LITERATURE.

Chemins de Fer. Mémoire sur la Marche à Contre-Vapeur des Machines Locomotives. Notice Historique. Par M. LE CHATELIER, Ingénieur en Chef des Mines. Paris: Paul Dupont, 1869.

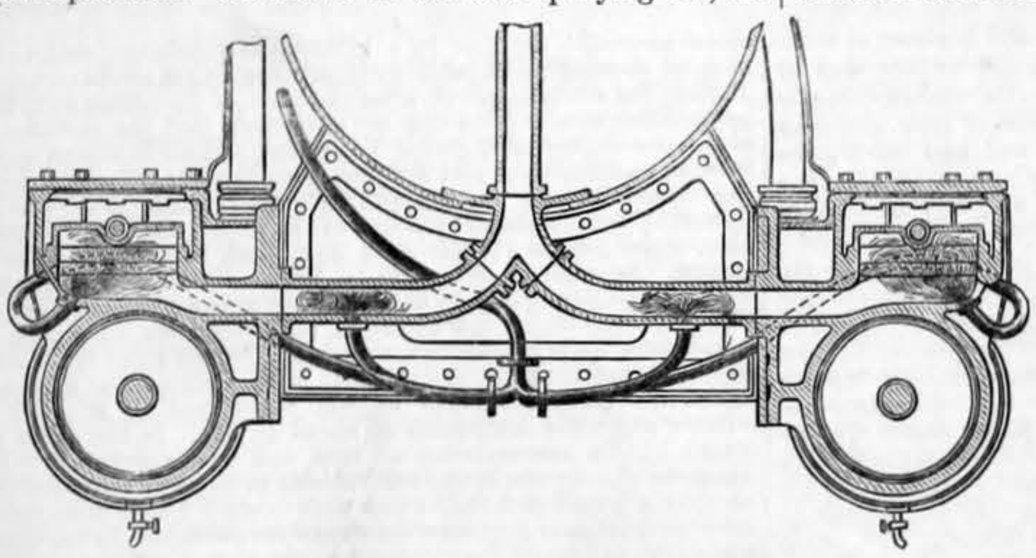
Chemins de Fer. Supplement au Mémoire sur la Marche à Contre-Vapeur des Machines Locomotives. Par M. LE CHATELIER, Ingénieur en Chef des Mines. Paris: E. Martinet, 1869.

Railway Economy; Use of Counter-Pressure Steam in the Locomotive Engine as a Brake. By M. LE CHATELIER. Translated from the Author's Manuscript by LEWIS D. B. GORDON, F.R.S.E., &c. Edinburgh: Edmonston and Douglas. 1869.

IT is very very seldom indeed that we have to notice such interesting and important works as these three small volumes. Merely the author's name, so well and so long known to the public in connection with important investigations into the counter-weighting of locomotive engines, the working of blast furnaces, and the influence of the temperature of the cylinder on the steam, would rouse attention. The subject he now handles has indeed a connection, possibly unconscious to M. Le Chatelier himself, with the last named of these investigations; but the present treatise is not of a theoretical character merely, as it embodies the description and theory of, and the results obtained with, an apparatus as yet scarcely known in England, but already applied to nearly three thousand continental locomotives.

It must have long been perceived that the locomotive might be made to develope within itself the means of retardation of a train to which it often contributes the greater part of the total mass in motion. The obvious advantages of a practical employment of back-pressure steam are that it would put a true steam brake into the hands of the engine-driver, and, as a consequence, a more independent control over his engine, diminishing the risk of collision and running past stations, and facilitating shunting. As it would diminish the number of brakes required, bringing into use, for the purpose of retarding the train, mechanism already in existence, it would also diminish the number of brakesmen. The use of brakes besides means more or less undue wear of rails and wheel-tires, and often a waste of grease from the heat by the friction conducted from the rim to the axle-box. In these directions, therefore, economy would also be effected. But the many drawbacks and injuries produced by reversing the gear with the engine running prevent drivers doing so except in cases of imminent danger. The hot gases of the chimney are exhausted out of the smoke-box and forced into the boiler, heating the cylinders and shaking the joints of the boiler. The piston rods get heated, the packings carbonise, the slide valves bite on the port faces, the injectors cease to act from the presence of incondensible gases in the steam, and, in some classes of engines, the reversing handle is often dangerously thrown back. In fact, reversing the engine by the inverse admission of steam, necessarily attended with the admission of hot gases from the smoke-box, often renders the engine unfit for service within less than five minutes. Even with imperfect forms of the plan to be here described, the same action takes place, though at a much slower rate. "Direct experiments made on the north of France line prove that by shutting the blast pipe and drawing in external air, with the engine running at a speed of twenty miles per hour, the stuffing boxes were carbonised after a run of one and a-half miles; and with an injection of steam alone there was a similar result after a run of two and a-half to three miles."

Now M. Le Chatelier has proved that all these inconveniences may be remedied by simply leading a small tube from the boiler to the bottom of the exhaust pipe near the cylinders. The eight to forty pounds of hot water per minute thus delivered under the boiler's pressure are instantaneously converted into a fine spray by contact with the hot metallic surfaces of the cylinders and pistons. While cooling them, and absorbing the heat produced in the motion of the parts, the steam produced not merely acts as an elastic brake, but it may be made to cause a discharge from the blast pipe sufficient to keep out any gases from the smoke-box. The apparatus may, therefore, be said to consist of a pipe from an inch to an inch and a quarter diameter, and a common tap. If, therefore, this can be dignified with the term apparatus, it is as simple as the principle itself. As shown in the accompanying cut, the



inch or so diameter tube communicates between the boiler and the exhaust pipe, and is regulated by a tap. It must be noticed that the figure represents two distinct arrangements. In the one the insertion is made on the branches of the exhaust tube, and the wet vapour has two distinct ways to traverse to reach the cylinders, viz., the part of the pipe near the cylinders, and the admission ports. This wet vapour does not get into the cylinders until after the steam, more or less dry, has been discharged from them at the end of the expansion, nor until that at the end of the cushioning has returned. If there be excess of injection water, it is projected through the blast pipe nozzle by the funnel. In the other arrangement the insertion is made under the slide valve itself in the side of the discharge port. In this case the wet vapour has only to traverse the passage to the ports; one part enters directly at the moment of induction, the other mixes with the discharged steam, returns in part to the cylinder, and goes off in part with it to the nozzle. Experience proves that, for equality of injection, much more water is projected by the funnel, and falls in rain on the engine, in the first arrangement than in the second. This arises from the greater quantity of steam generated in the first arrangement; whereas in the second the water is held in suspension by a greater quantity of steam." The process is found to act almost instantaneously, three or four seconds being ample after letting on the water jet, and without even opening the regulator, to make the change from full forward gear to full backward gear. Without it the drivers would of course have to signal to the brakesman to put on the brakes—an operation which, in the most favourable cases, takes some time. As was neatly observed by Mr. Siemens, in his presidential address to the Mechanical Section of the British Association, M. Le Chatelier's plan converts the engine "for the time being into a pump forcing steam and water into its own boiler." The spray reaching the cylinders is there converted into steam, and dried by the absorption of the heat generated by the cushioning and forcing back the steam at the return stroke of the piston. The cylinders may be said to be temporarily turned into apparatus for evaporating the injected water by means of the heat generated by the motion produced on the pistons by the work already accumulated, and, possibly further accumulating by gravity, in the moving train.

Whatever might be at first thought there is no danger for the cylinder covers. The driver has only to inject water in sufficient quantity to produce a white cloud out of the funnel; even any considerable excess of water is not attended with danger, as the spray in excess cannot penetrate into the cylinders, and is simply thrown out at the funnel. Already several slight modifications have been made by different engineers; for instance, M. Laurent, the engineer of the Chemin de fer du Midi, closes up the blast pipe, and injects the water into a closed space communicating with the cylinders. The resulting advantage is the prevention of all loss of steam and heat, any undue pressure being taken off by the safety valves. On the Paris, Lyons, and Mediterranean line the drivers are ordered to relieve the safety valves when running down an incline, so as to somewhat diminish the blowing-off pressure. By this means any undue rise of pressure, which might possibly cause a tube to burst, throwing the work of retarding the train on the usual brakes, is prevented.

Of all the advantages resulting from the use of this plan the most important is clearly, as we have noticed, the practical independence of the engine-drivers of the ordinary brakes and brakesmen. Incidentally the use of the plan must do away with a portion, at least, of that fearful shrieking of the steam whistle—such a nuisance on lines passing through towns. According to the author the ordinary brakes should only be regarded as incidentally furnishing additional resistance. At the least, the counter-pressure steam should be used concurrently with the brakes for the current service; and this combination allows to stop with exactness and without hesitation at the stations. On single lines of railway, where it is very important for safety not to pass a station, its use is indispensable; and the employment of the screw form of reversing handle and counter-pressure steam greatly facilitates shunting operations. With a sufficient injection of water, gradients can be run down at a regulated speed, and without fearing any injury to the engine. The diagrams before us show that when the engine is working on this system of back-pressure steam the resisting work can attain from 55 per cent. to 60 per cent. of the work developed in the ordinary working. Amongst the practical results are such as these:—"On an incline of from thirty-five to thirty-six millimetres the service can be carried out in both directions, without the use of brakes, with an eight-wheeled coupled engine running at the rate of fifteen to sixteen kilometres per hour, and drawing six loaded goods wagons or from ten to eleven passenger carriages." On the incline at Lannemezan on the Chemin de Fer du Midi, the inclination of which is one in thirty-four for a length of six miles and three-quarters, the company had ordered Bessemer steel rails for the descending line, but after a lengthened experiment it was evident that the rails did not wear more rapidly on the descending than on the ascending line, and the costly Bessemer steel rails were employed on other parts of the lines where there is a greater traffic. Experience on the Chemin de Fer from Paris to Lyons and the Mediterranean has also proved that the constant use of the back-pressure steam system has not in the least increased the cost of repairs and working of the engines. It therefore forms another and most important contribution to already existing means for safely working steep gradients; and it is stated that counter-pressure steam is already used in the current service of the trains on the gradients of the Semmering and the Brenner lines. No inconvenience has been found to occur on sharp curves from the resistance to motion being produced at the head of the train; any tendency in this direction being corrected by the complete command obtained by the driver over the rate of speed of the train.

Incidentally, the plan is extremely interesting to the scientific engineer, as the energy of the train is mainly converted into the steam partly employed in retarding it, and partly making its appearance again in the boiler; and this important point about it has been theoretically investigated by M. Le Chatelier himself, M. Combes, and others. On first thoughts, it might seem necessary to provide for some means of getting rid of incrustation left by evaporating water inside the cylinders. It must, however, be remembered that only heated water, already boiled, and hence freed from sulphate and carbonate of lime, is taken, so that this influence is scarcely felt, even if the plan be very extensively used. There can be no doubt that this system must for the future be taken into account in designing locomotive work. Observing the excellent lubricating effect obtained by injecting water, the engineers of the Orleans railway are studying its effect in preventing the injury to the steam packing and other rubbing surfaces produced when a train runs down a gradient with a closed regulator. In this case there is admission of the smoke box gases during the lead of the exhaust, to be corrected by the water jet. It would, it seems to us, be of great service on the Metropolitan Railway, and we would strongly suggest its trial by Mr. Burnett, especially as the plan is unprotected by patent right in any country besides Spain. If it were more complicated, this fact would no doubt be a drawback to its introduction, as it would require pushing; but, being so simple and cheap, its use ought to spread *almost* with the rapidity of an invention introduced by a locomotive superintendent on that locomotive superintendent's own line. An important application of the system would be to colliery winding engines, which are, in fact, generally two-cylinder engines with reversing gear, and otherwise of the locomotive stamp. It would form a substitute for, and at the least an aid to, the heavy friction brake at present employed; and many melancholy accidents from overwinding might be prevented. We may note that complete engraved working drawings of the simple form of apparatus used by M. Marié, the locomotive superintendent of the Paris, Lyons, and Mediterranean Railway, have been sent to the London Institution of Civil Engineers and to the Institution of Engineers in Scotland.

Like all other mechanical inventions, however simple they may seem when once carried out, this one also has its history, and it was mainly to defend himself against what seem to us to be unwarrantable claims as to priority of invention, that we owe the early accounts of the plan published by the author. M. Beugniot, in France, first experimented on a plan for causing a vacuum behind the pistons; and it is nearly twenty years ago that Mr. J. Zeh, of Vienna, proposed to use back-pressure on the pistons for an engine intended for the trials on the Semmering incline. The question had dropped until Mr. A. De Bergue, an English engineer of French extraction settled in Spain, at the beginning of 1864, brought out an ingenious form of applying back-pressure with air. For short runs it gave good results, but not under prolonged working. M. Le Chatelier frankly states that it was a cursory examination of Mr. De Bergue's plan which led him to direct experiments to be made on what may now be termed his own plan. Its advantages and drawbacks led him first to recommend the mixture of steam with the air, then steam alone sufficient to prevent the inlet of air, and, lastly, water alone. The development of the process has therefore advanced through five successive stages:—The mere motion of the parts; the use of air by Mr. De Bergue; the use of steam alone; the use of a mixture of water and steam; and, lastly, the injection of water alone from the boiler. M. Le Chatelier himself notices, by the way, that there is a slight analogy between his plan and the use by M. Hugon, in his gas engines, of a slight injection of water at the moment of the lighting of the inflammable mixture, for lubricating and cooling down the surfaces. As the chief engineer, in Paris, of the Spanish Northern Railway, he ordered trials to be made of his proposals by the resident engineers of that line. One of these, M. Ricour, has put forward, in the "Annales des Mines," claims to priority of a part, at least of the invention. After a careful examination of the question it seems to us that this gentleman has little right on his side; and he seems to have overlooked the importance, already in 1865 well pointed out by M. Le Chatelier, of using water rather than steam. The French engineers in Spain seem to have been afraid of using water, especially as good effects for *short* runs were obtained with steam. Already in 1866 a paper was read before the Society of Civil Engineers of France by M. Flachat, on the experiments conducted in Spain, on the Northern Railway, for the employment of back-pressure steam in the descent of inclines. It was then stated by M. Flachat that there was a considerable production of heat, almost corresponding, less by obvious losses, with the mechanical work of gravity. But it was only in January last (1869) that M. Le Chatelier was himself able to prove that the injection of water alone satisfies all the conditions of the problem. A great portion of M. Le Chatelier's writing is thus devoted to the assertion of his claims as to priority of invention. These questions seldom possess much interest for the public, especially a public like the English, to whom the contending parties are not personally known. Very properly, therefore, the object of Mr. Gordon's translation is to "explain the principles, the mode of application, and the results obtained from M. Le Chatelier's experiments;" and he does not enter much into the question of the priority of the invention. M. Le Chatelier specially recast his two memoirs in order to adapt them to English readers. The translation is fairly enough executed, although it would be improved by more workmanlike style and technical idiom; and it certainly gives all the practical information required to apply the system. It is stated that one of the principal causes of the success of the counter pressure system in France has been the substitution of the screw motion for the ordinary lever as a reversing handle. We rather fancy that the use of the screw motion instead of the ordinary reversing lever, was first due to Mr. Ramsbottom, of the London and North-Western, and not to Mr. Kitson, of Leeds, as here stated by Mr. Gordon. Modern locomotive makers do not improve locomotives. For the most part they simply work to specifications.

THE HATCHAM IRONWORKS.—These works, well known as the property of Mr. George England, have just been taken on a lease for fifty years by a company consisting of Mr. Robert Fairlie, Mr. George England, jun., and Mr. John Simpson Frazer, late of the Great Western Railway. Mr. George England has retired from ill health. The works will be carried on with spirit and enterprise we have no doubt, the assistance of so able an engineer as Mr. Frazer being a matter of no small importance. The principal business done will consist in the construction of the Fairlie double-bogie engine and light steam carriage, with which our readers must be familiar. The plant and machinery at the Hatcham Ironworks are very valuable and extensive, and the place possesses remarkable facilities for turning out good work.

CABLE TOWING ON RIVERS AND CANALS.

I.—The Principle of Cable Towing.

It is an undeniable fact that the movement on inland watercourses has not developed itself since the introduction of steam, in the proportion in which other branches of engineering and commerce have felt the influence of a new motive power. Although on larger rivers the employment of tugs and freight steamers has in many instances greatly facilitated, accelerated, or cheapened the regular traffic, steam could, up to the present day, not be employed with advantage on smaller rivers with greatly varying currents, nor is it anywhere on canals of ordinary dimensions of material assistance as a tractive power. Thus railways have steadily absorbed the natural traffic of rivers and canals, and these, once the only legitimate high roads for heavy goods, are falling into insignificance and disuse by the side of their younger and more energetic rivals.

The incongruity of this result is strikingly shown by a few comparative figures, based on the extensive system of canals and railways connecting Belgium with France. For moving 400 tons of coal the *Chemin de fer du Nord* employs forty trucks and one engine, which have a total weight of about 231 tons (engine with tank, 63 tons ; each truck 4⅘ tons), and which generally return empty. The dead weight moved is therefore 462 tons, for 400 tons of useful freight moved over the same distance. The same coal is shipped in two boats of 200 tons, weighing 30 tons each, and also returning empty. The dead weight in this case is consequently 120 tons, or one-fourth of that employed in railways. At a speed of 2½ miles per hour the traction on canals is about 2 lb. per ton moved; on rails, taking in account the gradients which have to be overcome, it averages 14 lb. per ton. The traction on canals requires, therefore, for the speed mentioned one-seventh only of the power necessary for moving the same weight by rail. The first cost of canals in France was, on the average, 130,000f. per kilometre (£8320 per mile), whilst railways running parallel with them were built for 400,000f. per kilometre (£25,500 per mile). The forty trucks used for moving 400 tons of coal cost exactly ten times as much as the two 200-ton boats, which replace them on canals. Finally, the expense for maintenance of the permanent way and stock was on the *Chemin de fer du Nord* more than 1500f. per kilometre in one year, whilst, on the northern canals between Belgium and Paris, 275f. per kilometre have covered all expenses for keeping the works in order. According to these data canal navigation requires one-fourth of the dead weight, one-seventh of the tractive power, one-third of the first cost of the line, one-tenth of the cost of trucks, and one-fifth of the maintenance of the permanent way, as compared with the movement on rails. And in spite of these astonishing differences, all telling against the rail, locomotion on land not only competes with the movement on water, but has superseded it in many cases, and is generally considered the ruin of inland navigation.

It is not our purpose here to show the many causes which have brought about this curious result. Suffice it to say that they may be all, almost without exception, traced back to the one great defect of canal and river navigation—the apparent impossibility of employing in a practical and advantageous manner, steam as the motive power of freight boats.

Screws and paddles, with their hundred varying shapes and arrangements, have all one great defect, which becomes simply fatal on the narrow channels usually at the disposal of inland navigation. The steam engine, for the purpose of propelling the vessel, has to take its fulcrum of resistance in the receding water through which the boat has to be pushed. On very large quiet rivers, and on the open sea, this reduces the effect of a propeller to 55·50 per cent of the power applied to it; but on rivers, where the varying currents place the paddle or screw generally under a considerable disadvantage; or on canals, where, in consequence of the small section of the watercourse, they produce currents around the ship which are scarcely felt on broader sheets of water, the effect sinks to 20 or 25 per cent.—in fact, to a minimum which is, commercialy speaking, no more admissible. Of the various devices which have been tried to overcome this fundamental difficulty, partially by improved forms of the ordinary propeller, partially by new principles altogether—as locomotives or traction engines on the tow-path (tried on the Raritan in the United States, and at Caen in France), wheels working against the bed of the river (tried on the lower Rhone), poles pushing the ground (tried on the Erie and several other American canals)—none, perhaps, promised so much of a final legitimate success as the system which we propose to describe in the following lines, and which is already in regular operation on several of the continental rivers and canals.

The employment of a loose iron wire rope laid on the bed of the river, and anchored only at its two extremities, acted upon by a revolving clip drum on board of the vessel (Baron C. de Mesnil and M. Eyth's system), is the principal feature of the new system. The clip drum, placed either on an ordinary boat or on a special tug intended to move a number of other vessels, is put in motion by a steam engine and suitable gear, taking the rope up from the bottom of the river and dropping it again into the water behind the machinery. Thus the boat is, by the revolving motion of the drum, moving along the cable, practically pulling at the weight of a wire rope, perhaps 100 miles in length, which, of course, will offer a corresponding resistance by its adhesion to the ground and the fixed end points. In fact, the wire rope is nothing but an uninterrupted flexible rail, along which the clip drum, with its well-known bite, works its way exactly in the same manner, and with the same effect, as the driving wheel of a locomotive along its rigid rails. Already a considerable quantity of rope is employed in this manner. Between Liege and Namur, 70 kilometres (42 miles) are placed in the Meuse and in active operation. On the Canal de Beveland (Holland), the Canal de Charleroi, the Canal de la Campine (Liege, Antwerp), the Canal de Terneuse (Ghent, Antwerp), we find either the cable already placed or about to be laid down. This gives for the moment a total of nearly 100 miles—a quantity which seems fully to prove the efficiency and the success of the first practical working experiments, and the importance which one of the first people of well-known activity and experience in matters of inland navigation attributes to this new application of steam power on rivers and canals.

II.—Description of Machinery for Cable Towing.

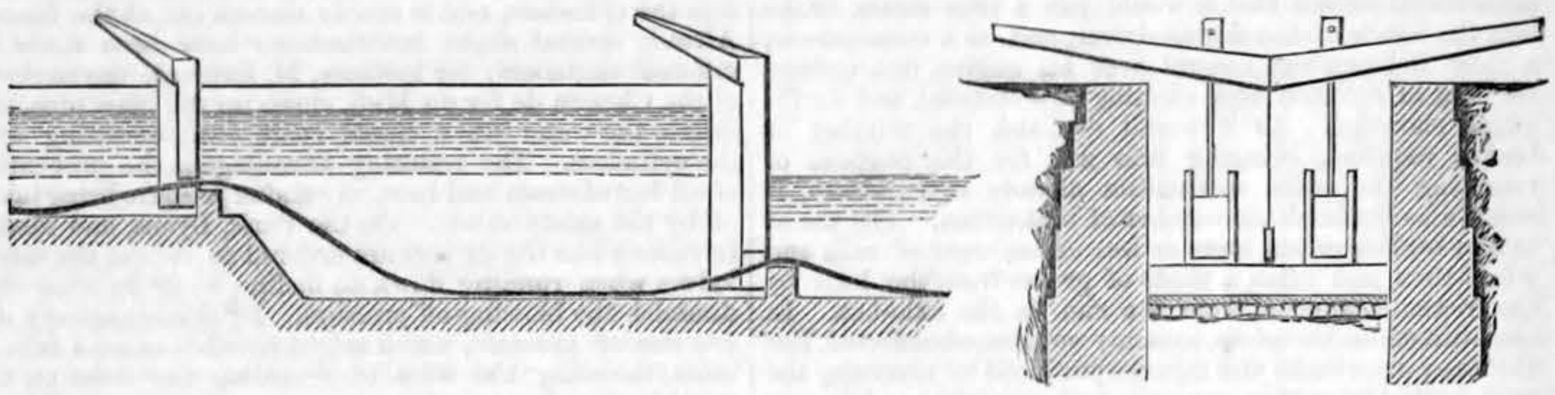
It is evident that the machinery for cable towing will b influenced to a great extent by the various local circumstances to which it has to be adapted. Thus, on large open rivers it will be most suitable to move great trains of boats by powerful tugs; and it may be advisable, where there are throughout rapid currents and a considerable up traffic only, to provide these tugs with auxiliary screws, so that they tow only in one direction by means of the rope, whilst they return with their propeller, towing comparatively empty boats with the full assistance of the currents. Under other circumstances, on tidal rivers, or where there is no current, and an even traffic both ways, either one rope will be used in both directions, on which the tugs may work between stations, or cross each other by an arrangement hereafter to be described ; or two ropes may be placed, one for the up and one for the down trains.

On smaller rivers, especially if canalised and provided with locks, the formation of large trains is forbidden by the long stoppages which the locking through of a train involves. The size of the tugs has therefore to be materially reduced, so far as to tow three to five boats only, whilst on canals with many locks the employment of small fixed or portable engines containing the whole apparatus, and placed on the ordinary canal boats, is the best, in fact we believe the only possible, plan to be adopted. They may be made, according to circumstances, either to tow only the boat on which they are placed, or to take a second and even third boat in tow, which is not provided with machinery. In fact, as we shall show at some future opportunity, the most suitable and most profitable size of boat trains and engines or tugs, and, in consequence, the whole arrangement and management of an effective river or canal traffic, depends almost entirely upon the number, distance, and capacity of the locks which the boats have to traverse on their line.

To give a clear idea of one method of cable towing, we shall describe now the first line put in active operation in Belgium, between Liege and Namur, on the Meuse, already alluded to in these pages. The distance between these two towns, measured in the axis of the river, is 42⅓ miles. The bed is partially muddy and sandy, but occasionally also very rocky. The depth varies between 6ft. and 20ft., and there are, especially in the upper part, some very sharp curves. The currents, originally very rapid, are greatly reduced by a complete and most perfect system of canalisation, and amount, on the average, to scarcely two or three miles an hour during the greater part of the season. But in winter and spring, when the movable weirs are opened, the currents are very violent, amounting occasionally to seven or eight miles an hour. There are between Liege and Namur eleven locks of nine metres (29½ft.) width and sixty-three metres (206½ft.) length, which, in consequence of the successful establishment of wire-rope towing, the Belgian Government intend to rebuild, giving them four times their present capacity.

