The low-pressure cards are not as full as is desirable, but we do not think you can remedy that, as the cause is probably condensation, although there may be some wiredrawing as well.*

AIR.—*If air is allowed to expand in a cylinder without doing work no effect will be produced; there will be no fall of temperature. If, however, you take a given weight of air, say* 1 *lb., and compress it, you will heat it. This heat can be taken out by cooling the cylinder down with cold water. If now the air thus cooled and under pressure be allowed to expand at any future time, it will be colder after expanding than it was before.*

E. N. S.—*Let* L *be the vertical height from the plane of revolution of the centre of the governor balls to the point of suspension in inches, and* R *the number of revolutions per minute, then* $R = \frac{187{\cdot}5}{\sqrt{L}}$ *and* $L = \left(\frac{187{\cdot}5}{R}\right)^2$. *Thus the height of your governor being* 5*in., the square root of that number is* 2·236, *and* 187·5 *divided by this gives* 84 *nearly as the proper number of revolutions per minute.*

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.*

Cloth cases for binding THE ENGINEER *Volume, price* 2s. 6d. *each.*

Many Volumes of THE ENGINEER *can be had price* 18s. *each.*

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, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, 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 in 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, Mauritius, 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 rom the country must be accompanied by stamps 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.*

THE ENGINEER.

JUNE 30, 1882.

THE ROYAL AGRICULTURAL SOCIETY.

THE annual show of the Royal Agricultural Society will be held this year at Reading, and will be thrown open to the public on Monday, the 10th of July. Reading is within less than one hour of London by rail. The showyard is well situated, and the entries, both of cattle and implements, are numerous. If the weather is favourable the show ought to be a success. As we have more fully explained in another page, trials of steam draining machinery, and of apparatus for drying corn and hay in the stack, will be made the week before the showyard opens. Experiments will begin on Tuesday, the 4th of July. Trials of creaming apparatus will also take place, but with these engineers have less concern. It is a noteworthy fact that neither Messrs. John Fowler and Co., of Leeds, nor Messrs. J. and F. Howard, of Bedford, nor Messrs. Barford and Perkins, of Peterborough, will compete for the steam drainage prizes. That the three largest makers of steam ploughing apparatus in the world should have nothing to offer purchasers in this direction seems strange. Messrs. Fowler have a steam drainage plough in course of construction, but it will not be completed in time, and Messrs. Howard tell us that they are too busy to make a new departure. It is to be presumed that those most competent to form an opinion of value hold that steam draining ploughs are wanted. If this were not the case the Royal Agricultural Society would not offer prizes for such machinery. But the fact that such firms as those we have named do not intend to compete, would seem to indicate either that the prizes of the Society are not as valuable as they once were, or else that there is really no demand for steam drainage tackle. Probably the truth lies midway. Medals and first prizes are now so common that we cannot call to mind a single agricultural engineering firm of any position that has not got a tray full of medals and enough "awards" to paper a large room. A medal more or less is no longer of importance. To some persons this is matter for congratulation; but for the Royal Agricultural Society it means loss of prestige. When its prizes are regarded by great firms as not being worth competing for, it will be hard to dispute that the period of decay has set in. No doubt there will be plenty of competitors to the end of time for any conceivable prize that can be offered; but the competitors will not be of the proper kind. It must not be forgotten that the status of the competitor is a matter of very great importance under all circumstances. The Derby owes its significance to the quality of the horses which run the race; and the Royal Agricultural Society owes quite as much to the men who have competed for its prizes as these owe to the Society. Let it once become an established fact that not one of the great Lincolnshire firms will compete for a Society prize, and the awarding of prizes may come to an end. It is to be supposed that the best that can be done in any way is done where men with every possible resource compete; and it is for the best that prizes are intended. If, however, only second-rate firms compete, the Royal Agricultural Society may find it very difficult to escape from giving prizes; but, on the other hand, the machine or implement which obtains a prize may be a very inferior commodity. The high position of the Society can only be maintained not alone by awarding prizes to the best, but by having the best in the world to award prizes to. There is some reason to think that these truths have been overlooked. It is not easy to escape from the conclusion that a period of decadence has set in. We wish we could add that this decay was due to entirely extrinsic causes, with which the management of the Society had nothing to do. Recently the Society has lost money, and its meetings have lost popularity. Injudicious outlay has gone hand in hand with yet more injudicious economies. A noteworthy instance of this was supplied by the arrangements made in connection with the Kilburn Show. A very large sum of money was paid for draining the showyard, although it was pointed out that one-half the sum spent on surface drains and roads would have answered much better. The deep drains put in have permanently benefitted the land. They were worse than useless for the purposes of the Society; and when the wet weather which was anticipated—if not why was money spent on draining?—had set in, and the showyard was a quagmire, no money could be obtained to make pathways. The result was, as a whole, disastrous as regarded the funds of the Society, and among exhibitors and the public the announcement of this fact was received without exception with rejoicing; on every side the verdict "serve them right" was pronounced.

Owing, we presume, to the low state into which the finances of the Society have fallen, a most injudicious bit of economy is now being carried out. Messrs. Eastons and Anderson are no longer to be the engineers of the Society. Mr. Anderson is, it is true, retained as consulting engineer; but those who know what a numerous and efficient staff has been hitherto provided by the Erith firm will see that either Mr. Anderson must discharge duties which are far beyond those of a consulting engineer, or else that the work to be done must be scamped. We learn with regret that the dynamometers and other instruments of precision which have been kept stored and in repair by Messrs. Eastons and Anderson for very many years, are now to be sent to the Society, by whom they will, we suppose, be carried about the country, with the clock and the façade so well known to all the world. We have heard it stated that the dynamometers are to be broken up, as the Society never intends to carry out any trials of steam engines again. We have not a list before us, and we do not know the names of those who have seats on the committee. To us, therefore, this committee is absolutely impersonal. We have no hesitation in saying that its policy is, in many respects, extremely injudicious; and its members will find, if they make inquiry, that they are accused, and that generally, of stopping competition lest new men should snatch from them a reputation which, it must be admitted, is now somewhat antiquated, as far as it is based on the past awards of the Royal Agricultural Society. Thus the fact that a firm took a prize at Cardiff just ten years ago is no evidence that the engines made to-day by the prize-taking firm are the best that can now be made. There is such a thing as living on the relics of a past reputation; and certain agricultural engineers and the Royal Agricultural Society seem determined to try how far in this direction they can go. The engineers are, however, wiser than the Society, for they have made many improvements in their machinery since the Cardiff meeting. We regret that it cannot be said that the policy of the Royal Agricultural Society has undergone any change for the better.

To revert in some degree to what we have already stated, it must not be forgotten that much of the influence of the Society was derived from its practice of testing machinery year after year. This system of testing did a great deal for the agriculturist. We do not now speak exclusively of steam engines; we have in mind corn drills, horse ploughs, thrashing machines, barn machinery, and so on. This practice of awarding prizes distinguished the Society from all kindred bodies; others might, indeed, hold shows, but to the Royal Agricultural Society pertained the all-but exclusive credit of providing for the carrying out, by trained engineers, of tests of all kinds of machinery and implements used by the farmer. To imagine that the Society can do without this system is to assume that it possesses some special internal vital force which can enable it to dispense with one of its limbs, so to speak, and yet compete with other societies, such, for example, as the Bath and West of England. We write in the best interests of the Royal Agricultural Society when we say that it possesses now no such element of vitality. There is nothing about the position of the leading men of the Society to justify such a belief. In the present day, more, perhaps, than at any other time, the value of institutions is estimated by the results obtained from them. If it can be shown that the Royal Agricultural Society is no longer useful to the public or the farmer it will soon cease to exist, no matter how eminent may be the names of those who have seats at its council board. One of the useful works done by the Society was the maintenance of what was for its purposes a staff of skilled engineers. The value of the independent opinions pronounced by Messrs. Eastons and Anderson on the implements which they tested cannot be overrated. It cannot for a moment be imagined that non-professional gentlemen can deliver opinions of equal value to the farmer. It is true that they can say whether a drill sows its seed, or a machine thrashes corn properly, but they cannot calculate the power wasted, or form a sound conclusion as to the quality of the design and workmanship. If the Society could but be got to see it, the fact that such a firm as Messrs. Eastons and Anderson gave the benefit of their professional knowledge to the Society, while such men as Mr. Bramwell, Mr. Cowper, the late Mr. Menelaus, Mr. Gooch, and others easily named, aided the judges with advice, and acted themselves in the same capacity in many instances, was really of transcendent importance. The reputation of the Society hung on such facts, as far at least as regarded its implement show, and we cannot but regard as a very great mistake indeed the elimination of the engineering element from the business of the Society. We venture to hope, indeed we do not hesitate to say that we wish, the proceedings at the forthcoming trials of machinery may prove so far unsatisfactory that the minority at the Council Board who opposed the present policy of unwise economy may be converted into a substantial majority. We are quite aware of the existence of trade rivalries among agricultural engineers; but the Royal Agricultural Society of England should hold such a position that it is independent of trade rivalries. It held this position once; it may, if it pleases, hold it again.

DIRECT-ACTING STEAM PUMPS.

IN our last impression, page 456, we stated our belief that the Pulsometer augmented the temperature of the water which it raised by from 8 deg. to 12 deg. In writing thus, without qualification of the statement, we inadvertently did an injustice to an excellent apparatus, which we hasten to repair. As will be seen from Mr. Moffat's letter, which will be found on another page, if the Pulsometer is worked with ordinary care the augmentation of temperature of the water lifted is very small, and the cases in which it reaches even 3 deg. appear to be strictly exceptional. Under certain unfavourable and abnormal conditions the water may be heated as we have stated to 8 deg. or 12 deg.; but these conditions need never obtain in practice. In 1876 a Pulsometer was tried at the Birmingham Show of the Royal Agricultural Society by Messrs. Eastons and Anderson, with the result that 181 gallons per minute were drawn through 65 yards of 6in. main and two yards of 3in. main, the elevation of temperature being $2\frac{1}{4}$ deg. to $2\frac{1}{2}$ deg. Fah., and the total lift about 20ft. It is to be observed that in the case of the Pulsometer, and all steam lifting apparatus of the kind, the principal source of loss lies in the heating of the pumped water; but this quantity is to a large extent independent of the height to which the water is raised, and consequently the greater the lift the greater will be the economy. The causes of condensation are practically constant in amount, and there is no reason why the weight of steam condensed should be much greater when the lift is 50ft. than when it is 10ft., and this fact should not be overlooked in estimating the economical value of the Pulsometer as a steam pump.

Since the Pulsometer was first tested at Birmingham in 1876, many very useful improvements have been introduced, both in design and workmanship, as was to be expected; and we have every reason to suppose that the economy of the apparatus is much greater now than it was then. But in point of fact the question whether such a pump does or does not use a little more or a little less coal is of very small importance compared to the direct value of the instrument as the simplest of all pumps, and the power which it possesses of dealing with all sorts of liquids in immense quantities. Comparisons are not to be drawn between the Pulsometer and highly economical pumping engines of large size, but between it and the donkey and other pumps of the same class which it is intended to replace. That its value in this respect is fully understood is proved by the large number of them now at work, especially on board steamers, where they have superseded the donkey and ballast pumps, and are stated by managing engineers to do the same work with a less consumption of steam, while costing nothing for repairs or renewals over a series of years.

In estimating the value of any piece of machinery attention should be paid to the conditions under which it is worked; and the consumption of steam by a pump is by no means the sole factor of expense. This is a truth often overlooked, but well worth the attention of engineers. In dealing with the cost of the electric light some time since, we had occasion to show that the outlay on coal is a comparatively insignificant item. The same truth applies largely to pumping. Taking coal at 10s. a ton, and assuming that one ton of coal will produce 6 tons, or 13,440 lb. of steam, we have 1344 lb. of steam for a shilling. If the consumption of steam were 134 lb. per horse power per hour, the cost would be one-tenth of a shilling; that is to say, $1\frac{1}{2}$d. for raising, say, 330 gallons 10ft. If 3300 gallons were raised through the same height per hour, the work done would be 10-horse power, and the cost 1s. A donkey pump of the best construction would use at least half as much steam, say 67 lb. per horse-power, representing 6d. per hour for fuel; but with the direct-acting steam pump the fuel would represent the whole cost, so far as the pumping apparatus was concerned, and leaving out interest on the cost price. But in the case of the donkey engine, oil, tallow, packing, and attendance must be included. A remarkable instance of this is supplied by a statement made by Mr. James Laing, of Deptford Yard, Sunderland. Mr. Laing has replaced a 15in. centrifugal pump at his graving dock with two No. 7 and No. 11 Pulsometers, and as a result he saves 3 gallons of oil, 10 lb. of tallow, and one man's labour per day. In addition his coal bill has been reduced by $1\frac{1}{4}$ tons per day. It is probable that the conditions here were not favourable to the centrifugal pump, or that the pump and

its engine were not of a good type ; but the fact remains that at least 5s. worth of lubricants were saved per day, and if we add 4s. for the man we have a total saving of 9s. per day, which would go a long way to defray the cost of coals rendered necessary by a large consumption of steam.

We have already dwelt on the extreme utility of pumping machinery which is simple and can deal with large quantities of water. Under very many circumstances these conditions quite overshadow all considerations regarding economy of fuel. Of course there are again other conditions under which the maximum economy in the consumption of fuel must be secured, and then piston pumps and regular steam engines must be used. There is, however, a point beyond which it is useless to employ steam pumps, using the words in their ordinary sense, with the view of obtaining special economy. What the point is has never been ascertained, because no experiments worth the name have ever been carried out to settle the question. The makers of donkey pumps now in the market can be counted by the score; and it is highly desirable that a competition of some kind should be held from which engineers might arrive at a few facts. We would suggest that the engineers of some of the boiler insurance companies should make the necessary experiments. The competition might be carried out without much cost, the only apparatus required being a tank into which the donkey pump should lift the water, and a boiler to supply steam. Pumps might then be submitted from time to time for test, a certificate of performance in terms of pounds of water lifted per pound of coal burned being given to each competitor, and the results might be tabulated and published in the reports of the engineers. The value of the figures obtained would be very great, not only to the users of donkey, ballast, and other forms of pump of small or moderate size, but to the successful competitors; and it would no doubt be followed by important improvements in the construction of such machinery. No one knows how steam can be wasted until they have had extended dealings with a donkey pump.

THE IRON TRADES EMPLOYERS' ASSOCIATION.

The report of the General Committee, which was presented at the annual meeting of the Iron Trades Employers' Association, held on Thursday, at Huddersfield, under the presidency of Mr. Greig, of Leeds, contains a review of the condition of the engineering trades, together with other matters interesting to employers. In the first place, the Committee congratulate the members on the revival in trade, which, though slow in many departments, seemed to be progressive, and would, it was hoped, be lasting in every district, In so far, however, as the improvement had influenced the labour market, the Committee had to remark that in every branch where skilled labour was required in the engineering and iron trades, the workmen had been the first to reap the benefit long before any corresponding advantage had been felt by employers, for though it was frankly admitted that orders had been greatly increased, it was nevertheless necessary to state that prices did not improve to the extent desirable, and that until competition became less eager, the pecuniary results to employers could not be satisfactory. At the present time wages in every department of the engineering trades had returned to, and in some cases advanced upon, the rates in force during the period of activity preceding the depression in 1879-9. Thus there was scarcely any industrial district in the kingdom in which advances had not been given by employers as a natural consequence of increasing activity, and it was gratifying to know that this result had been generally effected without the intervention of strikes or difficulties of that kind. With the view of affording some accurate means of guidance in meeting claims which might in the future be made upon members of the association, the secretary had been instructed to collect the fullest information as to wages paid at the present time in every branch of the engineering and iron trades. The paramount importance of piece-work in every department where it could be introduced had been kept constantly before the members, and it was making way in the country. Of course it was known that the leaders of some of the trades unions in the engineering and iron industries were unceasing in their efforts to prevent its extension and even to limit its application in shops where it had long been in operation ; but where the system had once been fairly established it remained unshaken. The matter which had been of greatest interest during the year had been the experiment made by the members with regard to the establishment of a system of mutual insurance against claims for personal injuries made upon employers by their workmen under the Employers' Liability Act. The results of the experiment so far had abundantly confirmed the steps taken by the promotion of the system. Every claim made upon the Committee had been met with all possible despatch, and the entire amount expended upon such claims had not exceeded 12 per cent. of the gross sum received as premiums. In view of the successful working of the system it was under consideration whether at a not very remote date it might not be possible under some modified form of subscription to merge into one the general and the insurance funds, and make one payment cover the privileges of membership and the insurance against claims for compensation under the Act as it now stood. In any case it was satisfactory to know that the investigation into the question of risks in the engineering and iron trades, and the classified ratio of such risks which was undertaken and completed about two years ago by the order of the general committee of management of the Association, had led to conclusions which had been shown to be sound, and by establishing a very moderate scale of premiums to cover such risks the Association had saved its members, and all employers in the engineering trades of the country, from a large annual contribution which it was once feared would have to be paid, and would have become an additional and a serious tax upon industrial enterprise. After referring to the steps taken to prevent the passing of the proposed Employers' Liability Amendment Bill, the Committee, in concluding their report, urge upon the members in every district the duty of taking steps to widen the area of the Association. In view of the position taken by trades unionists all over the world it was clear that reorganisation of employers for defence and mutual support was each year growing more necessary. The past year had been one of unusual quiet, but it would be contrary to all experience to hope that such quietness would continue without some interruption. The vicissitudes of trade, and the changing condition of the labour question, caused by emigration and the sudden call for labour in special industries—such, for instance, as the one now going on in the iron shipbuilding trade—might at any time become a serious source of disturbance, and it was a satisfaction to know that employers who were members of that Association could at once call to their aid an organisation which had branches all over the kingdom, and could thus be made useful whenever and wherever it was required.

THE CHANNEL PASSAGE.

In anticipation of the coming autumn exodus to the Continent, the South-Eastern Railway Company has just launched a new boat, the Mary Beatrice, built by Messrs. Samuda Bros., and to be engined by Messrs. Penn and Son. She is 5ft. longer than the two present largest boats on the Folkestone-Boulogne route, namely, the Albert Victor and the Louise Dagmar. The principal dimensions of the Mary Beatrice are :—Length, 255ft.; breadth, 29ft.; depth, 15ft. 6in.; burden 1063 tons. She is expected to attain a speed of 18 knots, and to be put on the line in August. At present the smaller boat, the Victoria, takes her turn with the two larger vessels in making the passage. The Chatham and Dover Company will shortly put a fine large boat on the Dover-Calais route, expected to do the passage in an hour ; her size is such as to render highly desirable some better arrangement for landing passengers on the Admiralty Pier at Dover. Three sets of apparatus for the alleviation of sea-sickness are on trial on the Folkestone-Boulogne route, all of them, of course, somewhat on the principle of the pendulum, so that when the ship rolls, the apparatus with a passenger in it shall keep nearly vertical. Two of these pieces of apparatus, the invention of M. Lebacq, of Brussels, are on board the Albert Victor, in the fore cabin. One of them consists of a couch slung from a ball-and-socket joint of considerable diameter, largely to abolish the effect of the rolling of the ship ; the whole is mounted upon a kind of bellows arrangement to moderate the pitching, which in heavy gales can never be entirely overcome. The other resembles an ordinary bunk, and the motions of the ship are reduced by mountings somewhat resembling those of the mariner's compass-box. The former apparatus takes up most room—the chief commercial objection to most such inventions, unless passengers are willing to pay more for the accommodation—but a passenger who is habitually sick at sea informs us it answered with him in rough weather rather better than the other ; he was sick, and only slightly, at least an hour later than would otherwise have been the case, and landed at Boulogne in a far better state than he had ever previously known in similar weather. The other piece of apparatus takes up less room, but he did not find it to be so efficacious as regards the pitching. Improvements are being made in both as experience is gained. The third piece of apparatus is the invention of Mr. Gardner, and after removal from the Naval Exhibition, is now in the ladies' cabin of the Louise Dagmar, where, as with the other two pieces of apparatus, it is often avoided by passengers, under the impression that it is erected for the benefit of habitual invalids, until the fact that it is for general trial is made known. Mr. Gardner's apparatus is slung upon a double ball-and-socket joint, with short india-rubber suspenders to alleviate the pitching a little. Certain strong-bodied passengers never speak respectfully of any apparatus for the alleviation of sea-sickness, but there is no question that such appliances seem to relieve others from a large proportion of misery. That apparatus is best in principle which, excluding the element of pitching, will swing most easily with equal evenness in any and every direction when pushed horizontally. The means adopted for the prevention of pitching require judging separately.

THE ELSWICK ORDNANCE AND ENGINEERING WORKS.

The conversion of the Elswick Ordnance and Engineering Works into a limited company is one of the signs of the age. It is only thirty-five years since their formation to carry on on a limited scale the engineering trade. A few years after their formation Mr. Armstrong came in. From 1857 the firm began in earnest to make artillery, and, as is well known, for the last twenty years that branch of their operations has chiefly been for foreign Powers. They may be said to have become by their extent, variety, and special features, the chief of the engineering works on the Tyne—a river always notable in the trade since the days of the establishment of the Stephenson works over half a century ago. Of late the Elswick Works have become very large producers of hematite iron, and at the present time they are sending it off in the pig to Rotterdam and elsewhere abroad in considerable quantities. Alike in all the branches of their trade the Elswick Works seem to flourish. But they meet with the common fate—years and other circumstances have lessened the number of the heads of the firm, and, possibly owing to the promotion of one member, it is now decided to form a limited company. The names of the seven subscribers to it show that those that have made the firm what it is are included, and it is probable that it only provides for the continuance of a great firm under other conditions, and in a mode that is now becoming increasingly in vogue. It is evident that it will be a limited company in few hands—the number of the shares being 494 only—and it is tolerably certain that the only result will be the accession of new blood when it is needed, and of prolonging the name and the fame of one of the chief of the engineering establishments in the north.

THE IMPROVEMENT OF THE IRWELL.

The long debated question as to the practicability of so widening and deepening portions of the rivers Irwell and Mersey as to provide a navigable tidal ship canal to Manchester, has again been brought prominently forward under the energetic patronage of Mr. Daniel Adamson, who on Tuesday assembled at his house, near Manchester, a number of gentlemen interested in the proposal. The suggested canal has been repeatedly condemned as impracticable, if not from an engineering point, as a commercial undertaking; but failure on either of the above grounds does not seem to be anticipated by the present projectors of the revived scheme, who have taken the preliminary steps for pushing forward the proposal in a more definite form than it has yet assumed. A provisional Committee has been appointed for inquiring into the best means of carrying out the project, and this Committee has been empowered to obtain a detailed survey by competent engineers for the purpose of ascertaining approximately the cost of the construction of the proposed tidal navigation. To cover the expense of this preliminary inquiry a guarantee fund is to be formed, and in the event of the report being satisfactory the Committee are empowered to forthwith form a company to be called "The Manchester Tidal Navigation Company." We may add that the present rough estimate of the approximate cost puts it down at a sum of £4,500,000.

THE MARINE EXHIBITION AT TYNEMOUTH.

At a meeting of the Building Committee held on Wednesday, Mr. P. J. Messent in the chair, it was found that in consequence of the numerous applications for space, that the buildings comprising the winter garden, aquarium, terraces, arcades, skating rink, &c., were not sufficiently large to meet the requirements. The committee therefore instructed their architect, Mr. W. Glover, Market-street, Newcastle, to prepare plans and advertise for tenders for the erection of additional buildings, with a floor area of about 20,000 superficial feet, so arranging the new buildings that they could be still further increased should the exigencies of the Exhibition require it. The committee are now able to announce that their efforts to combine an exhibition of electric and other patent lights is likely to be most successful, and they have good reason to hope that they will shortly be in a position to make a definite announcement on this matter. Count Ferd. de Lesseps has promised to send some interesting plans, &c., relative to his great work in the Isthmus of Panama; and as there are already several applications for space from foreign exhibitors, the Exhibition will doubtless assume quite an international character.

LITERATURE.

Our Factories, Workshops, and Warehouses ; their Sanitary and Fire-resisting Arrangements. By B. H. Thwaite, C.E. London : E. and F. N. Spon. 1882.