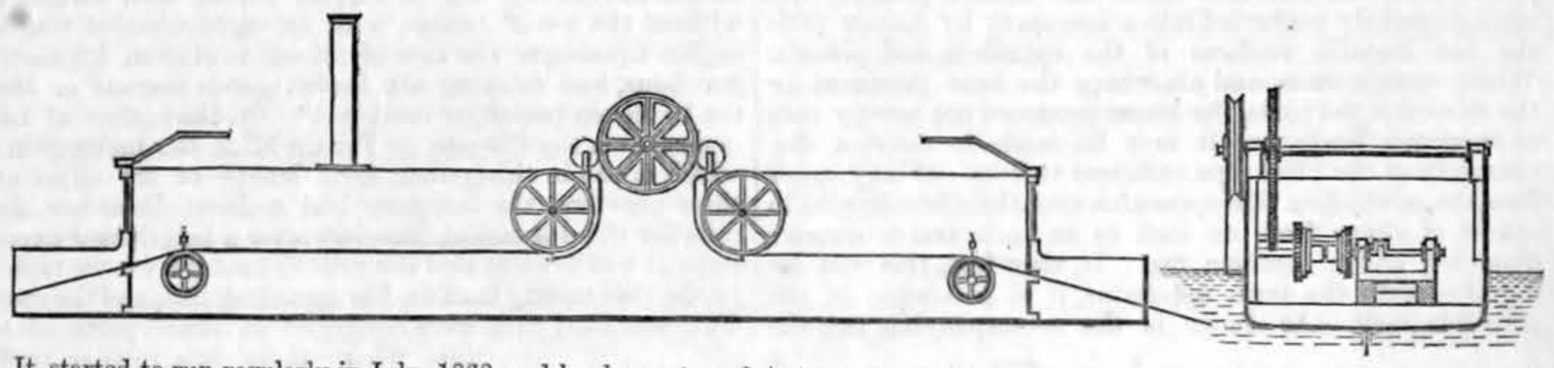
The traffic on the Meuse, not very considerable for the present, is visibly improving, and will, no doubt, in a few years assist one of the most lively trades in coal, stones, minerals, and general merchandise of the Continent. The rope laid down on this line has an outside diameter of 1in., consisting of six strands of seven wires each surrounding a tarred hemp core. Its weight is 2·25 kilogrammes per metre (1½ lb. per 1ft.), and its cost, placed in the river, was 1·4f. per metre, or £90 per mile. It was manufactured by three firms—Messrs. Glass, Elliot, and Co.; Mr. Henley, London; and Messrs. Felten and Guillaume, from Cologne; parts of it being galvanised, whilst others, for the sake of experiment, were placed without galvanisation. The laying was done by simply paying it out from rollers, each containing one mile in length, which were placed in an ordinary boat and towed down the stream by a small river steamer. Before leaving the boat the rope passed over two drums, which were provided with a simple brake, so that it could be tightened or slackened whenever required. In comparatively straight parts of the river it was by these means considerably stretched, whilst passing round bends some slack was allowed to drop into the water. The mile lengths were then spliced together in the ordinary manner, so that now the whole length of 42 miles forms one uninterrupted length.

In the locks the rope lies at the bottom of the water, just as everywhere else. For its passage through the gates there is just above the sill a small opening provided, by cutting off from the edge of each gate about ⅜in. of wood, the height of the opening being about 1½ft. to 2ft. The rope passes through this opening when the gate is closed, whilst when the gates open it lies perfectly free over the sill. The tug having passed, the closing gates sweep it again towards the centre of the lock into its old position.



By the accompanying sketch it will be seen how the openings in the gates are made. Where the water supply is not as abundant as on the Meuse, one would naturally not make them longitudinal, as was done in this case. There are now four tugs of 14-horse power and 20-horse power nominal in operation on this line, of which two were built by Messrs. Fowler and Co., Leeds; one by M. Beer, a Belgian engineer; and one by Cockerill, Seraing. The first boat, now working since the beginning of the year, has a total length of 66ft., a width of 13ft., depth of hold 7ft. 4in., and draws 3ft. 3in. It is entirely of iron, flat bottomed, provided with a false keel and two large rudders, bow and stern being exactly alike. The boiler, of the ordinary locomotive shape, with a total heating surface of 278 square feet, is placed longitudinally in the hind part of the tug. The machinery consists of a horizontal double-cylinder high-pressure engine, acting by suitable gear and by means of two horizontal intermediate shafts on the principal clip drum shaft. This shaft turns in two bearings bolted to the side of the boat and projecting a few inches above the deck line, lying right across the ship. Keyed to it is a 6ft. clip pulley, overhanging the side of the boat. On the same side, below the clip drum, are fixed the centre studs of two guide pulleys also of 6in. diameter. The grooves of these pulleys, so far as the rope touches them, are closed and protected by cast iron guards lined with wood, so that the rope if slack cannot escape. Near the bow and stern of the vessel, in the same vertical plan with clip drum and guide pulleys, we find the two "leading pulleys;" pulleys of about 3ft. diameter, suspended by a vertical arm swinging from a simple universal joint. These pulleys, over which the rope passes before passing along the side of the boat and entering the large guide pulleys, place themselves vertical, or more or less inclined, according to the slanting direction of the cable ahead of the tug, thus preventing it from jumping out of their grooves and leading it always correctly into the larger pulleys below the clip drum. The diameter of the cylinders of the engine is 7¾in.; the stroke, 12in.; ordinary pressure, 80 lb.; number of revolutions, 60. By means of the intermediate gear three different speeds can be given to the clip drum, so that at sixty revolutions of the engines the boat makes 2½ kilos., 5 kilos., and 10 kilos. per hour (one and a-quarter, three, and six miles). Of these the two quick speeds could be thrown in by means of a friction clutch, which was considered essential for starting large trains by degrees. But experience showed that the quick speed gear for 10 kilometres, which was intended for the down trains, in great currents was unnecessary, as the engine would make under these circumstances, easily, and with very little steam, 120 to 130 revolutions. The wheels are, therefore, at present taken off, and only the two slower speed gears used, whilst the engine on an average makes seventy to eighty revolutions. Also the friction clutch, which is indispensable on single-cylinder boat engines, was in this case found of no great practical value. The greatest trains could be started without its use with perfect ease and steadiness.

The accompanying sketch shows the general arrangement of this boat.



It started to run regularly in July, 1868, and has been at work constantly since, towing six to ten boats of 120 to 300 tons at the rate of four or five miles up stream. Its coal-consume is about half a ton per day, and its crew consists of four men—an engine-driver or stoker, a pilot or captain, and two sailors, the working expenses amounting to 545f. per month (£22). The average mileage per day, although twice as great as that of horse-towed boats on the same river, is comparatively very small, amounting, in fact, only to an average of 45 kilometres (27 miles) per day. This is owing to the long stoppages, which are unavoidable in passing the eleven locks with trains of eight and twelve boats. The maximum amount of work done by the tug was the towing of 1000 tons in fifteen boats, and 1200 tons in ten boats, towed at the rate of four miles against a current of one to three miles. The three new boats of this company are provided with an auxiliary screw, as it is intended to let them make the down journey independent of the rope by means of the propeller. Two of them are, nevertheless, provided with an arrangement which greatly facilitates the throwing off and replacing of the rope from the clip drum and the other pulleys, thus enabling the tugs to cross each other. It consists in simply making the centre studs of the two large guide pulleys movable in a slotted bracket, so that by means of a screw the pulleys can be lifted up and removed from the clip drum. In doing so the rope lying originally tight in the groove becomes slack, and can be thrown overboard by hand. In replacing it, it is simply placed on the top of the clip drum, whereupon the guide pulleys are screwed down, and press it again in its proper position.

(*To be continued.*)

McDonnell's Patent Adamantean Concrete Pavement.—In Carter-lane, St. Paul's Churchyard, there will be found laid about 1000 superficial yards of a new species of street paving, permitted by the Commissioners of Sewers to be tested by the traffic, in order, if possible, to its superseding the slippery stones of the London streets. This material is principally composed of broken stone cemented together by a bituminous substance, said to be of great durability and perfectly impervious to the action of water. In fact, the street is paved after the plan of McAdam, with this great difference, and we may say advantage, that the particles of stone are connected together by cement; and all engineers agree that no roadway can excel the "macadamised," if it could be kept free from holes for the lodgment of water. This last point is gained by the McDonnell process, as the paving in Great Carter-lane, which has been in use since April last, is free from holes or indent. In some of the cities on the continent of Europe the natural asphalte has given excellent results as a pavement, but in the patent pavement now before us, and which we have seen in use, we see much greater advantages, the broken stone it contains being the real roadway, the asphalte being only used as a binder. There are many points to be well considered in relation to this or any other description of street paving. Is the noise reduced by this new material, all mud and dust prevented? Are the wear and tear on horses and vehicles in any way abated? Can the public travel over the surface with safety? To all these points save the last we say yes, but when we saw the paving used a day or two since it was slippery, the water cart having been over it about twenty minutes previously. This point must be remedied if the paving is to be a success. There being no chance of the surface water entering the material, we are convinced that with a proper system of gutters and grating the surface water can be rapidly carried away. The pavement, being laid in blocks of large size, can be easily taken up and re-laid when required for gas or water purposes, and if the surface be worn a coating of the material can be readily applied, which will be firmly bound within one hour. The cost of this new paving will, it is stated, be at least 30 per cent. cheaper than the granite pitchers now in use, but we hope to see Mr. McDonnell's process receive a fair trial in a more public street before its merits or demerits are decided on.

Steam between London and Colon.—London is at last to have a direct line of steamers from Colon and the West Indies, the West India and Pacific Steamship Company (Limited) having arranged for a monthly line homewards, to commence in January next. By the new route produce will be brought from ports in Central America, California, and in the South Pacific, *vid* the Isthmus of Panama, to London.

RAILWAY MATTERS.

THE North London Railway Company own twelve miles of line, which cost £3,308,417.

THE rumours of an arrangement between the New York Central and the Great Western of Canada have been revived.

THE Metropolitan Railway Company hold nine miles fifty-four chains of lines of their own, and two miles seventy-seven chains partly owned by them, together twelve miles fifty-one chains. The capital expended on these amounts to £6,739,731.

DURING the year 1867 railway proprietors have paid an income-tax of something more than threepence-halfpenny in the pound, or one and four-fifths per cent., to persons injured by collision, or to their representatives. £19,630,000 has been paid as dividend during the year, and £347,379 as compensation.

THE Midland Railway Company has now completed its new engine shed at Wellingborough, Northamptonshire, and sixteen engines are now placed there for repairs, the full number being twenty-four. The company is now erecting thirty cottages near the Finedon-road, Wellingborough, for the use of the workmen employed at the station and repairing shops.

NO official announcement has yet been made of the Caledonian or North British dividends. Both lines continue to show an improvement on last year's traffic, but the increase for the two past weeks has been small, and the North British cannot now boast, as it did for a series of weeks after the separate publication was resumed, that its increase is both relatively and actually larger than that of the Caledonian.

ON Monday the Solway Junction Railway was opened for the carriage of goods and minerals. The line, however, has not yet passed the Government inspector, and it is intended to have some experience of it with heavy traffic before carrying passengers. The part where most difficulty has been experienced is Bowness Moss. This appears now to have become consolidated, for it has borne heavy trains with great firmness.

FROM an account in the *American Railroad Journal* of the 21st ult. we gather that the Port Hudson and Chicago, which extends by the shortest route the western end of the Grand Trunk of Canada line to Chicago, is in a very forward state, and is being constructed in the most substantial and complete manner. It is expected that in connection with the Grand Trunk it will have a very large through traffic, and also a large local traffic. The authority quoted speaks of it and its prospects in the highest terms.

THE traffic receipts on the Canadian lines have been seriously affected by the low rates of freight charged upon the competing American roads; and it will be satisfactory to bond and shareholders of the Great Western of Canada and the Grand Trunk railways to know that the managers of the rival American lines have met to consider the propriety of readjusting the rates, and putting an end to the present damaging state of things, which was beginning to affect the passenger as well as the freight charges. We understand that a decision has been come to on the subject, and that an advance will be made to more remunerative rates.

OUR Indian railway companies, while enforcing some of the most obnoxious practices of their tutors at home, introduce variations of their own. The last is a liberal supply of coffins at every station, to be had at a moment's notice. It is shrewdly hinted that these necessaries might be dispensed with if, in a burning climate, there was a free supply of water at the stations, and if at the ticket stations the passengers were not locked in for half an hour, and with the torrid atmosphere made more insufferable by the condition that the train is not in motion. It is not surprising that the Indian Government is taking the railways in hand.

WE are informed that the agreement entered into between the Great Luxembourg and the Eastern of France, the particulars of which will be fully explained at the next half-yearly meeting, is of the nature of a working arrangement, and free from any stipulations likely to cause embarrassment between France and Belgium. The agreement has, in fact, been submitted to and approved by the Belgian Government. Under the present arrangement the Great Luxembourg have secured more favourable terms for the shareholders than they would have obtained under the agreement which was recently set aside by the Belgian Government. The arrangements with respect to the through traffic are especially favourable to the Great Luxembourg.

THE report of the directors of the Melbourne and Hobson's Bay Railway states that the tonnage of coal was 5780 tons, and of broken metal, &c., for Melbourne Corporation, the suburban boroughs, shipping at the pier, and of rubble for private buildings, amounted to 17,901 tons for the half year. A considerable improvement had occurred during the same period in the passenger traffic of some of the suburban districts. The permanent way was in excellent working order, and the engines and other rolling stock were in an effective condition. The receipts for the past half year, after deducting the payment of interest on debentures and working expenses, left a balance available for dividend of £20,133, out of which was deducted £18,715 for dividend at the rate of 7 per cent. per annum, leaving a balance of £1418. The capital account to the 30th of June last showed that £970,394 had been expended. The revenue account for the half year showed that £70,053 had been received and £36,644 expended, leaving a balance of £33,409, out of which £13,276 was deducted for interest on loans, leaving £20,133 as above.

THE East London Railway is making progress. At the date of Mr. Hawkshaw's last half-yearly report the following works remained to be completed:—Fifty lineal yards of covered way on the south side of the Thames, the covered way on the north side, the construction of the openings under the Greenwich Viaduct, the superstructure of the bridge over the Surrey Canal, the station buildings, and the permanent way. The whole of the above are now finished, with the exception of the temporary wooden station at Wapping, and of such works as may be required at the footpath or occupation road alongside the Greenwich viaduct. The woodwork of the station building at Wapping has been framed together, and will only take a very short time to erect. The signals and signal boxes with the necessary fittings are completed, excepting the signals at the junction with the South London Railway, which, as well as the points and crossings there, are to be provided by the Brighton Railway Company. The requisite monthly notice has been given to the Board of Trade, who now await the ten days' notice before sending the Government officer to inspect the works.

AN extraordinary accident occurred to a train on the Preston and Longridge Railway, the property of the London and North-Western Company, on Saturday last. Fifteen wagons laden with stone, in charge of a breaksman, who occupied a van in front of the train, were running down the steep gradient from Longridge to Preston, without an engine as usual, when immediately after passing the Grimsargh station, about a third of the journey from Longridge, the sixth wagon from the break-van leaped up from the line, snapped the coupling-chains, and ran into the four-foot, where it remained stationary. At this point there is a siding, and the extraordinary features in the accident are, first, that the succeeding nine wagons all left the line, passed over and crushed to atoms the wagon lying in the four-foot, and then took their places in a line on the siding with as much order as if they had been properly shunted thereon; and next, that one of them took with it the wheels and axles of the wagon destroyed, and it appeared on the siding to have double the usual number properly attached. Three other wagons were greatly damaged; one belonging to the Lancashire and Yorkshire and another to the London and North-Western Company, were broken up beyond repair. Nearly 100 yards of the metals were torn up, and the contents of the wagons were partially strewn over the line that distance.

NOTES AND MEMORANDA.

AN average fibre of raw silk will sustain a weight of fifty grains.

A SEVENTY-FOUR gun ship used to require about 1300 blocks of 200 different sizes.

BIOT states that a difference of 5 deg. Fah. will produce a mirage over a smooth surface.

THE earth receives one out of 2300 million parts of light and heat given off by the sun.

BRUCINE is a most delicate test for nitric acid, being coloured rose red by water containing only the 100,000th part.

A SEVENTY-FOUR gun wooden ship consumed in building 3000 loads of timber, the produce of a century's growth of 57 acres.

IN America, Mr. Horsford has recently found that the element fluorine is generally present in the substance of the brain, and that its presence can be verified by the usual chemical tests in the ash, which results when the substance of the brain is calcined with pure lime or pure potash. The experiments appear to have been carefully made.

M. LANDRIN, having denied that pure coralline (peonine), much used as a dye for stockings, &c., is poisonous, M. Tardieu again states that the dye, as used, certainly produces irritation and eruptions; and though he cannot pronounce any opinion as to the chemical purity of the coraline, he has assured himself that it does not contain arsenic, lead, or mercury—the first of which has been found in some aniline reds.

MR. F. A. ABEL has communicated a long paper to the French Academy on the properties of explosive compounds, which contains the results of experiments with gun-cotton, gunpowder, nitro-glycerine, &c. He accounts for the difference remarked in the nature of the explosion produced by various substances when they act upon matter of a different kind by supposing that the explosion produces a certain kind of vibration that may or may not be synchronic with that produced in the body operated upon by the explosion.

MESSRS. LECHARTIER AND BELLAMY, in France, have studied the nature of the gases given off by various kinds of fruit after being plucked from the trees. They find that apples, cherries, gooseberries, and currants soon begin to absorb oxygen and to give off carbonic acid. The quantity of carbonic acid thus produced is sometimes very considerable when the fruit is stored up in a room. For instance, five apples weighing altogether only 348 grammes, yielded from the 19th of January to the 15th of July last, 6648 cubic centimetres of carbonic acid.

AN interesting discovery has just been made in Russia, namely, of a Byzantine cameo in onyx, dated from the seventh century. The gem, which is embedded in a golden cup, presented to the Cathedral of Ouspenski by Catherine II., is two inches in length and of an oval form. The relief represents a cross surmounted by a medallion bearing the effigy of the Saviour, accompanied by two figures of angels. An inscription in Greek characters contains the Emperor Leontius, who reigned at Byzantium from 696 to 699, having usurped the throne after the death of Justinian II.

THE exact altitude above sea-level is often required by engineer and meteorologists. The following is the height above the level of the sea of the ground on which the English cathedrals are built, according to the Ordnance survey records at Southampton, viz.: Lichfield, 287ft.; Lincoln, 217ft.; Durham, 215ft.; Salisbury, 153ft.; Exeter, 129ft.; Winchester, 125ft.; St. Asaph, 124ft.; Ripon, 114ft.; Chester, 88ft.; Worcester, 87ft.; Carlisle, 82ft.; Bangor, 68ft.; Bristol, 63ft.; London, 61ft.; Gloucester and York, 57ft.; Chichester, 47ft.; Canterbury, 38ft.; Rochester, 33ft., and Peterborough, 31.

DR. ANGUS SMITH has experimented on smoke of various degrees of blackness and brownness, and he shows that the difficulty of consuming smoke does not commonly arise from a deficiency of air in the furnace, but from the fact that a rapid draught often fails to allow time for proper combustion. It is now certain that the black smoke prohibited by Act of Parliament contains carbonic oxide, one of the most poisonous of gases. Carbonic oxide is only detected in smoke of the illegal density, and when we find that this black smoke is really an expensive article to produce we seem to be furnished with every reason why such a nuisance should be prohibited.

HERR HILLER has described a new and advantageous method of tinning copper and brass, which, he says, is decidedly more advantageous than the old process, by means of tin and cream of tartar, though this gives generally very satisfactory results. In the new process fifteen parts of salt of tin are dissolved in 150 of water, and to this is added a solution of thirty parts of caustic potash in 300 parts of water. The various objects to be tinned are placed on a sheet of tin, shaped like a funnel and pierced with numerous small holes. This is placed in another vessel containing the above solution, and the whole is heated over a fire whilst the objects are stirred with a tin rod. In the course of a few minutes they are covered with a thin layer of tin as white as silver.

MR. DANCER has studied the character of the solid particles contained in the air of Manchester. Samples of the air were washed by Dr. Angus Smith, and the fluid was afterwards microscopically examined by Mr. Dancer. A single drop of the water was computed to contain no less than a quarter of a million of fungoid spores. The fact was verified by examining an extremely small particle, and multiplying the result. The bottle of water having been kept for thirty-six hours, the quantity of fungi, already so great, "visibly increased," and on the third day minute creatures were observed moving about in the fluid. Keeping, however, to our former figures, we find that 150 drops of water would contain more than 37,000,000 of the fungi, these 150 drops being the washings of 2495 litres of the air of Manchester, which is about the quantity of air passing through the lungs of a man in ten hours!

THE *Scientific Review* says that an important chemical discovery has been recently made by Professor Schutzenberger, namely, a new sulphur acid, having for its composition S O, H O; it therefore contains one equivalent of oxygen less than sulphurous acid, and is formed when the latter is placed in contact with zinc. Its most remarkable property is that of possessing reducing qualities equal to those of nascent hydrogen; it consequently bleaches indigo and litmus almost instantaneously; it forms a characteristic salt with soda. The author calls his new acid hydrosulphurous acid, a name which evidently cannot be retained, by which he wishes to express that it always contains water (or hydrogen). Its proper name would be hyposulphurous acid, but unfortunately that term is already employed for another acid, the composition of which has given rise lately to some discussion. No doubt M. Schutzenberger's acid is the true hyposulphurous acid, analogous to hypophosphorous acid, &c.

THE equipment of a musketeer, as late as 1689, was very cumbrous. He was provided with a heavy wooden fork, which he had to stick into the ground with the prongs uppermost, to serve as a support for his matchlock, which he had to load with his powder-horn and measure, keeping the ball meanwhile between his lips. The wadding he had to get from his hat. Nevertheless, the wheel-lock, provided with pyrites instead of flint, had long been invented, but seems never to have come into general use in armies, except for cavalry pistols. The French lock which preceded the percussion system was invented as early as 1640, though it, of course, received successive improvements. But even before that time Gustavus Adolphus had introduced a great improvement in musketry, by reducing the weight of the piece to 10 lb. instead of 15 lb. This enabled the soldier to do away with the fork, and therefore increased the rapidity of the fire. The bullet weighed an ounce. Another improvement of his was the paper cartridge, which, however, at first only contained the powder, the bullets being kept in a bag.

MISCELLANEA.

MR. DURHAM has completed the Leigh Hunt memorial, which will be opened on October 19th.

THE rains in Canada have recently been very heavy, and several railroad bridges in the vicinity of Montreal have been washed away.

BRANCH telegraph offices are to be established in a number of Indian military stations, to be worked by soldiers, thereby effecting a considerable saving to the Government of India.

ONE effect of the beginning of the new street from the Mansion House to the Embankment is to bring into view the west side of the Mansion House, which is seen from the Poultry under a new aspect.

A MARBLE cenotaph, to the memory of the late distinguished astronomer, the Earl of Rosse, has just been erected in the church at Parsonstown (Ireland). It is said to be beautiful for its simplicity, yet not altogether unadorned.

A CONSIDERABLE number of diamonds and other precious stones has been lately found at Mudgee, in New South Wales, and a company has been formed to work diamond mines. A new discovery of rich coppor ore has been made at Ballarat.

THE authorities of the Louvre have had fixed in the windows of the rooms of Henri II., Henri IV., and of the Sauvageot Museum, 109 pieces of stained glass of the sixteenth and seventeenth centuries, Flemish, German, Swiss, and French, of great beauty and in excellent preservation.

THE French expedition to the North Pole, directed by M. Gustave Lambert, is unable to set out. A journal announces that about 180,000 francs are still required to carry out the undertaking, intended to last four years, with two of the winters passed in the neighbourhood of the Pole itself.

THE Empress Eugenie has founded an annual prize of £400, to be awarded by the Geographical Society of France to any Frenchman for the discovery, work, or enterprise which shall be judged to be the most useful to progress, to the science of geography, or to the external commercial relations of France.

SOME English miners in the Asturias have discovered at a short distance from Rivadellesa, an immense natural grotto entirely filled with stalactite columns of great beauty. Passages part in different directions, and extend for more than a league. The cavern is said to be one of the most beautiful in the world.

THE statute of Goethe, at Munich, was uncovered on the 28th of August. Count Potio opened the ceremony with a speech, and in the name of the King of Bavaria presented the statute to the representatives of the city. A large number of guests were invited to dine at the royal residence, and the evening Goethe's "Torquato Tasso" was given at the theatre.

THE authorities of Glasgow have granted permission to run, experimentally, omnibuses drawn by patent road steamers with india-rubber tires, built by Mr. R. W. Thomson, C.E. Edinburgh, through the streets of their city. Before coming to this decision, they sent an official over to Edinburgh, where he witnessed a trial run of a road steamer with an omnibus attached to it.

THE Fondaco dei Turchi, says the *Architect*, one of the oldest palaces on the Canal Grande, Venice, has been restored at the expense of the municipality. It is a fine specimen, perhaps the finest, of that peculiar style of Venetian twelfth century architecture in which the Byzantine and Oriental elements were, so to speak, blended, and was built by the once powerful family of the Pesaros.

THE Russian merchant, Ssidorow, who has several times visited the mouths of Petschora, is now engaged in exploring the new passage round Norway, through the Polar Ocean, to the mouths of the Petschora, and then through the Carian Sea to the Obi, and if possible to the Yenesei. Ssidorow sails on board his own steamer, the Georg, commanded by Capt. Beck. It is said that the Russian Government have granted him the sole use for the next twenty years of any passage he may discover.

ON Tuesday morning the northern and southern ends of the wooden footway on the west side of the temporary bridge at Blackfriars were closed to public traffic, and workmen were employed in removing the wooden framework and timbers to make a clear space for the roadway approaches to the new bridge, which it is now stated will be opened on Michaelmas day next. It is also intended to close the whole length of the western footway of the temporary bridge against the public in a few days.

MESSRS. HOPKINS, GILKES, AND COMPANY, Middlesborough, have recently completed the erection of the new bridge across the glen at Saltburn-by-the-Sea. The stucture is almost entirely composed of iron, and the whole now presents a light and elegant appearance. The railing is particularly neat, strong, and effective, being composed of angle iron, so arranged that no projecting stays are required to give stability to the long length of rail on either side. A specimen length of the railing will be shown in the Exchange, Middlesborough, next week.

A SERIES of experiments have been carried on during the last few days at the proof butt, Royal Arsenal, Woolwich, with instruments invented by Captain Noble, late of the Royal Artillery, and now one of the firm of Sir William Armstrong and Company, at Elswick, to measure the velocity of a shot while on passage in the bore of a gun when fired, and also to test the strength of gunpowder. The results of the experiments are not yet made known, but it is anticipated that they will materially alter the data upon which theoretical calculations are made in gunnery.

THE St. Louis County Court has decided to cease further operations in boring the artesian well, already the deepest in the world. The depth reached was 3843½ft., and the water obtained there was very salt. Some members of the court wished to continue the work until the well was 4000ft. deep, but a majority decided against this on account of the expense; the latest work in boring being nearly forty dollars a day, and the progress made in that time about 5in. The well is to be plugged up at a depth of about 1200ft., where pure water can be obtained by pumping.

DURING the six months ending June 30th this year, the value of the machinery exported was £1,472,572, as compared with £1,269,756 in the corresponding period of 1868, and £1,390,216 in the first six months of 1867. In these totals the shipments for June figured for £315,423, against £269,138 in June, 1868, and £299,786 in June, 1867. The increase observable in this year's figures arose in the shipments to Russia, Belgium, and Australia. Thus the value of the machinery exported to Russia in the first half of this year was £189,533, against £118,464 and £151,845 respectively; to Belgium, £94,468, against £68,970 and £77,924; and to Australia, £102,740, against £43,895 and £38,306. There has also been some increase this year in the value of the exports to Holland, Egypt, British India, &c.; but, on the other hand, the demand for British machinery appears to have decreased as regards France and Spain.

MR. WILLIAM F. DENNING, of Ashley-road, Bristol, has succeeded in forming "a society of gentlemen possessing astronomical instruments, for securing concerted observation of interesting astronomical phenomena." Amongst the list of members are the names of six fellows of the Royal Astronomical Society, including Mr. W. R. Birt, one of our leading authorities on lunar matters; and Mr. A. Brothers, the author of a very excellent catalogue of binary stars, and numerous valuable papers on celestial photography. The affairs of the society are managed by a president, treasurer, and secretary, and a committee of five members. The Rev. R. E. Hooppell, M.A., LL.D., F.R.A.S., of South Shields, is the president; Mr. William F. Denning, of Ashley-road, Bristol, is the treasurer and secretary, while the committee consists of gentlemen whose names are well known in connection with science. The society now consists of twenty-six members, and, if energetically managed, will be of great service in aiding the spread of practical astronomy.

FORGING MACHINE, CONSTRUCTED BY MR. W. CLAY, BIRKENHEAD.

MR. WILLIAM CLAY, of Birkenhead, has patented an invention which relates to that class of forgings known in the trade as heavy forgings, the object sought being to ensure sound forgings, which it is very difficult to obtain when manufacturing bulky articles, the thickness of the metal in which greatly and suddenly varies. In manufacturing, for example, marine engine shafts with disc couplings the point of junction of the disc with the shaft will generally be found, when cut into, to exhibit internal fissures which greatly detract from the strength of the shaft. In order to avoid this defect, and to ensure solidity throughout the metal of large forgings, Mr. Clay proposes when forming heads, collars, or flanges upon the ends of shafts or rods to employ a horizontal hammer of peculiar construction, which is connected with and operated by a piston working in a horizontal steam cylinder, and thereby materially to reduce the sectional thickness of the metal at the line of junction of the head, collar, or flange with the shaft.

In the accompanying engraving, Fig. 1 shows in side elevation the kind of steam hammer which Mr. Clay employs in manufacturing heavy forgings; Fig. 2 is a partial longitudinal section of the same; Fig. 3 is a transverse section taken at the line 1, 2 of Fig. 2, and looking in the direction of the arrow; and Fig. 4 is a transverse section taken in the same line, but looking in an opposite direction. A A is the bed of the machine formed in one casting. To one end of this bed the steam cylinder B is bolted, and to the other is secured a block C for receiving on its face the anvil D. The face of this anvil is shaped to correspond to the form the end of the shaft is intended to receive by its lateral expansion, and in order to allow of the anvil being changed to suit different sizes or kinds of work it is made to fit into V's formed on the face of the block C. The anvil is U-shaped, as shown at Fig. 4, and the block has a corresponding vertical hollow to enable it to receive the heated shaft that is intended to be brought under the action of the hammer. To facilitate the turning of the shaft on the anvil the block C is fitted with antifriction rollers *c c c* which support the shaft when it is presented to the hammer. E is the piston of the cylinder B, fitted to a cylindrical trunk E', which carries at its other end the hammer block.

FIG. 1.

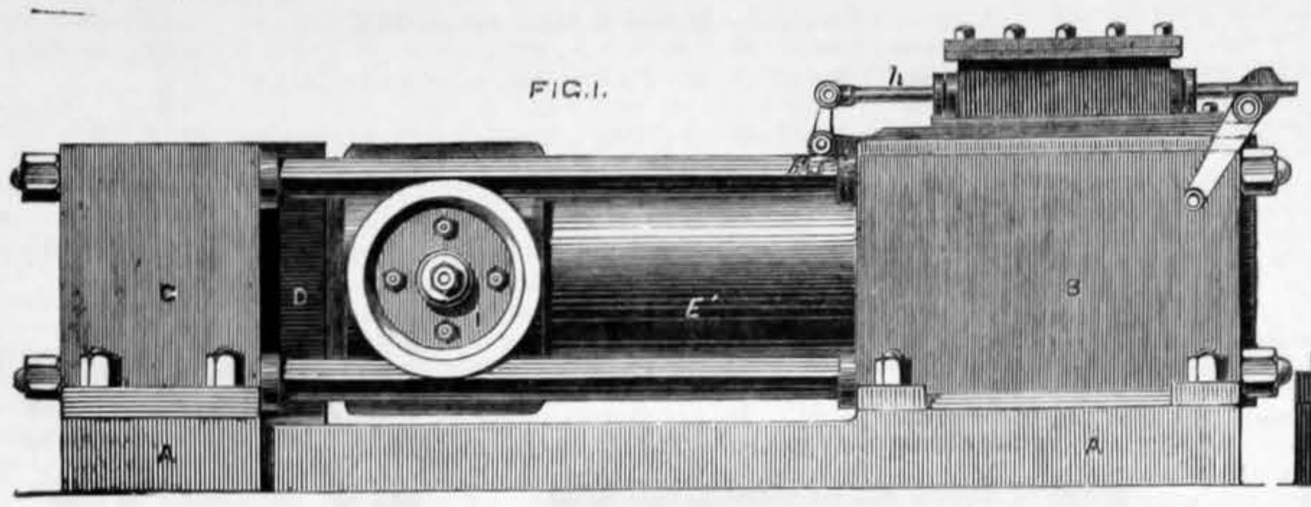


FIG. 4.

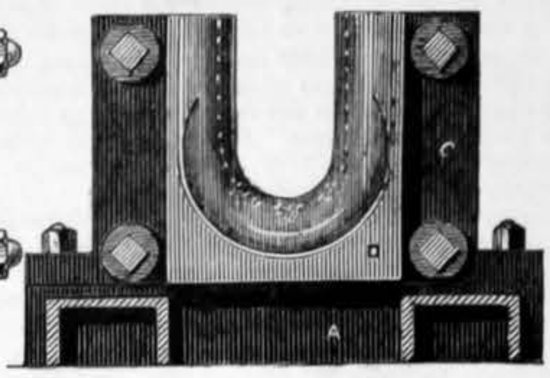


FIG. 6.

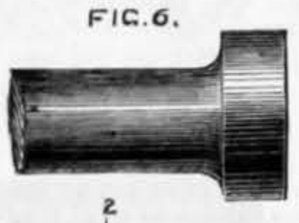


FIG. 5.

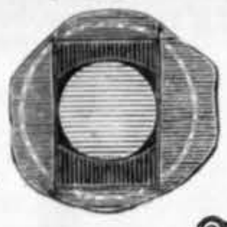


FIG. 2.

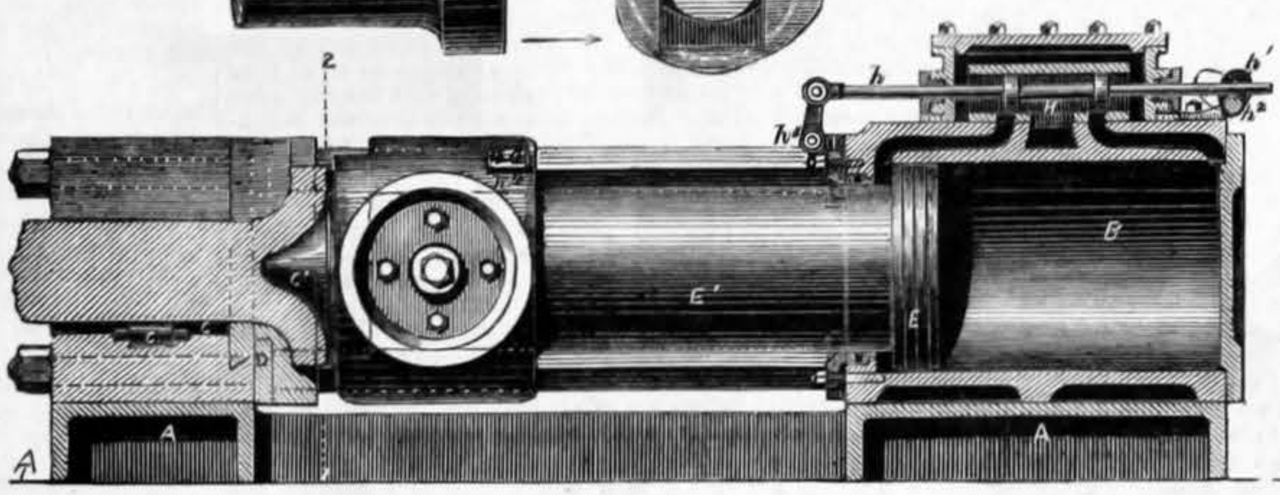
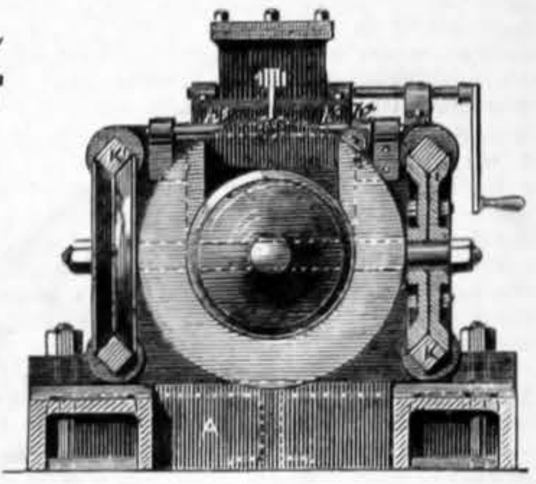


FIG. 3.



Fitted centrally in the face of this block is a conical piece G', which forms the striking part of the hammer; its object is to form a cavity in the end of the shaft, and thus by reducing the thickness of the metal at that part to remove the liability of fissures occurring in the forging. H is the slide valve, the rod *h* of which extends through the opposite ends of the valve box. At its rear end this rod is formed into a link to receive a cam h^1, which is keyed to a cross shaft h^2. This shaft rocks in bearings on the top of the cylinder B, and it is fitted with a handle, by raising or depressing which the attendant is enabled to operate the valve, and thus regulate the advancing and retrograde movements of the hammer at pleasure.

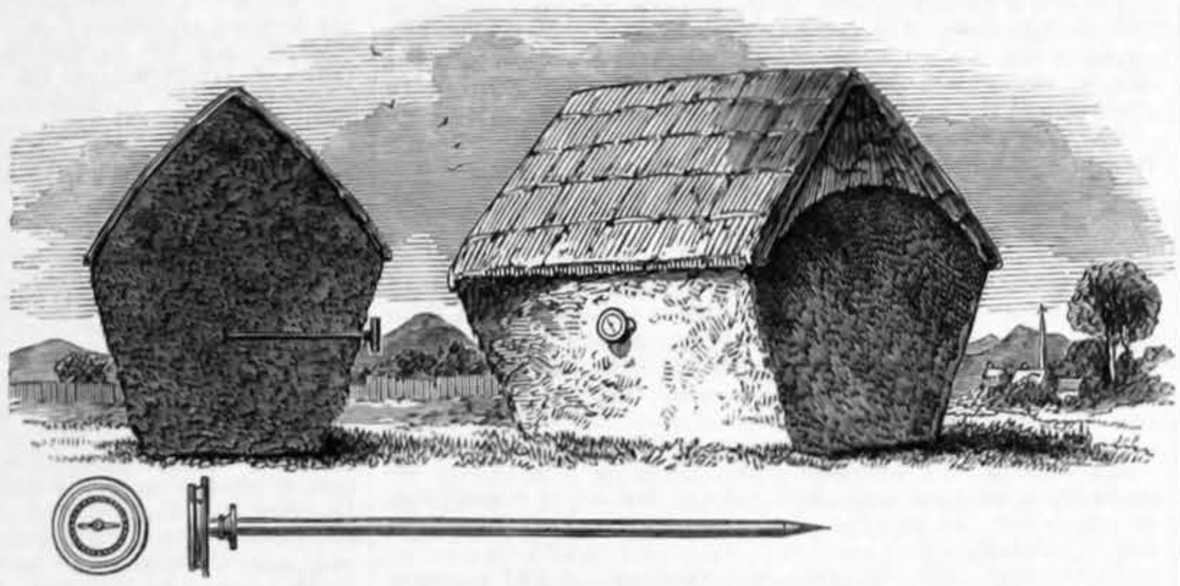
To prevent the risk of damage to the machinery from inattention the valve rod is jointed at its front end to the arm of a rock shaft h^3 mounted in bracket bearings at the front of the cylinder B, and fitted with a pendant arm h^4 carrying an antifriction bowl. In a line with this bowl on the hammer head is fitted an adjustable stop h^5, which as the piston is nearing its back stroke will strike the bowl of the arm h^4 and rock the shaft h^3. The motion of the rock shaft will, by reason of its connection with the valve rod, cause the valve to advance and cut off the supply of steam to the cylinder, while at the same time it will stop the escape of the exhaust steam, and thus provide an elastic cushion for the piston to strike against.

An incidental advantage derivable from making the cylindrical trunk E' of the large diameter indicated in the engraving is that it will allow of but a small amount of steam being used in the return stroke of the piston, while a powerful propelling force may be used for its advance. The hammer head is fitted with a pair of V-grooved wheels I, which turn freely on a fixed axle that passes through the hammer head. These wheels are intended to carry the weight and facilitate the traverse of the hammer, and for this purpose they run upon and between angular rails K K', which constitute also tie rods for connecting the cylinder B and blocks C together, and enabling the machine the better to resist the strain to which it is subjected. The lower rails K serve as track rails for the traverse to and fro of the hammer, and the upper rails K' assist in steadying the wheels on the track rails.

In order to form a head or enlargement on a shaft according to Mr. Clay's invention he first takes a shaft forged in any approved manner, and piles the end with pieces of wrought iron, after the manner indicated at Fig. 5, so as to approximate roughly to the shape desired. The piled end of the shaft is next brought to a welding heat in a furnace and the pieces reduced to a solid mass in the usual way, whereby a shaft head is obtained like that shown at Fig. 6. Having thus prepared the shaft-forging, instead of finishing it in the ordinary way it is submitted to the action of the forging machine we have described, previously reheating the shaft, if that is required, to enable the machine to act efficiently upon it. The heated shaft is placed with its head opposite the hammer head, as shown at Fig. 2, in the block or rest C, furnished with antifriction rollers *c c* for facilitating the turning of the shaft when required. The head of the shaft overlies the anvil which forms the face of the block C, and the hammer, by reason of its shape, will, in delivering its blows, form a conical hollow in the head of the shaft, and thereby to a considerable extent reduce the bulk and equalise the thickness of the metal at the centre or the junction of the head with the shaft. By turning the shaft from time to time on its axis as the operation proceeds its head will be reduced under the blows of the hammer to a regular figure, requiring comparatively little turning to finish it. This mode of forging thick portions hollow also ensures a more equable contraction of the metal when cooling than hitherto, and the formation of fissures in large forgings of the character illustrated will be thereby avoided. To ensure the best practical effect the cooling of the metal (when the forging is completed) is commenced at the centre of the head by the application of a jet of water or other cooling medium. By thus causing the metal to shrink towards the interior instead of the exterior the chief difficulty of obtaining sound forgings will be removed. Mr. Clay is now erecting large works at Birkenhead for the manufacture of heavy shafting, of which we shall shortly place a detailed account before our readers.

MR. W. H. BAILEY'S PATENT PYROMETER FOR HAYSTACKS.

AT the Royal Agricultural Show's meeting some attention was directed to the pyrometers for various purposes, exhibited by J. Bailey and Co., of the Albion Works, Salford, which we have before casually alluded to. The annexed cut shows one use to which the pyrometer can be applied, and we are informed that more were sold for this purpose than for the many other purposes for which pyrometers are wanted. It will be seen that it is an instrument pointed at the end, which, on being thrust into the stack, indicates the temperature on the dial. From experiments recently made at Shrewsbury the following figures were obtained. Messrs. Bailey consider a stack dangerous at 200 deg., and after that point it should be pulled to pieces:—



Day after stacking.	Temperature. 6 a.m.	6 p.m.
9th	130	122
11th	128	130
12th	132	126
13th	128	122
14th	126	124
15th	110	90
18th	110	100
19th	92	87
21st	98	88
22nd	80	72

Of course with this there was no danger, but according to the usual test by hand it was thought quite hot enough. Other modifications of their instruments are being introduced for indicating spontaneous combustion by Messrs. Bailey. One is to test corn in bulk, another as a fixture in coal-carrying vessels. The modifications for oil and tar and other stills, as well as those for blast furnaces and boiler flues, are worthy of the attention of practical engineering economists.

PONCELET WATER-WHEEL AT EXWICK MILLS, NEAR EXETER.

WE illustrate this week, at pages 195 and 198 a water-wheel and sluice belonging to a class which ought to be far better known than it has yet become amongst millwrights and engineers. The machine is fully represented in our engravings, which we have pleasure in laying before our readers as furnishing a good example of modern practice, bearing evidence of careful design, and containing some novel features which will well repay attention.

The wheel was erected, in 1867, to drive a new flour mill then building on the Exwick mill-stream, a diversion of the river Exe, near Exeter. The water power at this mill site was originally divided between two separate mills, a paper mill and a woollen mill; the latter, which was destroyed by fire, being situated immediately below the paper mill. Each mill was driven by two water-wheels working with a fall of about 2ft. 9in.

It was determined in 1867 to erect a flour mill on the site of the paper mill which had long been vacant. The larger of the two wheels at the paper mill was a low breast wheel 16ft. wide, and in planning the new mill it was arranged to replace this wheel by an undershot of the Poncelet class, and by removing the ruins of the old woollen mill, and lowering the bed of the stream, to amalgamate the two falls, and thus throw the whole water power on the new wheel. The maximum fall thus obtained amounted to 5ft. 7in., this of course being dependant on the level of the river, which if at all swollen causes the wheel to work in back-water, as is practically the case during the greater portion of the year.

The average flow of the mill-stream is about 8000 cubic feet per minute, the maximum flow permitted by its fall and section being about 11,000 cubic feet per minute when running bank high. In consequence of this increased volume of water requiring to be passed through the sluice under the diminished head caused by back-water in times of flood, it was decided to adopt Poncelet's curved form of race for directing the water upon the wheel. The effect of this is that with the highest opening of the sluice, the angle between the direction of the water and the circumference is maintained constant, or nearly so, throughout the whole depth of the vein of water impinging on the wheel; whereas with the ordinary straight inclined race there would be a difference of nearly 25 deg. between the angles made by the upper and lower surfaces of the vein, respectively, with the circumference of the wheel. The curved form of race, which is an essential part of the true Poncelet system, is often referred to in connection with wheels of this class, but the present instance is believed to be the first example of its complete adoption in this country. The wheel race is constructed of large blocks of Dartmoor granite, accurately worked to template, joggled together, and bedded on a foundation of brickwork and hydraulic concrete.

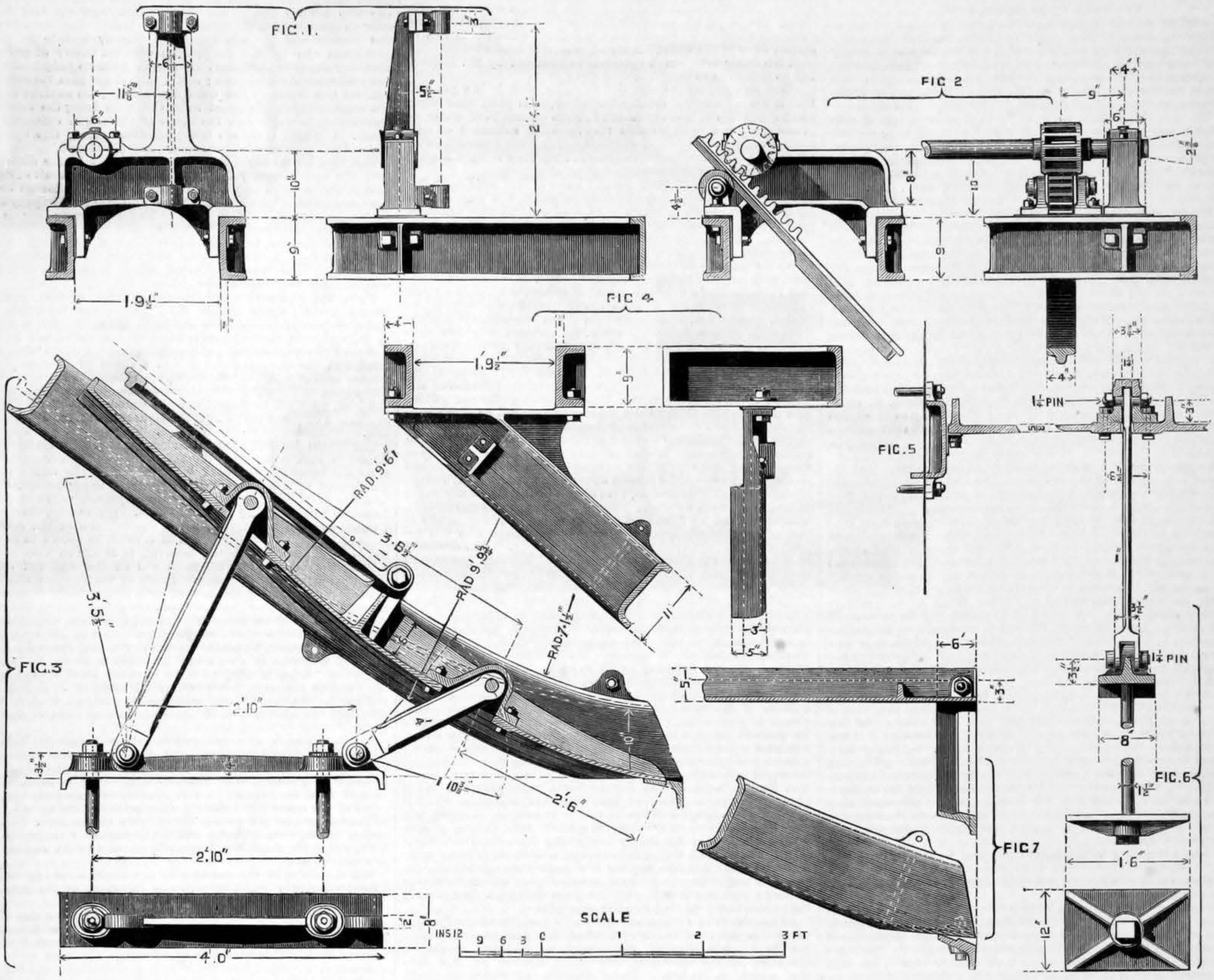
The water-wheel is 14ft. in diameter and 12ft wide. On the shaft, which is of hammered iron, 10in. diameter at the journals, are keyed four cast iron centres 3ft. in diameter, recessed to carry six arms each, the least thickness of metal in the webs being 1in. The arms are wrought iron flat bars 4in. + 1in., each accurately fitted and secured to the centres with three $\frac{7}{8}$in. bolts. The outer ends of the arms are widened into palms 6in. broad, and attached to the shrouds with two rows of $\frac{3}{4}$in. rivets, 3in. pitch. All the rivet and bolt holes in centres and arms are drilled. The shrouds are of plate iron $\frac{1}{4}$in. thick, each ring being formed of six plates jointed on the centre line of each arm. The floats are of sheet iron $\frac{1}{8}$in. thick, carried by curved angle-pieces riveted to the shrouds with $\frac{3}{8}$in. rivets, but attached to the floats by four snap-headed bolts in each, in order to facilitate repairs. The floats are stiffened by three rings of $\frac{3}{4}$in. stays and bolts, midway between the shrouds. The radial depth of the shrouding is 2ft. 9in., being equal to one-half the head, and the floats are thirty-six in number.

The sluice-gate is of the kind usually adapted to this class of wheel, but its novelty consists in its having a peculiar revolving motion, effected by the radius bars not being parallel to one another in each pair; and this arrangement possesses several advantages. The toe of the sluice in opening approaches close to the wheel, thus delivering the water with the least possible loss of velocity. The head of the sluice does not rise, but slides back almost horizontally, in consequence of which the centre of gravity of the whole sluice has only to be raised about one-half the height of the opening obtained; at the same time the point of application of the lifting power describes a path sensibly coinciding with the direction of the pitch-line of the rack. The length and divergence of the radius bars are adjusted so that the whole apparatus is kept as nearly as possible in equilibrium with the resultant pressure of the water, without requiring any counterpoise whatever. So completely has this result been attained in the present design that the cast iron sluice 12ft. by 9ft., and sustaining an average water pressure of about ten tons, can be raised or lowered by the pressure of a single finger. The facility afforded by this mode of construction for the employment of a sensitive governor and regulating apparatus will at once be apparent.

The body of the sluice works in a frame formed by two side jambs, bolted to a sill at bottom and to a pair of girders at the top. The cast iron sill is sunk flush into the granite masonry of the wheel-race. It is rebated to receive the toe of the sluice, and is bolted to a back flange at the foot of each jamb. The side

PONCELET WATER WHEEL AT EXWICK MILLS, NEAR EXETER.