Commencing with a brief account of the rise of the manufacturing industries of this country, and their effect on the health of the operatives, and the consequent legislation, some account and statistics of the existing sanitary arrangements of textile and other manufacturing occupations, and their effect on the health of the artisans, are next given. Factory and workshop sanitation are then considered at length under the heads, Site and Foundation, whereon the author's remarks are very acceptable ; but, unfortunately, an intending factory builder cannot control the geological formation of the ground he must use, and does not always find it convenient or practicable to drain the ground to the depth of 10ft., so that no water shall stand nearer than 5ft. to the bottom of the foundations. Closet arrangements are considered at some length and with advantage, and bath and sewer arrangements receive some notice ; but the most useful chapters in the books are those on ventilation, ventilating apparatus, and heating apparatus. From a safety point of view certain useful hints are given on the arrangement of shafting, belts, and gearing. The latter part of the book is occupied with chapters on the origin of conflagrations and their prevention, fire-alarms, escapes, and other apparatus, fire extinction and fire-proof construction.

The Boiler Maker's Ready Reckoner, with Examples of Practical Geometry, and Templating for the Use of Platers, Smiths, and Rivetters. By John Courtney. Revised and edited by D. K. Clark, C.E. London : Crosby Lockwood and Co. 1882.

The first few pages of this book are occupied with the simple geometry required by a boiler maker to enable him to set out plates and templates of any shapes and combinations, while the rest of the book contains tables to avoid or to facilitate calculation of the weight and strength of plates bars, circles of plates, materials, and for calculating wages and time sheets, diameters, circumferences, and decimal equivalents of the parts of an inch. To this latter table should be added decimal equivalents of the parts of a foot. The book is one of Weale's excellent series, or the series still known by that name, and is the companion to a very useful practical book by the same author, namely, the "Boiler Maker's Assistant."

A Practical Treatise on Mechanical Engineering, comprising Metallurgy, Moulding, Casting, Forging, Tools, Workshop Machinery, Mechanical Manipulation, Manufacture of the Steam Engine, &c. By Francis Campin, C.E. Weale's Series. London : Crosby Lockwood and Co. 1881.

Mr. Campin is usually practical in his contributions to this series, but it need hardly be said that in 206 of these small pages the long array of subjects can only be so treated as to give the book the character of being something of everything and little of anything ; and there are some rather old engravings used to illustrate, for modern students, certain machine tools and parts of steam engines. Some of those for illustrating slide valves are positively harmful, and especially is this the case with the expansion valve shown. Mr. Campin may not be responsible for this, and the character of the text supports this view; but he might have advised his publisher to have new woodcuts made of these things instead of those of the railway brake which he illustrates, and in speaking of which he, without any apparent reason, gives his gratuitous opinion that it is the best of all those at present before the public.

A Practical Treatise on the Joints made and used by Builders. By Wyvill J. Christy. Weale's Series. London : Crosby Lockwood and Co. 1882.

This is a new and amplified edition of a well-known book descriptive of the joints made in constructive work of all kinds by carpenters, joiners, cabinet makers, bricklayers, masons, tilers, slaters, smiths, fitters, plumbers, gas and water fitters, and glaziers, zinc workers, and coppersmiths, and is a book useful to students, though there are many of the joints referred to which should be illustrated, and there are many that need to be added to the book to make it complete.

An Elementary Treatise on the Construction of Roofs of Wood and Iron. By E. Wyndham Tarn, M.A. London : Lockwood and Co. Weale's Series. 1882.

This is a new edition of a familiar book of this series, in which well-known forms of wood roofs are described, and the simplest ways of arriving at the strains on the different parts explained. In the second part, namely, that on iron roofs, the most usual forms of roof truss and their strains are explained, and John Scott Russell's great Vienna Exhibition dome is dealt with at some length. The student must, it should be remarked, not be deceived by the remarks here made as to the self-destructiveness of ordinary iron beams—remarks which are quoted from some of Russell's writings.

South Kensington Museum.—Visitors during the week ending June 24th, 1882 :—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,458 ; mercantile marine, building materials, and other collections, 2929. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 6 p.m., Museum, 2271 ; mercantile marine, building materials, and other collections, 547. Total, 18,205. Average of corresponding week in former years, 18,888. Total from the opening of the museum, 21,087,107.

TRIAL OF A TORPEDO BOAT FOR THE BRAZILIAN GOVERNMENT.

MESSRS. YARROW AND CO., of Poplar, have recently completed four large torpedo boats for the Brazilian Government, which embody many improvements, and constitute a great advance over the boats previously built by this firm. They are 110ft. in length by 12ft. 6in. beam, and are provided with double torpedo launching apparatus suitable for discharging Whitehead torpedoes.

In addition to the two torpedoes which are carried ready to fire there are also provided two spare torpedoes which can with great rapidity be loaded into the launching apparatus and fired after the two first are discharged. The torpedoes are projected by means of compressed air, and the boats are provided with all necessary appliances not only for charging the torpedo guns but also the Whitehead torpedoes themselves. It will be recollected that Messrs. Yarrow and Co. have built a large number of sea-going torpedo boats. In all they dispatched last year no less than eleven, all of which arrived at their destinations in perfect safety, some being navigated across the Atlantic. The Brazilian Government gaining confidence by the success of these, have determined to sail the four boats under notice over to Rio instead of shipping them in pieces as they did in the case of a previous boat built by the same firm, and these vessels will very shortly leave this country fully equipped for the voyage. In addition to the armament of torpedoes these boats are furnished with Hotchkiss guns.

The machinery is of the usual type adopted by Messrs. Yarrow and Co., the engines being compound condensing, and the air pump, circulating pump, and feed pumps being worked by supplementary engines. The coal space is sufficient to carry fuel for a run of about 1300 miles at a moderate speed. The conditions of the contract were that on a continuous run of three hours without stopping, with twelve tons weight on board, a mean speed should be obtained of eighteen knots. Three of the boats have already been tested, and the result has been highly satisfactory and the stipulated speed exceeded. The trial under notice, which took place on Tuesday last, was of the fourth boat, the Brazillian Government being represented by Captain C. J. de Mello, naval attache, and Captain Lobo, and Messrs. Yarrow and Co. being represented by Mr. Crohn. Owing to the large number of gentlemen present, on carefully calculating the weights, it was found that there were 12 tons 13 cwt. on board instead of 12 tons as stipulated. The boat was run continuously for three hours, during which time three pairs of runs were made at the measured mile with the following results :—The first pair gave 20·721 knots ; the second pair gave 20·169 knots ; the third pair gave 20·362 knots ; giving a mean speed of 20·414 knots. The real speed obtained during the three hours was, however, ascertained by the number of revolutions recorded in that time divided by the number of revolutions per knot. It was ascertained from the runs over the measured knot that the number of revolutions required to do a knot in still water was 1312, and the total number of revolutions during the three hours amounted to 79,940, which gives a distance run through the water in the three hours of 60·93 knots, that is at the rate of 20·3 knots per hour, which is the highest result hitherto obtained by any vessel tested under the same conditions of load and duration. It will be of interest to observe that the weight of the machinery which gave this result in a vessel of between 50 and 51 tons displacement was 16¾ tons ; and when it is considered that the engines were making over 440 revolutions per minute, and working at 112 lb. per square inch, it will be admitted that the test was exceedingly severe, not only for the engines, but also for the boiler, the consumption of coal being at the rate of 1¼ tons per hour. After the trial the machinery was carefully examined and found to be in perfect condition, and to the entire satisfaction of the authorities appointed by the Brazilian Government.

These boats are provided with two rudders, one at the bow and one at the stern, and the rapidity with which this little vessel could be handled and turned at a twenty knot speed is very remarkable—a performance which could only have been obtained by the rudders being actuated by steam power, which has been found to facilitate the manœuvring capabilities of the boats to a great extent. The deck arrangements are very similar to what was adopted by Messrs. Yarrow and Co. in the boats built by them of the Batoum type for the Russian, Austrian, and Italian Governments.

It is worthy of note that the steam pressure on the trial just described was 112 lb. per square inch only, although the boiler and engines were designed for 130. This points not only to a further speed which might have been obtained had the full boiler pressure been adopted, but also that it admits of considerable deterioration taking place and several years of service before any perceptible reduction in the performance of the boat would be felt, which would not have been the case had the speed obtained only been secured by adopting the full pressure for which the boiler was designed.

REESE *v.* THOMAS.—The United States Commissioner of Patents has affirmed the decisions in the interference cases A and B of Reese *v.* Thomas and Harmet, and has thereby confirmed the award of priority to Reese. The latter, as we have already explained, claims to have invented the processes of (A) desiliconising steel in an ordinary Bessemer converter with a siliceous lining, subsequently dephosphorising in a converter having a basic lining, and (B) desiliconising in an ordinary converter and dephosphorising in an open-hearth furnace having a basic lining. Reese claims to have invented these processes in 1866-67, but till 1879, after the announcement of Thomas's invention, he did nothing toward protecting his inventions, which he alleges he was unable, financially, to patent. During that period, however, Reese took out nineteen patents for the manufacture of iron and steel. The question of abandonment by him is to be looked into, and the Examiner of Patents has been directed to inquire into this matter.

PROGRESS OF THE HUDSON RIVER TUNNEL.—The engineers in charge of the Hudson River Tunnel now pronounce the experiment of boring from the New York side, on substantially the same plan as that resorted to on the Jersey City side, to be a complete success. While they have been coming to this conclusion the work has been carried on at the outlay of much perseverance and not a little risk, and has been marked by one startling occurrence which has not before been made public. On March 31st last, the compressed air forced its way out of the unfinished end of the tunnel, and this withdrew the force which kept the soft mud and water from rushing in. The men were forced to retire, which they did without accident, and for several days the excavation and the caisson were filled with water. Despair seized upon some of the engineers, and those who had favoured old-fashioned methods declared that their predictions had been verified. But by the use of ingenious appliances the compressed air apparatus was again put to work, the water was driven out of the caisson and excavation, the leak was found and stopped, a section 12ft. in length was bricked up and completed, and the work of building the tunnel proceeded as before. The water could not be rapidly driven out through the holes at which it entered and a 4in. discharge pipe was brought into play.

WATER SUPPLY OF SMALL TOWNS.

No. IV.

HAWICK.

IN continuing the series of examples of small water supply works which we commenced to publish on the 10th inst., we cannot do better than to reproduce here the principal part of a paper which was recently read before the Royal Scottish Society of Arts by Mr. A. Fairlie Bruce, descriptive of the Hawick waterworks, of which he was the resident engineer, under Messrs. J. and A. Leslie. The paper is so full of particulars that it will be found of considerable interest especially to our younger readers as a worked-out example of a small supply.

Supply.—The Hawick supply is derived from the Dodburn, a tributary of the Allan Water, which has a drainage area of about 1200 acres above the point of abstraction, 6½ miles to the south of Hawick. It was estimated to be capable of yielding an average of 1,380,000 gallons a day throughout the year, representing an annual rainfall of about 31in., an average summer flow of 432,000, and a minimum of 216,000 gallons per day. Last summer, which was unusually wet, the minimum gauging was above half-a-million, and the average nearly 1¼ million gallons a day. Lest the Dodburn should ultimately prove insufficient to meet the demands of the increasing population, provision has been made for taking in the Priesthaugh and Skelfhill Burns, also flowing into the Allan, which would increase the contributing area fourfold. In the meantime it is believed that 600,000 gallons a day, in addition to the original supply of about 280,000 gallons, or above 50 gallons a head to the present population, will be found amply sufficient for some time to come. The works consist of an intake 6½ miles of main piping, a reservoir at Acreknowe—a point about three miles from the town, which performs the duties of both a store and a service reservoir ; and a general re-arrangement of the existing system of distribution.

Pipe Track to Reservoir and Intake.—The intake weir is constructed of pitching and crib work. It measures 26ft. wide over all at the upper, reduced to 16ft. in width at the lower end, and 25ft. long. The crest, at a level of 686ft. ordnance, is 18ft. long, with raking pieces at each side 4ft. long. The upper face is close sheeted with 6in. by 2½in. battens, 6ft. long, driven 4ft. into the bed of the burn. These are spiked to a waling supported by a row of 8in. square piles 8ft. long. There are three rows of 6in. square piles 6ft. long, and the whole tied together by 9in. by 3in. walings. All the timber is of the best Baltic red wood. The space between the woodwork is filled in with 12in. rubble pitching, on dry rubble under-building thoroughly blinded with gravel. To enable sand, &c., which might accumulate, to be cleaned out, there is an iron pipe 10in. in diameter in the weir closed with a flap valve, through which it can be raked. As the left bank of the burn is rather low, a small embankment is formed, extending for about 20 yards upwards from the weir. The supply pipe, 12in. in diameter, leaves from a masonry recess, protected by an iron grating and wire gauge screen at right angles to the weir. During the unusually heavy spate in November last, the whole intake was submerged without any damage being done to it.

Scouring Well and Overflow Well.—At 30 yards from the intake there is a scouring well 4ft. square and 7ft. 6in. deep. It is founded on concrete, and built of 14in. by 9in. brickwork in cement, surrounded with clay puddle, and covered in with Arbroath pavement 4in. thick. It is provided with an outlet and emptying pipes of 12in. diameter, the latter being 12in. below the former, closed by wooden sluices, and an overflow at the same level as the intake weir, 2ft. wide, tapering to a pipe of 10in. diameter connected with the emptying pipe at the back of the well, which discharges into the burn through a 12in. fireclay pipe. The overflow well is of very similar construction to the scouring well, save that the emptying pipe discharges into the byewash channel, and the overflow pipe, the water from which forms the chief feeder of the reservoir, is carried across the channel to the higher end of the reservoir. The well is provided with a gauge weir 2ft. 6in. long and a copper wire gauge screen of four wires to the inch.

Springs Collected.—In addition to the water drawn from the Dodburn, two groups of springs rising near the base of the shoulder of Penchrist Pen are also taken in, one group at 130 yards and the other at a distance of 930 yards from the intake. At the point where each spring rose, a rumble well, of dry stones and gravel surrounded and covered in with puddle, was made. Each of these communicated, by means of a 4in. fireclay branch pipe, with a fireclay pipe of 6in. diameter, which leads the water into a small brick collecting well, each provided with a gauge, weir, and sluice, and connected with the main pipe, by an iron pipe 3in. and 4in. diameter respectively ; their combined yield amounts to from 80,000 to 260,000 gallons per diem.

Main Pipe.—The main pipe to Acreknowe reservoir is of 12in. diameter, with turned and bored and lead and yarn joints having a scour cock in every hollow and an air cock at every summit. A considerable length of the track lies through a succession of mosses, the remains of ancient glacial lochs of various depths, composed of peat and white silt ; where the depth of this deposit did not exceed 2ft. or 3ft. below the pipe, it was excavated and the pipe supported on drystone building, 2ft. thick, but when the moss was of a greater depth the pipe was supported on piles, a pair of 6in. square piles with a crosshead being driven behind each faucet. The pipe discharges into an overflow well, near the upper end of the reservoir, at a level of 621ft. ordnance, where it is capable of delivering 1¾ million gallons a day.

The Bye-pass Pipe.—From the overflow well the water is led in a bye-pass pipe round the south-eastern margin of the reservoir to the back of the embankment, where it is connected with the supply pipe to the town, which was in this way since several months pending the completion of the reservoir works. When the Dod is discoloured, as it is liable to be in a spate, it is intended to shut it off at the intake, and to draw the supply for the town entirely from the spring supplemented by the reservoir.

Acreknowe Reservoir.—The reservoir works occupy an area of 25 acres, of which 19 acres are under water ; the level of top water is 606ft. above ordnance datum, the depth over the cill of the upstand is 20ft., and the storage capacity 56 million gallons, or ninety-three days' supply of 600,000 gallons a day. The works immediately connected with the reservoir are—the embankment, waste wier, bye-wash, and waste wier channels, upstand, screening well, &c.

Embankment.—The embankment is about 100 yards long, by 26ft. high in the middle, and 4ft. above top water. It is 8ft. wide at the top. It contains 2500 cubic yards of puddle and 8500 cubic yards of banking, including the banking round the screening well, being only one yard of embankment, &c., per 5000 gallons of storage capacity, a rather small proportion, which is due to the site being unusually good, the valley widening out immediately above the bank, without, as frequently happens, the bottom rising in level in the same proportion. In forming the embankment the base was first stripped of all soil and vegetable matter, and all field drains below it lifted. The puddle trench was then cut in the centre, 6ft. wide at either extremity, and 12ft. or 13ft. wide in the middle. The depth varies from 5ft. to 20ft., according to the position of the water-tight stratum. The middle half of the trench is in whinstone rock, containing seams of shattery rock, locally termed "dint" or "blae," which, however, disappeared as the bottom of the trench was reached. It is noticeable that the deepest of these seams nearly corresponded to the course of the burn, both in its position and in the indentation formed in the solid rock, where it ceased at a depth of 13ft. The trench is filled with puddle, and forms the foundations of the puddle wall, which is carried up with a batter of 1 in 8 to within 6in. of the top of the bank, where it is 6ft. wide. Both puddle and banking were put on in thin layers, the latter sloping upwards from the puddle wall to either side, the puddle wall being always kept a few inches higher than the surrounding banking. No rails or planks were allowed to be used on the bank, and, still further to consolidate it, it was watered with a hose every night. So completely was this accomplished that a row of pegs placed along the top of the inner slope, after a month's constant rain, only showed a subsidence of 1½in. in the middle. When they were again levelled, after a further period of three weeks of wet weather, no additional movement was observable. The inner or water face of the embankment has a slope of 3 to 1, the lower part, from 10ft. below top water downwards, is protected with beaching of stones, not larger than 6in. in their greatest dimensions, 9in. thick. From that level to the top the bank is faced with hammer-dressed rubble pitching, from 7in. to 9in. deep, on 6in. of broken stones, all blended with quarry shivers. The outer slope is 2½ to 1, covered with soil 6in. thick, as also is the top, all save a gravel path leading to the upstand and screening well.

Byewash Channel.—The branch channel, which leads the Acreknowe burn past the reservoir, is carried round its north-western margin for a length of 970 yards. It is 4ft. 6in. wide at the bottom, 3ft. 6in. deep, with side slopes from 1½ to 1. The banking, when necessary on the lower side, is 3ft. wide on the top, the gradient is 1 in 1000, and its greatest carrying capacity when filled 3ft. deep is 2300 cubic feet per minute ; the largest amount it has ever been required to convey is 1520 cubic feet per minute during the great flood in November, when it was filled 2ft. 6in. deep. The drainage area is about 500 acres, so this represented upwards of 3 cubic feet per acre per minute. There are 4·24 cubic yards of excavation, and 1·92 cubic yards of banking per lineal yard of channel. The field drains on the opposite side at the upper end of the reservoir are intercepted by 10in. and 8in. fire-clay pipes, and connected in a brick well whence it is carried across in 12in. iron pipes, and made to discharge into the channel, as also do all field drains intersected by it. The byewash channel is protected with 8in. pitching at one or two points, amounting altogether to about 50 yards in length, otherwise the sides receive no protection, and as yet, after being for five months in use, show no signs of abrasion.

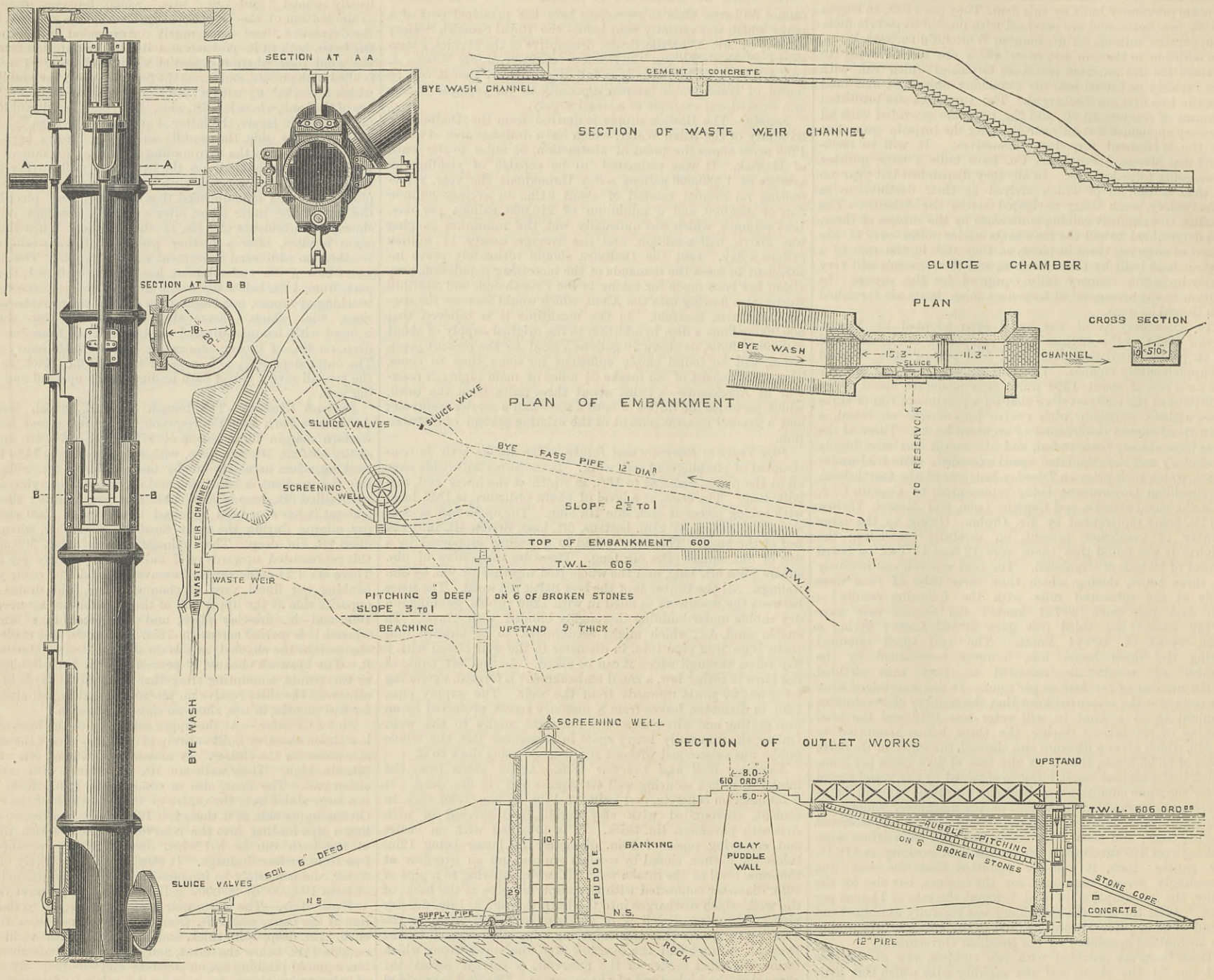
Sluice Chamber.—At the upper extremity of the byewash there is a sluice chamber built entirely of concrete, except the cills and side stone for the sluices. It measures 26ft. long, 5ft. wide, and 3ft. 6in. high. Their walls are 1ft. 9in. thick, with returns at either end. The floor, also of concrete, is 12in. thick. There is a large sluice near the centre of the full width of the channel. On the upper side of it there is a 12in. sluice in a recess, controlling a pipe leading into the reservoir, through which the water of the burn can be led when desired in dry weather when free from surface drainage. It consists almost entirely of spring water, and can safely be impounded, giving an additional supply of from 100,000 to 200,000 gallons a day when most required.