MR. E. W. BULLER, C.E., ENGINEER.



jambs are cast of the shape and section shown on the drawings. They project 3in. from the face of the walls, leaving a clear opening equal to the width of the wheel, and they have a projecting flange, or caulking, the whole length of their up-stream sides, sunk 2in. into the walls to a make a solid and water-tight joint. Each joint is bolted to the sill at foot, and has lugs for three holding bolts passing through the walls, and one bolt through the bottom flange of each girder. The body of the sluice is formed of three cast iron plates, ⅝in. thickness of metal, stiffened by flanges and cross feathers, planed and put together at the flanges with ¾in. bolts. The joint between the sluice and jambs is made perfectly water-tight by a strip of leather, held in place by a wrought iron bar 1½in. by ½in., and ½in. screws tapped into the sluice. The sluice is guided by two pairs of radius bars of wrought iron, 4in. by 1in., chamfered off on the edges. The upper end of each bar is jointed to a small cast iron trunk bolted on the down-stream face of the sluice. The lower ends of the bars are jawed and jointed in pairs to two cast iron sole plates. The sole plates bear on two sleepers, bedded flush with the pitching and extending under the flank walls on each side. Each plate is held down by two 1¼in. bolts, 3ft. 6in., long passing through the timbers. The sluice is regulated by a hand-wheel and gearing working two inclined racks, the lower end of each rack being jointed to a lug cast on each side plate of the sluice, at the junction of the two feathers across the centre of the plate. The gearing is carried on cast iron frames bolted to the girders, and is made sufficiently powerful to enable the sluice to be worked during examination and repairs when the water is withdrawn from the leat and the whole weight of the sluice is thrown upon the gear.

As has been explained above, the effective head of water is subject to considerable variations, whilst the speed of the mill must be maintained as uniform as possible. Many observations were made from which to compute the average mean velocity of discharge, which resulted in this being taken as 1000ft. per minute approximately. From this assumed value the wheel was set out, the velocity of the circumference being fixed at 585ft., giving 13·3 revolutions per minute, and the mill gear was speeded accordingly.

It was intended to start the mill with twelve pairs of stones and the accompanying machinery, but owing to financial affairs the internal arrangements of the mill were not completed, and an opportunity has not yet been afforded of testing the full power of the wheel. The most it has yet been called upon to do is equivalent to about 30-H.P. (six pairs of stones and dressing machinery), and it has proved fully equal to this with a consumption of rather less than 6000 cubic feet per minute, the remainder running to waste, and the wheel working in from 6in. to 9in. of back-water. The result is so far very satisfactory, and denotes a useful effect of about 60 per cent. of the actual water power. Negotiations are now in progress for completing the whole of the mill work, and it is hoped that careful observations will then be made of the performance of the wheel when working up to its full power, the result of which will have much interest. The wheel proves to be well adapted to situations where the mills are frequently "tailed" by high water.

The curved form of the floats is very favourable to their escape from the water, and the wheel labours much less than the commoner kinds with straight or angular floats when working deeply immersed.

The whole of the work was designed by Mr. E. W. Buller, C.E. under whose superintendence the water-wheel, sluice, and main stone gear were erected by Messrs. Martin and Son, of the Eagle Foundry, Exeter; the mill work being executed by Messrs. Bodley Brothers, of the same city, the entire job reflecting the highest credit on both these eminent west-country firms.

WHITWORTH SCHOLARSHIPS.—The following is a list of the successful candidates, with their ages, occupations, and the number of marks they obtained, who have been reported to the Science and Art Department as entitled to the ten Whitworth scholarships of £100 a-year each:—William H. Greenwood, aged 23, engineer, student at the Mechanics' Institution, Manchester, 143 marks; Thomas A. Hearson, aged 23, engineer, student, Royal School of Naval Architecture, 137 marks; John Hopkinson, B.Sc., aged 19, student at Cambridge University, 134 marks; Thomas S. Elgood, aged 24, mechanical engineer, Leicester, and Owen's College Manchester, 127 marks; George A. Greenhill, aged 21, student at Christ's Hospital School and Cambridge University, 116 marks; John R. Brittle, aged 23, engineer, student at Sir Walter St. John's School, Battersea, 113 marks; Thomas W. Philips, aged 23, student at British School, Millwall, and Royal College of Science, Dublin, 100 marks; Richard Sennett, aged 21, engineer, student at the Royal School of Naval Architecture, 98 marks; Robert B. Buckley, aged 21, engineer, student at Merchant Taylors' School, 97 marks; Charles E. Leeds, aged 23, B.A. (Oxon), student at Oxford University, 96 marks.

IMPROVED CABS.—The Council of the Society of Arts offer the following medals for improved hackney carriages specially suited to the metropolis:—The Society's gold medal for the best and most convenient open hackney carriage for two persons. The Society's silver medal for the second best ditto. The Society's gold medal for the best and most convenient closed hackney carriage for two persons. The Society's silver medal for the second best ditto. The Society's gold medal for the best and most convenient hackney carriage for four persons, either open or closed, or both. The Society's silver medal for the second best ditto. Lightness of construction, combined with adequate strength and durability, will be especially considered in making the awards. The awards will be made after actual trials of the carriages extending over a certain period. Communications describing the carriages must be sent to the secretary of the Society of Arts before the 1st January, 1870, the carriages to be sent to a place hereafter to be appointed. The council also offer the Society's silver medal for the best instrument to be affixed to a cab or other hackney carriage, for indicating the fare as between the passenger and the driver, whether by registering the distance travelled or otherwise, and which instrument shall also indicate, for the convenience of the cab-owner and of the driver, the total distance travelled during the day and the total amount earned. The instruments competing, with full descriptions of their construction, to be sent to the Society's house before the 1st of January, 1870. Competitors may, at their option, sign their communications, or may forward with them sealed letters containing the name and address of the writer. The council reserve to themselves the right of withholding all or any of the medals, in case none of the carriages or instruments possess, in their opinion, sufficient merit. In the trials of the several carriages the small amount of vibration and noise will be duly considered by the judges.

FINDING OF COAL ON THE CLIFTON ESTATES NEAR NOTTINGHAM.—*(From a Correspondent).*—There is at the present time a good deal of controversy going on as to whether coal does or does not exist in Northamptonshire. Without expressing an opinion as to the probabilities or otherwise, we may refer our readers to a great achievement in a similar branch in another part of the country. The question as to whether coal existed south of the Trent has been a debatable one for many years. Those skilled in geological and scientific knowledge declared that such could not be the case; but practical men adhered to the opinion that coal was there, and would repay the cost of winning it. The former pointed out the fact that twelve years ago borings were made in order to ascertain if coal did exist. The results, although the work was not carried out, were said to be such as to destroy the probability that such was the case. This fact, backed up by what was known of the coal which was being got at the Radford Pit, near to the Clifton estates, rendered the undertaking anything but of a safe nature. The coal which had been met with at the Radford Colliery was of such an inferior quality that the owners gave up the task, finding that it would not repay the trouble of getting it. In the midst of all these discouragements the late Sir Robert Clifton sought the advice of some of the most eminent engineers of the day. Amongst others he consulted John Brown, C.E., F.R.S., of Harbro' House, Barnsley, who, after making investigations, came to the conclusion that coal did exist. Mr. S. Marsh, the present manager of the works, also adhered to the belief that coal could be found. Mr. Lancaster was also consulted, and gave it as his opinion that coal measures were intact under the estate, but advised Sir Robert not to sink unless he was fully prepared with the means to carry the sinkings to a successful issue. Sir Robert determined to risk the chance, and on the 1st of May, 1867, the Messrs. Boot commenced the borings. On the 8th of June, in the following year, the first sod for the new shafts was cut. The work, although fraught with difficulties, went on, and after numerous obstacles had been gone through, and various beds penetrated, coal was found in the early part of the present month. The shaft is sunk nine yards into the seam which is a very good one, and of considerable thickness. The sinkers have also met with a rock which contains a seam of lead, and which was marked with coal. Arrangements are now being made for opening out the pits on a large scale, powerful machinery being about to be laid down.

LETTERS TO THE EDITOR.

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

NOTES ON A LEADING ARTICLE ON PATENT RIGHT IN THE ENGINEER OF SEPTEMBER 3RD.

Sir,—The writer* characterises the anti-patent movement as "advocating robbery." It would be stigmatised as such deservedly if it aimed at depriving patentees of the rights they have legally already acquired. But that is by no means the case; it is directed only against the concession to other patentees of more rights. We differ in the history of the recognition, as he would call it, or the institution as I regard it of property in inventions. He says:—

"The law, 'Thou shalt not steal,' existed in the minds of men though it was not written, and we defy Mr. Macfie to prove that the operation of this law is confined to any given object. It takes no cognisance of the value or kind of entity possessed, but simply the right of possession in the entity, which is universally recognised as pertaining to the first legitimate owner. . . . We absolutely deny that the operation of the conscience law to which Mr. Macfie refers applies solely to things material."

It being not easy to prove a negative, I reply by a counter demand, viz., that my adversary will prove the recognition in ancient law of any property other than in things material; or, if he cannot do this, that he will adduce any historic reason for believing that the conscience of mankind or of rulers ever responded among Greeks, Romans, Jews, or Egyptians, or does respond now in China or any country not sophisticated by European civilisation to the principle of conceding exclusive proprietorship in inventions to any owner, whether first or not, and however legitimate.

To proceed:—"Mr. Macfie confuses knowledge with original ideas. . . . In these last property is conferred by statute law, but why? Simply because most men have acknowledged that the law 'Thou shalt not steal' applies to original ideas; in other words, to the first possessors of ideas, just as freely as it applies to land. Statute law is a result," &c. I deny that patents originated in any view that there morally is exclusive property in inventions.

The writer says, "The opponents of patent law urge that inventors have no right to receive a reward based on the commercial value of their inventions; principally it seems, on the ground, that the rewards which some inventors receive are out of all proportion to the value of the invention." Let me explain. We deny that there is any right to rewards, and we allege that the rewards now given are objectionable for, *inter alia*, the reason stated above. The writer goes on to speak of this value thus:—"The commercial world, as a whole, never pays more for a thing than it is worth." To answer him satisfactorily here requires a long argument, which I will summarise thus:—The commercial value of an invention depends on the money it brings in or saves. If there were no patent, this benefit accrues to the inventor only so long as he alone knows the secret or uses it, and to anybody else who may in process of time do so. The effect of letters patent is twofold: they release the first inventor from the inducement to try to keep his invention secret, and by the monopoly they give enable him for fourteen years to restrain other persons from using it. Hence the commercial value of a patented invention is greater than that of an unpatented invention. Grant that people who have used Mr. Bessemer's or M. Golay's invention have paid no more than it was worth, and the fact remains that as they were not voluntary negociators they may have paid a great deal more than was fair, and perhaps more than they could afford, because the State left them no alternative, but compelled them to pay excessive royalties or suffer. The State, in fact, deprived the ironmasters and millers of their natural liberty to use certain processes, and subjected them at the will of patentees to certain charges (payable, too, whether trade was remunerative or not). The licencees were in the position of the man to whom is addressed the demand, "Your purse or your life." Nobody alleges that the patentees just named would have been ill remunerated if they had received very much smaller royalties than they drew.

In spite of the ingenious pleading of the article, a monopoly is a monopoly no less in virtue of its affecting only articles or operations that were previously unknown; and to abolish patents is not "abstraction from the individual by the community." The State would thereby merely leave every first inventor free to do with his invention what he would or could.

The writer says, "Another may hit on the same idea and be compelled to pay the first man for the right to develop it, but he will not pay him a farthing more than it is worth." In this sentence he admits what is indeed of very frequent occurrence, that an original but not first inventor may be hindered and taxed by a prior patentee who has not adequately developed the idea patented, and who has (as I contend) no, claim except by the patent, to get anything at all for what the "idea" is "worth."

I thank the writer of the article for his Peninsular illustration: it is quite *à propos*—a service was wanted, was obtained, and was rewarded well. Let the State by all means do what the officer he mentioned did, let it also pay for Moncrieff guns and perforations, and every service it asks and accepts. Not less let manufacturers singly, or, still better, in associations, do the same. This would be honest payment for work done. But, indeed, I go further, and advocate State rewards, only these must be paid by the State in money, not in monopoly.

R. A. Macfie.

THE UTILISATION OF SEWAGE.

Sir,—In the letter I addressed to you last week I ventured to make the assertion that pouring sewage on the surface of land is neither an effectual way of utilising its fertilising ingredients nor, it is to be feared, a very safe way of dealing with it in a sanitary point of view. We have plenty of cases of large crops of grass, &c., raised by sewage; but when the arithmetic of the matter is gone into it is found that the same amount of ammonia applied in the sewage would have raised at least five times the amount of vegetation if applied as a dry concentrated manure. The danger, in a sanitary point of view, of course is that part of the sewage runs off the land unpurified, and that a considerable portion of the ammonia flies off to taint the air. A very important question then comes to be asked, What is the best way of abstracting the ammonia from the sewage so as to be obtained in a concentrated form fit for manure? And it is here necessary to notice that sewage may be looked upon as simply a solution of ammonia, stronger or weaker, as the case may be. The strength of it in the sewage of large cities varies apparently from three grains to ten grains per gallon. It is also to be noted here that before sewage comes to the state when it may be looked on as a solution of ammonia it requires to be mixed with an alkali in order that the matter in suspension may be precipitated, and the ammonia liberated from any acids it may be combined with. When sewage is thus mixed with a due proportion of lime an immediate and striking change takes place. After being well stirred, the solid matter begins to separate and gradually sinks to the bottom, leaving the water above clear and transparent. This clear water, however, emits a distinct smell of ammonia, and if allowed to flow into a river in this state would pollute the water almost as much as if no precipitation had taken place.

It is very evident that if some very cheap and abundant substance, such as lime, could be obtained, which, when mixed with the sewage, would precipitate the ammonia along with the other solid matters, the thing would be done, and the problem of converting sewage into a portable and valuable manure would be solved. But this substance never has been found. There are no doubt some substances which partially precipitate ammonia. Some of the salts of magnesia will do it, although not when the solution is so diluted as in sewage. Then there are mixtures, such as those in use at Leamington, which evidently do it to a certain extent. But the drawback is their expense. Ammonia is a valuable commodity, but so are the materials—blood, alum, and clay—made use of at Leamington. If a statement given in a contemporary last week be a correct one, it takes 4 lb. of a mixture made up of these materials to purify 1000 gallons of sewage. No statement is made as to the expense entailed in providing the requisite materials, nor of the proportion of the ammonia retained, and I suspect a very large quantity is lost or carried away in the water. Another process of somewhat the same kind has lately been put in operation at Bradford by Mr. Holden, but no details as to results are yet given.

When we consider the nature of ammonia, that it is a gas, and that it has a powerful affinity for water, it is plain that when small quantities of it are dissolved in large quantities of water, as in sewage, it is very improbable that any solid substance or substances will have the power, when mingled in small quantities with the sewage, of abstracting the ammonia from the water and causing it to fall with the precipitate.

There is only one chemical agent I know of that can thoroughly and effectually separate ammonia from water, and that agent is heat; and the question comes to be, Can heat, in such a case, be applied with economy and effect? At first sight the idea seems a startling one. To heat and boil such enormous quantities of water seems the height of absurdity. But a little consideration shows the thing to be reasonable and practicable if the sewage be dealt with in a moderately concentrated state. It is for this purpose that I recommend a separate system of sewers, in which the whole excrementitious matter of cities can be carried away from water-closets, urinals, &c., to a place where it can be most conveniently dealt with. The sewage of Glasgow, for instance, where water is so largely used, is diluted to such an extent that probably it is not much more than one-third part of the strength of London sewage; that is, if we estimate its strength by the number of grains of ammonia per gallon which it contains, the average strength of the Glasgow sewage will not exceed, I think, three grains per gallon. Now it is not safe to make any dogmatic statement on such a subject as this; but I do not think it possible, by any system of irrigation or precipitation yet devised or likely to be devised, to utilise sewage profitably when diluted to such an extent. The necessity of concentrating the sewage into a separate system of sewers is not peculiar to my scheme, for diluted and mingled with so many foreign ingredients as it is at present, the attempt to utilise it in any way is certain to turn out a failure. The propriety of so concentrating it, even when intended to be used for purposes of irrigation, is now so generally recognised that Lieutenant-Colonel Ewart, who was appointed by the Home Secretary to give in a report on the sewage of some towns on the Thames, recommends a "separate system" as the right method of proceeding, in order to meet the difficulties which these towns experienced in dealing with their sewage.

Another very obvious recommendation of a separate system is that it is possible to ventilate such sewers at a moderate expense, and so prevent foul gases poisoning the air. To ventilate the huge sewers in which the filth of our great cities is carried along, with their innumerable gratings and openings, is at present almost an impossibility. No such difficulty would exist in the case of sewers of comparatively small dimensions, and with no openings except at their connections with the water-closets. The temperature within a house is of course generally higher than out, and the consequence at present is that whenever the valve of a closet is opened the gases in the pipe have a tendency to rush up into the house, and most certainly often do so. Beyond all question this is a great drawback to the water-closet system, causing evil smells, and especially poisonous gases, to be present in small warm houses. Now there is nothing that I know could counteract this but a state of things so contrived that whenever the closet valve is opened a downward current would be generated, carrying the gases along with it. In a "separate system" such an arrangement could be managed by simply connecting the sewers at proper intervals with brick stalks, thus causing a constant suction to be acting on them, and carrying the foul gases into the atmosphere at such a height that they would be innocuous. An improvement on such a plan would be to carry the gases through a furnace and burn them before passing into the atmosphere.

In the matter of a "separate system" a question arises of course as to the state of the sewers after the excremental matter has been taken out of them, and as to what would be the effect of the remaining sewage if allowed to flow into the rivers as before. There can be no doubt it would be desirable, in a sanitary point of view, to have no such thing as underground sewers with openings to the surface intersecting the streets of large cities; but this is impossible, and the next best arrangement is to keep the noxious and gas-generating substance, viz., the excreta, by itself, allowing it to have no communication at any point with the atmosphere which is to be breathed by human beings. What is then left in the large sewers has little or no tendency to generate gases of any description, or at least those which experience has shown to be prejudicial to animal life. And the same in regard to the pollution of rivers with sewage. The washings from the surface of the streets, the refuse from public works, &c., carried down by the sewage into the river, soon separate from the water, and fall as a harmless sediment; whereas excremental matter contains an immense amount of matter in solution which does not fall, but mixes with the water and pollutes the river for miles. The only real difficulty in the way of a "separate system" is a practical one. Is it possible to get all the polluting matter of a city into a system of sewers by itself? If so—and I see no reason why by proper management it may not be done—then beyond all question it is one great step in sanitary reform. It affords the possibility, as I have endeavoured to show, of preventing the contamination of the atmosphere, and it affords the possibility also of utilising profitably the manure which the sewage contains.

I have already said that ammonia was by far the most valuable of the manuring constituents, and that heat I believed to be the most effectual and cheapest agent in separating ammonia from water.

To store up ammonia in large quantities for the purpose of using it as manure, it must be put in the form of a salt—that is, it must be combined with an acid to fix it, to prevent it dissipating itself in the atmosphere like any other gas. The simple and obvious way to obtain the ammonia from its solution is to bring the water in which it is dissolved to ebullition; the steam which rises from it is then led by a pipe into a vessel containing an acid, generally sulphuric acid. The acid retains the ammonia and the water passes off as steam. A concentrated solution of sulphate of ammonia is thus obtained, which can easily be evaporated down to the dry salt. In its natural state the ammonia is partly in the form of a salt. The sewage requires, as I have already said, to be treated with lime in order to set the ammonia free. The lime, as is well known, has the property of clarifying the sewage, the matter in suspension, as well as the principal portion of the phosphoric acid, being precipitated. The clear liquor in the top is then a solution of ammonia. Were it neutralised with sulphuric acid and evaporated sulphate of ammonia would be left. This, of course, in the case of the sewage would be absurd. The ordinary method practised in obtaining the ammonia from gas-liquor, &c., is to fill a large boiler and bring its contents to ebullition. A pipe from the boiler conveys the steam through acid as I have described. Only about a fifth of the liquor requires to be evaporated until the ammonia is all driven out. Even this method, however, would not suit in the case of sewage, even when concentrated, as I propose it should be. The bulk of water is so great in comparison that some plan must be adopted where speed in the process and great economy of heat are studied and obtained.

The process I propose professes to accomplish these ends to a great extent. I have trespassed, however, so far again on your patience that I must put off till another time some further remarks I would like to make.

Glasgow, September 7th, 1868. Gavin Chapman.

THE WESTERN BOUNDARY FAULT OF THE SOUTH STAFFORDSHIRE COAL-FIELD.

Sir,—Under the above heading an account of a gate road driven across the western fault, is given in your paper of the 30th July. The two diagrams which accompany it appear to have been prepared with great care, and they give so much detail that possibly one who has not visited the underground workings may fairly offer an opinion upon the nature of the fault. The members of the Dudley and Midland Geological Society include so many gentleman who combine the practice with the theory of geology, that they are most competent to form an accurate judgment upon the evidence shown to them; and I should not have ventured to address this letter to you were it not that I am anxious to put the engineer upon his guard as to this fault being the result of denudation, to which view the writer of the article evidently inclines. I believe there are few geologists holding this opinion, which Mr. Jukes once held but afterwards abandoned.

This view has no doubt been encouraged lately by the discovery that the east boundary fault of Shropshire is the result of denudation, and so far as they have worked, even in the lowest coals, the denudation is found to cut them off. Geologists eagerly seek for the opposite side of this valley. No proof having been as yet made in the intervening district, they pass into Staffordshire to discover, if possible, from that side evidence of denudation which might lead them to suppose they had found the opposite side of the valley. Thus there is a predisposition to associate with this western fault some idea of denudation.

Upon the supposition of the Staffordshire western fault is merely a cliff, against which the Permian was deposited, the writer of your article explains the rapid dip of the coal in Fig. 2 by the undermining of the lower clunches and sandstones by the waters of the Permian Sea; the superincumbent strata then subsided, and the consequence was that a sharp declination of the strata occurred as far as the subsidence affected the strata. This may satisfactorily account for the *dip* of the coal strata westward; but how, upon such a theory, can you account for a sharp upward inclination of the strata? Your article does not attempt to explain this.

The Symon fault of Shropshire shows that the denudation that caused it took place after the formation of the older coal measures and before the deposit of the younger, for the valley which was formed by it is filled up with deposits of the latter age. The headway at Himley, Fig. 1, shows the supposed valley of denudation to be occupied by Permian strata. We cannot, therefore, I think, compare the Symon fault of Shropshire with the western fault of South Staffordshire, even if it could be shown to be the result of denudation. Since, however, it is known that at the close of the carboniferous age there was another period of denudation, as evinced by the nonconformity of the Permian and coal measures over probably the greater part of the tract of country between Shropshire and Staffordshire, the denudation spoken of in your article may be referred to that period, the vacuity being afterwards filled up with Permian strata. This is, however, contradicted by the sharp angle at which the Permian strata dip from the coal measures, as shown in Fig. 1 (about 55 deg.) According to the "water theory" we should require another washing of the Permian substrata to account for this rapid dip. In Fig. 2 it will be observed that the coal measures dip east and west, so that we require an undermining of the strata on both sides to account for it.

An examination of other portions of the western fault of South Staffordshire tends to show that it is unmistakeably a downthrow to the west—the main fault being sometimes approached by a succession of smaller faults. The direction of the vertical movement in such faults is commonly indicated by the edges of the strata being bent. When the fault is not cut off quite so shortly the coal and strata "drag" at a slower rate. This accounts for the dipping of the strata westward as we approach the fault, and as shown in Fig. 2, and it is not due to the washing out of strata beneath.

The upturning of the coal in Fig. 1 is due to lateral pressure—lateral pressure is also traced in the curvature of the strata in diagram 2.

It not unfrequently happens that the coals along the side of an important fault are bent like the letter S, and this occurs along the western fault of South Staffordshire, I believe not far from Sedgely Park. This tendency to curvature seems to settle the question in my mind that the fault is a dislocation, and not the result of deundation. If it were an old coast line the course would be irregular, indented by creeks and bogs, but we find that it rather keeps a fixed point.

The recent organisation of two institutions of mining engineers in South Staffordshire has very much stimulated geological research in that district. It is, therefore, highly desirable that correct views should be formed for the sake of those to whom geology is a new study, and I should much like to know whether the deductions recorded in your paper of July 30 represent the conclusions at which the Dudley and Midland Geological Society, as a body of scientific men, have arrived at. If so, it will upset the accepted view that the western fault of South Staffordshire is a "clean cut" fault or dislocation, and no pains should be spared to have the question cleared up, as it closely affects the question of the extension of the coal-field between Staffordshire and Shropshire.

F. G. S.

[We shall be glad to have the opinions of other correspondents on this interesting subject.—Ed. E.]

STEAM GAUGES.

Sir,—Being *en voyage*, I have not till this moment seen your valued journal of the 27th August. I thank you for the courtesy in inserting my last letter. I should have liked that it had produced from Mr. Rockner, or some other correspondent, something more defiant in favour of English gauges. I take my data entirely from your journal when I say that our gauges are almost entirely in use in your country. I do not consider it makes any difference that the gauge is made in Birmingham, the principle being invented here. I regret I have not your journal of the 26th July for reference, but it cannot affect the truth of my assertion that there is no English gauge known here of any merit, and that our gauges seem to be in universal use in England.

My object in writing this is to bring to the surface anything that has more of merit than what is generally known. In Saxony, from where I write, the State adopts the gauge which they find the best, and compels everyone having a boiler to use it. It becomes a serious matter to be constantly near a boiler with pressure up to five atmospheres, which may be put higher from error in gauge; but as we have not many accidents, perhaps our boilers are better than yours, as one of your correspondents asserts.

H. H.

THE LATITUDE WITHOUT ANGULAR INSTRUMENTS.