Waste Weir.—The waste weir is at right angles to the centre line of the bank, and 19ft. from it. It consists of a freestone curb 21in. deep, 15in. thick, and 12ft. long, with a cill on the outside 11in. below the crest, and on the inner side an apron of 9in. squared pitching set on concrete and grouted. At each end of the weir there is a concrete pilaster forming part of the side walls of the waste weir channel 2ft. 6in. high, with side stones grooved for stop planks, by means of which, after the embankment has become completely consolidated, the top-water level may be raised 12in. or 15in. if desired. The waste weir channel is a continuation of the byewash channel, which joins it just above the weir, where it is 8ft. wide, which width is reduced to 6ft. at a distance of 60ft. In the first 83ft. of its length there is a fall of 12in. to a flight of 31 altar steps, having a slope of 2 to 1. At the foot of the steps there is a level portion 15ft. long, pitched with 10in. squared pitching set on concrete, where, to break the force of the water, it is ponded to a depth of 9in. The floor of the upper portion of the channel is of concrete 14in. thick, with a feather 3ft. square below and 18in. square up the sides where it crosses the line of the puddle trench. The side walls are also entirely of concrete, 3ft. 6in. high for the first 50ft., and 3ft. in height for the remainder. The thickness throughout is 18in., with counterparts 18in. square in the upper part. The cutting above the walls is sloped at 2 to 1. The altar steps are 18in. wide and 9in. high, formed of stones 21in. by 10in., and 7ft. long, each checked 3in. by 1in. into that below it, and projecting 6in. under the side walls on either side, and resting on concrete 15in. thick, also stepped. The side walls were usually constructed in lengths of 34ft. Two frames were used, each 17ft. long, made of 11in. by 3in. horizontal members, with 6in. by 2in. verticals, morticed into the former, and the whole sheeted with ¾in. grooved and feathered flooring. The span of 1½in. was formed by nailing a triangular strip of wood at the level of the top of the cope. It was found that the concrete was prevented from adhering to the frames, as it is liable to do after they have been used once or twice, by rubbing them over with soft soap immediately before being used. The proportions adopted for all the concrete on these works were 1 of cement to 1⅝ of sand and 3½ of broken stones. They were turned over twice dry, and then twice wet. In the walls the concrete was conveyed to position in pails, which were passed from hand to hand by men standing on the frames. There is a considerable amount of knack required in the use of the shovel by the man building, so as to produce a good face by working the finer part of the mass up against the frames, and punning it thoroughly. If well done, no after rendering should be needed. The framing should not be removed for nearly forty-eight hours after the concrete is put in, and it should be kept as damp as possible by spraying it with water or otherwise. The concrete floor was tipped in with barrows and beaten with an ordinary beater till a smooth surface was produced. The water is drawn off by means of a cast iron column or sluice stand-pipe 18in. in diameter, having three sluices on it at different levels to admit of the water always being obtained from as near the top as possible, where it is necessarily purest. The screws for raising the sluices are all at the top of the stand-pipe, the amount to which each sluice is open being indicated by a gun-metal rod rising with the spindle in a shield above the flags on the top of the stand-pipe.

Masonry.—The ironwork is enclosed in a masonry tower 6ft. 6in. by 5ft. wide, the floor is of freestone blocks 9in. deep on 6in. of

HAWICK WATER WORKS.

MESSRS. J. & A. LESLIE, EDINBURGH, ENGINEERS



GENERAL PLAN. SECTIONS OF EMBANKMENT AND TOWERS, AND DRAW-OFF PIPE AND VALVE

concrete, 2ft. below the cill of the inlet channel, or 22ft. below top water. Up to the rake of the slope of the embankment it is built of concrete 2ft. 6in. and 2ft. thick at the back, and 2ft. 3in. and 2ft. at the sides, faced with 12in. by 6in. double stock bricks, which were built with three courses of headers to one of stretchers. The part above the line of the slope is of 14in. rockfaced parapet ashlar chisel drafted, chamfer grooved in beds and joints, and every third course tied together by means of an iron rod 1¼in. square checked into the masonry all round; it was all built in cement mortar. In the open side there are three lintels 15in. by 10in. to tie the building together. It has a droved cope of the same dimensions at 2ft. above top water level, and is covered in with 4in. Arbroath pavement, with a manhole in one corner, and the whole surrounded with an iron railing. There is also a grating of wooden spars in an iron frame to protect the sluices, which slides in a groove in the masonry on the outer side of the upstand.

Inlet Channel.—The inlet channel is 22ft. long and 5ft. wide. It is floored with 8in. rubble pitching set on 4in. of concrete and grouted. The side walls are built of concrete 2ft. 3in. and 2ft. thick, with freestone raking cope and putt stone. It has one lintel 12in. by 10in. to help it to resist the thrust of the bank.

Gangway.—Access is gained to the upstand from the bank by means of a wrought iron gangway 4ft. wide, supported between two lattice girders 35ft. span, 3ft. 9in. deep, with ten bays 3ft. 9in. centres. The booms are of 3½in. by 3½in. by ½in. angle iron; the strutts of 2in. by 2in. by ⅝in. angle, and the ties 2in. by ⅝in. bar iron. It rests on cast iron bed plates. The abutment on the bank consists of two blocks of stone, each 3ft. long by 2ft. wide and 12in. thick, resting on concrete.

Outlet Pipe.—The outlet, connected by a flange joint with the sluice upstand pipe, is 12in. diameter, of metal 1in. thick. It is laid straight to the burn, into which it discharges on the outer side of the embankment when the controlling sluice cock near that extremity is open. Where it crosses the puddle trench it is supported on and enclosed by a block of concrete, which has a feather formed on it all round to enable it to make a more water-tight joint with the puddle. As an additional precaution against any possible "creep" along the pipe, it is surrounded with concrete to the screening well 6in. thick below, and 12in. round the remainder. The outlet pipe communicates with the screening well by means of a bell-mouthed pipe near the centre of the bottom of the well, through which the water rises when the emptying sluice is closed.

Screening Well.—The screening well is a circular well 10ft. in diameter and 23ft. deep, the top being 1ft. 8in. above top water, 32ft. from the centre of the embankment. The floor is of concrete 2ft. 6in. thick, with a scarcement of 3in. all round beyond the wall; the wall is built of concrete in three sections of 2ft. 9in., 2ft. 3in., and 1ft. 10in. in thickness, faced with 9in. bricks built in alternate courses of headers and stretchers; outside it is surrounded with clay puddle 21in. thick, with an outside batter of 1 in 15. The wall was constructed in 7¼in. courses. A header and a stretcher course of bricks were first built, then the puddle behind was brought up to the same height, and the concrete tipped from barrows in between. Great care was taken to pun it well, to render it thoroughly compact, and each course was grouted well between the concrete and brickwork before another was put on. The well is surrounded with banking 6ft. thick at the top, which is 2ft. 4in. below that of the main embankment, of which it forms a part. On the top of the well there is a octagonal house 11ft. in diameter and 8ft. high to the eaves, built of perforated red brick 14in. thick, with a panel in each side 9in. thick surrounded with specially moulded bricks; the base course cornice, doorstep, jambs, and lintel are of freestone. The roof is also eight-sided, slated, and with a louvre boarded ventilator terminating in a finial. It is lighted from four skylights. There is a branch into the well from the bye-pass pipe terminating in a bell-mouthed pipe near the centre of the floor of the well, and controlled by a sluice cock worked by means of a lengthening rod from the top, to admit of the water from it being screened if need be independently of that from the reservoir. The supply pipe leaves from a masonry recess at the back of the well at the level of the floor. All the pipes have cast iron creeping flanges on the outside of the well, and are embedded in concrete to a distance of 20ft. from it. The screens are arranged inside the well in the form of a hexagon of 6ft. in diameter; they slide in standards of cast iron 22ft. high, batted to blocks of stone set in the floor. There are 125 square feet of screens of copper wire gauze of nine wires to the lineal inch, the remainder of the guides being boarded up. The top of the well is covered with a wooden platform, and there is an iron ladder by means of which access is gained to the interior if required. The quantity of water stored is measured by means of a floating gauge; it can also be used to measure the consumption in the town, by shutting off the water from the well and observing the rate at which the level of the water in it is reduced. Upwards of an acre of ground round the margins has been banked up, which would either have been so shallow as to be liable to grow up with rushes and weeds or laid awash. The shore is protected with beaching 6in. thick, and varying in width from 2 yards to 14 yards, the greatest width being near the bank, where it is most important that the water should not become discoloured by its abrading the margin. About four acres of the bottom have been stripped, and the remainder, where the soil was of a lighter nature, ploughed; the roots, &c., grubbed out and harrowed. The reservoir is enclosed partly with a drystone dyke and partly with a wire fence.

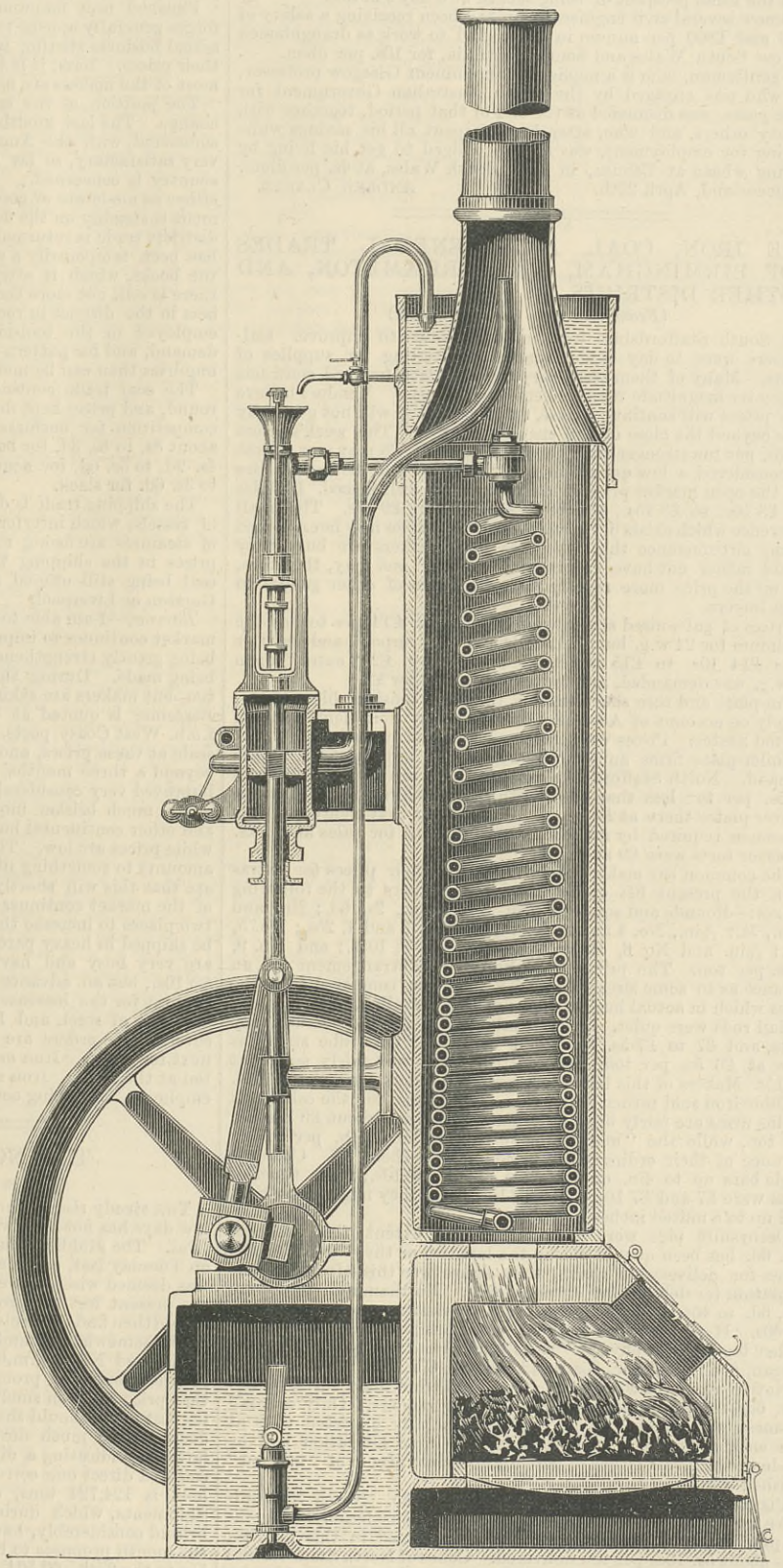
Cost.—On this question it must be remarked that the figures which follow, as given by Mr. Fairlie, would, without the necessary allowance for the cost of labour, be totally inapplicable elsewhere. They are, however, figures which are seldom obtained or given, and will be of considerable interest to many. The proportion of cement and gravel in the concrete was as 1 to 5, or about two bags to the cubic yard. It had to be carted a distance of nearly four miles from the railway station. The sand was chiefly obtained from the river Teviot, at a point between two and three miles distant. The stone was all obtained on the ground, and the ordinary rate of wages was about 4d. per hour. In the side walls of the waste weir channel the quantity of concrete executed per man per hour, including sand and stones, mixing, &c., was an average of 5·41 cubic feet; 6¾ cubic feet of metal were broken per man per hour. So that the cost per cubic yard was as follows:—For cement, including cartage, 9s.; sand, including cartage, 2s. 8d.; mixing, &c., 1s. 8d.; breaking stones, 1s. 4½d.; sundries, 3½d.—total, 15s. The contract price for all concrete was 15s. 9d. The cost of framing, including the price of timber, &c., was 2s. per square yard. The contract price was only 1s., but as this covered all exposed surfaces, as the floor, cope, &c., where very little work comparatively was expended on the face, it did not entail much loss. In the floor of the channel where the concrete could be tipped in with barrows, about 8¼ cubic feet were done per hour. Thus at the above rates it cost about 14s. 3d. per cubic yard. The concrete in the screening well was somewhat more costly, owing to the impossibility of getting the mixing platform nearer than about 30 yards from it at first, but as it rose in height the cost was progressively reduced. Thus in the lower third of the wall only 3·47 cubic feet were built per man per hour, in the middle third 5·8 cubic feet, and in the upper section, notwithstanding the disadvantage of its being so much thinner, this quantity rose to 7·87 cubic feet per hour. The average for the whole was 4½ cubic feet per hour, making the price of execution about 15s. 3d. per cubic yard. A mason was able to build about 5 superficial yards of brick lining per day, assisted by one labourer. Thus it cost as follows:—For building, 1s. 8d. per square yard; bricks, including cartage, 2s. 3d.; cement, mortar, &c., 10d.—total, 4s. 9d. The scheduled price was 7s. 6d. per yard. Of the pitching, 1·45 square yards were done per hour by each pitcher, who was paid 7d. per hour, and 2½ square yards per hour of each labourer, bringing forward the stones and blinding the pitching. About five-eighths of the whinstone of which the pitching was formed was obtained from the excavations of the puddle trench, &c., at about 4d. per square yard. The remainder had to be carted a distance of nearly three-fourths of a mile, which increased its cost to 15d. a yard. The average of the whole amounted to about 8d. per yard. So:—Time of pitchers, 4·8d.; labourers, 1·6d.; stones, 8d.; sundries, 0·6d.—total, 15d. per square yard. The contract price per square yard was 2s. 6d. The scheduled price for excavations of puddle trench in soft was 10d. per cubic yard; do. do. rock, 2s.; do. puddle, 2s. per cubic yard, it actually cost about 1s. 3d.; do. banking, 8½d., actually costing 8d. to 9d.; do. broken stones, 1s. 9d. per square yard, actual cost about 1s.; do. beaching, 1s. 9d., actual cost 9d.; do. stripping, £9 per acre; do. ploughing, &c., 20s.; do. ashlar, chiefly obtained from Fairloan quarry, 4s., actually costing 5s. 6d. The ironwork contract amounted altogether to £282 5s. 4d. The whole cost of the reservoir works amounted to about £2900, or 12½d. per thousand gallons, capitalised feu duty and agricultural damages. The entire price paid for the reservoir amounts to nearly £4900, or 21d. per thousand gallons of storage. The supply pipe to the town is 12in. diameter and about 3 miles long. On reaching the town the pipe divides into several branches of smaller diameter. The whole of the system of distribution is divided into a high and low-pressure service; the latter delivering

water to the lower parts of the town, is supplied from the old town cistern, which is connected by a branch pipe with the new pipes. The upper districts from about 400ft. Ordnance to 550ft. Ordnance are supplied direct from Acreknowe. The price for 12in. pipes was £4 12s. a ton, the thicknesses used being $\frac{9}{16}$, $\frac{5}{8}$, and 1in. Only a few lengths of the last were used, however, viz., under the reservoir embankment and where the pipe is laid across the North British Railway. The prices on the main pipe track contract :—For excavation in soft, from 7½d. to 8½d. per cubic yard; for excavation in rock, from 2s. 2d. to 2s. 3d.; 12in. turned and bored pipes jointed with cement and sal-ammoniac, 9½d.; 12in. lead and yarn joints, 3s. 6d. Pipes and pipe laying altogether amounted to about £10,200. The whole cost of the works including all legal and engineering charges, &c., will not exceed £16,000, which is borrowed from Government, repayable at the rate of £893 6s. 8d. per annum in 30 years. So that if the consumption is taken at 600,000 gallons a day the price paid per 1000 gallons will not exceed 1½d.; or if we take the supply at a million gallons per day, which it is believed to be capable of yielding if required, it will only amount to less than ¾d. per thousand gallons after making all due allowance for cost of management, &c., which is a very small sum, when 3d. is not considered an extravagant rate, and 4d. and upwards are frequently paid. The contractors for the reservoir and laying the main pipe were Messrs. M'Donald and Son, for the town piping Mr. J. W. Blaikie, both of Hawick. The pipes were supplied by Messrs. M'Farlane, Strang, and Co., Glasgow; and the ironwork for the reservoir by Messrs. Oliver and Arrol, Leith Walk.

THE SIMPLEX MOTOR.

LAST year in our notice of the exhibits at the University College *conversazione*, we mentioned a small motor which was used to drive the machinery, and possessing some novel features. At that time the machine was quite new, and the makers had very little experience with it; but since then they have experimented with it, and perfected it in detail. We illustrate it in its improved form in the accompanying engraving. It will be seen that the motor consists of a small steam engine and generator combined, but without a boiler according to the usual acceptation of the term. The generator simply consists of a coil of wrought iron pipe inserted in the chimney of a small furnace. The piston rod of the engine is continued through the upper cover and made to form the plunger of a little pump. Into a funnel containing the suction valve of this pump is allowed to run a small stream of water from a tank formed at the base of the chimney. During the down stroke of the plunger of the pump, air and water are taken in through the suction valve, and during the return stroke the air and water are together forced in the form of spray into the top of the coil generator. This spray courses through the convolutions of the coil until it reaches the bottom, by which time the water is converted into steam. That steam passes immediately into the steam cylinder, and works the engine in the usual way. A throttle valve is inserted in the steam pipe, actuated by means of a small governor fixed on the side of the steam cylinder.

The advantages of the coil generator are — that it is exceedingly cheap and simple, requiring none of the fittings of an ordinary boiler, and being secure against explosions. There is no reservoir of water in the coil, consequently it is almost impossible to accumulate pressure when the engine is standing. The coil is so arranged that the fire does not impinge directly on the lower portion, and is found not to burn out. These coils have been in use for more than twelve months without showing any signs of burning. Should a coil fail at any time it is replaced at a very trifling expense. The coil for a 1-horse power engine is made of wrought iron tubing only ½in. diameter. The motor is made for all purposes requiring small powers, and is specially suited for pumping water for the supply of country houses, or for any purpose requiring intermittent work. The engine can be started in from seven to eight minutes after lighting the fire, and as it has no delicate fittings about it of any sort, it can be worked by a labourer or gardener. When used for pumping purposes the small feed tank at the base of the chimney is supplied by means of a small pipe from the pump; but when required for driving purposes a little pump without valves or stuffing-box is provided in the base of the engine, which forms a cistern. By this arrangement the feed-water tank is automatically supplied. An overflow pipe is provided in the feed cistern to prevent a possibility of its running over. The machine is made by Messrs. Hathorn, Davey, and Co., Sun Foundry, Leeds.



HARDENING STEEL BY PRESSURE.—From a communication made to the Paris Academy of Science, Clémendeau has discovered a method of hardening steel which seems likely to become a very important one. The rod to be tempered is heated to a cherry red and put into a holder which just fits, and then quickly subjected to enormous pressure in a hydraulic press. It is allowed to cool in the holder, and when taken out it is very hard. It is well adapted to making permanent magnets, and has already been used for telephones. This steel also makes excellent tools. The hardness may be regulated by varying the pressure to adapt it to different uses.

LETTERS TO THE EDITOR.

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

KIDD'S WATER LIFTER.

SIR,—Will you kindly excuse my drawing your attention to a slight inaccuracy in your notice of my elevator in your last issue? The data published in your previous number, page 441, were obtained at an experimental trial at Wrexham, and not at Watford, as my letter may have led you to suppose. But taking for granted that 30,000 gallons of water were raised to a height of 17ft., and that the whole contents were discharged from the cylinder which has a cubical capacity of 3·6ft. or 22 gallons, this would give 23 strokes per minute. A pressure of 18 lb. per square inch in the boiler would eject this quantity of water with considerable violence at 23 strokes per minute, seeing that a pressure of 8 lb. balanced the column and discharged a head of 6in. of water during the continuance of the stroke and lifted a heavy valve in addition. The pressure in the elevator cannot get above that required to eject the column. In using steam of 40 lb. pressure the strokes would be nearer doubled in number and the stream almost continuous.

The function of the "snifting valve" is to prevent condensation by allowing the steam in the cylinder to exhaust into the air, so as to obtain a more rapid action than by means of total condensation and vacuum; for this reason I immerse it in the fluid so that the elevator may be filled by gravity, and I think that any loss of steam occasioned thereby is more than compensated for by the greater quantity of water the elevator will discharge than when filled by suction.

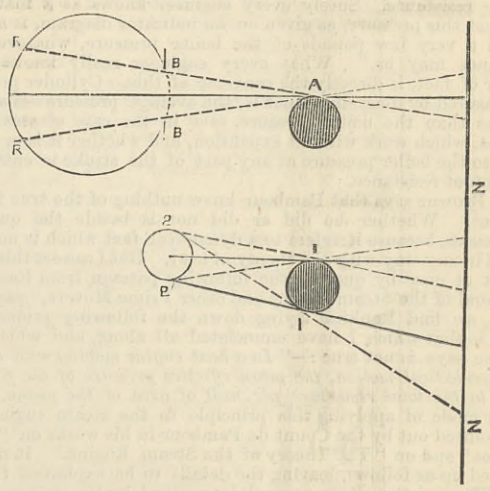
Under these circumstances I fail to see that there can be such a large consumption of steam as you state. I do not venture to correct your calculations, but I am afraid that my previous letters have been deficient in information. The simplicity of the apparatus, its non-liability to get out of order, the saving of costly engines, engine-house foundations, repairs, and skilled attendance ought to be sufficient to compensate for even the large expenditure of steam given in your calculations.

I thank you for the interest you have taken in my invention and the notice given to it. JOHN H. KIDD.

Westminster-buildings, Wrexham,
June 27th.

THE TRANSIT OF VENUS AND OPTICS.

SIR,—Some time back you published some notes of mine on the subject of a curious optical problem, involved in the observations of the transit of Venus. The next transit will occur, as you are aware, at the end of the year, and the same difficulty which stood in the way of the successful observations at the last transit of the moment of contact must again be met, and if not mastered, must needs vitiate the whole work everywhere, and render the observations, however carefully performed, nugatory. Will you, therefore, allow me a few words of further explanation? As a problem in optics it is curious and noteworthy. In the annexed diagram, A is the planet Venus, B B is the eye pupil, through which the outline or edge of the planet is seen. The retina R R behind it is the screen, on which the picture of it as it meets the outline or edge of the sun is thrown. The dotted lines show how this edge or outline cannot be seen as a clear and sharply defined edge, or line, or outline; two points on the retina R and R taking it in at the same instant, thus producing between these two points the confused or shaded-off outline, always perceived when the eye is looking at a dark object against a light background, or at a light object against a dark background. Any object, therefore, as another planet, or the sun nearing and touching the planet as in a transit, and likewise equally shaded off, must on nearing it blend its outline or shading with the other's outline or shading, and thus the "drop" as the necessary result is produced. It is caused solely, as I have said, by the sensible size, or dimensions, or diameter of the eye-pupil. Thus far the transit difficulty; but there is a most curious and analogous phenomenon, which has not, I believe, been as yet noticed, and which may help to make the work of the coming transit somewhat easier if carefully studied.



It is seen most readily when the shadow of an object is thrown on to a screen by a light of sensible and measurable dimensions, as by the sun or the flame of a candle, thus :—In the second diagram 1 1 is any opaque object throwing its shadow on to the screen N N; 2 2 is the source of light, as the sun or the flame of a candle, or better still—if the experiment be tried—the flame of a paraffine lamp throwing its light through a round hole of the same size as the eye pupil, 2 2 being equal to B B in the upper diagram. Thus the shadow of the object 1 1 is found to be surrounded by a shaded or hazy outline, commonly attributed to what has been called irradiation or diffraction—as by Newton—but which is in reality caused simply and solely by the size of the source of light, whatever that may be. Sir, I cannot but think that this curious problem, if analysed, will throw some light on and help to explain an admitted difficulty in optical science. It must be carefully kept in view that the source of light throwing the shadow from the object does precisely the same work as does the eye pupil in the looking at it, both being, as here, of equal size.

June 27th. C. B. ALLEN.

BOILER INSPECTION.

SIR,—I should like to say a few words in reference to "Inspector's" remarks about hammering a boiler all over. I would like to ask him how he could tell whether a boiler was thin or not if he did not hammer it. When I spoke of hammering a boiler all over, I do not mean to use a flogging hammer such as boiler-makers use, but an ordinary-sized hand hammer made on purpose, such as I have seen the Midland inspectors use. I will just give "Inspector" one proof whether it is not advisable to thoroughly search a boiler all over with a hammer or not. A friend of mine had his boiler examined the other day, and any inspector would have passed it as being in good condition and safe to work, as there was no leak nor any sign of corrosion inside or out. My friend asked me to come across and have a look at it. I found on going that the inspector had knocked a hole in one of the plates, which was free from scurf, and looked as clean as a new one; and my friend informs me that he should think the inspector did not miss 6in. of any plate but what he gave a blow with the hammer. The plate in which he knocked the hole was in the brickwork, so could not be detected from the outside, and would not have been found out if the boiler had not been thoroughly hammered, although it was not more than ½in. thick.

There are two questions I should like to ask "Inspector." First, what he would think of an inspector, who, from the tone of his letter, hails from the same company, passing a Lancashire boiler working at 65 lb. pressure as being in good condition? On the engineer going over the boiler after the inspector, and having it filled, he found there was a crack in the fire-box 22in. long, and the angle ring was broken in the root for 3ft. 6in. I may say that the fire-doors were off and the bars out, so that he had every facility for seeing it. I should like to know what is the use of having the boilers inspected at all if we are to have such serious defects as these overlooked; and, secondly, what he would think of an inspector saying that a boiler was safe to work till the next holidays, which was three months after, being informed by the stoker, as there was no regular engineer kept, that the holes were broken round one of the fire-box rings for 2ft. sufficient for him to get a penny in between the rivets? I may say the boiler did not leak when the inspector called, as it had only been cleaned out the Sunday before, when the holes were found to be broken, and the manager told the man to put some bran in, which he did—about twelve buckets—so that it stopped the leaking, and by so doing, I suppose the inspector thought it was safe because it did not leak.

June 20th. ENGINEER.

THE FOUNDATIONS OF MECHANICS.

SIR,—Will you kindly allow me space for a few observations upon the boiler pressure and the cylinder pressure in steam engines, with reference more especially to Mr. W. R. Browne's statements upon this subject, as contained in THE ENGINEER of the 23rd inst. Suppose, for argument's sake, the absolute boiler pressure, in the case of some given steam engine, to be 63 lb. upon the square inch, and the steam to be cut off after the piston has performed one-third of its stroke. Now, Dr. Rankine, at page 404 of his "Manual of the Steam Engine and other Prime Movers," eighth edition, has the following equation :—

$$\frac{p_m}{p_i} = 17\,r^{-1} - 162 - \frac{17}{16},$$

where p_m is the mean cylinder pressure, p_i the initial pressure, and r the effective ratio of expansion; so that if we assume $r = 3{\cdot}5$ we shall have, in the engine under consideration, $p_m = 37{\cdot}80$ lb.

Next, let us suppose—and something of this kind incessantly occurs in the case, for instance, of saw mills, grinding mills, rolling mills, &c., without even the possibility of the stoker or machinist as much as attemping to alter the boiler pressure, because the full engine power would probably again be required almost immediately afterwards—that, by throwing off a portion of the machinery (load) which the engine was originally driving, p_m had been reduced to one half of its former value, viz., to 18·90 lb., in which case the initial pressure would, according to Dr. Rankine's formula, become 30 lb. The question which I would ask Mr. Browne is, whether the boiler pressure would, under these circumstances, be reduced to something like 33 lb., and if so, what becomes of the 30 lb. which make up the original 63 lb.?

It is quite true that De Pambour wrote before the true theory of heat was known, but the laws which regulate the pressure of the steam in the cylinder were probably the same forty years ago as now. In fact, Dr. Rankine himself, who knew all that was to be known about the theory of heat, adopted De Pambour's theory in its essential features, as Mr. Browne will find on referring to "The Manual," page 426, formulæ 7, 8, and 9. C.

June 26th.

SIR,—I have read with the utmost surprise Mr. Browne's letter of the 15th inst., which appeared in your last impression. I gather from it that Mr. Browne is not only quite ignorant concerning the working of the steam engine, but that he has read Rankine with little profit, and Pambour not at all. He says :—"The discussion between 'Φ. Π.' and myself has narrowed down to two points, which are matters of fact, and need not detain us long—the first is whether the pressure in the cylinder of a steam engine is measured by the resistance. Surely every engineer knows as a matter of fact that this pressure, as given on an indicator diagram, is always within a very few pounds of the boiler pressure, whatever the resistance may be." What every engineer really knows, as a matter of fact, is directly the converse of this. Cylinder pressure as measured by diagrams—that is, the average pressure—is always far less than the boiler pressure, save in the case of steam fire engines, which work without expansion, and whether it is or is not equal to the boiler pressure at any part of the stroke is entirely a question of resistance.

Mr. Browne says that Pambour knew nothing of the true theory of heat. Whether he did or did not is beside the question between us, because it refers to a dynamical fact which is not concerned in any way with the theory of heat. But I can set this point at rest at once by quoting the following passage from Rankine's "Manual of the Steam Engine and other Prime Movers," page 341, where we find Rankine laying down the following proposition, which is that which I have enunciated all along, and which Mr. Browne says is not true :—"*In a heat engine moving with a uniform periodical motion, the mean effective pressure of the fluid is equal to the total resistance per unit of area of the piston.* The proper mode of applying this principle to the steam engine was first pointed out by the Count de Pambour in his works on "Locomotives" and on "The Theory of the Steam Engine." It may be summed up as follows, leaving the details to be explained further on :—The resistance is in general determined by the nature of the work performed by the engine, so that in most cases R is known from data independent of the action of the fluid. The resistance being a fixed quantity, fixes the mean pressure according to equation four $\frac{R}{A} = \frac{U}{V^2 - V_1}$; in other words, the action of the fluid adjusts itself until the mean effective pressure balances the resistance." Rankine then proceeds to explain how this takes place, and adds, "This goes on until the effective pressure exactly balances the resistance."

Thus, then, Mr. Browne will have to prove not that an anonymous correspondent of THE ENGINEER is wrong in his assertion that the pressure in a cylinder exactly balances the resistance, but that men of the great mathematical attainments of Rankine and Pambour were quite in error. I am content to stand or fall with them. If Mr. Browne would but read something of the theory of the steam engine, and examine a few diagrams taken from locomotives, he would learn, I hope, that, led away by an entirely erroneous theory concerning the nature of motion, he is actually controverting the statements of some of the most able mathematicians that ever lived, and asserting that not to be true which no engineer ever questions in the present day.

May I venture to think that I have disposed of one of the "matters of fact" in dispute between us? May I dare to re-assert, without further fear of contradiction from Mr. Browne, that in all cases the resistance is the exact equivalent of the force exerted; that, in other words, the resistance is the measure of the force? In every dynamical problem we have, according to Mr. Browne, the equations F M = R or F = M R. He does not seem to be quite certain which; but, as a matter of fact, F = R, and M, that is motion, is a distinct quantity, which, although it bears a definite relation to R, is in no sense or way R. Resistance may augment as the velocity of motion augments—as, for instance, in the case of a ship; but it is not the motion which causes the resistance, for take away the water, leaving the motion, and even Mr. Browne will admit that there would be no resistance at all.

I will turn now to the second matter of fact in discussion between us, viz., that "the communication of heat to water will neither make it hotter nor melt it." "The question of melting has nothing to do with the matter," says your correspondent, "for a liquid is not necessarily in motion any more than a solid." I confess I scarcely know how to deal with such a statement as this. It manifests either an astounding ignorance of physics, or a deliberate expression of the belief that I do not know what I am writing about. To ask Mr. Browne to read, seems to be absurd, and yet I do not know what else to do, save to take my word for it that ice cannot have heat imparted to it without becoming hotter or melting, and the act of melting is nothing more than the moving of the water molecules, and the internal motion of a liquid is greater than the internal motion of a solid, and this is the difference between liquids and solids; and the motion of the molecules of a fluid, as air or oxygen, is greater than that of the molecules of a liquid. It is impossible to believe that Mr. Browne, an ex-Fellow of a great college, and a writer on the "Foundations of Mechanics," can be ignorant of such rudimentary truths. Yet, if he is not ignorant, how he has managed to persuade his pen to write as he has written is a riddle which I find it impossible to solve. The idea that heat can be imparted to a body without producing any effect whatever, is really too absurd to bear discussion.

Mr. Browne is fighting against facts. He is shutting his eyes to the statements of the ablest men of the day. He has ignored my quotation concerning the nature of heat from Clerk-Maxwell. He has condemned Pambour obviously without even making himself acquainted with what Pambour has to say. He has asserted as a fact concerning cylinder pressures what every engineer who can read a diagram knows is not a fact. It only remains for him to assert that Rankine was not an authority on the theory of the steam engine. Whether he will do this or not remains to be seen. Before he can prove that I am wrong in the matters of fact in dispute between us he must prove that Rankine and Pambour were wrong.

Lest Mr. Browne should have any doubt concerning the effect produced by melting ice, I will refer him once more to Rankine's "Manual of the Steam Engine and other Prime Movers," where on page 331 he will find the words and formula, "Thus the latent heat of fusion in units of work is $H = r \frac{dp}{dr} (v - v)$." Will Mr. Browne assert that work is done without motion? I would also refer him to the preface, page xii., to Isherwood's "Experimental Researches in Steam Engineering," vol. ii., for further information on this point. Φ.Π.

London, June 27th.

DIRECT-ACTING STEAM PUMPS.

SIR,—Having seen your leading article on "Direct-acting Steam Pumps," in your paper of June 23rd, and comments thereon, contrasting unfavourably for the working of the Pulsometer, it appeared to me a duty to correct you on the point about the amount of steam used and waste of heat as to the Pulsometer.

Personally, I have no interest in the one patent or the other, and, like yourself, welcome all new comers that are useful, practical, and profitable.

But the statement that the discharge water from the Pulsometer was raised in temperature from 8 to 12 deg. is quite erroneous, and as our ss. Earl Percy was at the quay here and fitted with a No. 7 Pulsometer, to-day, June 26th, I had it started and kept going some time, and I can testify that the temperature was certainly not raised more than 2 deg.—was less in fact. In the face of this fact, the Pulsometer is a much better appliance than you say, and if your other figures and calculations built on them proceed on the same lines, then your readers are apt to be misled, though it may be unintentionally so.

We have worked these Pulsometers about four years, and on two separate occasions that I remember, when the circulating pump was limping, we kept up a perfect vacuum with the Pulsometer, doing half the work it can do, viz., going at 30 strokes per minute in place of 60, which it can do. DAVID MOFFAT,

Newcastle-on-Tyne, June 28th. Marine Superintendent.

DRAUGHTSMEN IN QUEENSLAND.

SIR,—I would call the attention of engineering draughtsmen and civil engineers, through your paper, to the advisability of being extremely cautious in either accepting engagements from any of the colonial Governments or coming out to the colonies in search of employment.

Gentlemen who are engaged in London for two or three years, at a salary of from £250 to £300 per annum, find themselves, on commencing work in any of the public departments, put to do tracings or copy specifications, and, in addition, get bullied by the head draughtsman, who originally was either a carpenter or fitter, or perhaps an attorney's clerk, if not worse, and who makes any "new chum" with the least appearance of respectability or education an object to be badgered and insulted as much as possible.

The *modus operandi* of the colonial departments in securing the services of gentlemen is as follows, viz.:—They send home instructions to their agent-general to engage engineers—civil—at, say, from £250 to £300 per annum, for three years, at the expiration of which time their services are dispensed with, or they are told that if they like to remain on at £100 a year less they can; but they are paid by the day, and can, and have been, dismissed with a day's notice. This offer they are generally glad and obliged to accept, as foolishly thinking from the commencement that they will be permanently kept on, they have spent all their money; but those who have saved up some of their salary leave for other colonies, and are eventually glad to take a billet as draughtsman at 10s. per diem, with the usual prospect of being sacked at a day's notice.

I know several civil engineers who had been receiving a salary of £600 and £800 per annum in India glad to work as draughtsmen in New South Wales and South Australia, for 10s. per diem.

A gentleman, who is a nephew of an eminent Glasgow professor, and who was engaged by the South Australian Government for three years, was dismissed at the end of that period, together with twenty others, and who, after having spent all his savings while looking for employment, was at last obliged to get his living by loading wheat at Echuca, in New South Wales, at 4s. per diem.

Queensland, April 25th. ANDREW CLARKE.

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

(*From our own Correspondent.*)

THE South Staffordshire iron trade continues to improve. Galvanisers were to-day again eagerly negotiating for supplies of sheets. Many of them were prepared to place forward contracts of greater magnitude than makers would accept. Vendors believe that prices will continue to rise, and hence they will not generally book beyond the close of the ensuing quarter. This week's prices are 5s. per ton stronger than three weeks ago. £8 may now almost be considered a low quotation for "singles," and £8 5s. is more like the open market price of makers who are well placed. Doubles are £8 10s. to £8 15s., and trebles £9 10s. to £9 15s. The small difference which exists between singles and doubles may be explained by the circumstance that when, as now, makers are busy, they would rather not have orders for "singles," and may, therefore, put up the price more rapidly than the price of other gauges to deter buyers.

Prices of galvanised sheets were £13 15s. to £14 per ton as the minimum for 24 w.g. bundled, delivered in Liverpool, and superior sorts £14 10s. to £15 per ton. For 26 w.g. £2 "extra" upon 24 w.g. was demanded, and for 28 w.g. a further £2.

Tin-plate and thin sheet makers reported considerable activity, largely on account of Australia, the European Continent, and the United States. Prices were unchanged on last quotations.

Boiler-plate firms announced only slight improvement in the demand. North Staffordshire plate makers can get to Liverpool at 5s. per ton less than the South Staffordshire people, and can deliver plates there at £8 5s. per ton, whereas that figure was this afternoon required by makers in this district for sales at works. Superior sorts were £9 at works.

The common bar makers have advanced their prices for extras upon the present list quotations for small bars to the following figures:—Rounds and squares, $\frac{7}{16}$in. and $\frac{13}{32}$in., 2s. 6d.; $\frac{3}{8}$in. and $\frac{11}{32}$in., 5s.; $\frac{5}{16}$in., No. 1 and 2, 15s.; $\frac{1}{4}$in., Nos. 3 and 4, 25s.; No. 5, 35s.; $\frac{3}{16}$in. and No. 6, 50s; No. 7, 75s.; No. 8, 105s.; and No. 9, 145s. per ton. The prices fixed by the new arrangement are an advance as to some sizes of quite £1 per ton compared with the rates which in actual business have of late prevailed.

Nail rods were quiet. Prices were easy at £6 10s. for ordinary sorts, and £7 to £7 5s. for better qualities. Gas tube strip was slow at £6 5s. per ton, but bedstead strip was fairly active at £6 15s. Makers of this latter iron reported orders some way ahead.

Cable iron sold rather better than a while ago, for the cable and chains firms are fairly busy. Ordinary sorts were about £6 17s. 6d. per ton, while the "marked" houses demanded 10s. per ton in advance of their ordinary bar price, making them £8. Common angle bars up to 4in. or 6in. were about £6 10s., while superior sorts were £7 and £7 10s. At this last price they might have been had up to 8 united inches.

Derbyshire pigs were advanced to the extent that whereas 47s. 6d. has been quoted during the last two or three weeks as the price for delivery to works, that figure was this afternoon the quotation for delivery at stations only. Northampton pigs were 46s. 6d. to 46s. Thorncliffe—South Yorkshire—sorts were firm at 60s. Hematites were without much business, the prices being rather too high for buyers. The Blaina brand was quoted 62s. 6d.; Wigan, 65s.; Tredegar, 66s.; and Barrow, 67s. 6d.

Native pigs were 60s. to 70s. for all-mine hot blast sorts, 50s. to 52s. 6d. for part-mine, and 37s. 6d. for cinders. Only a small business was done in these. It is not generally expected that at the ensuing quarterly meetings any declared alteration will be made in the prices either of best Staffordshire pigs or of "marked" finished iron.

Pig-making materials were in fairly brisk sale. North Staffordshire ironstone sold freely, but prices varied considerably. Northampton stone, of which a great deal is consumed in this district, was about 5s. 10d. per ton delivered. Cokes of North Staffordshire makes were 15s. delivered for hard fine washed sorts, and 15s. for Welsh sorts, clean but not washed. Furnace coal fluctuated between 7s. 6d. and 9s. per ton at the pit, the "list" price of 10s. being nearly nominal.

Some of the ironworks property in this district is just now offered for public sale. Under this head ranks the Darlaston-green Forge, lately in the occupation of the Darlaston Coal and Iron Company, which is being broken up, and will be disposed of early in July. There is both ironworkers and engineering plant to be sold, consisting of engines, boilers, force and merchant trains of rolls, &c. Some 500 tons of rails, floor plates, and scrap iron from about the works will be offered at the same time.

The bridge and girder works are on the whole well employed, though many of them could do more. Amongst the foreign work of this sort now under execution I may mention girders for wool and grain stores at Port Adelaide, and a large bridge for New South Wales.

Makers of cultivating and edge tools report a large amount of business doing on foreign account.

Some local machinery and implement manufacturers have this week been exhibiting at the annual Worcestershire Agricultural Exhibition, which has been held at Dudley. The first prize for "the best collection of ironwork exhibited by manufacturers" was taken by Messrs. Hill and Smith, of Brierley Hill, near Dudley; and the first prize for "the best collection of implements" was taken by Mr. B. Saunders, of Stourbridge. The representation of implement firms at a distance was weak, a circumstance doubtless due in much part to the near approach of the "Royal."

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron market has maintained a firm tone during the past week, with a moderate amount of business doing at improved prices. Although new orders are not coming forward in any really large volume, there has been a steady trade doing for the last two or three weeks, which has placed makers in a much stronger position than of late, and although local makers have not advanced their quotations, the low-priced district brands have all made a decided move upwards, until in the place of underselling they are now being quoted at even higher figures than the local irons.

Lancashire makers of pig iron report an increased amount of business, chiefly in forge, on the basis of late rates, viz., 45s. to 46s., less 2½ for forge and foundry qualities delivered equal to Manchester, and at these figures they are very firm. In Lincolnshire brands considerable sales have recently been made at an advance of 1s. 6d. per ton upon the lowest figures, and makers have in some cases been asking during the week a further advance of 1s. per ton, bringing quotations for delivery into this district up to 46s. 10d. and 47s. 10d., less 2½, for forge and foundry numbers. For Derbyshire iron about 1s. per ton above these figures is being asked, but the top prices quoted are at present scarcely more than nominal, as little or no actual business has been done at these figures. Middlesbrough iron still meets with very little sale in this district, but one or two special parcels have been sold at 51s. 10d. per ton net cash, delivered equal to Manchester.

Finished iron manufacturers report more inquiries, and the forges generally appear to be fairly well supplied with work. The actual business stirring is increasing, and makers are stiffening in their prices. Bars, it is true, can still be bought at £6 2s. 6d.; but most of the makers are now asking £6 10s.

The position of the engineering trades remains without much change. The last monthly reports issued by the various branches connected with the Amalgamated Society of Engineers continue very satisfactory, so far as the condition of trade throughout the country is concerned. With few exceptions, trade is returned either as moderate or good, and the number of men out of employment is steadily on the decrease. In the Manchester and Salford districts trade is returned as good throughout, and although there has been temporarily a slight increase in the number of men on the books, which is attributed to the holiday stoppages of works, there is still not more than 2 per cent. of the total number of members in the district in receipt of out-of-work donation. For men employed in the tool-making trades especially there is a good demand, and for pattern-makers and heavy smiths there are more inquiries than can be met from the society's books.

The coal trade continues very quiet, with supplies plentiful all round, and prices kept down to the lowest point by the consequent competition for business. At the pit mouth quotations average about 8s. to 8s. 6d. for best coal, 6s. to 6s. 9d. for second qualities, 4s. 9d. to 5s. 6d. for common, 4s. 3d. to 4s. 6d. for burgy, and 3s. to 3s. 6d. for slack.

The shipping trade is dull, and there is also at present a scarcity of vessels, which interferes with business. Tenders for the supply of steamers are being made at very low figures, and altogether prices in the shipping trade continue very unsatisfactory, steam coal being still offered at from 6s. 6d. to 7s. per ton either at Garston or Liverpool.

Barrow.—I am able to say that the position of hematite pig iron market continues to improve week by week, and gives evidence of being greatly strengthened by the slow but sure progress which is being made. During the past week prices have gone up 1s. per ton, but makers are asking higher rates than those quoted. No. 1 Bessemer is quoted at 57s.; No. 2, 56s.; No. 3, 55s. per ton net, f.o.b. West Coast ports. Smelters decline to contract on a large scale at these prices, and the orders which are accepted do not go beyond a three months' delivery. The business on the week has improved very considerably. Home buyers maintain their demands, but a much brisker inquiry comes from America, while Russian and other continental buyers seem disposed to give out their orders while prices are low. The output of the furnaces is very large, and amounts to something like 30,000 tons per week. The indications are that this will shortly be augmented—if the present briskness of the market continues—as preparations are being made at one or two places to increase the production. Iron and steel continues to be shipped in heavy parcels, principally to America. Steel workers are very busy and have no lack of orders. Prices are firm at £5 10s., but an advance may be confidently looked for. This may account for the increased inquiry which has set in for all round qualities of steel, and I am assured on the best authority that several large orders are likely to be booked in the course of the next few days. Iron ore in better request at from 14s. to 16s. per ton at the mines. Iron shipbuilders, engineers, and others steadily employed. Shipping active.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE steady rise of the Glasgow pig iron market during the last few days has not been without a sympathetic effect on its Cleveland rival. The Middlesbrough ironmasters met as usual before 'Change on Tuesday last, and many were in favour of advancing prices. It was deemed wiser, however, by the majority to let them alone for the present lest the growing demand should be checked, and they should then find themselves unable to get rid of the stocks which have lately somewhat encumbered them. Consequently no change was made, and No. 3 g.m.b. was officially quoted at 43s. 6d. f.o.b. Middlesbrough for prompt delivery. A brisk trade was done at that price between smelters and consumers direct, the latter fearing lest a rise should shortly take place. Connals' stores have not decreased so much during the past week as has been the case latterly, indicating a diminished trade through merchants, and of course a direct one correspondingly increased. The quantity now held is 124,724 tons, or only 1713 tons less than a week ago. Shipments, which during the earlier part of the month lagged behind considerably, have now made a spring, and the total for the month promises to be up to the average for the time of year. Up to the 27th, 60,564 tons had left the port. There is at the moment a greatly increased trade with Russia, as it is expected that heavier import duties will shortly be demanded. For the first time since the great fight between the "bears" and the makers begun, merchants are asking full makers' prices for prompt delivery. For forward delivery, however, they still, in some cases, are willing to sell at 43s. Warrants are in quiet demand at about 43s. 3d. per ton.

The manufactured iron trade continues remarkably steady. Plates still command from £6 15s. for large to £7 for small quantities free in trucks Middlesbrough. Bars and angles are quoted at £6 5s. There is a brisk inquiry, induced no doubt by the gradual improvement of the Glasgow pig iron market, which is taken as an index of the position of the prospects of the whole iron trade by consumers all over the world.

An important meeting of the Board of Arbitration was held at Darlington on Monday. On the previous Saturday a ballot had been taken at all the works connected with the Board to ascertain what proportion of the ironworkers were in favour of continuing the Board, and would pledge themselves to abide by its decisions.