Sir,—It is known that a great circle traversing the Pole star (α Ursæ Minoris), and the star Alioth in the Great Bear (ε Ursæ Majoris), passes very near the Pole. Hence, in the northern hemisphere, a meridian line may be fixed approximately by observing, by the aid of a plumb line, the instant when those two stars appear in the same vertical plane, as shown in the figure.

This vertical plane is approximately the plane of the meridian, and as Polaris appears in it that star is near its upper or lower culmination. In this instance it is near the upper culmination.

The latitude of a point on the earth's surface is the altitude of the elevated pole at that point. As the polar distance of Polaris is known if the altitude of that star at one end of its culminations can be obtained, then by adding or subtracting the polar distance to or from this quantity the altitude of the pole is found, which is the latitude of the place of observation. One method I propose for finding the latitude without angular instruments is as follows: When the star is at one of its culminations make it coincide by approaching or receding with some more or less elevated point whose height above a line level with the observer's eye, has been or

* [Mr. Macfie forgets that the personality of contributors is merged in that of the Editor.—Ed. E.]

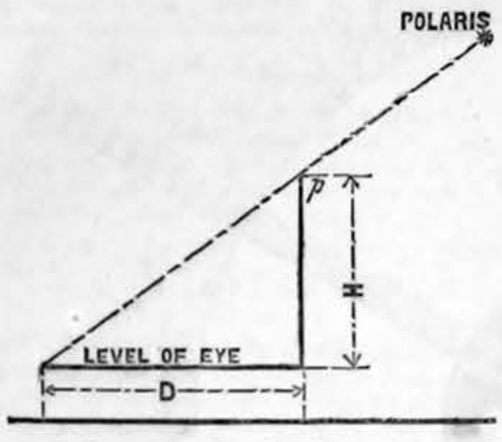
is to be, measured with as much accuracy as available. The distance from the observer's eye to a perpendicular, let fall from the point, must next be accurately measured then.

$$\frac{\text{Height of point}}{\text{Distance of perpendicular}} = \text{tangent of star's altitude}$$

p = point selected
H = height above level of eye.
D = horizontal distance.

Hence $\frac{H}{D}$ = tan. alt. of polaris.

Next, having found the angle of altitude from tangent, add or subtract the star's polar distance. In this case, the star being supposed at its upper culmination, subtract the polar distance, which s 1 deg. 23min. 46sec. I do not think the latitude obtained in this

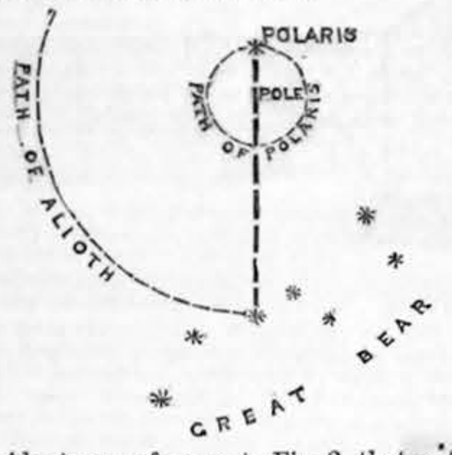


way, when carefully managed under favourable conditions, will be more than 2min. or 3min. more or less than the latitude obtained by the most perfect instruments, and the method would apply in unexplored or partially explored portions of North America, Asia, and Africa, and the northern hemisphere generally, if Alioth were only visible above the horizon at the critical moments. But this is not always the case, and, therefore, the method can unfortunately only be employed at certain times of the year. If, though the meridian can be obtained by any other means, the culminations of Polaris can be observed, and the latitude, as I have before stated, found with considerable accuracy when the explorer's quadrant or theodolite is lost or destroyed.

In THE ENGINEER some weeks since you published a letter I wrote relative to the ascertaining of heights without angular instruments, the latitude being known. The latitude and other elements are necessary in this calculation of height. Hence, if the height and the other elements excepting latitude are given, the latitude can be found.

The reader, on reference to this letter published July 30th, will, I have little doubt, perceive how, the height of p being known, the latitude can be found without angular instruments, and without any reference to the direction of the meridian at any instant that Polaris is visible—and of course Polaris is always visible in the northern hemisphere at night unless obscured by clouds. I found the latitude of a station near Brighton, by this deducible means, to be 50 deg. 48min. 13sec., by the Ordnance Survey, 50 deg. 50min., and by a sidereal observation, with one of Troughton and Simms' theodolites, 50 deg. 49min. 46sec.

The objection I made to the method of obtaining heights, when the point of observation is at or near the equator, does not apply to the method for obtaining the latitudes.



It will be evident, on reference to Fig. 2, that as the tangent is simply a ratio, no particular standard of length is required for taking the necessary measurements, a capstan bar would do as well as a metre, and this fact is important in the case of shipwrecked seamen in an unknown locality whose instruments have been destroyed.

I may also remark that as Polaris apparently moves round the pole with a radius of 1 deg. 23min. 46sec., its altitude can never be greater or less than the latitude by more than this quantity. Therefore if the altitude be obtained when the star is in an unknown position in its diurnal course quite irrespective of the meridian, its difference from the true latitude, will be between the limits 0 deg. 0min. 0sec. and 1 deg. 23min. 46sec., and the doctrine of chances, I think, would indicate less than a degree as the probable error; but on referring to Fig. 1, it will appear that, by noting roughly with the eye the angular position of Alioth, or other stars with a vertical, passing through Polaris, the position of Polaris in its diurnal path can be concluded without any great error. The error in the diurnal path of one degree would represent an error of altitude of less than one minute. Hence the angular distance above or below the pole can be deduced approximately, and the error of latitude reduced to a small quantity. This last method is the least accurate of the three, but it is at the same time the most independent.

C. M. POOLE.

FLOW OF GASES.*

SIR,—Mr. Baldwin, in designating a certain formula for the flow of a gas through an orifice as "Rankine's formula,' gives me more credit than I deserve. The formula is not specially mine, but is a result which has been arrived at independently by various writers on thermodynamics, and to which every one must necessarily be led who investigates the problem of the flow of gases from orifices agreeably to the principles of the mechanical action of heat. It was first published, so far as I know, by Weisbach, in his "Ingenieur und Maschinenmechanik," third edition (vol. i., p. 821). In 1856 the same author compared it with an extensive series of experiments on the outflow of air, and found, amongst other results, that when the outlet was a short conoidal tube of the form of the contracted vein, the actual weight discharged in a given time was only from one to three per cent. less than that given by the formula (see "Der Civilingenieur" for 1857). The same formula was independently investigated by Thomson and Joule, and compared by them with experiments on the outflow of air (see the "Proceedings" of the Royal Society for May, 1856). The formula may be applied to any gas or vapour whose pressure can with sufficient precision be treated as varying proportionally to a certain power of the density, and such is the manner in which it is applied to saturated steam by Mr. Baldwin in THE ENGINEER of the 10th inst. For another mode of mathematical treatment in the case of saturated steam reference may be made to a paperby Zeuner, published in 1864 (see "Der Civilingenieur," vol. x.).

W. J. MACQUORN RANKINE.

Glasgow, 14th September, 1869.

WIDENING LONDON BRIDGE.

SIR,—I read your excellent leading article of last week on the proposed widening of London Bridge with much interest, more particularly because the plan suggested by Mr. Fulton is similar to that I designed and carried out for widening Newport Bridge, Monmouthshire, in the year 1866. Newport Bridge, although a fine stone structure, 400ft. long, and five spans, had become a nuisance, and dangerous, by reason of the large increase of traffic. The total available width between parapets before the alteration was only 21ft.; it is now 36ft., and might have been 46ft. if funds had permitted; and, as regards appearance, the general opinion seems to be that the bridge is by no means disfigured by the alteration. The cantilevers, 7ft. apart, are bolted together in pairs by strong tie-rods running right across the bridge, under the roadway. The parapets consist of strong wrought iron girders resting on ornamental cast iron supports fixed on each cut-water; these girders are sufficiently strong to support the footways, even were the cantilevers struck away. The entire width of masonry is now utilised as carriage way; the footways are floored with Mallet's buckled plates covered with asphalte. The work was completed without scaffolding and without stopping the traffic one single day. My own impression is that London Bridge may be treated in a similar manner with marked success, and that the vastly increased accommodation thereby acquired would far more than compensate for any possible disfigurement of that really splendid work by such "ironmonger style of architecture," as a *Times* correspondent describes Mr. Fulton's proposal. I enclose carte photograph of Newport Bridge, which will enable you to judge of its present appearance.

F. DYNE STEEL, M. INST. C.E.

VERY NEAT INDEED.

SIR,—Allow me to draw your attention to an advertisement which has lately appeared in the newspapers of a competition for a bridge at Leeds, and which appears to me to be worthy of special notice. The premium offered for the best design is 100 guineas, and that for the next best is fifty guineas. The remarkable part of the advertisement is that competitors are told that before they can be furnished with the block plan and conditions to enable them to compete they must pay one guinea to Mr. C. A. Curwood, the town clerk of Leeds. Thus, if 150 competitors (no unusual number in these days) apply, they will between them pay the two premiums; and, as the corporation expressly guard themselves from undertaking to employ the recipient of the first premium in the execution of the work, the competition resolves itself into a sweepstake, where the entrance money is one guinea, and the first and second prizes 100 guineas and fifty guineas respectively. It appears to me that the competitors might as well invest a guinea in a good sweepstake on next year's Derby as spend a guinea in acquiring the plans and particulars in this competition. In the former case their guinea would have an equally good chance of being returned with ninety-nine more guineas, and they would save themselves the trouble and expense of preparing the competition designs. If the guinea were demanded as caution money, it should be returned to those who send in designs; but as the case now stands it is an ingenious device for making the competitors pay all or part of the premiums, and does credit even to a Yorkshireman's acuteness.

Westminster, Sept. 15, 1869. C. E.

PROTECTING SHIPS' HULLS.

SIR,—Mr. Grey thinks that "simply riveting" to the iron must be less "expenssive" than first sheathing an iron ship with wood ("teak") and then sheathing that again with zinc. Well, perhaps it might be—at any rate, the sheathing of "teak" in addition to the zinc would be not only "expensive" but quite superfluous, and would effectually prevent the accomplishment of the end in view. I never suggested such a plan, but it appears to me that such is Mr. Grey's interpretation of my reference to Mr. Daft's system, regarding which your correspondent is, in that case, somewhat "at sea," and I would again recommend a perusal of Mr. Young's interesting and instructive book, which, besides describing Mr. Daft's method, likewise gives a history of what has been done in the sheathing of iron ships from their first introduction.

The amalgamating of the zinc plates as your correspondent proposes would be a very expensive affair, and although the amalgamated plate, by presenting a cleaner surface for the water to act upon, might give more electricity, yet I doubt whether Mr. Grey is correct in assuming that it would be more efficacious as an antifouler, because the amalgamation would render the surface of the zinc less oxidisable; and it appears to me that it is the exfoliation or dissolution of the outer surface of the zinc that prevents the adhesion of foreign matters.

I am informed it has been practically ascertained that the zinc will last as long as copper, and of course it will cost much less.

Mr. Grey's plan, moreover, appears to have been anticipated by Mr. Monckton, who took out a patent in 1867, and from whose specification I take the following extracts, which may prove interesting to your correspondent:—"I apply zinc by a novel method to iron vessels. . . . I effect this by forming holes into the previously well-cleaned iron of the hull, and either enlarge these holes inside, or else I make a female screw in them; the zinc is then placed on the ship and zinc plugs with heads to them are driven through corresponding holes in the zinc into these holes, when by the force of the blow the plugs expand in the hole in the iron and fill up either the enlarged space or the screw indentations within it, and are thus held secure. . . . I, secondly, use amalgamised zinc plates for this purpose, whether applied as above or otherwise."

W. LLOYD WISE, Assoc. Soc. Engineers.

Chandos-chambers, Adelphi, W.C., Sept. 9, 1869.

TRIPLE EFFECT AND VACUUM PAN *v.* TACHE AND OTHERS.

SIR,—On reading your concluding remarks on Knagg's Process of Cane Sugar Making," in your last issue, I cannot resist the temptation of submitting for your consideration and that of your readers some practical data and remarks in favour of the "plaintiffs" in the trial for superiority for some years going on in sugar-producing countries between the two systems, having had exceptional opportunities of practically comparing the results of both. When in Spain I had the good fortune to be intimate with a most successful planter and sugar maker there, who initiated me in every practical result of the operations as then carried on by him by the old or Tache system, obtaining thus most reliable information, as he was acknowledged to be a most careful observant of every detail, and considered by the trade as an authority in sugar making by the Tache, and his sugar always commanded an additional price in the market.

Although he was thoroughly acquainted with the "new system," and was, in fact, a large shareholder in a most extensive sugar house, the machinery of which is all by Messrs. Cail, he nevertheless was distrustful of adopting it, believing it might not be adaptable to his comparatively small plantation, and also disliking to submit for a while to foreign engineers, sugar boilers, &c., until he should be able practically to grapple all the details of manipulation which a change of system would incur. However, after some time of intimate intercourse with him, he intrusted to me the making of plans, erection, &c., for a new sugar house, in which were introduced all the modern improvements; and this gave rise to my being engaged to erect not only large sugar houses with triple effects, &c., all complete, but also to convert some of the old systems into new ones, and thus I have practically seen the superiority of this last. I mention all these details to show that I have had practical experience of both systems, and it has always been a matter of regret to me that the English colonies resist so pertinaciously the vacuum pan, &c., and will make their molasses a little better, furnishing thus our home refiners with a source of profit which they might to a great extent add to their own, and, in fact, make thus "payable" some of those estates almost abandoned as unremunerative. And I attribute as a partial reason for this apathy—and as an Englishman it pains me to confess it—that whereas the French engineers, such as Cail, &c., have done everything possible, and given every assistance to their colonists and to Cuba to introduce their machinery and improvements, we and our colonists have been content to make little or no advance, and kept to the Tache, &c., burning sugar and attributing all unsuccess to the want of slave labour in our colonies and Customs restrictions at home.

I will now give some practical data, observing that in Spanish sugar houses the standard of weight for comparison, statistics, &c., is the aroba (25 lb. weight), and market value of sugar, &c., in reals (two and a-half pence English).

By the old system my friend had found that on an average of years and of localities 100 arobas of cane gave twelve arobas of saccharine matter, and these when bleached by the wet clay system in the moulds gave 40 per cent. sugar of from No. 15 to No. 20, and 60 per cent. treacle highly charged with saccharine matter, but "commercially" uncrystallisable by the "Tache" having burnt it, and was sold at an average price of three times that produced by the new system.

By the triple effect and vacuum pan, &c., and charcoal filters, 12 per cent. of saccharine matter was obtained; but this gave by the centrifugal, reboiling and refiltering, &c., 60 per cent. sugar of from No. 19 to No. 20, 18 per cent. sugar of from No. 16 to No. 18, 7½ per cent. sugar of from No. 12 to No. 15, 11 per cent. syrups, 3½ per cent. waste.

Commercially, the advantage by the new system is thus:—

Old system: 12 arobas of saccharine matter give 4·80 arobas (40 per cent.) sugar No. 15 to No. 20, at 45 reals, average 216 reals; 7·20 arobas (60 per cent.) treacle, at 20 reals, average 144 reals. Expenses: 100 arobas cane, 200 reals; manufacturing expenses, &c., 106 reals; showing a profit of 54 reals—equal to 0·54 reals, or little above half a real per aroba of cane.

New system: 12 arobas of saccharine matter give 7·20 anobas (60 per cent.) sugar, No. 19 to No. 20, at 47 reals, average 338·40 reals; 2·16 anobas (18 per cent.) sugar, No. 16 to No. 18, at 43 reals, average 92·88 reals; 0·90 arobas (7½ per cent.) sugar, No. 12 to No. 15, at 38 reals, average 34·20 reals; 1·32 arobas (11 per cent.) syrup 7 reals, average 9·24 reals; 0·42 arobas (3½ per cent.) loss. Expenses: 100 arobas canes, 200 reals; manufacturing expenses, &c., 137 reals; showing a profit of 137·72 reals; equal to 1·37 reals, or 1⅓ reals per aroba of cane.

By comparison we have 100 anobas of cane, new system, 137·72 reals; 100 arobas of cane, old system, 54· reals; difference in favour of new system, 83·72 reals.

This great additional profit was necessarily inducement enough even in land of high interest for loans (10 and 12 per cent.), consequent on scarcity of capital, to induce several old sugar makers (except one who insists in spending his life and money in trying all kinds of open-air steam and direct firing crystallisers) to use all their means for converting their Taches into vacuum pans and charcoal filters, at least as few could at once reach so far as a complete "Feu Derosne," and if the unhappy political condition of that country had not put a severe check to all improvements the conversion of old and erection of new works would have been considerable. I hope that the above data, founded on practical experience of work done, may be taken into some consideration by our colonial planters, and give thereby fresh impulse to that branch of their industry, and not longer allow Cuba the lead it has, owing to their system of work, and not exclusively, as asserted so often, to their "slave labour" and "Customs restrictions at home."

S. S.

Sept. 13th, 1869.

CABLE-TOWING.

SIR,—Your correspondent "M. E." asks some of your readers to prove the correctness of one of either of the proofs given by him by demonstrating the errors of the opposing one. I cannot exactly comply with his illogical request, but, with your permission, will endeavour to demonstrate the falsity of both proofs, and to supply an illustration of the original problem treated, as "M. E." has done it, in his second proof, statically.

Adopting the notation used by "M. E.," except that P is always to mean the total tension at the highest point d, where the drum clips the rope. It is to be observed, with regard to proof No. 1, that "M. E." simply begs the question by assuming that P is the power exerted by the engine at the drum; the equation ought to be written—

$$l\,Q = l\,P = l\,M + l\,p\,h \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

the value of the element, $l\,M$, is the bone of contention.

In proof No. 2 the equation

$$d\,L : d\,y = P : p\,L$$

is not true; the ratio $P : p\,L$ is constant, and therefore, if the equation were true, it would prove that the rope in tension hangs in a straight line. Further on the equation is integrated as if L were variable.

If we suppose that the tow boat, instead of moving, is simply held stationary by the tow rope in a steady current of given velocity, we shall have a statical problem, the solution of which will contribute something towards setting the question at rest. If we neglect the pressure of the current against the rope, which is, I suppose, what "M. E." means by the phrase "exclusive of the immersion," the rope in tension will hang in a catenary curve, and a well-known property of this curve gives the equation—

$$P = p\,h + p\,c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Where c is a length of the rope whose weight is equal to the tension at the lowest point; comparing equation (2) with equation (1), we see that—

$$M = p\,c,$$

or the force exerted by the engine on the drum is equal to the horizontal tension on the tow rope at the lowest point. This, however, does not solve the question; when the boat is in motion the two parts of the rope are in motion, and we shall have to consider both the relative weights and the relative motions of the two parts of the chain—a problem which I must leave to some mathematician more learned than myself, if to solve it be worth his while.

CONTRACTOR'S ENGINEER.

September 8th, 1869.

HYGROMETERS.

SIR,—I am unable to inform you when the Mexican or South American hygrometer, claimed by M. Bonville, and referred to in one of your recent impressions, was invented; but, several years ago, I perceived the notice of that instrument in the cheap publication called the *Family Herald*, in which the process of manufacture was fully described, and so simply that all could have constructed, each, of course, according to his skill. For my part I have had one accordingly for several years, and find it an admirable indicator of damp merely; but I have an instrument to denote thunder, or the electric condition of the atmosphere, to which, as an invention, I think I can lay claim. If your numerous correspondents are unable to make out what my invention may be, perhaps they will describe what each one, in his capacity, may be able to suppose my invention to be. It is sufficient for me to declare that I think I have an invention worthy of the attention of the patent law wranglers. I am a member or fellow of some scientific societies, and thus have the pleasure of setting your correspondents right with regard to the claim of M. Bonville with respect to the hygrometrical machine or instrument he has claimed.

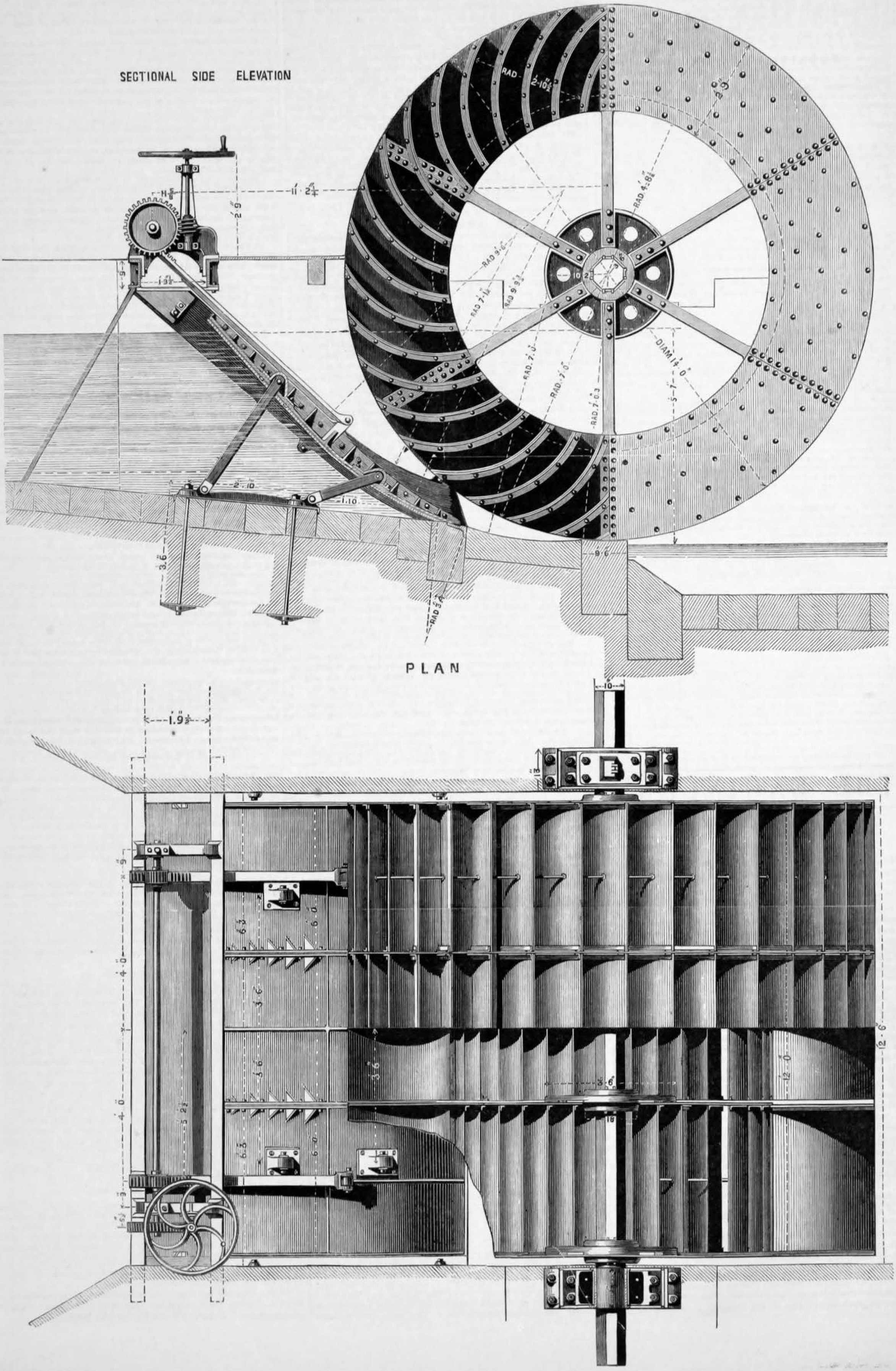
Larchwood, near Amersham, Buckinghamshire, 6th September, 1869. J. S. EIFFE.

A NEW BRANCH OF INDUSTRY has been successfully introduced into the Middlesborough district. It has been previously announced that Messrs. Hill and Ward were erecting works at Newport for the manufacture of wire. The machinery has been in working order for some little time, but the mill in question was not formally opened until last week. The wire works are situated near to the iron works of Messrs. Fox, Head, and Co., and between the North Eastern Railway and the river. The firm intend to manufacture wire for telegraphic, fencing, rope-making, and other purposes. The machinery has been supplied by Messrs. Claridge, North, and Co., Bilston, and is of the most approved description. It is proposed to use puddled billets made from Cleveland iron.

* See THE ENGINEER for the 10th of September, 1869, pp. 180, 181.

PONCELET WATER WHEEL AT EXWICK MILLS, NEAR EXETER.

MR. E. W. BULLER, C.E., ENGINEER.



TO CORRESPONDENTS.

*** *We cannot undertake to return drawings or manuscripts, we must therefore request our 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.*

H. M. C.—*Received. Thanks, all right.*
W. RIDDLE.—*A letter lies at our office for this correspondent.*
T. C.—*We do not care to see more than the drawings at present.*
FOREMAN.—*Galvanising was patented by Mr. Crawfurd in* 1837.
R. T. J.—1. *Not for ordinary building purposes.* 2. *Not nearly.* 3. *About* 8*d.*
R. B.—*Mr. Thompson, of* 3, *Moray-place, Edinburgh, will supply you with full information.*
T. D. E. F., AND OTHER CORRESPONDENTS (Thompson's Road Steamer).—*See notice above.*
C. J. W.—*Your letter, being anonymous, was destroyed before your card reached us. Please write again.*
W. B. W.—1. *Ten-inch wheels, unless the roads are* very *good, when as little as six will do.* 2. *About one in ten.*
T. C. (Brighouse).—*Air cannot be used at all, as you propose, in a condensing engine; the vacuum would be destroyed.*
G. W. (Steam Lifeboats).—*Our correspondence columns are open to you if you think proper to call attention to the subject.*
W. S.—*You cannot do better than apply to any of the makers of centrifugal pumps whose names are to be found in our advertising columns.*
A POOR INVENTOR.—*The Inventors' Institute, of which Mr. Latham is the Secretary, professes to do what you want. The offices are in Fleet-street.*
R. C.—*There is no such work in existence. "Clegg, on the Manufacture of Gas," or "Ure's Dictionary" may supply you with all the information you require.*
T. W. M. C.—*We believe the plan would answer. It is so far promising that we advise you to make a model and fit it to a small engine. In* THE ENGINEER *for October 2nd, 1868, you will find the subject of condensers without air pumps fully handled.*

A CORRECTION.