It was announced that out of 9817 employed, 7346 had voted. Of these 56 per cent. were in favour and 44 per cent. against the continuance of the Board. Analysing the result still further, it appeared that, generally speaking, Middlesbrough, Stockton, and Hartlepool, which may be considered as constituting the heart of the iron-making district, were against the Board, and all the outlying districts in its favour. By the rules of the Board three months' notice must be given by any member before severing connection; and therefore it must necessarily continue until the end of September. But Sir Joseph Pease's award extends a month longer, or until the end of October. It was also argued that time ought to be given to both sides to consider the result of the ballot, and the effect it would have. Also to decide in what way wages should in future be regulated in case the Board were abolished. Under all these circumstances it was agreed unanimously to continue the Board until the end of October next. In the meantime the rules will be reconsidered, and printed and circulated in their revised form among all the members. Then another ballot will be taken. It is to be hoped that in this way a stepping-stone will be made of the difficulty to some better and surer means of settling wages disputes for this most important northern industry.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THOUGH the iron markets have been rather firmer this week, with an improved demand for certain makes, there is really very little doing. Ironmasters are pretty generally limiting their output, and this has had some effect in causing prices to be less unsteady. There is some expectation of a rise in prices at the next quarter day, and if there was any certainty of a heavy demand from the States the advance would not be very difficult to secure; but the stoppage of work, owing to the ironworkers' strike, has not yet even cleared off American accumulations, and any hope of a "boom" is very shadowy. The concessions already made to ironworkers in the States must have a beneficial effect on the English iron trade, provided the operatives on this side of the water do not follow suit.

A leading manufacturer of agricultural machinery, who has exceptionally good means of knowing the country, tells me that if the present fine weather lasts for six or seven weeks a splendid harvest is certain, and it will be the turning point of English trade. What the effects of another failure in the crops would be he hesitates to say. At present affairs look very promising.

There are considerable complaints in the smaller steel houses of the lightness of recent orders; but I do not find any cause for grumbling on this score in the larger establishments, where business is reported brisk. The ship-plate and boiler makers are also well off for orders, and the engineers' tool makers are also pretty active. Rails are not quite so freely ordered, even at the present very low quotations. Saws and files are in active request, and all kinds of agricultural and garden machinery and implements continue in demand. Silver and electro-plated departments quiet.

Major-General Grassi, Lieutenant-General Sachero, and Lieutenant-Colonel Ellena, of the Royal Italian Commission for Artillery, visited the Atlas Works on Friday, and inspected a considerable part of the establishment, chiefly with the view of seeing the manufacture of compound armour-plates. Admiral Costa Azevedo, of the Brazilian Navy, also made an official visit during the afternoon to these works, where plates are at present being made for the Brazilian Government. The special machinery lately erected for the manufacture of these plates attracted particular attention.

Messrs. Burgon and Ball, of the La Plata Works, Malin Bridge, have received a telegram to the effect that they have gained a gold medal for their sheep shears exhibited at the New Zealand Exhibition now being held at Christchurch.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Glasgow iron market has continued very brisk during the week, and a very extensive business has been done in warrants at prices which show a decided advance upon those of last week. The past week's shipments have not been quite so good, but this circumstance has in view of the strong feeling in the market almost passed without effect. The home inquiry continues upon an extensive scale, and a substantial reduction is at length apparent on the stocks of ordinary pigs in Messrs. Connal and Co.'s stores. A very large amount of speculation is taking place in the warrant market, and it is not unlikely that in the upward course of prices several reactions will be experienced.

Business was done in the warrant market on Friday up to 48s. 10d. cash. On Monday morning the market opened briskly at 48s. 10½d., receding to 48s. 8d. cash; the afternoon quotations being 48s. 9d. to 49s. 1½d. cash and 49s. to 49s. 3d. one month. On Tuesday the market was exceedingly active, with an extensive business in the forenoon at 49s. 1½d. to 49s. 6d. cash, and 49s. 5½d. to 49s. 6d. one month; in the afternoon the tone was irregular, with business at 49s. 5½d. to 49s. 1d. cash, afterwards improving to 49s. 4d. cash and 49s. 6d. one month. The market was flat on Wednesday, with business between 49s. 5d. and 48s. 10½d. cash, and 49s. 7d. to 49s. one month. To-day—Thursday—business was done at 48s. 9d. to 49s. cash, and 49s. 2d. one month.

In consequence of the strong position of the warrant market, and also of the large and steady demand for pigs, makers' prices again show a substantial increase, and the quotations are now as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 60s. 6d.; No. 3, 55s.; Coltness, 61s. 6d. and 55s. 6d.; Langloan, 60s. 6d. and 55s. 6d.; Summerlee, 59s. and 52s. 6d.; Calder, 59s. and 52s.; Carnbroe, 53s. and 50s.; Clyde, 53s. and 50s.; Monkland, 50s. 6d. and 49s.; Quarter, do. do.; Govan, at Broomielaw, 50s. 6d. and 49s.; Shotts, at Leith, 61s. and 55s. 6d.; Carron, at Grangemouth, 50s. (specially selected, 52s. 6d.) and 49s.; Kinneil, at Boness, 49s. and 48s.; Glengarnock, at Ardrossan, 53s. and 50s.; Eglinton, 50s. and 48s. 6d.; Dalmellington, 50s. 3d. and 49s.

The quantity of Cleveland pig iron being consumed in Scotland still continues comparatively small, owing to the high rates asked at Middlesbrough, and the imports to date are fully 40,000 tons less than they were at this time last year.

The malleable iron trade continues fairly well employed. There is still a lack of fresh orders for shipbuilding iron, but a better demand has sprung up for rails. Prices are as yet unaltered.

A rather better inquiry is being experienced for castings of the smaller class of gas and water pipes. These are at present particularly in request for Australia. A number of fresh orders are also in the market for schemes at home; none of them, however, of a very extensive character.

There are appearances of greater activity in the steel trade, and the demand for hematite continues very good, the late improved prices being maintained. Large imports of Spanish ore continue to be received for use at the works employed in the manufacture of hematite pig.

No complaint can be made with reference to the volume of the coal trade. The past week's shipments have not been quite so large as those of the preceding week, but they still compare very favourably with those of the corresponding week of last year. The inland trade, both for home consumption and for use in the public works, is very good. A movement has commenced among the colliery owners of the West of Scotland with the object of advancing the prices of coals. They are not likely to accomplish this object unless some agreement can be arrived at to restrict excessive production. So far as can be ascertained, the ironmasters do not look upon the proposal with much favour, and without their co-operation it has little chance of succeeding.

At a meeting of the Executive Board of the Fife and Clackmannan Miners' Association, held at Dunfermline on Saturday, reports were submitted from the various districts showing that the coal trade is in a most satisfactory condition, the stocks having been considerably reduced during the preceding month.

The demand for dock accommodation in the harbour of Burntisland, in connection with the shipment of coal, has of late been so pressing that several schemes are now proposed for the enlargement of the harbour. These will no doubt receive due consideration in the proper quarters.

A few days ago the Niddrie and Benhar Collieries, belonging to the Benhar Coal Company, Limited, which is now in liquidation, were offered for sale in Edinburgh, at the upset price of £70,000 for Niddrie and £45,000 for Benhar. No offers were received, and the sale was adjourned. It is understood in the meantime that efforts will be made to reconstruct the company, so as to retain possession of their property, and endeavour to work the collieries in a profitable manner.

WALES & ADJOINING COUNTIES.

(From our own Correspondent.)

A FALSE impression seems to prevail about the Plymouth coalfield, and it has been stated that having been worked for 100 years it is now fairly worn out. This is far from being the case. I am assured by competent authorities that the coalfield is still most valuable, that plenty of four feet coal exists, and that there need be no fear of any falling off for a long period of years. The workings extend into the Taff Bargoed Valley, and it must be remembered that at no period has there been any high-pressure outputs there, such as characterises many of the Rhondda collieries. In 1806 there were only about half-a-dozen collieries employed. For a number of years the primitive condition of the coal works may be seen by the fact that Mr. Morgan Joseph worked the coal for Mr. Hill, the arrangement being 4s. per ton paid to him for the coal on every ton of pig iron that was made, and this for years was only 3000 tons per annum. Various names are mentioned as likely buyers of the coalfield or of the works, or of both—Mr. Cory, Stephenson, and Clark, a Scotch Company, a Limited Liability Company, the Great Western Railway, &c.

A large number of men now find employment at Cyfarthfa, where the process of clearing away the old plant to make room for steel plant is being actively carried on. Three furnaces are to be constructed, 70ft. high, and it has been judiciously decided to obtain the best new plant possible, and to discard patching up and utilising. But it is astonishing what a quantity of old iron is being turned out from the old works; the very paving was made of iron.

The steel trade is a little more satisfactory than it was, and a few good cargoes have been sent away, principally to Montreal, Genoa, and Iquique. The largest cargo sent was 1800 tons to St. John's, Newfoundland, from Cardiff.

Satisfactory progress is being made at the extension of Penarth Docks by Mr. Walker.

With regard to the tone of the market, the best coals remain high. I have heard of one quotation 10s. 6d. into trucks at pit, but this is not general. Seconds show a slight weakness, but for best coals the steady demand ensures great firmness in price. An undeveloped coalfield, of 3000 acres in extent, has been brought into notice during the last few days. It lies twelve miles from Cardiff, includes the No. 3 Rhondda, and is well placed for railways. The present estimate, which, of course, may be affected by more practical knowledge, is that the coalfield contains an aggregate of 18ft. of coal.

A new manager has been appointed for Blaenavon in the room of Mr. Edward Martin, who has accepted the vacancy at Dowlais, caused by the death of Mr. Menelaus. There is also a change of management at the Great Western colliery, Rhondda Valley, and the advent of new management is to be signalised, I see, by the erection of fifty Coppée coke ovens, instead of the existing blocks. It has been urged, but incorrectly, against these ovens, that the make is too rapid, and the coke containing too much volatile matter, is not so well adapted for iron making as the coke of the old-fashioned bee-hive ovens. The fact is that the Coppée coke is freer from volatile matter than any, and this can easily be proved by experiment.

Rival dock schemes are being discussed at Cardiff by those opposed to the Bute Dock new Bill. A meeting of influential coalowners has been held, when it was shown that if the new Bill should be carried in its present form, or abandoned, the freighters must seek for new docks. Various sites were proposed, and it was resolved to appoint an engineer, and be prepared with all practical data for carrying out the movement. New docks are also spoken of at Ogmore, and Mr. Abernethy has given a favourable opinion as to site.

The tin-plate trade is looking better. Prices have advanced slightly, and some orders have been booked for coke brands at 16s. 6d. Pantyffynon Works, Swansea, are in the market. Gorseinon is to be re-started by a fresh company, and a change in the management of the Swansea Tin-plate Works has been effected.

The annual meeting of the Miners' Provident Association has been held, and a satisfactory report given. There are now 9000 members, and £5000 in hand to meet contingencies. The surplus of the Hartley fund has been received, and other funds are expected.

6980 tons of patent fuel left Swansea last week.

A petition has been filed by the Furness Iron Company to wind up the Cwmavon Estates and Works Company at Port Talbot. There is considerable excitement in the district regarding this.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

20th June, 1882.

2903. PLAITING CLOTH, C. & A. Edmeston, Manchester.
2904. TAPS, &c., J. Nixon, Oldham.
2905. TELEPHONE RECEIVER, W. H. Snell, Tiverton.
2906. REEL APPLIANCES, T. Culpin, London.
2907. TELEPHONY, J. G. Lorrain.—(*A. Dunand, Paris.*)
2908. DRYING APPARATUS, W. Combe, Glasgow.
2909. LIGHTING, J. H. Johnson.—(*A. Jeansaume, Paris.*)
2910. ELECTRICITY, C. E. Kelway, London.
2911. CARRYING ELECTRIC WIRES, J. Kincaid, London.
2912. ELECTRIC CURRENTS, S. H. Emmens, London.
2913. SECONDARY BATTERIES, S. H. Emmens, London.
2914. ELECTRIC LAMPS, S. H. Emmens, London.
2915. HOISTING GEAR, W. J. Brewer, London.
2916. CHILDREN'S COTS, G. W. Moon, London.
2917. DYNAMO-ELECTRIC MACHINES, T. Parker, Coalbrookdale, and P. B. Elwell, Wolverhampton.
2918. AMMONIA, &c., S. Pitt.—(*H. Bower, U.S.*)
2919. TRACTION TRAMWAYS, J. Wright.—(*C. E. Findlay, Chicago, U.S.*)
2920. CLEANING POTATOES, C. L. Hancock, London.
2921. MASKING the TASTE of MEDICINE, W. H. McLaughlin, San Francisco, U.S.
2922. BROOCH FASTENINGS, E. P. Wells, London.
2923. LATHES, J. A. Farnworth.—(*A. Muir, U.S.*)
2924. PENCIL HOLDERS, F. Hardmuth, Bohemia.
2925. LEATHER, E. G. Brewer.—(*A. Levy, Paris.*)
2926. COOKING RANGES, A. K. Robinson, Leeds.
2927. RAISING WATER, W. R. Lake.—(*F. A. Grunow and H. Meyer, U.S.*)
2928. SPINNING MACHINES, S. Mock, Providence, U.S.
2929. METALLIC PRINTING, H. Panowski, Clapham, and K. M. Ross, London.
2930. COKE OVEN GASES, J. Imray.—(*G. S. Page, U.S.*)
2931. UMBRELLAS, &c., B. J. Mills.—(*J. Dupuy, France.*)
2932. MANURE, H. J. Haddan.—(*T. Richters, Germany.*)
2933. FIRE ESCAPES, H. J. Haddan.—(*C. H. Höhmann, Germany.*)
2934. ELECTROLIERS, A. W. Brewtnall, Warrington.
2935. FIREPROOF SCREEN. A. Clark, London.
2936. SOAP SHEETS, G. F. Redfern.—(*H. Büczkowski, Vienna.*)
2937. UMBRELLAS, J. Feldman, London.
2938. PIANOFORTE ACTIONS, J. Mallinson, Selby.

21st June, 1882.

2939. VALVE COCKS, T. S. Truss, London.
2940. DISINFECTING URINALS, T. Beddoe, Bermondsey.
2941. WHEEL, J. S. Ayton, Stoke-upon-Trent, and T. Floyd, London.
2942. BIER, C. D. Goldie, St. Ives.
2943. GALVANIC BATTERIES, H. Aron, Berlin.
2944. CARTS, &c., W. March, London.
2945. PLATES for BATTERIES, C. Sorley, London.
2946. AZO-COLOURS, C. Holliday, Huddersfield.
2947. BICYCLES, J. S. Edge, jun., and F. W. Ticehurst, Birmingham.
2948. VALVES, W. R. Lake.—(*F. F. Raymond, U.S.*)
2949. CARDBOARD BOXES, M. D. Wood, Stafford, and E. P. Smyth, London.
2950. NAILING HEELS on BOOTS, W. R. Lake.—(*F. F. Raymond, U.S.*)
2951. SHARPENING PENCILS, H. F. Hambruch, Hamburgh.
2952. CLEANING KNIVES, H. F. Hambruch, Hamburgh.
2953. BOOTS, P. Lehany, London.
2954. ELECTRIC CURRENTS, C. A. Carus-Wilson, London.
2955. TREATING NITROGENOUS MATTERS, J. C. Mewburn.—(*L. Fouque, Paris.*)
2956. COLLECTING DUST, J. F. Stewart.—(*A. H. Kirke and W. J. Fenner, U.S.*)
2957. PRESERVING WOOD, G. J. Cross, New Cross.
2958. VALVES, T. Penn, Wandsworth.

22nd June, 1882.

2959. LOOMS, R. Illingworth, Blackburn.
2960. NAILS, J. W. Summers, Stalybridge.
2961. FLUSHING WATER-CLOSETS, J. Harsant, Wandsworth.
2962. INCANDESCENT LAMPS, M. Volk, Brighton.
2963. MULES for SPINNING, J. S. Cooke and A. Hardwick, Liversedge.
2964. VELOCIPEDES, W. Morgan-Brown.—(*F. White, U.S.*)
2965. FUEL, B. E. W. Siffken.—(*C. W. Siffken, Canada.*)
2966. LAWN TENNIS, W. Brookes, Manchester.
2967. SHOE FASTENERS, H. Haddan.—(*H. Dieler, U.S.*)
2968. PROPELLING VESSELS, W. C. Cowie, London.
2969. PREVENTING INCRUSTATION in BOILERS, E. Edwards.—(*J. Vernanchet, Paris.*)
2970. TREATING SEWAGE, E. Edwards.—(*L. de Soulages, Paris.*)
2971. FURNACES, R. Potter, Stairfoot.
2972. HAT-FORMING UMBRELLAS, A. Gros and C. Salbreux, France.
2973. VENTILATORS, R. Boyle, London.
2974. ELECTRIC LIGHTS, O. G. Pritchard, Penge.

23rd June, 1882.

2975. FIRE-ARMS, B. Burton, London.
2976. HANDLES for JUGS, J. Grundy, Glasgow.
2977. FEED-WATER, E. de Pass.—(*La Société Volp Schwarz, et Cie., Paris.*)
2978. GAS, G. W. and E. H. Stevenson, London.
2979. BALL, &c., JOINTS, H. Haddan.—(*O. White, U.S.*)
2980. HORSESHOES, J. C. Mewburn.—(*L. Claude, U.S.*)
2981. GAS, J. Duke, Glastonbury.
2982. MOTIVE POWER, J. G. Parker, Plymouth.
2983. TROWELS, A. Reaney, Sheffield.
2984. MARINE ENGINES, G. Rodger, Barrow-in-Furness.
2985. THRASHING MACHINES, E. Foden, Sandbach.
2986. REGULATING WATER SUPPLY, J. McDougall, Glasgow.
2987. STEAM ENGINES, R. Duncan, Glasgow.
2988. HARNESS, W. Powell, Merthyr Tydvil.
2989. CARTRIDGE CASES, G. Kynoch, Witton.
2990. GENERATING ELECTRIC CURRENTS, J. H. Johnson.—(*La Compagnie Electrique, Paris.*)
2991. EXTRACTING COLOURING MATTER, J. H. Johnson.—(*E. Pereire, Paris.*)
2992. REGULATING ELECTRIC ARC LAMPS, W. R. Lake.—(*J. M. A. Gérard-Lescuyer, Paris.*)

24th June, 1882.

2993. REMOVING INCRUSTATION in BOILERS, E. Field and W. L. Thompson, London.
2994. ASH RECEIVER, R. and S. Jackson, Broadbottom.
2995. BEER, E. R. Moritz, London.
2996. CLEANING MEAL, S. Bruce, Dublin.
2997. OIL CAN, G. Cornut and A. Castelin, Paris.
2998. WEIGHING MACHINES, C. D. Abel.—(*H. Gerike, Berlin.*)
2999. RAISING WEIGHTS, E. Edwards.—(*V. Cassin, France.*)
3000. KITCHEN RANGES, G. Dawson and C. Butcher, Thorncliffe.
3001. CORSETS, C. L. Reynolds, Landport.
3002. DYNAMO-ELECTRIC MACHINES, P. Jensen.—(*D. A. Schuyler and F. G. Waterhouse, New York.*)
3003. TELEPHONE WIRES, A. Wilkinson, Camberwell.
3004. PROTECTING TAPHOLES, L. J. Prosser, London.
3005. SIGHTS for FIRE-ARMS, W. A. Blakeney, London.
3006. PRESERVING MILK, H. von Roden, Hamburgh.
3007. REGULATING SPEED, F. Jenkin, Edinburgh.
3008. TELEPHONIC INSTRUMENTS, J. D. Husbands, London.

26th June, 1882.

3009. FIREPLACES, W. S. Morton, Edinburgh.
3010. ELECTRIC LAMPS, W. E. Debenham, London.
3011. LAMPS, S. Grafton, Birmingham.
3012. STEERING, J. Saunders, Liverpool.
3013. FIXING PHOTOGRAPHIC PICTURES, H. H. Lake.—(*E. J. Irlande, Paris.*)
3014. TRICYCLES, T. F. Marriott, Leeds.
3015. EDGE MILLS, B. Mills.—(*F. Wanneveich, France.*)
3016. ASCERTAINING the STABILITY of SHIPS, A. Taylor, Newcastle-upon-Tyne.
3017. SORTING GRAIN, A. J. Boult.—(*L. Rappaport, Germany.*)
3018. SHEEP SHEARS, G. Burgon, Sheffield.
3019. ELECTRIC SOCK, F. W. Woodman, Brixton, and T. W. Aylesbury, Sutton.
3020. WEIGHING MACHINES, H. E. Newton.—(*E. A. Chameroy, Paris.*)

Inventions Protected for Six Months on Deposit of Complete Specifications.

2865. RAILWAY CAR WHEELS, H. A. Bonneville, Cannon-street, London.—A communication from E. B. Meatyard, Lake Geneva, Wisconsin, U.S.—17*th June*, 1882.
2879. PRINTING MACHINES, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from E. Anthony and J. E. Harvey, New York.—19*th June*, 1882.
2885. ELECTRO-DYNAMO MACHINES, J. A. Berly, New Bridge-street, London.—A communication from Mr. F. V. Maquaire, Paris.—19*th June*, 1882.
2886. PRINTING MACHINES, J. H. Johnson, Lincoln's-inn-fields, London.—A communication from E. Anthony and J. E. Harvey, New York.—19*th June*, 1882.
2921. MASKING the NAUSEOUS TASTE of MEDICINES, W. H. McLaughlin, San Francisco, California, U.S.—20*th June*, 1882.
2936. SOAP SHEETS, G. F. Redfern, South-street, Finsbury, London.—A communication from H. Buczkowski, Vienna.—20*th June*, 1882.

Patents on which the Stamp Duty of £50 has been paid.

2448. BOILERS, J. Wavish, Leytonstone.—19*th June*, 1879.
2524. FOUNTAINS, J. Needham, London.—24*th June*, 1879.
2591. CREAM, H. J. Haddan, Strand, London.—27*th June*, 1879.
2706. METALLIC SULPHIDES, J. B. Spence, London.—3*rd July*, 1879.
2979. SAND BLAST, B. C. Tilgman, London.—22*nd July*, 1879.
2465. SCREWS and SCREWBOLTS, W. R. Lake, London.—20*th June*, 1879.
2475. CARDING ENGINES, W. Tatham, Rochdale.—21*st June*, 1879.
2497. TRANSMITTERS, A. Marr, Manchester.—21*st June*, 1879.
2575. TELEGRAPHIC APPARATUS, E. Tyer, London.—26*th June*, 1879.
2584. TURBINES, W. R. Lake, London.—26*th June*, 1879.
2486. COVERING FLOORS, G. P. Chiles, London.—21*st June*, 1879.
2512. PRESERVING SUBSTANCES, T. F. Wilkins, London.—23*rd June*, 1879.
2554. MOTIVE POWER, J. B. Rogers, London.—25*th June*, 1879.
2910. CAPSULES, J. H. Johnson, London.—17*th July*, 1879.
2518. OILS, T. H. Gray, Clapham Junction.—23*rd June*, 1879.
2607. SHIPS' BERTHS, W. R. Lake, London.—27*th June*, 1879.
2626. ROLLER MILLS, E. R. and F. Turner, Ipswich, and J. H. Carter, London.—28*th June*, 1879.
2640. EXTINGUISHING FIRE, H. S. Parmelee, New Haven, U.S.—30*th June*, 1879.
2733. TAPS, W. Bartholomew, Albert Embankment.—4*th July*, 1879.
2543. CARBON CANDLES, F. J. de Hamel, London.—25*th June*, 1879.
2560. ASPHALTUM, G. E. Vaughan, London.—26*th June*, 1879..
2520. MARINE SIGNALLING, W. B. Barker, Hoboken, U.S.—24*th June*, 1879.
2535. CEMENT, T. C. Stone, Bishopsgate-street, London.—24*th June*, 1879.
2547. ROLLING, &c., MACHINE, F. H. F. Engel, Hamburgh.—25*th June*, 1879.
2568. STEAM ENGINES, L. A. Groth, London.—26*th June*, 1879.
2576. DISAGGREGATING CAKED FLOUR, H. Simon, Manchester.—26*th June*, 1879.
2577. PRESERVING RAW MEAT, J. Imray, London.—26*th June*, 1879.
2608. MOULDING BRICKS, T. G. Messenger, Loughborough.—27*th June*, 1879.
2652. ELECTRIC LAMPS, C. W. Siemens, London.—1*st July*, 1879.

Patents on which the Stamp Duty of £100 has been paid.