(*To the Editor of The Engineer.*

SIR,—I observe in your list of "Abstract of Specifications" in last week's ENGINEER, you erroneously stated that the patent in my name, No. 404, dated February 9th, 1869, was "not proceeded with." As this statement misleads the public, and may affect my client's interests, I shall feel obliged by your rectifying the error in your next number. The patent was sealed July 20th, and the final specification was filed on the 7th of August.

J. HENRY JOHNSON, *pro* T. AND B.

September 15th, 1869.

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 number) .. .. .. £0 15s. 9d.
Yearly (including two double numbers) .. .. .. £1 11s. 6d.

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

Advertisements cannot be inserted unless delivered before six o'clock on Thursday evening in each week. The charge for four lines and under is three shillings; each line afterwards, ninepence. The line averages eight words; blocks are charged the same rate for the space they fill. All single advertisements from the country must be accompanied by stamps in payment.

THE ENGINEER.

FRIDAY, SEPTEMBER 17, 1869.

MR. MACFIE ON PATENT RIGHT.

MR. MACFIE may, we have reason to think, be regarded as the most able debater in the ranks of the anti-patent-right party. If he cannot adduce convincing arguments in favour of the general adoption of the faith which he has embraced, no one can. Mr. Macfie has every possible incentive to speak strongly and well on this subject. He has lost large sums of money on patents taken out by other people, which did not succeed. He is a thoroughly earnest reformer. He has, as a public man, a duty to perform, and he is heartily convinced that this duty can only be fulfilled by the destruction of what he regards as the last relic of monopolies. He is as honest as the sun. He does not lack ingenuity; nor is he deficient in the power of expressing his opinions, either *vive voce* or on paper; and, lastly, he enjoys that blind, child-like faith in the accuracy of his own views which is essential to the character of a good "arguer"—we use the word advisedly; nothing else will answer our purpose. Mr. Macfie is not and never can be a great debater, for the simple reason that he lacks the power of mentally putting himself in his opponent's place; but he is a great "arguer," and as such his opinions deserve some attention; in a word we wish our readers to fully understand that Mr. Macfie is really—if he will pardon us for the familiarity—one of the great guns of the anti-patent party. We reprint in another place two highly characteristic communications from his pen. It is quite possible that some people might fall into the error of thinking that the fallacies, and weaknesses, and frivolities, in these letters were due to the writer, not to the cause which he defends. On this point we beg to set everyone right. Mr. Macfie has done very fairly indeed. We cannot call to mind the name of any individual who has said more against patent law, or said it better, than Mr. Macfie. If the arguments he uses break down, the world may still rest content; it is the arguments, not the man, who are to blame. The anti-patent party may bear their champion off the field; they may wrap their standard round him; their best and bravest may carry him on their shields with pride, tempered by sorrow, and accord him every honour ever paid to a valiant man; it is the cause, not the individual, which is answerable for the defeat.

And now at the risk of wearying our readers, we propose to consider Mr. Macfie's letters at length, and, if possible to convince the waverers—we have no hope of convincing Mr. Macfie—that the arguments contained in the letters in question are of no value whatever. Nothing, indeed, but the respect which we entertain for Mr. Macfie as a conscientious but self-deluding gentleman, would have induced us to deal with the feeble things at all. They represent the best that the best man can do, and we are glad that such is the fact. Their refutation, the exposure of their childishness, will be the more serviceable that they are the production not of the small, jealous, snarlers at patent right, but of Mr. Macfie.

Mr. Macfie's somewhat eccentric communication to ourselves begins:—

> The writer characterises the anti-patent movement as advocating robbery. It would be stigmatised as such deservedly if it aimed at depriving patentees of the rights they have legally already acquired. But that is by no means the case; it is directed only against the concession to other patentees of more rights.

Our distinct charge is that Mr. Macfie, in proposing to refuse patent rights to inventors, proposes also to rob them of the money which they could obtain if, possessing patent rights, they went into the open market and sold their invention to the highest bidder. Mr. Macfie is a respecter of the law, and we never supposed for a moment that he wished to introduce a retrospective reform (?) in patent law, any more than we conceived it possible he should contemplate picking pockets, or breaking open Compton House; Mr. Macfie, beyond a doubt, draws the line somewhere. We have defined very clearly what we meant by the word "robbery," and we repeat the assertion that the anti-patent right party, with Mr. Macfie at their head, contemplate what we, in common with the great mass of mankind, call robbery. Mr. Macfie must prove that granting permission to what he calls the "State," to obtain for nothing what this same "State" would pay for rather than go without, is not robbery. If Mr. Macfie imported a cargo of sugar from Jamaica into this country, he would not be particularly pleased, we fancy, if every one who wanted sugar went and took as much as he wished in the name of the "State." He would not be slow to denounce this as robbery; yet if an individual imports an invention from the realms of imagination, the "State," according to Mr. Macfie, should have a right to seize it at once. Will no one explain this, to us, great inconsistency? Does the nature of an article modify the action of the law? Would it be less robbery to take a cargo consisting of Bessemer steel than one of sugar, and if less, how much less? Does the port of departure affect the action of legislation? Would it be a sin to take sugar without paying for it which came from Jamaica, but a less sin to take it if it had come from Ostend, and if less, how much less? In what way does the introduction of a new machine or a new process into this country, which did not exist in it before, differ from the introduction of a cargo of sugar or Bessemer steel? Mr. Macfie will not find it easy to answer these questions. The task is difficult, so difficult that neither our correspondent nor any of his party have tried to grapple with it. Indeed, Mr. Macfie, more far-seeing, or more honest, than his fellows, has sought a way out of the difficulty, and instead of robbing the inventor completely, proposes that the "State" shall give him a reward. Mr. Macfie, having imported a cargo of sugar, has it seized before his eyes and taken away for the good of the "State." The "State," overflowing with gratitude, gives Mr. Macfie a gold medal and promises to give him another medal for another cargo. Cannot our readers picture to themselves Mr. Macfie going for the second cargo?

Mr. Macfie next quotes the passage: "The law, Thou shalt not steal, existed in the minds of men," &c., and comments on it thus:—

> It being not easy to prove a negative, I reply by a counter demand, viz., that my adversary will prove the recognition in ancient law of any property other than in things material; or, if he cannot do this, that he will adduce any historic reason for believing that the conscience of mankind or of rulers ever responded among Greeks, Romans, Jews, or Egyptians, or does respond now in China or any country not sophisticated by European civilisation of the principle of conceding exclusive proprietorship in inventions to any owner, whether first or not, and however legitimate.

If Mr. Macfie had never written anything more sensible—or shall we say less imbecile—than this, we should not have noticed him at all. Mr. Dircks so ably refutes in a paper already published in our columns, the lurking argument subtly hidden in the query—such as it is—that we need scarcely notice it. The ancients did not recognise patent law, because—in the modern sense—they had no inven- inventions. Invention and patent law depend for existence on each other; they cannot have a separate being. It required the "sophisticated civilisation of the nineteenth century" to recognise the right which Mr. Macfie disputes. Abolish this recognition, and we at once return to the condition of the ancient "Greeks, Romans, Jews, or Egyptians." China, too, which has neither advanced nor receded for centuries in the art of construction, is an admirable illustration of the advantages which follow on the non-recognition of right of property in ideas! Was Mr. Macfie in sober earnest when he wrote the concluding sentences of the paragraph—"sophisticated by European civilisation?" It must be his fun, and very funny it is. *Mais revenons à nos moutons.* Mr. Macfie goes on:—

> The writer says, "The opponents of patent law urge that inventors have no right to receive a reward based on the commercial value of their invention; principally, it seems, on the ground that the rewards which some inventors receive are out of all proportion to the value of the invention. Let me explain. We deny that there is any right to rewards, and we allege that the rewards now given are objectionable for, *inter alia*, the reason stated above. The commercial value of an invention depends on the money it brings in or saves. If there were no patent, this benefit accrues to the inventor only so long as he alone knows the secret or uses it, and to anybody else who may in process of time do so. . . . The commercial value of a patented invention is greater than that of an unpatented invention. Grant that people who have used Mr. Bessemer's or M. Golay's invention have paid no more than it was worth, and the fact remains that as they were not voluntary negotiators they may have paid a great deal more than was fair, and perhaps more than they could afford, because the State left them no alternative, but compelled them to pay excessive royalties or suffer. . . . The licencees were in the position of the man to whom is addressed the demand, "Your purse or your life."

No passage could be written which would show more conclusively how completely Mr. Macfie and his friends fail to comprehend the true nature of the question with which they have presumed to deal. It actually assumes that the State compels a manufacturer to pay more for an invention than it is worth, Mr. Macfie completely losing sight of the fact that no man is compelled to buy. If a steel maker or a miller thinks that it will be to his advantage to use Mr. Bessemer's or M. Golay's inventions he will do so; but in estimating the advantage which will arise, neither the steel maker nor the miller will forget to include as a working expense the royalty which must be paid to the inventor. If a miller finds that he will make better flour for less money by paying for the use of Golay's dressing apparatus, than he can make without it, then he will have it, not otherwise. Every invention which is worth anything, first pays a profit to the user, and this profit is divided between the user and the patentee. If the user thinks his share too small he says so, and leaves the thing alone. If the patentee thinks his profit (royalty) too little, he refuses to license the invention—just on the same principle that a tenant will not give more or a landlord take, less rent than a house is worth. The smallest information on the subject of political economy would have kept Mr. Macfie from committing the absurd blunder contained in the foregoing extract. The statement that licencees are ever in the position of the man to whom is addressed the demand, "Your purse or your life," is absolutely untrue. If Mr. Bessemer's process with the royalty added was good for nothing, why on earth did any manufacturer touch it? The truth is that Mr. Bessemer's patent was worked at a large profit. Steel was made more cheaply by its aid, including the royalty, than it could be made in any other way, royalty or no royalty. What of the footpad was there about Mr. Bessemer? He did not say "you must use my process, whether you like it or not." He *did* say "if you want to make cheap steel you must use my process, and pay me part of the profits you will realise;" and the same holds good of M. Golay, and of every successful inventor. No manufacturer will use a patent unless he can make a profit out of it, after he has paid the royalty, and this Mr. Macfie should understand perfectly well; and he doubtless does understand it, because in his letter to the *Liverpool Courier* he says: "Look at the Mersey Steel and Iron Company, shutting up the steel department of their works till the Bessemer royalties cease to be due." No better illustration of the truth of our argument that an invention just brings what it is worth, and no more, could be afforded. The company referred to say that they cannot make Bessemer steel at a profit and pay Mr. Bessemer. They reason, consequently, that the invention is not worth to them what Mr. Bessemer asks, and they decline to avail themselves of it. Cannot Mr. Macfie see that if all the steel makers found out the same thing, Mr. Bessemer's royalties would be *nil*, and he would have to re-adjust them, which he would not be slow to do? Mr. Macfie has in this case, however written with a sublime disregard of facts. The Mersey company closed their Bessemer works because, owing to mismanagement, they could not make them pay. The experience of Messrs. John Brown and Co., The Ebbw Vale Company, and many others is totally different. It would be most unfair to cut down Mr. Bessemer's reward to suit the results brought about by the incompetent management of any single concern; but this is one of the things Mr. Macfie will not see.

Denuded of the sophistries with which the subject has been surrounded, the arguments of the anti-patent right party stand thus:—"Inventors now get more for their inventions than the inventions are worth. We propose to take from them the surplus." We reply that inventors, upon the whole, *never get more for their inventions than the nation, as represented by those using the invention, considers them to be worth*, and that to compel them to take less would be simply to rob the inventor in order that the manufacturer might augment his profits. This argument we consider to be irrefutable, and it has never been really touched by anti-patent right debaters. Until it is overset we must continue to maintain that Mr. Macfie and his friends advocate the robbery of the individual by the "State," which "State" we more than suspect means in Mr. Macfie's vocabulary, the capitalists of Great Britain.

GOVERNMENT AID TO SCIENCE.

Two or three years ago several thousands of pounds per annum were placed by the late Government at the disposal of the Royal Society, to be expended in the establishment of meteorological observatories in different parts of the United Kingdom, in order to supply accurate daily weather reports to the Board of Trade. This step was not without its moral influence upon the scientific world, for at the British Association at Norwich last year it was suddenly discovered that the scientific world generally was very badly off, and most decidedly in want of money aid from the Government. Lieutenant-Colonel Strange read a paper at Norwich on the subject. He acknowledged that Government aid would be certain to give rise to "jobbing" and jealousies, but urged that the good done would outweigh the evil. The opposite side of the question was then taken up by Professor Huxley, who said, with much reason, that the present free and easy way of pushing on scientific research was the best for the nation and best for philosophers. Nothing would so chill and deaden the energies of the scientific world as the transformation of any large portion of it into a Government department. The result of the conference at Norwich was the appointment of a committee of eminent philosophers to inquire whether adequate means exist for the vigorous prosecution of scientific research; and if not, what remedy should be provided.

So far everything went on swimmingly, but then a frost, a chilling frost, blighted the bright dreams of the philosophers. A new Chancellor of the Exchequer came

into power, who has said "No!" many times and oft to demands made by individuals and corporations for aid from the national coffers. He not only refused a modest demand for cash made by a Scotch scientific society, but expressed doubts whether the grant made for meteorological observations under the Board of Trade ought to have been made. The Government, he stated, ought to do nothing which the people are likely to do for themselves if left free to act. With the prospect looming in the future of facing a gentleman of this description, the British Association Committee, of course, could not very well come to the conclusion that application should be made for a Government grant, which everybody a year ago thought would be the result of their deliberations. But they have unanimously decided that scientific bodies want more funds; and what corporation of human beings does not? A direct onslaught on the national resources being manifestly injudicious, they then recommended that application should be made for the appointment of a royal commission to inquire into the subject. Lieutenant-Colonel Strange read this report of the committee a few days ago at the Exeter meeting of the British Association, and he prefaced it with a doleful introduction of his own, read with the countenance of a mute at a funeral. He evidently was hoping against hope, and he reviewed the bright visions of the past with a tone implying his belief that

"Those days are gone, Floranthe!"

Many will doubtless think that a scientific journal is bound to support scientific men in all and every rush at the public purse. Apart from the selfishness of such a line of action, and its neglect of the general interests of the nation, in this case it is no use doing so. Very recently an application of a very influential character was made to the Chancellor of the Exchequer to appoint a royal commission to inquire into the working of the Bank Charter Act of 1844. This Act is believed by the political economists to be the source of many commercial panics and of a vast amount of pauperism, while any banker can bear witness that it has indirectly been cause of the ruin and bankruptcy of many honestly managed banks. Yet this application, of more importance than the one proposed to be made by the British Association, was refused on the ground of the expense of the commission, and because the action of the law upon the public is perfectly understood already by those educated in the science of political economy. Of course, once let the proposed commission on scientific needs be appointed, the result of the large amount of talk which would follow would not certainly be a recommendation of increased national expenditure. Instead of trying to obtain a few thousands of pounds annually in this way, with the certainty of failure, why do not the committee take steps to get a few tens of thousands of pounds annually from a more legitimate source? The subject of national education must soon come to the surface, and if the British Association then urged the necessity for general teaching of elementary science in schools, and the desirability of making grants to encourage this branch of education, all the members of the British Association would support the movement. At present there is a division in the camp, and very many hold the views of Professor Huxley. If science were generally taught in schools we should soon have a population willing to subscribe largely to push on scientific research without aid from the Government. The Wesleyans have shown what enormous sums can be raised annually by private subscriptions, where large numbers of people join together in favour of any particular line of action. Those numbers may or may not be one in twenty of the total population, but is it hopeless to attempt to train up a similarly large number of people to have an interest in science? If the British Association and its president of next year were to make a dead set at the Government, insisting that the teaching of science in schools shall be a marked feature in all future educational legislation, they will succeed to a large extent, for they would carry national opinion with them. The present plan will fail, and even the intention mentioned by the President of Section A, of getting up a discussion upon it before the sittings of the British Association came to a close at Exeter, was abandoned.

South Kensington Museum.—Visitors during the week ending 11th September, 1869:—On Monday, Tuesday, and Saturday, free from 10 a.m. to 10 p.m., Museum, 14,747; Meyrick and other galleries, 2348; on Wednesday, Thursday, and Friday (admission 6d.), from 10 a.m. till 6 p.m., Museum, 1606; Meyrick and other galleries, 148; total, 18,849; average of corresponding week in former years, 12,064; total from the opening of the Museum, 8,792,855.

A bridge across the Clyde forms the most important and difficult engineering work upon the City of Glasgow Union Railway. It is constructed upon the lattice girder principle, and notwithstanding its great strength it is light and graceful in appearance. From abutment to abutment the bridge is about 600ft. in length, a distance attained by seven spans, which are supported at their junction by octagonal piers. The piers rest upon iron tubes which are carried down through some 70ft. of sand, forming the bed of the river, until solid rock is reached.

Dangerous Illness of the Master of the Mint.—We are concerned in having to announce that the faintest hopes of the recovery of Professor Graham, F.R.S., Master of the Mint, are entertained by the friends of that gentleman. Some ten days since Mr. Graham caught cold, and this induced an attack of inflammation of the lungs. Medical agencies overcame the latter complaint, but exhaustion at present constitutes the main element of danger. From inquiries made last evening at Mr. Graham's residence, in Gordon-square, we ascertained that the patient was then considered to be rapidly sinking.

An agreement has been arranged between the Earl of Warwick and the Leamington Local Board for the latter to pump the town sewage on to his lordship's estate for thirty years at £450 a year. The rise is about 100ft. and the distance about two miles. It is estimated that the necessary works will cost the board £12,000, and that the annual expenses will be £700, so that a large sum of money will be sunk by the town in order to get rid of the sewage difficulty, the Earl taking all responsibility as to injunctions. The Warwick Local Board Sewage Farm pays its expenses, and that at Banbury will, in thirty years, have paid for its works and all expenses, by a yearly loss of £100, in all probability, unless a farm can be made more productive. The A B C process of Messrs. Sillar and Wigner is in operation at Leamington for this year.

ON THE DETERMINATION OF THE REAL AMOUNT OF EVAPORATION FROM THE SURFACE OF WATER. *

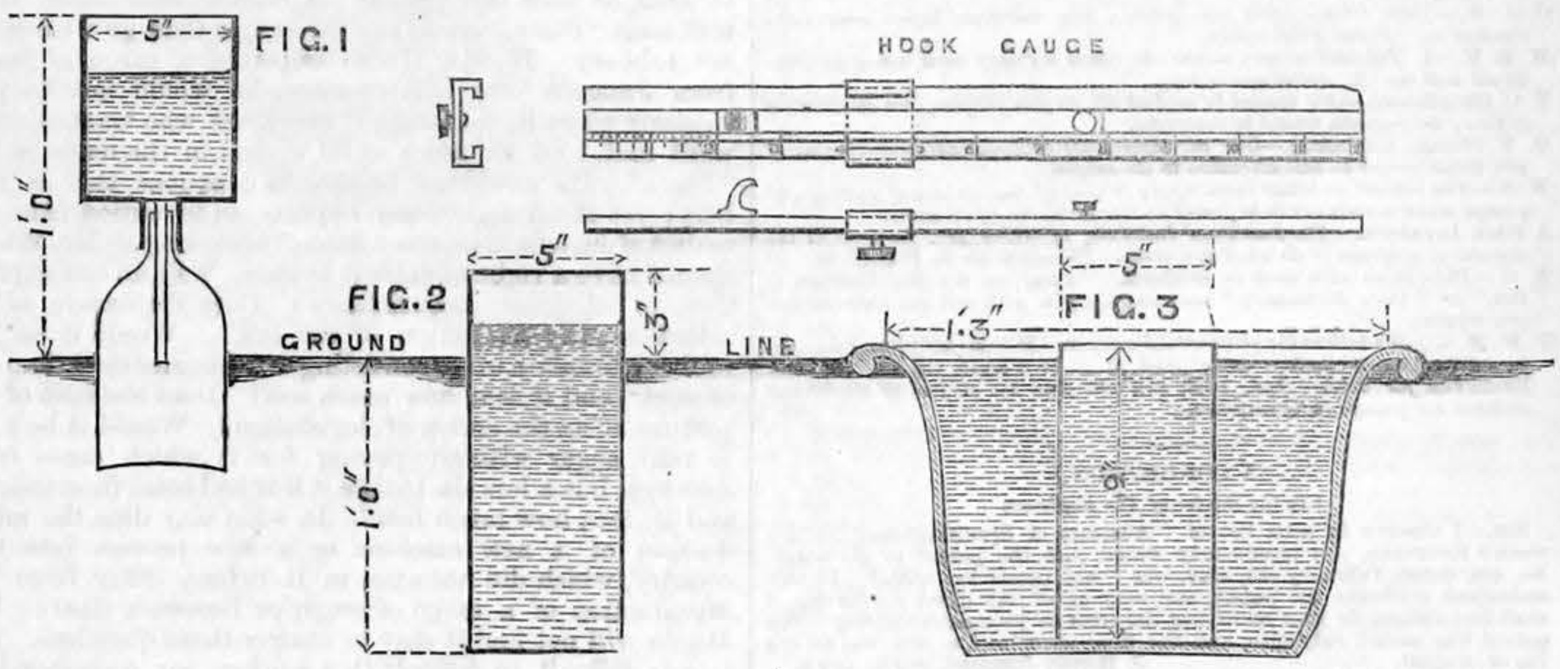
By Mr. Rogers Field, B.A. and Mr. G. J. Symons.

The determination of the amount of evaporation from a water surface would appear at first sight a very simple problem, but that it is really by no means such is shown by the extremely discordant results arrived at hitherto by the highest authorities. To take two instances—Mr. Fletcher, M.P., F.R.S., of Tarn Bank, who is too well known as a careful observer to require that more than his name should be mentioned, and Mr. Proctor, of Barry, whom Mr. Buchan describes as one of the ablest observers of the Scottish Meteorological Society. The returns from these two stations are generally in the ratio of three to one; *e. g.*, in 1864, Tarn Bank, 44·23in.; Barry, 11·09in.; and in 1865, Tarn Bank, 47·86in.; and Barry, 28·65in. The high values returned by Mr. Fletcher do not result from any oversight, because a year or two since he concluded a note on evaporators in the following words:—"The mean evaporation is 47in., a quantity vastly in excess of the amount arrived at by Mr. Howard (20in.) and Dr. Miller (30in.), but I believe it to be more correct than either."

Some difference might be expected in the results arrived at, in consequence of the difference of locality; but such startling differences can, we believe, only be explained by the very faulty nature of the evaporators in common use.

Professor Daniell, in his "Meteorological Essays," refers to the ordinary evaporators in the following terms:—

"The notion that these afford the absolute measure of the quantity of water raised into the air is absurd, for the instrument can only give the amount of evaporation from the shallow body of water in the place where it has been fixed. The conditions which modify the process vary almost *ad infinitum;* they vary on the land and on the water, they vary in the sunshine and in the shade, they vary as the land is more or less clothed with vegetation, or as the water is more or less deep. The evaporating gauge, so far from representing the circumstances of those bodies which yield the great body of vapour on the earth's surface, probably does not correspond in all essential particulars with a dozen puddles in the course of the year, and the pains which are often taken to make the results tally with those of the rain gauge, or to compare the two, are wholly misdirected." Similar condemnation has been passed by other authorities.



Professor Daniell proposes, as a substitute, two methods of calculating the amount of evaporation from observations of his dew point hygrometer; but he states that it depends on the observer's estimate of the force of the wind. We do not understand why the evaporation from the moistened surface of the hygrometer bulb does not proceed, *pari passu*, with that from a water surface; but, assuming it to be so, there is little probability that the force at the time of observation would be exactly the average of the day, or that it would be accurately estimated. Even Professor Daniell admits that the amount deduced by this method may exceed or fall short of the tabulated quantity to the extent of one-fourth. We venture, therefore, to consider this plan so inaccurate as to be practically useless.

In this interim note we do not purpose discussing the various methods hitherto proposed, but not one of which has been generally adopted; even the best pattern of evaporator, to which we shall hereafter refer as the ordinary evaporator, is not used by one observer in twenty.

The great objection to nearly all evaporators hitherto used has been their diminutive size, and the consequent fact that the pint or two of water they contain has become unduly heated, and therefore the recorded evaporation has been largely in excess of what it would have been had this artificial elevation of temperature not been produced..

The only published experiments with evaporators of large size, of which we are aware, are those made some years since at Dijon and other places on the Burgundy Canal, recorded in the "*Annales des Ponts et Chausées.*" The evaporators used in these experiments consisted of square masonry tanks about 8ft. on each side, and 1ft. 4in. deep. They were lined with zinc so as to be perfectly watertight, and sunk in the ground. The amount of evaporation from these tanks was found to be less than half what was generally adopted by the best authorities as the evaporation in that district. Experiments were also made during one year with an evaporator 1ft. square by the side of the large ones, and the evaporation in this case was found to be some 50 per cent. greater in the smaller than in the larger tank.

Professor Haughton of Trinity College, Dublin, has published in the Proceedings of the Royal Irish Academy some observations on evaporation at St. Helena, by Major Phillips and Lieutenant Haughton, which, though on a smaller scale, have an important bearing on the question. These experiments were made with two different kinds of evaporators placed near each other, (1) A glass cylinder 9in. high, and 9·85in. in diameter fully exposed, and (2) a similar glass cylinder placed in a large tub of water so as to have the water inside the cylinder always surrounded by water nearly the same level. In these experiments, carried on for two years, the evaporation from the exposed cylinder was found to be nearly 50 per cent greater than that from the cylinder surrounded by water. In both the above quoted instances, the small evaporators which gave an excessive amount of evaporation were better and less liable to become unduly heated than those ordinarily in use, which may therefore be reasonably assumed to give still more erroneous results.