2268. PREPARING FOOD, J. Fordred, Tottenham, and J. A. Clarke, Long Sutton.—21*st June*, 1875.
2292. COMBING MACHINES, T. H. Rushton and B. A. Dobson, Bolton.—23*rd June*, 1875.
2346. DISCHARGING GAS RETORTS, J. West, Maidstone.—28*th June*, 1875.
2333. DRESSING LEATHER, E. Tombs, Clapham.—26*th June*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 14*th July*, 1882.

631. CORSETS, &c., A. Wardrop, London.—9*th February*, 1882.
690. FASTENING RAILS, G. Schwartzkopff, Berlin.—13*th February*, 1882.
771. PUNCHING HOLES, J. Tushaw, London.—17*th February*, 1882.
792. PLOUGHS, E. G. Lakeman, Modbury.—18*th February*, 1882.
799. ORGANS, J. B. Hamilton, Greenwich.—18*th February*, 1882.
807. DRYING WOOL, J., C., and W. Whiteley, Lockwood.—20*th February*, 1882.
809. WATER FILTERS, F. Ross and A. Buxton, London.—20*th February*, 1882.
811. LUBRICATORS, J. Lumb, Elland.—20*th February*, 1882.
812. SOLID LYE, W. H. Beck, London.—A com. from C. Levey & G. Alexandre.—20*th February*, 1882.
821. ELECTRIC TELEGRAPHS, C. N. Talbot, U.S.—20*th February*, 1882.
825. FOUNTAIN PENS, M. Benson, London.—A communication from W. Stewart.—21*st February*, 1882.
826. SCOURING, A. Adam and D. Stewart, Glasgow.——21*st February*, 1882.
827. OMNIBUSES, J. Abbott, Bideford.—21*st February*, 1882.
837. STORING ELECTRIC CURRENTS, I. Pulvermacher, London.—21*st February*, 1882.
846. WELDLESS TUBES, R. Elliott, Newcastle-on-Tyne.—21*st February*, 1882.
850. RAISING BLINDS, J. Everard, Birmingham.—21*st February*, 1882.
871. SHOWING SHIP'S SPEED, T. Davison, Glasgow.—23*rd February*, 1882.
880. ELECTRICAL SIGNALLING, C. Spratt, Peckham.—23*rd February*, 1882.
888. WATER-CLOSETS, H. Sutcliffe, Halifax.—23*rd February*, 1882.
889. WATER-CLOSETS, J. Mewburn, London.—A com. from J. Boyle and H. Huber.—23*rd February*, 1882.
910. CORES, B. Johnson, jun., Pudsey.—25*th February*, 1882.
914. WATER-CLOSETS, S. Hellyer, London.—25*th February*, 1882.
916. FOLDING PAPER, H. Nicholls, London.—25*th February*, 1882.
952. PUMPS, C. D. Abel, London.—A communication from A. Osenbrück.—27*th February*, 1882.
953. STARCH BLOCKS, C. D. Abel, London.—A com. from C. Rudolph and Co.—27*th February*, 1882.
954. ICE, C. D. Abel, London.—A communication from Osenbrück and Co.—27*th February*, 1882.
956. VENTILATING, C. D. Abel, London.—A communication from E. Oehlmann.—27*th February*, 1882.
1036. CARBONS, H. Liepmann and P. Looker, London.—3*rd March*, 1882.
1092. KNITTING, T. Priestley, Bradford.—7*th March*, 1882.
1174. GENERATING ELECTRICITY, J. S. Williams, U.S.—10*th March*, 1882.
1198. FOUNTAIN PENS, W. E. Kay, Farnworth.—11*th March*, 1882.
1214. FURNACES, H. H. Lake, London.—A communication from C. Olson.—13*th March*, 1882.
1308. CONFINING HEAT, M. Arnold, Whitehorns.—17*th March*, 1882.
1348. GAS LIGHTING, T. Thorp, Whitefield.—20*th March*, 1882.
1539. PORTABLE STEAM ENGINES, G. Mather, Wellingborough.—30*th March*, 1882.
1699. MOTIVE POWER, A. Wilson, Handsworth.—8*th April*, 1882.
1753. SULPHIDE of SODIUM, W. Weldon, Burstow.—A com. from W. Helbig.—13*th April*, 1882.
1901. VOLTAIC BATTERIES, A. R. Bennett, Glasgow.——21*st April*, 1882.
2024. EXHAUSTING GAS, T. Thorp, Whitefield, and T. Marsh, Oldham.—28*th April*, 1882.
2144. ELECTRIC LAMPS, J. H. Johnson, London.—Com. from J. M. A. Gerard-Lescuyer.—6*th May*, 1882.
2286. ELECTRIC LAMPS, R. Kennedy, Glasgow.—16*th May*, 1882.
2328. DOUBLING COTTON, F. J. Smith, Heywood.—18*th May*, 1882.
2427. ERASING KNIVES, C. H. Wood, Sheffield.—23*rd May*, 1882.
2429. WATER METERS, B. Healey, Brighouse.—23*rd May*, 1882.
2456. DRIVING DYNAMO-ELECTRIC MACHINES, J. Swallwell, Battersea.—24*th May*, 1882.
2458. STOPPERS for BOTTLES, N. Thompson, London.——24*th May*, 1882.
2519. AIR EXHAUSTING, W. H. Akester, Glasgow.—27*th May*, 1882.
2540. FIRE-GRATES, G. F. Janes, London.—27*th May*, 1882.
2565. DYNAMO-ELECTRIC MACHINE, A. J. Jarman, London.—31*st May*, 1882.
2568. KEYS of LOCKS, G. Bolton, Wolverhampton.—31*st May*, 1882.
2612. STOVES, C. Lister and T. Wardle, Middlesbrough.—2*nd June*, 1882.
2616. CHURNS, G. Hathaway, Chippenham.—3*rd June*, 1882.
2652. CALENDERS, W. R. Lake, London.—A communication from J. Cussons.—6*th June*, 1882.
2865. RAILWAY CAR WHEELS, H. Bonneville, London.—Com. from E. Meatyard.—17*th June*, 1882.
2885. DYNAMO-ELECTRIC MACHINE, J. Berly, London.—A com. from F. Maquaire.—19*th June*, 1882.

Last day for filing opposition, 18*th July*, 1882.

849. GLASS REFLECTORS, F. Engel, Germany.—A com. from G. Franke.—21*st February*, 1882.
851. FILES, R. Setten, Birmingham, and H. Dyer, Bridgwater.—21*st February*, 1882.
852. SHEAF BINDING, J. Harrison, Ipswich.—21*st February*, 1882.
865. HAIR FELT, J. Forsyth, Glasgow.—22*nd February*, 1882.
869. DYNAMO-ELECTRIC MACHINES, G. Spagnoletti, London.—22*nd February*, 1882.
870. RESERVOIR PEN, O. Bussler, London.—23*rd February*, 1882.
874. WROUGHT IRON, J. Maynes, Manchester.—23*rd February*, 1882.
879. ANNUNCIATOR, M. Volk, Brighton.—23*rd February*, 1882.
881. WOOL COMBING, W. Lake, London.—A communication from W. Grundy.—23*rd February*, 1882.
884. GRIPPERS, J. Hardaker, Leeds.—23*rd February*, 1882.
885. EXTRACTING GOLD, &c., W. Barlow, London.—A com. from C. de Vaurel.—23*rd February*, 1882.
887. DIFFUSION of LIGHT, J. Smith and J. Learoyd, Halifax.—23*rd February*, 1882.
893. MIXING CONCRETE, A. Jamieson, Blantyre.—24*th February*, 1882.
896. FRICTIONAL GEARING, W. Lake, London.—A communication from J. Tibbits.—24*th February*, 1882.
908. WASHING WOOL, W. Lake, London.—A communication from E. Mehl.—24*th February*, 1882.
919. ELASTIC FABRICS, T. Harrison, Derby.—25*th February*, 1882.
932. TEMPERING HACKLE, T. Crabtree, Leeds.—25*th February*, 1882.
933. COMPASS CORRECTORS, J. Wilson, Sunderland.—25*th February*, 1882.
934. OPENING WINDOWS, J. Carpenter, Southampton.—25*th February*, 1882.
980. MOULDING BRICKS, T. le Poidevin, Guernsey.—28*th February*, 1882.
991. HANGING WINDOWS, G. Haycraft, Lyme Regis.—1*st March*, 1882.
1007. DAMPER REGULATOR, S. Wilding, London.—A com. from V. Hallock.—2*nd March*, 1882.
1062. TRAP BALLS, A. Clark, London.—A communication from P. and E. Jarre.—4*th March*, 1882.
1084. LOCOMOTIVE WHEELS, R. Brandon, Paris.—A communication from A. Cottrau.—7*th March*, 1882.
1090. WEAVING, E. Taylor and T. Brierley, Marsden.—7*th March*, 1882.
1091. LOOMS for WEAVING, D. Bailey, Yorkshire.—7*th March*, 1882.
1821. SILICIOUS COPPER, J. Mewburn, London.—A communication from L. Weiller.—17*th April*, 1882.
1971. UMBRELLA RACKS, C. Appleton and S. Ogden, Manchester.—26*th April*, 1882.
2251. ROCK BORING, J. Urwin, Scotswood-on-Tyne.—12*th May*, 1882.
2280. FILLING BOTTLES, C. Sombart, Magdeburg.—A communication from O. Assmann.—15*th May*, 1882.
2499. BORING METALS, A. Higginson, Liverpool.—26*th May*, 1882.
2613. ELECTRIC LAMPS, W. Ayrton and J. Perry, London.—3*rd June*, 1882.
2614. DOMESTIC STOVES, C. E. Green, London.—3*rd June*, 1882.
2690. BRUSHES, J. Wetter, New Wandsworth.—A communication from the Eagle Metallic Brush Company.—8*th June*, 1882.
2813. SHIRTS, D. Belknap, San Francisco.—14*th June*, 1882.
2921. MASKING NAUSEOUS TASTE, W. McLaughlin, U.S.—20*th June*, 1882,

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the* 23*rd June*, 1882.)

5677. OPENING DOORS, J. Barrett, Eastburn.—27*th December*, 1881.
5678. SPINNING, M. Wright, Wibsey.—27*th December*, 1881.
5686. CUT-OFF VALVES, H. H. Lake, London.—27*th December*, 1881.
5687. DISTRIBUTION of ELECTRICITY, C. Carus-Wilson, London.—27*th December*, 1881.
5688. CYMAPHEN, C. Varley, Bexley Heath, and F. Varley, London.—27*th December*, 1881.
5696. RECORDING MUSIC, J. Wallis, London.—28*th December*, 1881.
5704. EDGESETTING, W. R. Lake, London.—28*th December*, 1881.
5705. SHIPS' STERN POST, W. Cooke and D. Mylchreest, Liverpool.—29*th December*, 1881.
5736. SHIRTS, &c., J. Ridley, London.—31*st December*, 1881
5738. ELECTRIC LAMPS, J. G. Lorrain, London.—31*st December*, 1881.
5744. MARINE GOVERNORS, J. Batchelor, Liverpool.—31*st December*, 1881.
5745. FILTERING WATER, F. and W. Atkens, London.—31*st December*, 1881.
3. PRESERVING TIMBER, H. Aitken, Falkirk.—2*nd January*, 1882.
4. LOCKS for BAGS, V. Huppe & A. Bender, Germany.—2*nd January*, 1882.
14 ELECTRICITY, A. Mackie, London.—2*nd January*, 1882.
21. SECURING CORKS in BOTTLES, W. R. Lake, London.—3*rd January*, 1882.
27. BALL BEARINGS, A. J. Boult, London.—3*rd January*, 1882.
33. STREET CLEANING, S. L. Hunt, London.—3*rd January*, 1882.
51. ARTIFICIAL PARCHMENT, C. Weygang, London.—5*th January*, 1882.
65. CONSTRUCTING BRIDGES, H. H. Lake, London.—5*th January*, 1882.
69. INCANDESCENT LAMPS, E. Liveing, London, and C. Boys, Wing.—6*th January*, 1882.
76. DOMESTIC STOVES, J. H. Johnson, London.—6*th January*, 1882.
83. RECLAMATION of SWAMPY LAND, W. R. Lake, London.—6*th January*, 1882.
92. PIANOFORTES, F. C. Glaser, London.—7*th January*, 1882.
101. WRITING PADS, W. R. Lake, London.—7*th January*, 1882.
104. LAMINATED STEEL SPRINGS, R. B. Hansell, Sheffield.—7*th January*, 1882.
106. PAPER BARRELS, W. R. Lake, London.—7*th January*, 1882.
123. STILLIONS, R. Moreland, London.—10*th January*, 1882.
143. LOCOMOTIVE, R. H. Brandon, Paris.—11*th January*, 1882.
158. SEWING, W. R. Lake, London.—11*th January*, 1882.
159. CARDBOARD BOXES, S. Wood, Cleckheaton.—12*th January*, 1882.
192. OCHRE PIGMENTS, J. Cameron, London.—13*th January*, 1882.
213. BREECH-LOADING FIRE-ARMS, H. Thorn, London.—16*th January*, 1882.
242. LOADING CARGOES, A. M. Clark, London.—17*th January*, 1882.
269. PERMUTATION LOCKS, J. R. Nottingham, U.S.—19*th January*, 1882.
338. KNIVES, H. H. Lake, London.—23*rd January*, 1882.
406. SECURING RAILS, A. M. Clark, London.—26*th January*, 1882.
466. SEWING MACHINES, J. McLaren, Glasgow.—31*st January*, 1882.
714. LAMP-WICK, W. R. Lake, London.—14*th February*, 1882.
756. ELECTRIC CURRENTS, J. Brockie, London.—16*th February*, 1882.
898. ELECTRIC ARC LAMPS, J. Brockie, London.—24*th February*, 1882.
1101. METALLIC PACKING, G. Holcroft, Manchester, & J. Grundy, Ashton-under-Lyne.—7*th March*, 1882.
1234. PUMPS, G. V. Fosbery, Britton.—14*th March*, 1882.
1343. DUST COLLECTORS, L. Varicas, London.—20*th March*, 1882.
1363. SECONDARY BATTERIES, F. Maxwell-Lyte, London.—21*st March*, 1882.
1414. PULLEYS, G. W. Beynon, Reading.—23*rd March*, 1882.
1433. WASHING, &c., ROLLERS, J. Lewthwaite, Halifax.—24*th March*, 1882.
1604. VAPORISING FLUIDS, C. Scott, Belfast.—3*rd April*, 1882.
1620. PLASTER for CASTS, P. M. Justice, London.—4*th April*, 1882.
1622. ROCK DRILLING, H. Pearsall, London.—4*th April*, 1882.
1630. CAUSTIC SODA, J. Spence, London, and A. Watt, Charlton.—4*th April*, 1882.
1682. RAILWAY SIGNALS, J. Harrison, London.—6*th April*, 1882.
1706. BOILING of FATS, C. Pielsticker, London.—10*th April*, 1882.
1715. HYDRAULIC ENGINES, B. and F. Walker, Leeds.—11*th April*, 1882.
1726. ELECTRICAL SIGNALLING, E. Tyer, Dalston.—12*th April*, 1882.
1747. DYNAMO-ELECTRIC MACHINES, D. Chertemps and L. Dandeu, Paris.—12*th April*, 1882.
1763. IRON and STEEL, H. C. Bull, Liverpool.—13*th April*, 1882.
1778. BURNING COKE, J. Cropper, Birmingham.—14*th April*, 1882.
1784. HOT-AIR ENGINES, M. Boulton, Tew Park.—14*th April*, 1882.
1787. DYNAMO-ELECTRIC MACHINE, B. Antill, London.—14*th April*, 1882.
1788. CALORIC ENGINES, M. Boulton, Tew Park, and E. Perrett, London.—14*th April*, 1882.
1790. LOCOMOTIVES, W. R. Lake, London.—14*th April*, 1882.
1794. GENERATING CURRENTS, E. Voice, London.—14*th April*, 1882.
1824. DISTILLING, W. T. Y. Dicey, Brockley.—17*th April*, 1882.
1845. MAINS, W. T. Whiteman, London.—18*th April*, 1882.
1848. CRYSTALLISED GRAPE SUGAR, W. Lake, London.—18*th April*, 1882.
1860. DRYING GOODS, J. Worrall, Ordsall, and J. Kershaw, Wadsworth.—18*th April*, 1882.
1870. LOCKS, W. S. Frost, Peckham.—19*th April*, 1882.
1879. SACCHARINE, W. R. Lake, London.—19*th April*, 1882.
1880. AUTOMATIC MOTION, P. Pfleiderer, London.—19*th April*, 1882.
1932. SELF-LEVELLING BERTHS, A. A. Young, U.S.—22*nd April*, 1882.

(*List of Letters Patent which passed the Great Seal on the* 27*th June*, 1882.)

5433. LOCKS for CARRIAGE DOORS, W. St. Aubin, Bloxwich.—13*th December*, 1881.
5710. BATHING, C. E. Winterros, Norway.—29*th December*, 1881.
5734. BINDING SHEETS, W. Lotz, London.—31*st December*, 1881.
5735. HEATING WATER, T. Drake, Huddersfield.—31*st December*, 1881.
5739. PREPARING MAIZE, T. Kinder, Anerley.—31*st December*, 1881.
5740. HOISTS, J. and J. T. Pickering, Stockton-on-Tees.—31*st December*, 1881.
5742. HEATING METALS, J. S. Williams, U.S.—31*st December*, 1881.
5748. CONSUMING SMOKE, J. McDonald and A. Bolanichi, Dulwich.—31*st December*, 1881.
5749. ALLOYING METALS, P. de Villiers, St. Leonards.—31*st December*, 1881.
5750. ALLOYING METALS, P. de Villiers, St. Leonards.—31*st December*, 1881.
5. MASHING MALT, L. A. Groth, London.—2*nd January*, 1882.
9. TUBE EXPANDERS, G. Allix, London.—2*nd January*, 1882.
10. TUYERES, E. G. Brewer, London.—2*nd January*, 1882.
25. SOAP, G. Payne, London.—3*rd January*, 1882.
28. TREATING FIGS, J. W. Wood, Liverpool.—3*rd January*, 1882.
38. STRIPPING CYLINDERS, G. Kenworthy and J. Beard, Ashton-under-Lyne, and J. G. Whitehead, Newton Moor.—4*th January*, 1882.
86. STEAM GENERATORS, J. Jones, Liverpool.—7*th January*, 1882.
135. FIRE-LIGHTERS, F. Holmes, New Cross.—10*th January*, 1882.
160. STAY FASTENINGS, J. Salisbury, Sheffield.—12*th January*, 1882.
165. PUMP VALVES, P. Reid, Glasgow.—12*th January*, 1882.
203. DISTILLING GLYCERINE, G. Payne, London.—14*th January*, 1882.
207. PERAMBULATORS, J. H. Mills, Birmingham.—14*th January*, 1882.
219. CORRUGATED TUBES, S. Fox, Leeds.—16*th January*, 1882.
221. WELDLESS TUBES, S. Fox and J. Whitley, Leeds.—16*th January*, 1882.
245. REGULATING ELECTRICAL CURRENTS, W. R. Lake, London.—17*th January*, 1882.
307. WEAVING LOOMS, T. Sutcliffe, Todmorden.—21*st January*, 1882.
1088. STEAM-JACKETTED COPPERS, G. Inskipp and J. Mackenzie, London.—7*th March*, 1882.
1597. STOPPERS for BOTTLES, H. West, London.—1*st April*, 1882.
1746. ECONOMISERS, T. Sykes, Manchester.—12*th April*, 1882.
1915. ELECTRIC LAMPS, W. Whiteman, London.—22*nd April*, 1882.
2035. INTENSE WHITE LIGHT, J. Imray, London.—29*th April*, 1882.

List of Specifications published during the week ending June 24th, 1882.

*4589, 4d.; 3291, 2d.; 4997, 6d.; 4016, 6d.; 5020, 4d.; 5025, 8d.; 5027, 2d.; 5037, 6d.; 5065, 8d.; 5067, 6d.; 5079, 6d.; 5083, 2d.; 5087, 6d.; 5089, 6d.; 5092, 2d.; 5093, 6d.; 5095, 6d.; 5096, 6d.; 5097, 6d.; 5098, 8d.; 5099, 6d.; 5103, 6d.; 5104, 4d.; 5105, 2d.; 5106, 6d.; 5108, 2d.; 5109, 8d.; 5110, 6d.; 5111, 6d.; 5113, 6d.; 5115, 6d.; 5118, 2d.; 5119, 2d.; 5120, 2d.; 5122, 6d.; 5123, 8d.; 5124, 2d.; 5126, 4d.; 5128, 2d.; 5129, 6d.; 5130, 2d.; 5132, 8d.; 5133, 2d.; 5134, 6d.; 5135, 6d.; 5136, 2d.; 5138, 2d.; 5140, 6d.; 5141, 6d.; 5142, 6d.; 5144, 6d.; 5145, 2d.; 5147, 2d.; 5148, 6d.; 5151, 2d.; 5152, 6d.; 5153, 6d.; 5154, 6d.; 5155, 4d.; 5156, 6d.; 5157, 2d.; 5158, 6d.; 5160, 6d.; 5161, 4d.; 5162, 6d.; 5164, 4d.; 5165, 6d.; 5168, 2d.; 5172, 6d.; 5173, 6d.; 5174, 4d.; 5175, 6d.; 5176, 2d.; 5177, 2d. 5178, 6d.; 5179, 2d.; 5180, 6d.; 5182, 2d.; 5185, 1s.; 5190, 6d.; 5191, 2d.; 5192, 4d.; 5194, 2d.; 5195, 2d.; 5200, 6d.; 5204, 4d.; 5205, 4d.; 5208, 6d.; 5209, 6d.; 5215, 4d.; 5217, 6d.; 5218, 4d.; 5219, 6d.; 5223, 6d.; 5226, 6d.; 5234, 6d.; 5245, 8d.; 5252, 6d.; 5271, 4d.; 5280, 6d.; 5289, 8d.; 5315, 4d.; 5337, 6d.; 5498, 6d.; 5586, 2d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

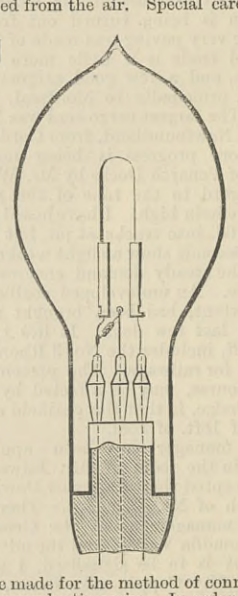
Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

3291. RETORTS FOR THE CONTINUOUS DISTILLATION OF SAWDUST, &c., *T. F. Haldane, Glasgow.*—27*th July*, 1881.—(*Not proceeded with.*) 2*d.*

This relates to the general construction or arrangement and combination of the parts of a retort and its accessory fittings.

3890. ELECTRIC LAMPS, *D. G. FitzGerald, Brixton.*—8*th September*, 1881. 6*d.*

Unsized paper or any suitable vegetable fibre is treated with a concentrated solution of zinc chloride, to be formed into parchment and then carbonised whilst protected from the air. Special care is taken,



and claims are made for the method of connecting the filament to the conducting wire. In order to obtain a globe perfectly free from oxygen, the oxygen remaining after exhaustion is extracted by oxidising a strip of magnesium ribbon. The figure shows a section of the finished lamp.

4005. STORING ELECTRICITY, *J. S. Sellon, London.*—16*th September*, 1881.—(*Not proceeded with.*) 2*d.*

Sheets, foil, gauze, or any form of suitable material have deposited on them suitable metallic salts.

4310. SECONDARY BATTERIES, *A. P. Laurie, Edinburgh.*—4*th October*, 1881. 4*d.*

Copper plates are immersed in a solution of chloride of zinc, the essential feature being the storing of chlorine for use as a source of electricity by combining it with the copper to form cuprous chloride.

4641. TARGETS, *W. R. Lake. London.*—(*A communication from A. Eowin, Paris.*)—22*nd October*, 1881. 6*d.*

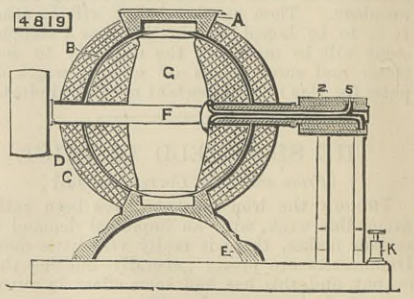
The target is made of small pieces, which, when hit, make an electric contact, and a signal is given indicating the part hit.