There can be no question that the most accurate method of arriving at the evaporation from a water surface is by observation on large tanks, as at Dijon; but we cannot hope that apparatus of this kind will be used save in exceptional cases, and it therefore becomes important to devise some simple arrangement which should give approximately correct results. Our own experiments having only recently been commenced; we by no means consider that we have overcome all the difficulties of the subject; but we desire to place upon record a few facts which we hope may act as incentives to further and more complete researches on this very important subject.

One fact, which partly explains the comparative neglect into which this subject has fallen, is the difficulty of measuring accurately the quantity of water abstracted, the process usually consisting in measuring the whole volume with a graduated glass; and this is also probably one reason for the small capacity of many of the evaporators, some holding only one inch deep of water.

This difficulty has been entirely obviated in our experiments by the use of a small instrument called a "hook gauge," designed some time since by Mr. Field as a portable instrument for purposes of hydraulic observations. The principle is borrowed from an elaborate fixed arrangement described in Francis's "Lowell Hydraulic Experiments." All other known methods of observing the height of the surface of still water are interfered with by the effects of capillary attraction, whereas this instrument owes its great precision to that phenomenon. If the point of the hook is ever so slightly raised above the water surface it raises a small cone of water with it, which is at once rendered visible by the distortion of the reflection. If, on the other hand, the point is depressed below the water, it carries the water down with it, and forms a depression, which also causes distortion of the reflection. It is, therefore, only necessary to adjust the hook so that there shall be no distortion, and the point will then be precisely level with the surface of the water. A vernier on the slide enables the depth to be read to one-hundredth of an inch with undeviating certainty. There is a clamped bar attached, by adjusting which, and resting it on the top of the evaporator, the zero thereof can be placed in any convenient position, without the necessity of having a fixed point for the zero at the bottom of the vessel.

The arrangements we have adopted are shown on the diagram.

Fig. 1 represents, perhaps, one of the best forms of ordinary evaporators, many of those used even by the highest authorities (such as Luke Howard) being much more objectionable. It will be seen that it consists of a copper vessel containing about a quart of water exposed to direct and reflected heat on every side, and even on the bottom, so that if it were required to obtain the maximum temperature to which that volume of water could be raised by the solar beams, the arrangements could hardly be improved upon.

Fig. 2 represents an arrangement designed by Mr. Symons some months since wherein the vessel, still of metal, is sunk almost wholly into the ground, so as to obviate as far as possible artificial heating.

Fig. 3 is a modification of the plan adopted by Major Phillips a St. Helena, and already referred to. In this the water to be measured is contained in a glass cylinder, which is placed in the centre of a much larger vessel of water, the whole being buried in he earth up to the brim of the large vessel.

The following table gives the detailed results of our observations:

Evaporation during part of July and August, 1869. (*Camden-square, London, 111ft. above Sea Level.*

Date of Reading.	Evaporation in hours stated. Total hrs.	Cassellas.	Symons.	Phillips.	Evaporation in 24 hours. Cassellas.	Symons.	Phillips.	Computed from hygrometer.	Temperature of water. Cassell	Symons.	Phillips.
		in.	2in.	3in.	1in	2in.	3in.	in.	Deg	Deg	Deg
July 22, 9 a.m.	24	·18	·16	·13	·18	·16	·13	·17	82·8	77·9	74·0
,, 22, 2 p.m.	5	·19	·08	·04					95·8	86·4	82·1
,, 23, 9 a.m.	19	·18	·17	·14	·37	·25	·18	·30			
,, 24, 9 a.m.	24	·18	·15	·08	·18	·15	·08	·19	79·4	74·2	73·8
,, 25, 9 a.m.	24	·32	·25	·20	·32	·25	·20	·18	75·0	73·8	73·2
,, 25, 9 p.m.	12	·20	·11	·14					83·4	79·8	76·0
,, 26, 9 a.m.	12	·05	·06	·03	·25	·17	·17	·22			
,, 26, 1 p.m.	4	·12	·06	·05							
,, 26, 6 p.m.	5	·12	·08	·04							
,, 27, 9 a.m.	15	·05	·06	·08	·29	·20	·17	·17			
,, 27, 2 p.m.	5	·16	·05	·06					82·1	77·8	73·9
,, 28, 9 a.m.	19	·11	·09	·06	·27	·14	·12	·10			
,, 29, 9 a.m.	24	·09	·12	·03	·09	·12	·03	·06			
,, 29, 1 p.m.	4	·04	·03	·02					79·2	72·2	71·8
,, 30, 9 a.m.	20	·20	·12	·12	·24	·15	·14	·15			
,, 30, 7 p.m.	10	·11	·06	·06							
,, 31, 9 a.m.	14	·05	·04	·03	·16	·10	·09	·16			
Aug. 1, 9 a.m.	24	·12	·12	·11	·12	·12	·11	·12	80·4	76·1	73·0
,, 1, 1 p.m.	4	·08	·05	·02							
,, 1, 6 p.m.	5	·09	·07	·04							
,, 2, 9 a.m.	15	·07	·07	·08	·24	·19	·14	·14			
,, 2, 3 p.m.	6	·11	·06	·06							
,, 3, 9 a.m.	18	·02	·01	·03	·13	·10	·09	·11			
,, 4, 9 a.m.	24	·08	·06	·00	·08	·06	·00	·10			
,, 5, 9 a.m.	24	·19	·08	·10	·19	·08	·10	·16			
,, 5, 2 p.m.	5	·07	·05	·02					72·0	68·1	70·2
,, 6, 9 a.m	19	·10	·10	·12	·17	·15	·14	·21	76·4	71·3	69·5
,, 6, 6 p.m.	9	·07	·06	·05							
,, 7, 9 a.m.	15	·06	·04	·03	·13	·10	·08	·21			
,, 7, 5 p.m.	8	·13	·11	·05							
,, 8, 9 a.m.	16	·06	·06	·07	·19	·17	·12	·11			
,, 9, 9 a.m.	24	·04	+·01	+·01	·04	+·01	+·01	·06			
,, 10, 9 a.m.	24	·31	·21	·16	·31	·21	·16	·15			
,, 11, 9 a.m.	24	·27	·17	·13	·27	·17	·13	·18			
,, 12, 9 a.m.	24	·15	·10	·09	·15	·10	·09	·14			
Total		4·37	3·13	2·46	4·37	3·13	2·46	3·39			
Ratio					1·78	1·27	1·00	1·38			

It would be quite premature to draw definite conclusions from the short period of observation hitherto elapsed, but we may point out a few remarkable results.

(1.) During the three weeks ending August 12th the total evaporation from Fig. 1 was 4·37in.; from Fig. 2, 3·13in.; and from Fig. 3, 2·46in., numbers which are to each other in the ratio of 1·78, 1·27 and 1·00. Fig. 1 therefore lost 78 per cent. more water by evaporation than Fig. 3.

(2.) During the daytime the sunshine heats Figs. 1 and 2 to such an extent that the ratios of evaporation become about 250, 150, and 100.

(3.) During the night there are indications of a slight addition to Fig. 3 from condensed vapour.

(4.) It will be seen that the evaporation as computed from the hygrometer bears no regular relation to any of the others, being sometimes greater than any of them and sometimes less.

We have already pointed out that we consider the accuracy of an evaporator is largely dependent on its capabilities of retaining the temperature of the contained water at as nearly as possible

* British Association.

that of large volumes of water, such as reservoirs, rivers, and ponds. Hitherto we have not been able to institute regular comparisons of the temperatures of the water in our experimental vessels with that of the surface of large bodies of water. Surface temperature alone is concerned, because therefrom alone can evaporation take place. On the few instances when we have done so we have found that the water in the water-surrounded glass cylinder (Phillips, Fig. 3) has been nearly identical with that of a rather shallow reservoir one acre in extent. We do not, however, consider our observations sufficiently numerous to prove this. They, however, abundantly prove the faulty nature of all ordinary evaporators, for we find the average temperature at about 2 p.m. to have been in Fig. 1 80·7 deg.; Fig. 2, 75·8 deg.; Fig. 3, 73·8; showing an average excess of 7 deg. in the temperature of Fig. 1 over that of Fig. 3. In sunshine there is an excess of twice that amount; in fact, at times the metal becomes so hot as to scorch the hand. Before leaving the subject of temperature we may mention a singular and suggestive fact. The average excess of the temperature in the three vessels above 65 deg. is respectively 15·7 deg., 10·8 deg., and 8·8 deg.; and these values are to one another in the ratio of 1·78, 1·23, and 1·00, or nearly identical with the ratios of the amount of evaporation, viz., 1·78, 1·27, and 1·00.

We commenced this paper by placing in juxtaposition the values assigned by two high authorities in our own country, of which one was thrice the other. We can hardly more strongly advocate the claims of this question to investigation than by quoting, in conclusion, M. Vallès, the French engineer, who first called attention to the great discrepancy between the observations on the canal of Burgundy and the data generally adopted in France by scientific men. M. Vallès says:—"We do not understand how in a country like ours, and with reference to one of the most important of hydraulic data, we can rest content with only knowing that the numerical value to be attributed to this datum, so essential for a large number of engineering works, lies between two limits, one of which is double the other!"

BIRMINGHAM PATENT FILE COMPANY (LIMITED).

(*Concluded from page* 158.)

WE have now to record the end of the six days' auction at the above works, the sale being brought to a close on Monday, August 16th. The important part of the machinery was sold on Wednesday and Thursday; the result, with accompanying notes, will be found hereafter. It will be seen that the more useful machinery fetched a fair auction price; while some of the other, such as the grinding machinery, erected at a cost of nearly £3000, and sold for £140, was, we may say, almost given away. How it is this company could not make a profit we are almost at a loss to understand; but we suppose it is attributable to the fact that they expended far too much capital to start with, and were not able to pay a sufficient percentage upon it. Like a great many other companies that have met the same fate, they launched out into an enormous expenditure before they had any idea of what they were going to realise. In these cases we are afraid that too often the directors, not being interested as much as a private proprietor would be, and also being easily led astray by the misrepresentations of managers, do not bestow as much care on affairs as they should do. Managers and directors are mostly chosen from or by those who have the greatest number of shares, and these are generally people of large resources, independent of the company, and they cannot take the interest in it that many a man would who perhaps has staked the whole of his capital and is far more competent to manage.

THIRD DAY'S SALE, WEDNESDAY, AUGUST 11TH, 1869.

Foreman's Office.

Lot

433. Four sets of stocks, forty-two taps, and nine pairs of dies for gas fitting, £5 10s.
434. A set of three stocks and eight pairs of dies, by Whitworth, from ¼in. to 1¼in., twenty-four taps, and six wrenches, £6 10s.
435. Screw plate, eight taps, and three ratchet braces, £1.
436. Eleven rimers and two drill braces, 18s.
437. Sixteen drills and one counter-sink, 5s. 6d.
438. Thirty-four chasing tools, £1.
439. Small hand vice and ten leather punches, 4s.
440. A patent spring gas-pipe spanner, 11s.
441. Two patent screw spanners, 16s.
442. Two American sliding gauges, £1 11s.
443. Three sliding gauges and straight edge, 16s.
444. A 4ft. spirit level, 13s.
445. Drill brace, painter's knife, two awls, and gimlet, 6s. 6d.
446. Lot of letter and punch stamps, 13s.
447. Brace, saw, pair of callipers, and six saw blades, 18s.
448. Cotterill's patent climax detecter lock and two cupboard keys, 16s.
449. Glass gauge, 6s.
450. Five sets of letter and figure punches, £1.
451. Sets of 1in. letter and figure punches and rack, 14s.
452. Two dozens patent lubricators for shafting,
453. Ditto ditto ditto
454. Ditto ditto ditto
455. Ditto ditto ditto
456. Ditto ditto ditto
457. Ditto ditto ditto } 5s. 6d. per doz.
458. One and a-half dozen small ditto 4s. 6d. per doz.
459. Twelve small tin oil cans,
460. Twelve ditto } 4s.
461. Three 10ft. measuring staffs, and sundries, 6s.
462. A Gauntlett's pyrometer, for measuring high temperature, £1 1s.

Fixtures.

464. Two deal panelled cupboards and six drawers, 10ft. 2in. by 2ft. 6in., as fitted in recess, £1 17s. 6d.
465 Deal drawing table, 10ft. by 2ft. 11in., on trestles, 6s.
466. Shelf and racks for stocks and dies, 1s. 6d.

Fitting Shop.

467. A vertical drilling machine, by J. S. Hulse, Manchester, with 12in. bed plate and 10in. face plate, on strong frame, with overhead motion; consisting of cone pulley, fast and loose pulleys, and hanging brackets, £12. [This was a good small machine and fetched a fair price.]
468. Steel tools for ditto, 16 lb., 14s.
469. One 7in. back geared hand lathe, by Collier and Co., with 14in. face plate, rest and T, and the overhead driving gear; consisting of small cone pulley, fast and loose pulleys, and disengaging gear, £12. [A fair price.]
470. Tools to lathe, 13 lb., 6s.
471. A 12in. slide and screw-cutting gap lathe, by Shepherd and Co., Leeds; with 22ft. bed, with guides for extending same to 24ft. 6in., nineteen change wheels, compound slide rest, one 12in. and one 7in. chuck plates, one 24in. chuck, two face plates, 40in. and 24in., a slide rest for cutting teeth of racks, and extra plate for slide rest, 30in. by 20in.; also the overhead motion, consisting of a five-speed cone pulley, two pairs of fast and loose pulleys, with disengaging gear, hanging carriages, &c., complete, £140. [This was a first class lathe, and sold for a fair auction price.]
472. Two carriages for lathe, 2 cwt. 10 lb., 10s.
473. Steel turning and boring tools, 1 cwt. 1 qr.; and small steel turning and boring tools, 20 lb., £1.
474. Two cramps, 7s. 6d.
475. Five large drivers, 15s.
476. Five smaller ditto, 5s.
477. Fourteen large spanners, 1 cwt., £1 1s.
478. Twenty-six smaller ditto, 48 lb., £1 11s.
479. Nine key wrenches, 6s.
480. Thirteen hand hammers, 18s.
481. Fifteen files, 3s.
482. Twelve packing plates for lathe, 2 cwt. 2 qrs. 14 lb., 10s.
483. Six planed face plates, 10in. by 11½in. 16s.
484. Small emery-grinding wheels, with spindle, pulley, cast-iron frame, &c., complete, £1 10s.
485. Drilling cramp, 7s. 6d.
486. A very powerful drilling and boring machine, by Collier and Co., with universal action, sliding table 2ft. 6in. by 1ft. 5½in., with double cone pulley, fast and loose pulleys, &c., complete; also an under foundation table, 5ft. 4in., by 3ft. 1in., and a boring bar, steady and block, £55. [A fair price.]
487. Steel boring tools and cutters, 3 qrs. 7 lb., 15s.
488. Three large bright steel boring bars, 2⅜in. and ⅜in. diameter, 4 cwt., 18s. per cwt.
489. Eight small ditto, various sizes, 2 cwt., 19s. per cwt.
490. Wrought iron oil cistern, 2ft. 10in. by 2ft., with wood cover, £1 3s.
491. A planed face plate, 30in. by 25in., 2 cwt., 7s.
492. Muris' patent double grinding stone, with driving pulleys and cistern, on strong stand, £4.
493. A Parnacott's patent emery-grinding wheel, 12in. diameter, 4in. on face, with screw spindle, iron carriages, cistern, brasses, &c., complete, £3 15s.
494. A very powerful hydraulic press, by Greenwood and Batley, Leeds, with six loose tubes, £14.
495. A very powerful and valuable shaping machine, on 6ft. planed bed, by Hulse, Manchester, with two sliding tables, 24in. square each, with screw vice, pair of cramps for slitting screw heads, &c., complete, with back gearing cone pulley; also the overhead gear, with cone pulley, two pairs of fast and loose pulleys, disengaging gear, brackets, carriages, &c., complete, £80. [A fair auction price.]
496. Steel tools to ditto ditto, 16 lb., 5s. 6d.
497. A very powerful and costly roll-turning and engraving machine, on very massive bed, calculated for turning and grooving rolls of any required form, together with change wheels, and a great variety of valuable fittings connected therewith; also the overhead gear, consisting of a pair of 30in. fast and loose pulleys, two small pulleys, spindles, hanging brackets, brasses, &c., £25. [Very cheap, almost new, and cost nearly £200.]
498. Thirty large planed, bored, and keyed cams to the above machine, 2s. 9d. per cwt.
499. Sixty-five smaller ditto and five chucks, about 37 cwt., 2s. 9d. per cwt.
500. Steel tools, for turning chilled rolls, 1 cwt. 3 qrs. 7 lb., £2 17s. 6d.
501. A very massive and powerful roll-turning lathe, by Walter May and Co., with 28in. centre, slide rest, on 12ft. planed bed, sliding edge stocks, five-speed cone pulley, change wheels, chuck, &c., also the overhead motion; comprising a five-speed cone pulley, pair of 30in. fast and loose pulleys, with spindle, carriages, brasses, hanging brackets, &c., complete, £65. [This was also cheap, being nearly new.]
502. A capital 7½in. back geared screw-cutting lathe, on 9ft. bed, with compound slide rest, ten change wheels, one chuck, and 12in. face plate; also the overhead gear, comprising a four-speed cone pulley, two sets of fast and loose pulleys, disengaging gear, &c., complete; also boards for change wheels and table, £40. [This was cheap, it being a very good lathe.]
503. Steel tools for lathe, 3 qrs. 10 lb., £1 1s.
504. Twelve spanners, 28 lb., £1.
505. An excellent planing machine, by Fox Brothers, Derby, with table, 7ft. by 1ft. 9in., on 9ft. 6in. bed, on strong supports, with fast and loose pulleys, complete; also additional apparatus for planing curved surfaces, cam, &c., £80. [A fair price.]
506. Twelve angle plates for planing machine, 3 cwt.
507. Eight packing blocks for ditto, 1 cwt. 1 qr. } 8s. 6d.
508. Wrought iron cramps and washer plates for ditto, 1 cwt. 3 qrs. 7 lb., 4s. 6d.
509. Wrought iron ditto, 1 cwt., 4s. 6d.
510. Five cutter holders and two cramps, 2 qrs.,
511. Cramps, bolts, and nuts, 1 cwt. } 8s.
512. Steel planing tools, 104 lb., 5½d. per lb.
513. Sundry steel chisels, gauges, and punches, 42 lb., 3d. per lb.
514. Ditto ditto 38 lb., 3d. per lb.
515. Twenty-seven mandrils, 7 cwt. 3 qrs., 5s. 6d. per cwt.
516. Four round cast iron gauges, 1 cwt., 13s.
517. A valuable file cutting machine, by Greenwood and Batley, Leeds, with extra apparatus for cutting horse rasps; also a lot of costly experimental apparatus. [Passed.]
518. 22ft. of 3in. bright turned shafting, with three plummer blocks and brasses, and one coupling, two strong hanging brackets, one 5ft. 3in. turned pulley, 8in. on face, one 4ft. ditto, 10in. on face, one 15in. ditto, one 18in. ditto, and one 24in. ditto, 8in. on face, £9.
519. 22ft. of 2½in. bright turned shafting, two plummer blocks and brasses, one hanging bracket, three 10in. pulleys, 9½in. on face, one 24in. ditto, 8in. on face, one 20in. ditto, 7in. on face, two 18in. ditto, 12in. on face, one 12in. ditto, 9in. on face, and 48in. driving pulley, £6.
520. 5ft. of 1¼in. bright turned shafting, with two plummer blocks and brasses, two hanging brackets, and three 16in. pulleys, £1.
521. Pair of 8in. single-flanged pulleys, with spindles, brackets, &c., 6s.
522. An excellent 12-horse power horizontal high-pressure steam engine, with expanding valve, by Walter May and Co., with fly wheel, driving pulley, &c., complete, £90. [Cheap, it being nearly new.]

The rest of the lots up to 635 consisted principally of cast iron pulleys., turned, bored, and keyed, which averaged about 8s. 6d. per cwt., and fitters' vices, which averaged 2d¼. per lb.

FOURTH DAY'S SALE, THURSDAY, AUGUST 12TH, 1869.

File Forge Shop.

Lot

636. A smiths' cast iron double hearth, with bonnet, hearth plate, water bosh and tuyere blast plate, &c., by the Northmoor Foundry Co., Oldham, £4.
637. Ditto ditto, £4.
639. The wrought iron chimney to the above hearth, 11s.
640. A smiths' single hearth, by the Northmoor Foundry Co., with chimney, &c., complete as before described, £4.
641. Ditto ditto, £4.
642. File forge, anvil, swage block, tanging tool, and gauge, on massive stone block, 10s.
643. Ditto ditto, 8s. 6d.
644. Ditto ditto, 19s.
645. Ditto ditto, 17s.
646. Ditto ditto, 9s.
647. Ditto ditto, 18s.
648. Box and vice block, 3s. 6d.
649. Two wood-boarded partitions enclosing shop from furnace shop, £1 1s.

Furnace Shop.

650. A very powerful stamping machine, by Walter May and Co., on very massive bed and standards, with 6ft. fly wheel, 6½in. on face; a 3ft. driving wheel and pinion, and pair of fast and loose pulleys, 3ft. diameter, 5½in. on face, £29. [Very cheap, it having cost £140.]
651. Tools to ditto, 2 qrs., 6s.
652. A powerful shearing machine, by F. Berry and Sons, Yorkshire, with 4ft. driving wheel and pinion.
653. 3ft. 6in. fly wheel and pair of 18in. fast and loose pulleys, 4in. on face. } £17

[Cost £55, but there was a flaw in the casting.]

654. 22ft. of 3in. wrought iron turned shafting, with two plummer blocks and brasses, two strong carriages, with wall plates, bolts and nuts, one coupling, and one driving pulley, 3ft. diameter and 9½in. on face.
655. 6in. of 2½in. shafting, with two plummer blocks and brasses, two carriages, wall plates, nuts and bolts, and pair of 18in. fast and loose pulleys, 4in. on face. } £21
656. 47ft. of ditto, with four plummer blocks and brasses, four wall brackets, wall plates, bolts and nuts, one coupling, one 12in. pulley, 8in. on face, and one 15in. ditto, 14in. on face.
657. Smiths' hearth, with bonnet and chimney, blast pipe to floor and water bosh, £1.
658. Strong anvil, 3 cwt. 25 lb., £2 2s.
659. Grindstone, with strong frame, and trough, 7s.
660. Nine shovels, 1s. 6d. each.
661. Lot of buckets, &c., 6s. 6d.
662. Stone block, 1s.
663. A double annealing furnace, 10ft. by 4ft. 6in., and 6ft. high, with strong cast iron plates, fire-doors and bars, tie rods, damper plates, and fire-brick lining, £12.
664. One single annealing furnace, 6ft. by 5ft. 6in., and 6ft. 3in. high, with cast-iron plates and buckstaves, tie rods, fire-doors, and grates, fire-brick lining, brick casing, and chimney, £5.
664. Lot of boiler and furnace tools, 1 cwt, 5s. 6d.

Rolling Mill.

667. A pair of 1ft. 9in. rolls, 7½in. diameter, for rolling 18in. files, with their massive frames, coupling box, pinions, table, &c., as fixed on cast iron sills; also a pair of driving wheels, 10ft. and 3ft. diameter, 8in. on face, and 3½in. pitch on 7in. shaft, two massive carriages, plummer blocks and brasses, £35. [Very cheap, almost given away it being nearly new.]
668. Two turned driving pulleys, one 1ft. 6in. diam., and 12in. on face, and one 4ft. 10in. ditto, 10in. on face, £1.
669. Two pairs of 20in. rolls and frames, as before described, for rolling 15in. and 16in. files, with pinions, driving wheels, and couplings; also the pair of main driving wheels, 7ft. and 6ft. diam., 8in. on face, 3½in. pitch on 7in. shaft massive carriages and brasses; £42. [Very cheap.]
670. Two pairs of 20in. rolls and frames, as before described, for straightening and rolling 9in. and 10in. files, with their tables, pinions, driving wheels, and coupling; also pair of driving wheels, 7ft. and 6ft. diameter, 8in on face, and 3in. pitch, £38. [Very cheap.]
671. Pair of 20in. breaking down rolls, with their frames, pinions, and coupling, as before described; also pair of driving wheels, 7ft. and 6ft. diameter, 8in. on face, 3in. pitch, £27. [Very cheap.]
671*. The whole of the 5½in. shafting driving the roll machinery, £60.
672. A very powerful and costly tanging, shearing, and straightening machine, on massive 8ft. 2in. planed bed, on strong standards, with apparatus complete, worked by an eccentric shaft; also the 5½in. main driving shaft, 5½in. diameter, 7ft. 6in. long, £16 [Cheap.]
673. Ditto ditto ditto
674. Ditto ditto ditto } £16 each. [Cheap.]
675. Ditto ditto ditto
676. The 5in. main shaft driving the above machines, 13ft. 3in. long, with three plummers blocks and brasses, on three massive carriages, with holding-down pins, &c., and 5ft. wheel, 6in. on face.
677. Three driving wheels, two 4ft. 6in. diameter, 6in. on face, and 2½in. pitch, and one 1ft. 3in. ditto, 2½in. pitch.
678. Pair of mitre wheels, 4ft. 2in. diameter, 5in. on face, and 2in. pitch. } £11. [Cheap.]
679. Pair of ditto ditto
680. Pair of ditto, one 3ft. 6in., 6in. on face, and 2½in. pitch, and one 2ft. 6in. ditto, 6in. on face, and 2½in. pitch.
681. A 5½in. driving shaft, 14ft. long, with two plummer blocks and brasses, two carriages, holding-down pins, and couplings.

About 50 tons of rolls to the above were sold for 6s. per cwt. Nothing else of importance was sold this day with the exception of the following.

761. A valuable grinding apparatus, consisting of an emery and cast iron grinding wheel, 10ft. diameter, 12in. on face, with wrought iron bonnet, on 12ft. shaft, 6in. diameter, with plummer blocks and brasses, pair of 4ft. fast and loose pulleys, 8in. on face, and disengaging gear; one 21in. pulley, 5½in. on face; one 24in. flanged pulley, with brake and screw arrangement at end; the whole on very massive cast iron sills, with holding-down pins, &c., also the grinding tables, with their shafting, pulleys, carriages, plummer blocks, brasses, &c., as fixed, £42. [This machinery, as before stated, cost nearly £3000. It is far too costly for the purpose intended, and, although new, was bought to break up.]
762. Ditto ditto ditto, £50. [The things sold on Friday were chiefly office fixtures, &c., and fetched a fair auction price.]
763. Ditto ditto ditto, £45. [On the last day of sale, Monday, were sold about 5000 dozens of files, which went rather cheap.]