4777. ELECTRIC LAMPS, *E. R. Prentice, Stowmarket.*—1*st November*, 1881.—(*Not proceeded with.*) 2*d.*

The regulation of the carbon was to be effected by fluid pressure.

4819. MOTORS ACTUATED BY ELECTRICITY, *W. L. Wise, Westminster.*—(*A communication from E. Bürgin, Basel, Switzerland.*)—3*rd November*, 1881. 6*d.*

A is a hollow sphere of thin brass or other non-magnetic metal divided into the hemispheres B and C. These latter, B and C, are wound with insulated wire D in convolutions parallel to the horizontal plane



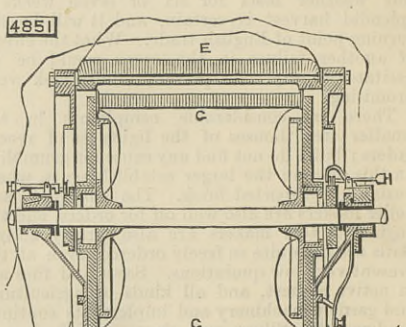
of the junction. The pedestal E is formed in one with C. On the shaft F is an iron core C wound with insulated wire H till it is rather less than interior of sphere A. The other parts of the machine are clearly shown. The current enters at K, traverses the coils H to S, then by brush to outer conductor, and through Z and a brush to a second terminal.

4825. REGULATING DYNAMO-ELECTRIC MACHINES, *C. A. Carus-Wilson, London.*—3*rd November*, 1881. 6*d.*

The current is used to act on the governor of the steam engine.

4851. ELECTRO-MOTIVE ENGINE, *D. T. Piot, London.* 5*th November*, 1881. 8*d.*

The figure shows a longitudinal section, by means of which the arrangement of field magnets E and armature coils G will be seen. The inventor has these crank-shaped cores wound circularly with insulated wire also the arrangement adopted.



4882. ELECTRIC TIMEPIECES, *W. P. Thompson, Liverpool.*—8*th November*, 1881.—(*A communication from A. Lemoine, Paris.*) 8*d.*

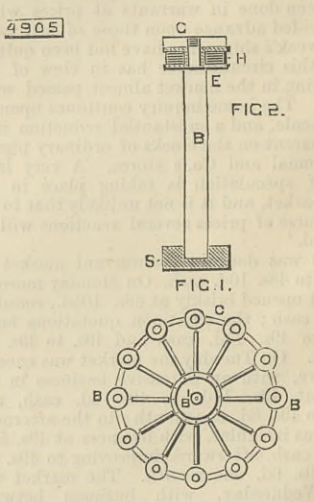
The working parts are said to be reduced to a minimum, and the hours struck by electrical mechanism, as is also the regulations.

4885. INSULATION OF WIRES, *W. C. Johnson and S. E. Phillips, Charlton.*—8*th November*, 1881.—(*Not proceeded with.*) 2*d.*

The wires of the cable were each wound with tape which had been dipped in insulating materials, and the whole enclosed in lead.

4905. IMPROVEMENTS IN APPARATUS FOR THE TRANSMISSION AND RECEPTION OF SOUNDS, *W. C. Barney, London.*—9*th November*, 1881. 8*d.*

Fig. 1 shows one form of the inventor's microphone; pencils P of hard coke carbon are held loosely by their ends in carbon blocks B, the other ends being held in a central carbon block B[1], to which is connected one terminal of the primary wire of an induction coil about 1in. diameter and ½in. thick. The outer blocks are connected together by a conductor C, which is



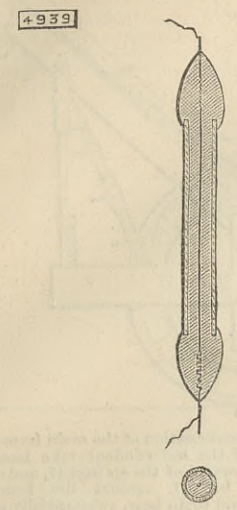
connected to one pole of a battery, the other pole being connected to the other terminal of the primary wire of the coil. Fig. 2 shows one form of the inventor's telephone. A bar, B, of iron, which may or may not be a permanent magnet, has one end fastened to a shoe, S, of soft iron, equal to about five times the weight of E, a soft iron elongation at the other end, on which is placed the helix H. To the end of E is fixed a spiral spring G of iron, the end of which may be capped with an iron disc.

4947. ELECTRO-PLATING, *F. Wirth, Frankfort.*—11*th November.*—(*A communication from A. Classen, Aix-la-Chapelle.*) 4*d.*

Solutions of chlorides or sulphates of the metals to be deposited are transformed by a solution of neutral potassium oxalates into soluble potassium double salts. The solution is heated, and in it is dissolved an

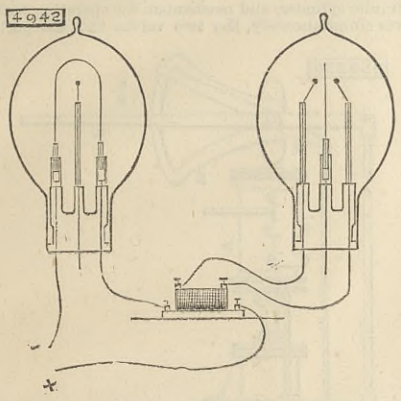
excess of ammonium oxalate. A small quantity of sodium carbonate is added. The article to be plated is connected to the pole of the battery.

4939. APPARATUS FOR PRODUCING LIGHT BY MEANS OF ELECTRICITY, *A. F. St. George, London.*—11*th November*, 1881. 6*d*.
This is an electric lamp where its filament is



embedded in its transparent envelope, as shown in the figure.

4942. APPLYING ELECTRIC CURRENTS IN THE PRODUCTION OF LIGHT, *S. Pitt, Sutton.*—11*th November*, 1881.—(*A communication from L. Goulard and J. D. Gibbs, Paris.*) 6*d*.
This lamp is a mixed lamp—that is, partly incandescent and partly arc. A carbon thread to be



rendered incandescent is supplemented by two insulated platinum conductors terminating in spheres and connected to a Rhumkorf coil.

4966. SIGNALLING APPARATUS FOR RAILWAYS, *W. R. Lake, London.*—12*th November*, 1881.—(*A communication from J. B. Johnson, Boston, U.S.*) 6*d*.
Mechanism connected with the rotating armatures of a magneto machine is actuated by the passing train.

4997. LUBRICATOR, *T. Allison and G. Senior, near Huddersfield.*—15*th November*, 1881. 6*d*.
The invention relates to the method of forcing the lubricant to enter the steam engine cylinder by means of the action of the steam itself upon a piston of larger area than that which acts upon the lubricating material.

5002. IMPROVEMENTS APPLICABLE TO DYNAMO-ELECTRIC CIRCUITS, *S. Vyle, Middlesbrough.* — 19*th November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to a method of dispensing with the return wire to the dynamo, and connecting instead to specially prepared earths.

5006. A NEW OR IMPROVED METHOD AND APPARATUS FOR REGULATING THE PRODUCTION OF ELECTRICITY BY DYNAMO-ELECTRIC MACHINES, *F. Wright, London, and F. A. Ormiston, Twickenham.*—15*th November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to the introduction of varying resistances into the circuit of the field of magnets of the dynamo, and thereby regulating the current.

5016. APPARATUS FOR SOAKING, &c., WOVEN FABRICS, *J. and P. Hawthorn and J. P. Liddell, New Mills, Derby.*—16*th November*, 1881. 6*d*.
This consists, First, in the use of hollow revolving shafts provided with pipes, which are carried round with the shafts and discharge lye or liquid on to the cloth with a centrifugal action, and with rubbers or beaters, which rub or beat the same; Secondly, in the use of the system of carrying rollers whereby the fabric is led nearly around the revolving liquid discharger and rubber or beater, so as to receive the action of the jets and rubbers or beaters at three different parts simultaneously.

5020. KID GLOVES, *A. C. Henderson, London.*—16*th November*, 1881.—(*A communication from T. P. Labrousse, Grenoble, France.*)—(*Not proceeded with.*) 4*d*.
This relates to a novel method of cutting the kid or other skin.

5025. ELEVATORS AND HOISTS, &c., *H. Garland, Liverpool.*—16*th November*, 1881. 8*d*.
A bucket or like elevator is combined with a hoist elevator, with a view that the parts may be used for various purposes and adapted thereto.

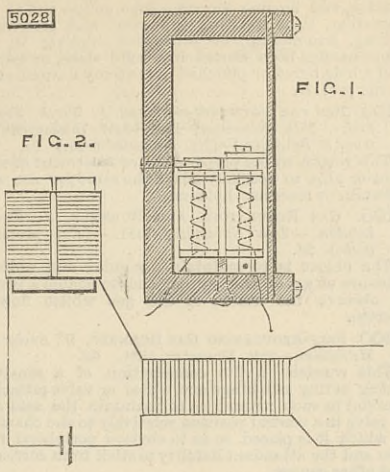
5026. IMPROVEMENTS IN TELEPHONE RECEIVERS, *F. H. W. Higgins, Stoke Newington.*—16*th November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to the use of a solenoid attached to the diaphragm, a magnet fixed to the handle of the telephone projecting into but not touching the solenoid.

5027. OPEN STOVES FOR FIRE-GRATES, *E. R. Hollands, Newington-green.*—16*th November*, 1881.—(*Not proceeded with.*) 2*d*.
The bottom and the back of the fire basket is composed of parallel bars with spaces between, which admit of a rake entering and rising between these bars. This rake lifts the fuel in the fire basket and provides a free space in the lower part of the basket to receive the fresh fuel.

5037. MACHINERY FOR GRADING OR ROLLING AND DRESSING GRAIN, &c., *W. Korth, Belfast.*—17*th November*, 1881. 6*d*.
The chief feature consists in the movement of the two adjustable rollers by means of an excentric and lever in horizontally plane slots, instead of their being moved in a circular or vertical direction as heretofore commonly practised.

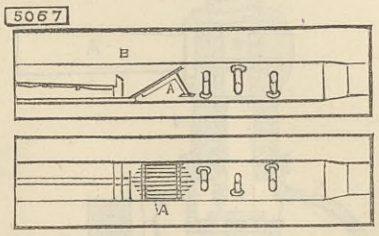
5065. CURING FISH, *G. Leach, London.*—19*th November*, 1881. 8*d*.
This relates to improvements in the treatment of fish to effect the preservation or curing thereof by the regular or equable process of drying, smoking, and curing, by traversing the fish through various positions in the smoke house or chamber, and it also relates to the construction of apparatus therefor.

5028. TELEPHONE RECEIVERS, *R. and M. Theiler, London.*—16*th November*, 1881. 6*d*.
The lateral vibrations of the cores of the electro-



magnets are communicated as shown in Fig. 1 to a diaphragm or diaphragms. A local battery is used to excite the electro-magnet on long wires, as in Fig. 2.

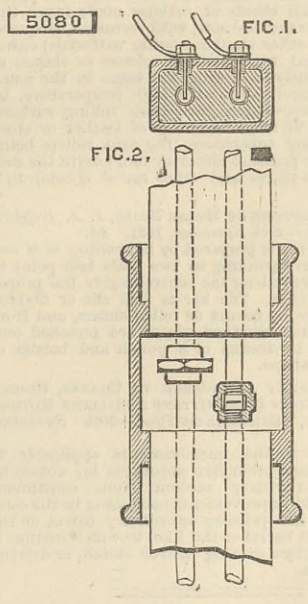
5067. FURNACES, &c., FOR ECONOMISING FUEL AND CONSUMING SMOKE, *W. P. Welton, London.*—19*th November*, 1881. 6*d*.
In the drawings A is an inclined rack or grating of iron bars. It is preferred to coat these bars with ganister to protect them from the heat, or they may be protected by other well-known means. The rack is set in an inclined position, and when the furnace is in use is covered with a stratum or asbestos fibre. The



asbestos is mixed with sufficient fire-clay to admit of its being moulded into porous blocks. The blocks may be about 4in. square and 1in. thick, and they are perforated with holes ¾in. in diameter on the side facing the fire, increasing to 1¼in. in diameter on the other side. The asbestos thus prepared is so arranged upon the grating that the whole of the products of combustion from the fire at B have to permeate and traverse the stratum of incombustible material in passing through the boiler to the chimney.

5079. CLEANING AND LUBRICATING WIRE ROPES, *M. W. Parrington and C. Almond, Sunderland*—21*st November*, 1881. 6*d*.
This consists in cleaning wire ropes by revolving brushes, operating by friction rollers, to which motion is given by the rope to be cleaned.

5080. IMPROVEMENTS IN APPARATUS FOR THE CONDUCTION AND DISTRIBUTION OF ELECTRIC CURRENTS, *R. E. B. Crompton, London.*—21*st November*, 1881. 6*d*.
The inventor enlarges the end of two copper conductors, and on these ends cuts screw threads, the pitch of the thread on the end of each conductor having a slightly different pitch; over these ends is fitted a sleeve or socket, and when this is screwed up the conductors are forced into intimate contact, Fig. 1. The conductors are placed in pairs in iron tubes and retained in proper position by core nails; the tubes are then placed in a vertical position, and purified blast furnace slag poured in to insulate the con-



ductors. To procure intimate contact between the conductors and slag the former are enamelled. The core nails are then withdrawn and the holes made by them filled with insulating material. For a branch circuit, a copper plug is screwed into the conductor and brought out through a porcelain washer, the branch wire being connected to the stud as in Fig. 2.

5083. WHETTING SCYTHES, *A. J. Boult, London.*—21*st November*, 1881.—(*A communication from T. Jacquot and J. Thirion, Nancy, France.*—(*Not proceeded with.*) 2*d*.
The principal part of the machine is a piece preferably of cast iron serving as a hammer, and hollowed out or recessed in such a manner as to receive a hammer face of steel which is belted to the same and is guided in an appropriate path by two pins or keys.

5087. APPARATUS FOR TREATING AND CUTTING HORN, *W. Hughes, Pimlico.*—21*st November*, 1881. 6*d*.
This relates to apparatus by which horn can be heated or kept heated, scored, severed, and stretched or brought into fibrous length-like bristles, suitable for brooms, brushes, and the like.

5089. COMBING WOOL, &c., *A. Smith and M. Firth, Bradford.*—21*st November*, 1881. 6*d*.
The inventor claims, First, the feeding of a "Noble's" comb by means of a circular nip; Secondly, the special form of the adjustable and flexible bar over or under the revolving frictional disc; Thirdly, the arrangement of the pins set vertically in either of the circles.

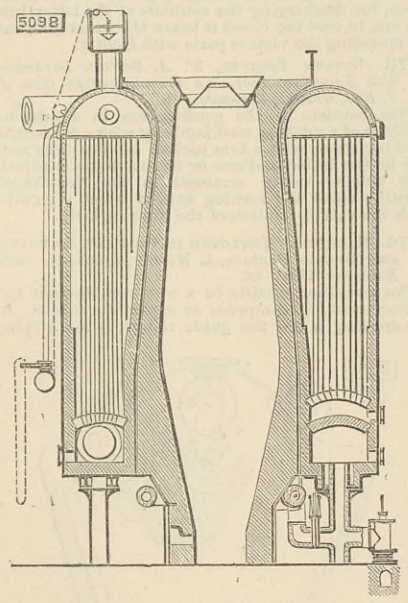
5092. LOOMS, *J. Holding, near Chorley.*—22*nd November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to that class of looms known as "underpick" looms, and especially to that part of such looms known as the "picking-stick buffer."

5093. TRAVERSE MOTIONS OF A LATHE, &c., *J. Whitejun., near Leeds.*—22*nd November*, 1881. 6*d*.
This consists, First, in the use of a cam in combination with a clutch for the purpose of imparting a reversing motion to the back shaft of a lathe and giving the alternate traverse motion to the saddle of a lathe; Secondly, the use of interchangeable spur wheels as a means of regulating the length of traverse to be given to the saddle of a lathe; Thirdly, the use of a revolving cutting tool working in and between the centres of a lathe; Fourthly, the method of making cutting tools or rose cutters in two or more parts.

5095. MANUFACTURE OF BRICKS, &c., *W. R. Lake, London.*—22*nd November*, 1881.—(*A communication from W. W. Potts, Bridgeport, U.S.*) 6*d*.
The invention comprises a press having two cams, one for pressing the brick or block, and the other for ejecting the same from the mould, both being on the same shaft and directly beneath the plunger, whereby the two operations of pressing and ejecting are quickly accomplished.

5097. FOLDING BEDSTEADS, &c., *A. J. Boult, London.* 22*nd November*, 1881.—(*A communication from O. Guinchard, Geneva.*) 6*d*.
The object is to construct a folding bedstead that it will be applicable for the purposes of a bed, a sofa, an invalid chair, a wash-stand, and a night table.

5098. APPARATUS FOR HEATING THE BLAST FOR BLAST FURNACES, *T. F. Harvey, Dowlais.*—22*nd November*, 1881. 8*d*.
The invention consists essentially in combining the regenerative hot blast stoves in one structure with the furnace, by forming the said stoves in an annular



space between the furnace and the other iron casing, by which the whole building is enclosed. The drawing shows a vertical section of the combined regenerative stoves and furnace.

5099. AUTOMATIC OR SELF-BINDING ATTACHMENTT TO HARVESTING MACHINES, *W. P. Thompson, Liverpool.* —22*nd November*, 1881.—(*A communication from C. H. McCormick, Chicago.*) 6*d*.
This consists in constructing the tripping arm in sections, one of which is permanently pivotted to the sustaining bar, and the other of which is adjustable along the top of the first, so as to increase or decrease the grain receiving and compacting span without disturbing the pivot.

5103. APPARATUS FOR DISTILLING WATER IN SHIPS, *E. Wimshurst, Victoria Park.*—22*nd November*, 1881. 6*d*.
This consists essentially in providing a series of tubes arranged in and heated by the waste heat passing through the uptake or funnel of the boiler furnace for first converting the water into steam by passing it therethrough, and then condensing the steam thus produced. Each tube is fitted with a revolving scraper.

5105. TAPS FOR BEER CASKS, &c., *W. Rose, Halesowen.* —22*nd November*, 1881.—(*Void.*) 2*d*.
The invention relates to a tap, whereby the tapping of a barrel or vessel is effected with certainty and ease, and the loss of any of the liquid contained in the barrel or vessel avoided.

5106. VELOCIPEDES, &c., *W. E. Price and W. D. Overton, Hampton Wick.*—22*nd November*, 1881. 6*d*.
This relates to the construction of velocipedes whereby each velocipede is made convertible, so as to carry one rider or more, and also to the construction of the wheels.

5108. CUTTING PAPER, *E. Edwards, London.*—22*nd November*, 1881.—(*A communication from H. Gamichon, Paris.*—(*Not proceeded with.*) 2*d*.
This relates to the general construction of a machine for cutting into pieces of any desired length continuous rolls of paper.

5109. VACUUM BRAKE APPARATUS, *J. Gresham, Salford.*—23*rd November*, 1881. 8*d*.
According to one arrangement the invention consists in an improved combination, arrangement, and construction, viz., of an external casing, into which is screwed by a screw at one end a nozzle which forms the steam cone of a large ejector, and within it there is another nozzle carried on a cross-bar forming the discharging cone of a small ejector, and in the first large nozzle there is a small nozzle screwed, within which a plug is screwed, upon the end of which a seating is formed for a ball valve for the small ejector.

5110. APPARATUS FOR GENERATING MOTIVE POWER, *R. Hallewell, Blackburn.*—23*rd November*, 1881. 6*d*.
This relates to a pressure generator having a generating space of such proportions and so suitably heated as that the pressure required for any single stroke can be generated by the sudden injection into the generator at a suitable period in the out or instroke of the piston of a suitable quantity of liquid.

5111. WATER FITTINGS, &c., *J. R. Hargreaves, Haslingden.*—23*rd November*, 1881. 6*d*.
This consists in the method of obtaining a service of heated water in any part of a building by the employment of separate cold and hot water pipes extending from the place where the said service is required to the hot water heater, and of arrangements for sending cold water into the said heater to displace the heated water.

5113. VELOCIPEDES, *W. T. Eades, Birmingham.*—23*rd November*, 1881. 6*d*.
This consists, First, in the application to the crank shaft of tricycles of excentric pedals; Secondly, in the application of a balance brake; Thirdly, the application of differential ratchet driving gear to tricycles; Fourthly, in an arrangement for altering the speed of tricycles; Fifthly, in the arrangement of a clutch motion, so as to permit of the crank shaft remaining at rest when the tricycle is running down hill, or making it fast with the driving wheel when required.

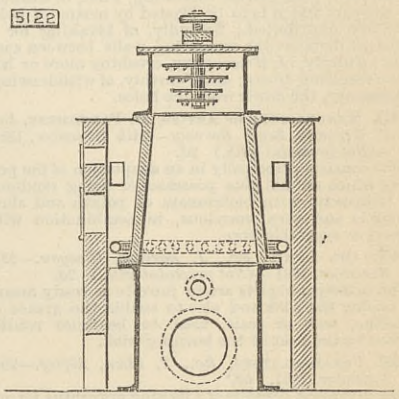
5115. LOOMS, *R. S., E., and R. Collinge, Oldham.*—23*rd November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to improvements of that part of a loom known as the tappet or shedding motion, the object being to construct a simple apparatus which can be readily adapted to alter the positions of the healds any number of times, in order to weave any desired number of picks to the round.

5118. ROADS AND PAVEMENTS, *H. J. Haddan, Kensington.*—23*rd November*, 1881.—(*A communication from J. Salvat, Morceux, France.*) 2*d*.
This consists in using tar, sand, and pebbles in certain proportions and ways.

5119. COMB CLEANER, *H. J. Haddan, Kensington.*—23*rd November*, 1881.—(*A communication from H. Ullrich, Leipsig.*)—(*Not proceeded with.*) 2*d*.
A two-branched fork, provided with a handle, carries a number of thin parallel wires or strips of metal, which are stretched from one branch of the fork to the other, and secured to the ends of the branches in any suitable manner.

5120. MADE-UP SCARVES AND NECKTIES, *A. Lemay, London.* — 23*rd November*, 1881. — (*Not proceeded with.*) 2*d*.
The object is to prevent the loosening of the spike or pin which forms the fastening for the neck band, and also to prevent the said spike or pin injuring the shirt in the case of a reversible scarf.

5122. MANUFACTURE OF IRON AND STEEL, &c., *J. C. Bromfield, Brighton.*—23*rd November*, 1881. 6*d*.
The invention consists in the preparation and combination of coal-dust, crushed or powdered iron ore, and seaweed mucilage with cement or lime, and its subsequent treatment by pressure into blocks, bricks,



cylinders, or other forms, and then the coking thereof, whereby the impurities are eliminated from the metal, which metal in a pure, or practically pure, state is left in the coke ready for the smelting furnace. The drawing shows a longitudinal vertical section of a part of the furnace and retort employed.

5123. VACUUM BRAKES, *J. A. F. Aspinall, Dublin.*—23*rd November*, 1881. 8*d*.
The inventor claims, First, a valve for use by the driver to admit air to the train pipes, or to remove air by aid of the ejector or other appliance. Secondly, the combination of parts forming an improved directing valve for use under each vehicle.

5124. TIP VANS OR WAGONS, *E. Hora, London.*—23*rd November*, 1881.—(*Not proceeded with.*) 2*d*.
This invention relates to means of operating tip vans or wagons with or without springs, and also to effect the automatic opening of the tail-board simultaneously with the tipping of the van.

5128. HEEL PORTION OF BOOTS AND SHOES, *W. Reid, Bristol.*—24*th November*, 1881.—(*Not proceeded with.*) 2*d*.
This consists in providing an inner lining heel on which the foot can rest, and the heel be lifted within the boot or shoe itself instead of the heel proper being built up on the outside as at present. Said lining heel may be, if desired, in conjunction with a low outside heel.

5129. UMBRELLAS, &c., *R. H. Brandon, Paris.*—24*th November*, 1881.—(*A communication from J. P. d'Aragon, Paris.*) 6*d*.
This relates to the peculiar construction of the top notches, the runners, and ribs of umbrellas, &c.

5130. OPTICAL INSTRUMENTS, *R. F. Woodford, Upper Norwood.*—24*th November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to an instrument designed to demonstrate the crossing of the optic nerves of the eyes.

5132. TEMPLES FOR WEAVERS' LOOMS, *W. R. Lake, London.*—24*th November*, 1881.—(*A communication from La Société de Tassigny, Frères, et Cie., Reims.*) —(*Not proceeded with.*) 8*d*.
The invention consists essentially in providing two cylindrical or conical rollers, over which the fabric or web passes with an adherence which is regulated by the pressure (variable at will) which is brought to bear upon the said rollers by a third cylindrical or conical roller, the pressure being sufficient to hold or retain the fabric, and to cause it to be maintained in the loom at its regular or proper width.

5133. PRINTING CROSS-STITCH EMBROIDERY PATTERNS UPON VARIOUS MATERIALS, &c., *A. J. Boult, London.* —24*th November*, 1881.—(*A communication from J. Mössmer, Vienna.*)—(*Not proceeded with.*) 2*d*.
Type, such as is used in printing, is employed, but bearing instead of letters either crosses or squares, and is set up according to the desired pattern. The forme may be stereotyped in the ordinary manner.

5134. SPINNING WOOL, &c., *W. T. Emmott, Manchester.*—24*th November*, 1881.—(*A communication from E. Appenzeller, Mulhouse.*) 6*d*.
This relates to improvements on patent No. 319, A.D. 1880, the object being to regulate the motion of the apparatus, and of its alternating action upon the sliver.

5135. SPINNING MACHINERY, *F. Ripley and T. H. Brigg, Bradford.*—24*th November*, 1881. 6*d*.
This relates to the construction, combination, and arrangement of parts of flyer, or a spinning "ring" and "traveller" or "carrier" spindle driving and lubricating, the whole being designed so as to render high speed of rotation available.

5136. STAYS OR CORSETS, *D. Davies, London.*—24*th November*, 1881.—(*Not proceeded with.*) 2*d*.
The object is to strengthen the side ribs, and provide against the liability thereof to breakage.

5138. TRAM-CARS, &c., *H. Betteley, London.*—24*th November*, 1881.—(*Not proceeded with.*) 2*d*.
This relates to improved details connected with tram-cars and their brakes, and stopping and restarting apparatus.

5140. IMPROVEMENTS IN TELEPHONIC AND TELEGRAPHIC SIGNALLING APPARATUS, *A. C. Brown and H. A. C. Saunders, London.*—24*th November*, 1881. 6*d*.
This relates to improvements whereby a series of stations are connected by one line wire, and any station can communicate with any other station on the same line, the wire being unoccupied, without the intermediate stations being able to interrupt. This is accomplished by the provision at each station of an instrument with a graduated series of resistances which the operator can insert in the line circuit; each instrument is provided with an electro-magnet, with armatures held back by springs differently adjusted for appreciating the resistance in the line circuit. This controls the connections both of the resistances and the receiver and transmitter, preventing their being placed in connection with line except the line resistance has been set to a pre-arranged quantity. Each instrument is also provided with blocking parts, which render the variation of the resistance inoperative in the instrument in which it is produced. The inventors claim the above arrangements, also a method of connecting two telephones by an induction coil, and

a switch arrangement for shunting the receiving telephone and secondary coils of the induction coil out of the line circuit. We described this invention in our articles on the Crystal Palace exhibits some weeks ago.

5141. HATCHING EGGS BY ARTIFICIAL HEAT, &c., *C. E. Hearson, London.—24th November*, 1881. 6*d*.

This consists in the combination with the apparatus for hatching eggs by artificial heat of a means for heating the water contained therein, and of mechanism operated by the expansion and collapsion of a hermetically sealed case or capsule containing a liquid which boils at the temperature at which the interior of the apparatus is required to be kept, the said mechanism being so arranged that heat shall pass to the water while the said case or capsule is in a collapsed state, and shall be diverted from the water while the said case or capsule is in an expanded state.

5142. APPARATUS FOR WARMING OR HEATING, *L. A. Groth, London.—24th November*, 1881.—(*A communication from C. Ostlund, Stockholm.*) 6*d*.

The object is to produce an apparatus by which great heat may be produced at a low cost by burning paraffine or other suitable oil without danger of explosion.

5144. EMPLOYING EXPLOSIVE SUBSTANCES FOR BLASTING ROCK, &c., *E. Edwards, London.—24th November*, 1881.—(*A communication from E. Wickersheimer and L. Pech, Carcassoune, France.*) 6*d*.

This relates to the process of making the chambers in the rock, such process consisting, First, of weakening the part which is to be blasted by means of holes regularly distributed; Secondly, of breaking for a sufficient distance the separating walls between such holes; Thirdly, of, if necessary, crushing more or less of the resulting *débris*; and Fourthly, of withdrawing, if necessary, the *débris* from the holes.

5145. MANUFACTURE OF ARTIFICIAL PARCHMENT, &c., *C. Weygang, South Hornsey.—24th November*, 1881. —(*Not proceeded with.*) 2*d*.

This consists principally in an adaptation of the property which animal glue possesses of being rendered by treatment with bichromate of potash and alum insoluble and very tenacious, in combination with animal or vegetable fibre.

5147. OIL LAMPS, &c., *J. Darling, Glasgow.—25th November*, 1881.—(*Not proceeded with.*) 2*d*.

The principal objects are to provide a ready means for raising the wick and also to enable the grease or paraffine, wax or scale, used to be more readily melted by the heat of the burning wick.

5148. PERAMBULATORS, &c., *T. Steen, Ripley.—25th November*, 1881. 6*d*.

The invention consists of a locking apparatus for one or both of the carrying wheels, by the use of which the said wheel or wheels will be prevented from moving, thus preventing the vehicle from moving down an incline.

5151. SOLITAIRES, &c., *A. B. Furlong, London.—25th November*, 1881.—(*Not proceeded with.*) 2*d*.

This relates to a means of fastening the solitaires, &c., in shirts.

5152. BOBBINS, TUBES, &c., USED IN TEXTILE MACHINERY, *J. H. and L. Wilson, Todmorden.—25th November*, 1881. 6*d*.

This relates to various improvements upon the bobbins and tubes described in patent No. 1772, A.D. 1881.

5153. SLIPWAYS, *J. Thompson, Newcastle-on-Tyne, and G. Cooper, Penarth.—25th November*, 1881. 6*d*.

This consists of a mode of constructing the cradles and longitudinal sloping rails or "ways" in such a manner that a ship having been hauled up to a certain point upon the main cradle can be transferred to an auxiliary cradle, the main cradle being thereby liberated to receive another ship.

5154. STOPPERS FOR BOTTLES, &c., *H. Barrett, Westminster.—25th November*, 1881. 6*d*.

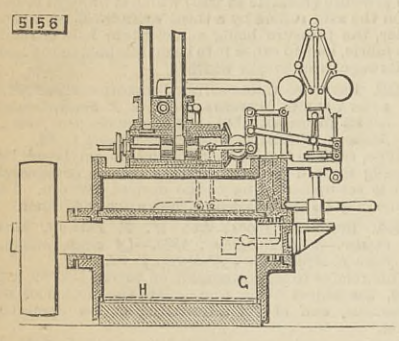
This refers to the manufacture of what are known as screw stoppers, when such stoppers are made from a plastic material, such as bionite, which is liable to be acted on by heat or by the liquid to be bottled.

5155. MANUFACTURE OF MINERAL WHITE SUBSTANCES SUITABLE FOR DRESSING AND FACING PAPER, &c., *T. H. Cobley, Dunstable.—25th November*, 1881. 4*d*.

This relates, First, to the manufacture of mineral white by treatment of sulphate of magnesia with hydrate of lime; Secondly, the manufacture of mineral white by treatment of chloride of calcium with sulphate of magnesia; Thirdly, the manufacture of white paste for preventing mildew of fabrics by treatment of chloride of magnesium with hydrate or carbonate of lime and addition of alumina.

5156. ROTARY ENGINES, *A. Brossard, Paris.—25th November*, 1881. 6*d*.

The invention consists, First, in the novel construction of the piston, whereby the dead point may be overcome. The piston consists of a blade or palette G suitably mounted on or secured to the shaft C, and a small cylinder H enclosing the shaft C and the blade



G. A longitudinal slit or opening is formed in the cylinder H, through which the blade G projects. The outer edges of the blade G and the edges of the cylinder on either side of the opening or slit are provided with suitable packing to render the parts steam tight. The Second part consists in a novel arrangement of cut-off, and in means for working the same.

5157. TOOL FOR HOOPING BALES OR BOXES, *J. McClure, Belfast.—25th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists of a novel arrangement of apparatus for drawing together the ends of metal or other bands on bales or boxes and holding them firmly, ready to be secured by rivets or otherwise.

5158. APPARATUS FOR INDICATING THE CONDITION OF THE WARES BEING BURNED DURING THE FIRING OF KILNS USED IN THE MANUFACTURE OF POTTERY, &c., *A. Turner, Worcester.—25th November*, 1881. 6*d*.

This consists in a tube which is placed through the wall of the kiln, and so far into the interior as will insure the closed end—against which is a piece of unburnt clay—receiving the full heat of any given part of the kiln where it may be placed. As the burning proceeds the piece of unburnt clay contracts, and pieces of burnt clay or other suitable material being forced up the tube, the movement is indicated by any suitable means.

5160. COAL-CUTTING MACHINERY, *J. R. Bower, J. F. A. Pflaum, and J. T. Tannett, Leeds.—25th November*, 1881. 6*d*.

The inventors claim a coal-cutting machine having electro-magnets and an armature imparting motion to a lever carrying cutters.

5161. RIBBED HOSE AND SOCKS, *W. Raven, Leicester.—25th November*, 1881. 4*d*.

This consists in the making of an extra course at the commencement of the work, from which is suspended a weight by means of a row of hooks, which extra course is so made that it can afterwards be removed.

5162. VENTILATING BUILDINGS, &c., *F. Löndholdt, Frankfort.—25th November*, 1881. 6*d*.

The object is to heat ventilation shafts by a special construction of heating chambers or wall-boxes, to provide cowls on the said shafts to prevent down draught or the wind from blowing down, and to increase and regulate up draught; also to provide apparatus by which fresh air can be introduced without causing a draught.

5164. APPLIANCE FOR LAWN TENNIS POLES, *E. Haskell, London.—26th November*, 1881. 4*d*.

This relates to a contrivance for straining and fixing lawn tennis nets.

5165. DISLODGING THE GERMS FROM WHEAT, &c., *T. H. D. Voss, London.—26th November*, 1881. 6*d*.

This consists in the process for dislodging the germs from wheat and other cereals by guiding the grains between annularly ridged and grooved rollers, so that they are opened or split longitudinally along their creases or germ lines.

5168. SCREW BUTTONS FOR ARTICLES OF APPAREL, *E. A. Brydges, Berlin.—26th November*, 1881.—(*A communication from B. Fischer, Stuttgart.*)—(*Not proceeded with.*) 2*d*.

The button proper acts as a nut, and is so attached to a suitable screw that the said button cannot leave the screw.

5172. WATER-CLOSETS FOR SHIPS, *C. Pieper, Berlin.—26th November*, 1881.—(*A communication from R. Henneberg and A. Herzberg, Berlin.*) 6*d*.

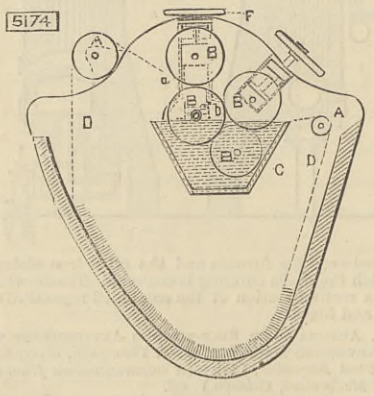
The improvements consist in the means applied for securely closing the discharge pipe, for flushing the basin, for discharging the contents of the latter into the sea, in case the closet is below the water-line, and for operating the various parts with facility.

5173. ROTARY ENGINES, *W. A. Barlow, London.—26th November*, 1881.—(*A communication from J. J. Ritz, Gmünd, Germany.*) 6*d*.

This consists in the combination in a rotating machine of a rotating working body with a concentric working space, with a firm packed locking piece resting in the latter, and one or more automatic adjustable locking valves arranged in the ring-shaped working space, the turning axis of which is parallel with the axis of rotation of the working body.

5174. MACHINERY EMPLOYED IN WASHING, SCOURING, AND DYEING FABRICS, *L. Webster, Dewsbury.—26th November*, 1881. 4*d*.

The invention consists in a new combination and arrangement of the nipping or squeezing rollers. In the drawing A are the guide rollers, B the nipping



rollers, and C the trough containing scouring or dye liquor. Two of the nipping rollers are capable of adjustment by sliding pedestals and screws F. D is the fabric which is nipped in its passage through the machine at the points *a b c*.

5175. APPARATUS FOR RECORDING THE SPEED AND THE DURATION OF STOPPAGES OF ROTATING SHAFTS, &c., *D. Young, London.—26th November*, 1881. 6*d*.

This consists essentially of an apparatus for recording the speed of rotating shafts, in which a governor operated by the shaft whose speed is to be recorded gives to-and-fro motion to a pencil by means of levers and connections in such a manner that the travel of the pencil is greater than that of the sleeve upon the governor spindle, suitable devices being provided for causing the pencil to move in a straight line.

5176. STEAM BOILERS, *J. Harrison, Jarrow-on-Tyne.—26th November*, 1881.—(*Not proceeded with.*) 2*d*.

The internal flues are not only formed of a circular or curved form in cross section, but they are also formed with their sides, tops, and bottoms curved or arched in longitudinal section, the flues being of larger diameter at the centre than they are at the one or their two ends.

5177. REPRODUCING VIEWS, &c., IN PHOTO-LITHOGRAPHY OR PHOTO-TYPOGRAPHY, *B. C. le Moussu.—26th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in the employment of photography in combination with the photo-embossed tint process described in specification of patent No. 3570, A.D. 1881.

5178. GAS MOTOR ENGINES, *J. Shaw, Liversedge.—26th November*, 1881. 6*d*.

The invention consists partly in the use of a separate combustion chamber in combination with air and gas supply pipes or passages and valves, so arranged as to deliver the combustible mixture to the upper part of the said combustion chamber.

5179. RENDERING HARMLESS FIRE-DAMP AND OTHER EXPLOSIVE GASES, *D. R. Jenkins and G. Treharne. Aberavon.—28th November*, 1881.—(*Not proceeded with.*) 2*d*.

A lamp or portable furnace is employed having the usual protection against the communication of its flame with the explosive gas. Above this, and near enough to be kindled by its flame, is placed a fumigant, consisting of a mixture of Peruvian bark and tobacco, in a suitable holder encased with wire gauze to prevent it setting fire to the explosive gas.

5180. MACHINES FOR WASHING, &c., *N. Bradford, Manchester.—28th November*, 1881. 6*d*.

The improvements that relate more especially to washing machines consist of a rectangular or other shaped washing vessel with a solid partition extending its entire length, thereby forming two compartments. The vessel itself is fitted with a water-tight lid or cover of a peculiar construction.

5182. BOILERS, *W. Mather, Newark-on-Trent; C. Cousins, Lincoln; and H. Wurr, London.—28th November*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in the combination of a pocket, water space, or interior chambers with vertical and hollow cross-stays, the said pocket or interior chambers being attached to a ring—of U, trough, or other suitable section—from which it depends perpendicularly in the centre of the fire-box, the said ring being secured to the upright sides of an ordinary vertical fire-box.

5190. SECURING KNOBS OR HANDLES TO SPINDLES, *G. Harper, London.—28th November*, 1881. 6*d*.

This consists in the employment of an intermediate collar provided with passages for projections upon the knob or handle, and a holding and releasing catch or device.

5191. HEATING APPLIANCES, *A. C. Henderson, London.—28th November*, 1881.—(*A communication from C. G. A. Masson, Roigneau, Paris.*)—(*Not proceeded with.*) 2*d*.

This relates to an apparatus to be sunk underground,

5192. GUN BARRELS, &c., *W. C. Stiff, Birmingham.—28th November*, 1881. 4*d*.

This consists essentially in taking a bar of approximately square or other suitable angular or other section, and heating the same from end to end at one operation, then twisting the same and afterwards rolling, hammering, or otherwise working it, the same having been heated in a solid state, or having had a hole bored or punched in it at any desired stage of the process.

5194. PEN FOR FOUNTAIN-HOLDERS, *F. Wirth, Frankfort.—28th November*, 1881.—(*A communication from E. Spindler.*)—(*Not proceeded with.*) 2*d*.

This relates to the preparation or treatment of steel pens or nibs to specially adapt the same for use with fountain or reservoir holders.

5195. GAS REGULATORS AND BURNERS, *J. Ungar, London.—28th November*, 1881.—(*Not proceeded with.*) 2*d*.

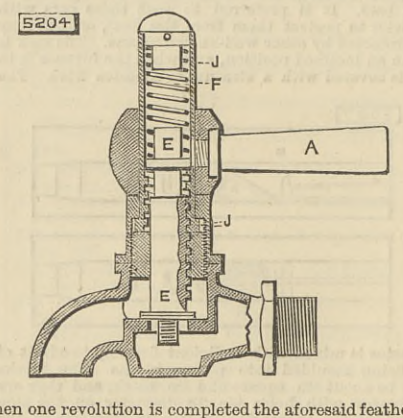
The object is to maintain a regular and uniform pressure of gas at the burner, and to enable a person to observe the action of the gas whilst flowing thereto.

5200. SELF-REGULATING GAS BURNERS, *W. Snelgrove, Melksham.—28th November*, 1881. 6*d*.

This consists in the combination of a sensitive spring acting as a hinge and a disc or valve (attached thereto) in such manner as to maintain the said disc or valve in a central position relatively to the chamber in which it is placed, so as to obviate peripheral friction and the attendant liability to stick from corrosion and other causes.

5204. STOP-COCKS OR SAFETY TAPS, *C. Stuart, Fenny Stratford.—29th November*, 1881. 4*d*.

In the drawing J is the spindle or valve-box having the female screw, and the slot cut in it, and E is the spindle having a screw cut feather to work in the slot. By moving the handle at the spindle E is raised, and



when one revolution is completed the aforesaid feather meets the slot, and the pressure of the spring F forces the spindle back to its normal position, the rising and falling being thus repeated at each revolution.

5205. DRILLING APPARATUS, &c., *C. Stuart, Fenny Stratford.—29th November*, 1881. 4*d*.

The invention consists in forming an outer shell or casing to enclose the drilling mechanism, and in the manner of producing a continuous rotary movement of the drill spindle, combined with a self-acting forward or feed motion of the drill.

5208. STOPPERING JARS, &c., *H. Mardon, Bristol.—29th November*, 1881. 6*d*.

This consists in the employment for closing bottles, jars, or other receptacles, of spring catches in the side of the plug of the stopper to take under a flange in the mouth of the bottle or receptacle in combination with a washer between the top of the bottle and a flange of the stopper, the parts being so proportioned that as the stopper is being inserted into the bottle the washer becomes compressed and makes a tight joint before the catches pass the flange in the bottle.

5209. COATING THE SURFACE OF TIN-PLATE, &c., *A. H. Hopkins, Birmingham.—29th November*, 1881. 6*d*.

This consists in coating the surfaces of tin-plates and other metal sheets of articles made from tin-plates and other metal sheets, with varnishes, lacquers, and japans (or other similar coating materials) either alone or mixed with suitable colours or stains, as desired, previously to storing the same in the usual manner, and, preferably, at a high temperature, by means of rollers which have their rolling surfaces formed either of india-rubber or of leather or other suitable yielding substances, the said rollers being operated under pressure either by hand or (in the case of coating tin-plates and other metal sheets) in a machine.

5215. MANUFACTURE OF HORSE NAILS, *J. A. Huggett, Kensington.—29th November*, 1881. 4*d*.

A mild steel bar is prepared by hot rolling of a sectional form corresponding to two nails laid point to point and grooved along the centre to give the proper bevel to the points. The bar is first slit or divided along the centre by means of roller shears, and from the lengths thus obtained pieces are punched out, forming nails by means of a punch and bolster of corresponding shape.

5217. MACHINERY APPLICABLE TO CRANES, HOISTS, &c., TO OBTAIN INTERMITTENT AUXILIARY MOTION, *W. Clarke, Gateshead-on-Tyne.—29th November*, 1881. 6*d*.

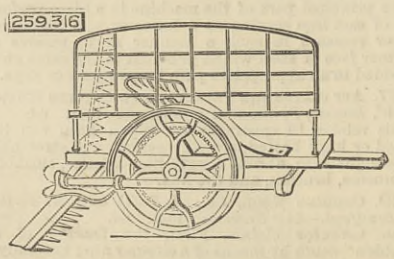
This relates to the improvements applicable to cranes, hoists, and other like apparatus for obtaining intermittent auxiliary motion from continuous motion, the said improvements consisting in the combination with the primary or ordinary barrel or the like of a second barrel or the like, to which motion is communicated by a driving disc or clutch, or driving disc or clutches.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

259,316. LIFE-GUARD FOR REAPERS AND MOWERS, *Richard A. Kelly, Manchester, Iowa.—Filed 19th September*, 1877.

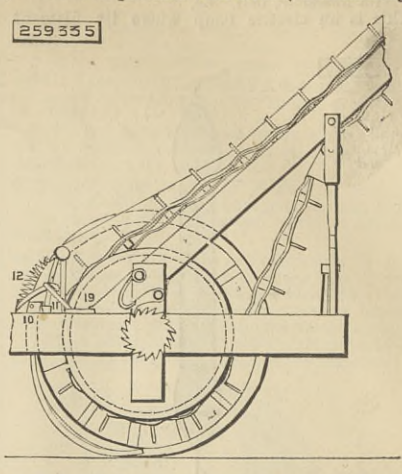
Claim.—(1) In combination with a harvester frame carrying a driver's seat and having a folding cutting bar attached thereto, a life-guard located on the frame



between the seat and the folding bar, substantially as described. (2) In combination with a harvester frame carrying a driver's seat and having a cutter bar attached thereto, a grated guard, substantially as described, adapted to serve as a hand or foot rest for the driver.

259,335. HAYRAKE AND LOADER, *Thomas E. Shoemaker, West Salem, Ohio.—Filed March 14th*, 1882.

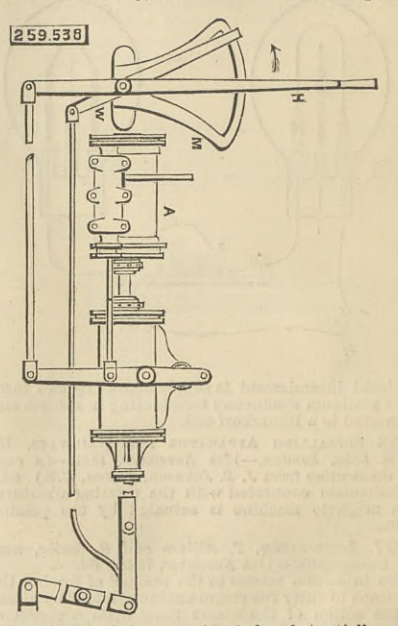
Claim.—(1) The combination of the main frame and carrying wheels, the stacker pivotted to the main frame, the standard 19, and the pivotted bail having the pivotted lever provided with a rack, substantially



as described. (2) The combination of the main frame, of the cross bar 10, of the independent rake teeth mounted or pivotted thereon, of the springs 12, and of the adjustable cross bar 11, against the lower surface of which the said teeth bear, substantially as described.

259,538. REVERSING GEAR FOR LOCOMOTIVES, *William P. Henszey, Philadelphia, Pa.—Filed November 7th*, 1881.

Claim.—(1) The combination of the steam cylinder A and its piston, a valve for admitting steam to and exhausting it from the said cylinder, the hydraulic cylinder having a piston connected to that of the steam cylinder, a valve for opening and closing a communication between the opposite ends of the said hydraulic cylinder, and mechanism for operating both valves simultaneously, the two valves and the ports



relating thereto being constructed substantially as herein set forth, so that on moving the valves in either direction that of the steam cylinder will always act in advance of that of the hydraulic cylinder, as described. (2) The two cylinders and their connected pistons, the valves, and the hand lever H, for operating the same, in combination with the stand M, its graduated segment, the pointing lever W, and mechanism by which the piston rod of the two cylinders is caused to actuate the said lever, all substantially as specified.

CONTENTS.

THE ENGINEER, June 30th, 1882.