APPLICATION OF LEICHTENBERG'S EXPERIMENT TO THE MINERALOGICAL ANALYSIS OF ROCKS.—M. S. Meunier proposes to make use of the well-known experiment of Leichtenberg's electric figures to separate from each other the divers mineralogical constituents of some kinds of rock. We briefly remind our readers that the experiment alluded to consists in charging with electricity a cake of resin or sealing wax, by means of a previously-charged Leyden jar; it is thus possible to charge certain portions of the cake with positive, others with negative electricity. In order to exhibit this to sight it is usual to blow, by means of a small pair of bellows, on to the cake of the resin, a mixture of very finely powdered red lead and sulphur; the friction, on leaving the nozzle, causes the powders to become electrified, and the sulphur being negatively electric is attracted by the curved figures positively electric on the cake, while the red lead follows the opposite course. M. Meunier has tried thus to separate sulphur-bearing trachite into its mineral constituents, and succeeded perfectly in getting the sulphide and feldspar from each other; he states that he has equally well succeeded with rocks made up of two different silicates.—*Cosmos.*

THE PATENT LAWS.—The following letter has been addressed to the Editor of the *Liverpool Daily Courier*:—"Sir,—You have transferred to your columns, and so have given currency to a question put to me by the editor of THE ENGINEER in his last number.—'Does Mr. Macfie,' he asks, after telling the reader that Mr. Bessemer enjoyed enormous royalties for a series of years, 'seriously believe that the steel-masters of great Britain paid Mr. Bessemer a single farthing more for his invention than it was worth?' My readiest reply is, Look at the Mersey Steel and Iron Company's (Limited) procedure in shutting up the steel department of their works (with published approval of trade periodicals), until these royalties cease to be due.' Surely this is evidence that the royalties exacted are, in this company's experience or belief, higher than the use of the invention is worth. But a far more important consideration remains behind, one generally by inventors' so-called friends left out of sight, viz., the effect on British and Irish national interests. What a patent brings in to its possessor and his licensees is one thing, what its effect on commerce and manufacture another and very different thing. To illustrate: I ask if the loss of orders to the extent of 5100 tons of steel rails, mentioned in the last *Ironmonger*, is not attributable to these royalties. That periodical, which ought to know the facts, says that 'English railmakers formerly supplied the great part of the steel rails required for the United States railways,' and that this country has lately lost orders likewise for 'considerable quantities to other companies.'—I am, sir, your faithful servant, R. A. MACFIE."

"Ashfield Hall, 9th September, 1869."

THE IRON AND STEEL INSTITUTE.

THE Iron and Steel Institute will hold a meeting on September 22nd and 23rd, 1869 at Middlesborough. The proceedings will prove exceedingly interesting, to judge from the following programme of arrangements, with which we have been favoured by the secretary, Mr. J. Jones.

The Royal Exchange (near the railway station) will be made available for members from Tuesday to Friday, as a general reception-room, post-office, telegraph office, &c. In the same hall arrangements have been made for the exhibition of models, specimens, diagrams, and other objects of interest to the iron and steel trades. The quarterly meeting of the North of England iron and allied trades has been fixed for Tuesday, 21st September, to suit the convenience of gentlemen attending the Institute meeting. It will be held in the Royal Exchange from eleven to one o'clock on that day. As regards lodgings, accommodation for visitors can be obtained at Saltburn-by-the-Sea, at Redcar, also by the sea, or at the hotels in Middlesborough. Members can secure lodgings through the secretary, previous to the time of meeting, and are requested to make early application. A list will also be kept in the reception-room, and may be there consulted. On Wednesday morning a general meeting will be held in the Odd Fellows' Hall, near the railway station, commencing at ten o'clock, and lasting about two hours and a-half. The election of members will first take place, after which several of the papers mentioned below will be read and discussed. On Thursday morning a general meeting will be held, at the same time and place, for the reading and discussion of the remainder of the papers, or such of them as can be taken during the time allotted for the meeting. Each member can obtain two visitors' tickets on application to the secretary. These will admit to the meetings and excursions. The various railway companies have declined to grant any special arrangements. Members from a distance are therefore advised to obtain tourists' tickets to Saltburn, which will be available for a month from the day of issue. It is proposed to read the following papers :—

"On the Development of Heat and its Appropriation in Blast Furnaces of Different Dimensions," by Mr. Isaac Lowthian Bell, Newcastle, Vice-President.

"On Siemens' Regenerative Furnace, and its application to Reheating Furnaces connected with Rolling Mills," by Mr. Josiah T. Smith, Barrow-in-Furness, Vice-President.

"On the Manufacture of Rails," by Mr. Edward Williams, Middlesborough, Member of Council.

"On Iron as a Material for Shipbuilding, and its consequent influence on the Armament and Commerce of Nations," by Mr. C. M. Palmer, Newcastle.

"On the Siemens-Martien Process of Manufacturing Steel," by Mr. R. Howson, Middlesborough.

"Description of a Hot-blast Fire-brick Stove," by Mr. T. Whitwell, Stockton.

"On the Production and Application of Combustible Gases under Pressure," by Mr. G. H. Benson, Staleybridge.

"On a New Process of Refining Iron," by Mr. J. Palmer Budd, Ystalyfera.

After the morning sitting on Wednesday, the remainder of the day will be available for visiting the iron and other works in the neighbourhood of Middlesbrough and Stockton. The following is a list of the works that will be open to visitors on presenting their cards of membership.

Middlesborough: Tees Side Iron and Tees Engine Works (Hopkins, Gilkes, and Company, Limited), blast furnaces, rolling mills, engine and bridge building works, foundries; Middlesborough Ironworks (Bolckow, Vaughan, and Company, Limited), blast furnaces, rolling mills, foundries; Cleveland Bolt and Nut Works (Cleveland Bolt and Nut Company); Cleveland Ship Yard (Backhouse and Dixon), iron shipbuilding; Tees Ironworks (Gilkes, Wilson, Pease, and Company), blast furnaces; Ormesby Foundry (Cochrane, Grove, and Company), foundries and engine works; Ormesby Ironworks (Cochrane and Company), blast furnaces; Normanby Ironworks (Jones, Dunning, and Company), blast furnaces; Cargo Fleet (Swan, Coates, and Company), blast furnaces; Linthorpe Ironworks (Lloyd and Company), blast furnaces; Acklam Ironworks (Stevenson, Jacques, and Company), blast furnaces; Newport Ironworks (B. Samuelson and Company), blast furnaces; Clarence Ironworks (Bell Brothers), blast furnaces. —*Cross river by ferry.*

Stockton: Rail Mill (Stockton Rail Mill Company), rolling mills; Malleable Ironworks (Stockton Malleable Iron Company), rolling mills; Thornaby Ironworks (W. Whitwell and Company), blast furnaces and rolling mills; Teeesdale Ironworks (Head, Wrightson, and Company), engine works and foundries; North Yorkshire Ironworks (North Yorkshire Iron Company), rolling mills.

After the conclusion of the general meeting on Thursday it is proposed to visit the mines and ironworks at Eston and the neighbourhood. The following will be available, but detailed programmes will be issued at the time of meeting, and will be found in the reception room.

Eston: Southbank Ironworks (Southbank Iron Company), blast furnaces; Clay Lane Ironworks (Clay Lane Iron Company), blast furnaces; Cleveland Ironworks (Bolckow, Vaughan, and Company), blast furnaces; Eston Mines (Bolckow, Vaughan, and Company), by private railway from Eston Junction; Normanby Mines (Bell Brothers), by railway from Cargo Fleet; Upleatham Mines (J. and J. W. Pease), by rail to Marske.

At six o'clock on Thursday, 23rd inst., the North of England Iron Trade will entertain the members at dinner, at the Zetland Hotel, Saltburn (morning dress), and after the dinner a special train will be provided to convey visitors back to Middlesborough, Stockton, &c. Tickets will be addressed to all members who have intimated their intention of being present; other members are requested to apply to the secretary. A limited number of tickets will be sold to non-members, price 21s. Early application should be made to the secretary.

On Friday the works at Darlington, Consett, Ferry Hill, Hartlepool, Grosmont, &c., will be available for the members to visit. The following is a list :—Darlington Ironworks (Darlington Iron Company), rolling mills; Shildon Works, Darlington (Shildon Works Company), locomotive engine works; Skerne Ironworks, Darlington (Pease, Hutchinson and Company), rolling mills; Rise Carr Ironworks, Darlington (Fry, Ianson, and Company), rolling mills; Darlington Forge (Darlington Forge Company); Grosmont Ironworks, Whitby (C. and T. Bagnall), blast furnaces; Glaisdale Ironworks (Glaisdale Iron Company), blast furnaces; Consett Ironworks (Consett Iron Company), blast furnaces and rolling mills; Ferry Hill Ironworks (Rosedale and Ferry Hill Iron Company), blast furnaces; West Hartlepool Ironworks (T. Richardson and Sons), rolling mills, engine works, and foundries.

Members wishing to visit any of the above works on Friday, will have to give in their names in the reception-room on Thursday.

THE ST. LEGER, 1869.—Time as taken by "Benson's Chronograph :—Start, 3h. 49min. 30sec.; arrival, 3h. 52min. 51½sec. Duration of race, 3min. 21½ sec. Won by Pero Gomez. Duration of race, 1868, 3min. 19½sec.

CHICAGO AND NORTH-WESTERN RAILWAY.—(*From our Correspondent.*)—This company provides its shareholders with a dividend for the year ending May 31, 1868, at the rate of 10 per cent. per annum. The total length of the lines owned and leased by the company is 1156 miles. The length of the different divisions is as follows :—Wisconsin division, 314½ miles; Gallena division, 261 miles; Iowa division, 354 miles; Madison division, 67½ miles; Peninsula division, 73¾ miles; Milwankee division, 85 miles.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Grants and Dates of Provisional Protection for Six Months.

2240. HENRY PINKUS, Camden-road, Camden Town, London, "Improvements in furnaces and other heating apparatus, and in the methods of applying and using therewith certain elements of combustion, and in the combinations therewith of the processes with materials to be used in the manufactures of metals and other things and uses, and in the mechanical constructions necessary therefor."

2443. JOHN GALLEMORE DALE and EDWARD MILNER, Warrington, Lancashire, "An improved method of producing white pigments from lead."

2445. HENRI ADRIEN BONNEVILLE, Sackville-street, Piccadilly, London, "Improvements in the process of charging and discharging fuel in gas retorts or other gas distilling apparatus."—A communication from Henry Ludovic, Boulevart Richard-Lenoir, Paris.

2447. SAMUEL HARVEY, Dale-road, Haverstock-hill, London, "Improvements in apparatus for indicating signals between passengers and guards in railway trains."

2449. JOHN LAWSON and EDWARD GERRARD FINTON, Leeds, Yorkshire, "Improvements in spinning flax, hemp, jute, and tow, and in machinery employed for these purposes."—16*th August*, 1869.

2451. ROBERT HARVEY CHARSLEY, Beaconsfield, Buckinghamshire, "A new or improved carriage for locomotion by manual labour."

2455. JOHN WILLIAMS, Wigginton Rectory, Oxon, "Improvements in maps and in scientific and educational diagrams to facilitate references and ascertain distances."

2457. ROBERT FRANCIS FAIRLIE, Victoria-chambers, Westminster, "Improvements in locomotive engines and carriages, and in the mode of coupling the same together."

2459. WILLIAM ROBERT LAKE, Southampton-buildings, London, "Improvements in penholders."—A communication from Louis Dezarnaud, Paris.—17*th August*, 1869.

2461. JOHN CHECKETTS, Raglan-street, Wolverhampton, Staffordshire, "An improved window blind."

2467. THOMAS PARKINSON, Liverpool, "Improvements in or connected with doors for regulating the admission of air to furnaces."

2473. JOSEPH MITCHELL, Sheffield, "Improvements in machinery for forging, stamping, tilting, swaging, hammering, or planishing metals."—18*th August*, 1869.

2476. JOHN JABEZ EDWIN MAYALL, Brighton, Sussex, "Improvements in obtaining motive power, and in the machinery or apparatus employed therein, parts of which improvements are applicable to the forcing and exhausting of air."

2477. WILLIAM CAMPION, Nottingham, "Improvements in sewing machines."

2478. ARCHIBALD GILCHRIST, Glasgow, Lanarkshire, N.B., "Improvements in slide valves."

2479. HENRI NICOLAS MOYON and JACQUES EUGENE LEMERCIER, Rue St. Appoline, Paris, "Improvements in machinery for the manufacture of coverings for the feet, together with apparatus and instruments connected therewith."

2481. JOHN BLAKEY, Leeds, Yorkshire, "Improved means and apparatus for utilising waste leather, or the small pieces of leather resulting from the cutting out of the several parts for boots and shoes."

2482. FREDERICK BRABY, Fitzroy Works, Euston-road, London, "Improvements in the means and apparatus for the manufacture of caustic ammonia and ammoniacal salts."

1456. HENRY ROBINSON, Skipton, Yorkshire, "Improvements in the construction of kilns for burning limestone, chalk, cement, or for calcining ores."—12*th May*, 1869.

1911. WILLIAM ROBERT LAKE, Southampton-buildings, London, "An improved combustible compound."—A communication from Joseph Philipps, Louis Kiesling, and Ferdinand Kohlstadt, jun., Cologne, Germany.—22*nd June*, 1869.

2313. PAUL RAPSEY HODGE, Adam-street, Adelphi, St. Martin's-in-the-Fields, London, "Certain improvements in the manufacture of luminous and heating gas from hydrocarbonaceous fluids, and in the methods of using and applying such gas for illuminating and heating purposes."—2*nd August*, 1869.

2338. GEORGE CHARLES RAMSEY, Aldermanbury, London, "Improvements in the construction of fancy circular boxes."—4*th August*, 1869.

2357. EDWARD WILLIAM HAWES, Balmoral Lodge, Clontarf, Dublin, Ireland, "Improvements in the construction of buoys and other floating sea-marks."—7*th August*, 1869.

2395. SAMUEL JOSEPH WOODHOUSE, Holbeck, Leeds, Yorkshire, "Improved apparatus for purifying and regulating the supply of gas to burners, and also for an improved standard tap."—10*th August*, 1869.

2423. ISRAEL EDWARD WOOLF, New Bond-street, London, "Improvements in casters for furniture and other like articles."—A communication from John Louis Woolf, St. Louis, Missouri, U.S.—13*th August*, 1869.

2433. THEOPHILUS COAD, Truro, Cornwall, "Improvements in the construction of sewing machines."—14*th August*, 1869.

2463. JOSEPH PRATO and FRANCIS POLACCO, Great Winchester-street, London, "Improvements in charcoal filters for purifying water or other liquids, likewise in the mode of applying the same."—18*th August*, 1869.

2483. WILLIAM JONES, Guide Bridge, Lancashire, "Improvements in or applicable to sewing machines."—19*th August*, 1869.

2511. JACOB FRENGLEY, Dublin, Ireland, "An improved tell-tale clock."

2513. JOHN WILLIAMS, South Castle-street, Liverpool, "An improved junction of barrel and action for breech-loading fire-arms and sporting guns, with self-acting exploded cartridge extractor."

2517. THOMAS BRIGGS, Manchester, "Improvements applicable to machinery for spinning and doubling cotton and other fibrous materials."

2519. JAMES VALTERS, Great Dunmow, Essex, "An improved agent for fining and clarifying ale and other fermented liquors."—24*th August*, 1869.

2522. ROBERT MAYNARD, Whittlesford, Cambridgeshire, "An improvement in portable chaff-cutting machines."

2523. COLIN MACKAY and THOMAS KENNEDY WHEELER, jun., Belfast, Antrim, Ireland, "Improvements in cops for wefting and warping purposes, and in machinery for making and in shuttles for containing the same."

2524. THOMAS SHAKESPEAR and GEORGE ILLSTON, Birmingham, "Improvements in sewing machines."

2527. THOMAS COLEY, Bower Farm, Maidstone, Kent, "Improved means or appliances to be employed in the cultivation of hops."

2529. HORACE CALL, Concord, Merimac, New Hampshire, U.S., "An improved mode of and machinery for obtaining and applying motive power, more especially designed for the transmission of the same to long distances."

2530. GUSTAVE ZOEH and ALEXANDRE LEHMANN, Havre, Seine Inferieure, France, "A novel process of manufacturing yeast or artificial ferment."

2532. WILLIAM BROWN, St. Mary-street, Portsmouth, Southampton, "Improvements in the mode of constructing and disposing ships' cabins to prevent sea-sickness, the said improvements being also applicable to gun carriages on board ship."—25*th August*, 1869.

2533. CHARLES DENTON ABEL, Southampton-buildings, Chancery-lane, London, "Improvements in the means and apparatus for separating or dividing the carded fleece into slivers in carding machines for all kinds of filaments."—A communication from Jean Baptiste Marée-Gist and Louis Julien Varlet-Marée, Remilly sur Meuse, France.

2535. BRISTOW HUNT, Serle-street, Lincoln's-inn, London, "Improvements in steam condensers, and in supplying steam generators with water."—A communication from Jean François Cail, Paris.

2536. HENRY YATES, Rue Lafayette, St. Pierre les Calais, France, "Improvements in the manufacture of lace on bobbin net or twist lace machinery."—26*th August*, 1869.

2538. EDWARD ALFRED COWPER, Great George-street, Westminster, "Improvements in treating cast iron for the production of wrought iron and steel therefrom, and in apparatus employed for that purpose."

2540. JOHN MARTIN STANLEY, Sheffield, "Improvements in the manufacture of iron and steel, and in furnaces and converting crucibles used in connection therewith."

2541. OCTAVE VIVIER, Sekforde-street, Clerkenwell, London, "Improvements in means or apparatus for measuring and indicating the distance travelled by vehicles."

2542. FRANCIS JOSEPH DRECHSLER, Cockspur-street, Westminster, "Improvements in stoves and grates or apparatus for cooking, heating, and other stove or grate uses, with rotary motion arrangements and with appliances for rendering the same useful for fumigating, refrigerating, sifting, winnowing, churning, cutting, and other purposes where such rotary motion arrangements may be capable of being used."

2543. WILLIAM EDWARD GEDGE, Wellington-street, Strand, London, "A novel construction of railway sleeper."—A communication from Camille Bernard, Paris.

2544. BRISTOW HUNT, Serle-street, Lincoln's-inn, London, "Improvements in machinery or apparatus for hulling, cleansing, and polishing or preparing coffee, rice, and other berries or grain."—A communication from James Fowle Baldwin Marshall and Augustus Jones, Boston, Massachusetts, U.S.

2545. JEAN TEYCHENNE, Rue Prégon House, Small Heath, near Birmingham, "Improvements in or additions to springs for mattresses, sofas, chairs, and other articles of furniture."

2547. WILLIAM ROBERT LAKE, Southampton-buildings, London, "An improved method of and apparatus for rendering and refining lard, tallow, and other fatty and oleaginous matter."—A communication from Charles James Everett, Highwood Park, New Jersey, U.S.

2549. SAMUEL CUNLIFFE LISTER, Bradford, Yorkshire, "Improvements in looms for weaving pile and other fabrics, and in yarns for pile fabrics, and in sizing them."

2550. RICHARD CHRISTOPHER RAPIER, Westminster-chambers, London, "Improvements in railway water cranes."

2551. JOHN RITCHIE, Stonefield-street, Barnsbury, London, "Improvements in the construction of tents and sunshades or weather protectors suitable for carriages and other vehicles."—27*th August*, 1869.

2552. CHARLES DUFF, Russell-street, Bermondsey, Surrey, "Improvements in the manufacture of paper pulp and paper."

2553. THOMAS SCHOENBERGER BLAIR, Pittsburg, Pennsylvania, U.S., and FRANCIS ELLERSHAUSEN, Southampton-buildings, Chancery-lane, London, "Improvements in treating conglomerates of cast iron and other substances."

2554. JAMES BUTTERWORTH and JOSEPH AINSWORTH, Bury, Lancashire, "Improvements in mangling and squeezing machines."

2556. JOHN HOLDSWORTH, Kingston-upon-Hull, "Improvements in apparatus for loading or discharging grain, coals, ballast, or other materials."

2557. ROBERT HILL HERRIOTT, Skegby, Nottinghamshire, CHARLES PLUMBE, Mansfield, Nottinghamshire, and WILLIAM ALVEY PLUMBE, Sutton, Ashfield, Nottinghamshire, "Improvements in communicating between passengers and the guard and driver of railway trains, and in the machinery or apparatus employed therein."

2558. JOHN BROWN, Padiham, Lancashire, "Improved means of and appliances for facilitating the exercise or riding of bicycles or velocipedes."

2559. CHARLES SAMUEL WALKER MUIR, Kilmarnock, Ayrshire, N.B., "Improvements in safety apparatus for steam boilers, in apparatus to provide for and regulate the admission of air to steam boiler and other furnaces, and in apparatus to provide for the escape of water from steam pipes."

2560. RICHARD CARDWELL ROBINSON, Avenham-terrace, Preston, Lancashire, "An improved construction of stove or fire-grate."

2561. JOHN LOADER, Upper Clifton-street, Worship-square, London, "Improvements in rotary engines and pumps."

2562. ROBERT PRIESTLEY, London-wall, London, "Improvements in fastenings for gloves."—28*th August*, 1869.

2563. LOUIS GOLDBERG, Love-lane, London, "Improvements in watches, toy watches, personal ornaments, purses, pocket-books, walking-sticks, and certain other portable articles."

2564. ROBERT JEKYLL WESTLEY, Camden-road, Camden Town, London, "Improved methods of constructing, converting, and using billiard and other tables."

2566. THOMAS CATTELL, Strand, London, "An improved method of treating wood for the production of paper pulp."

2567. WILLIAM FREDERICK WILLIAMS, Broad-street, Golden-square, London, "Improvements in boxes for holding jewellery and other articles."

2568. WILLIAM WINTER, Leeds, Yorkshire, "An improved metallic driving belt or band, and the means of manufacturing same, also the application thereof and other metallic belts for driving sewing machines."

2569. WILLIAM EDWARD NEWTON, Chancery-lane, London, "Improved machinery for manufacturing nails, brads, and other analogous articles."—A communication from Edwin Lewis Brundage, Middletown, New York, U.S.

2570. HENRY EDWARD NEWTON, Chancery-lane, London, "Improvements in furnaces."—A communication from George Graeme Clarkson and James Lewis Paige, Rochester, New York, U.S.

2571. CHARLES ROBERT STOOKE, Teignmouth, Devonshire, "Improvements in safety cages for mine shafts, which improvements are also applicable to lifts for warehouses, hotels, and for other places."—30*th August*, 1869.

2572. FREDERICK WILLIAM POTTER, Barbican, London, "A new or improved construction of wire-work, applicable for sieves, screens, and various other articles in which wire-work is used."

2574. ALFRED PIERRE TRONCHON, Rue St. Appoline, Paris, "Improvements in the construction of elastic seats."

2575. ALEXANDER MCNEILE, John-street, Pentonville, London, "Improvements in brakes for retarding the progress of wheeled carriages."

2576. WILLIAM GLOVER, Prestwich, Lancashire, "Improvements in looms for weaving."

2577. WILLIAM EDWARD NEWTON, Chancery-lane, London, "Improvements in washing machines."—A communication from John Jackson Grant, Philadelphia, Pennsylvania, U.S.

2578. THOMAS COLES, Fort-place, Sandy-hill, Woolwich, Kent, "Improvements in the construction of the running wheels of carriages and other vehicles mounted on wheels, and wheels and riggers used in machinery."

2579. THOMAS WARDLAW, Toughmill, Dunfermline, N.B., "Improvements in reaping machines."—31*st August*, 1869.

2585. GEORGE HENRY NUSSEY and WILLIAM BRADSHAW LEACHMAN, Leeds, Yorkshire, "Improvements in machinery or apparatus for pressing woollen and other woven or felted fabrics."—1*st September*, 1869.

2591. ROBERT PITCAIRN, Trafalgar-square, London, "A new or improved rest for supporting the arms, feet, or body of a person, or books and other small objects."

2593. PETER MCGOUGH, Halifax, Yorkshire, "Improvements in sash frames and sashes, particularly applicable to the windows of railway and other carriages."—2*nd September*, 1869.

2595. EDWIN DANIEL TEMPLE, Circus-place, Finsbury-circus, "Improvements in the construction of telegraph railway signal, scaffold, and other posts."

2599. HENRY BRIDGEWATER, Watford, Hertfordshire, "Improvements in railway chairs, and in the means of securing bridge and flanged rails to their sleepers."

2601. ALEXANDER OGG, Kynaston-street, Oakley-street, Lambeth, Surrey, "Improvements in printing machines."

2603. GEORGE HENLEY, Essex-street, Islington, London, "Improvements in dial or needle and alphabetical telegraphs and relays."—3*rd September*, 1869.

Invention Protected for Six Months on the Deposit of Complete Specification.

2597. THOMAS SLATER, Euston-road, St. Pancras, London, "Improvements in the construction of electro-magnetic machines as motors, and in the construction and mode of exciting batteries, and in the application of such motors and batteries to various useful purposes."—3*rd September*, 1869.

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

2374. BENJAMIN BAYLISS, Pontnewydd, near Newport, Monmouthshire, "Iron."—15*th September*, 1866.

2375. CHARLES CUNNINGHAM CONNOR, Spamount Mills, Castlederg, Tyrone, Ireland, "Flax, tow, hemp, &c."—15*th September*, 1866.

2388. GEORGE TOMLINSON BOUSFIELD, Loughborough Park, Brixton, Surrey, "Steam jets."—17*th September*, 1866.

2430. ALFRED VINCENT NEWTON, Chancery-lane, London, "An improved construction of weight."—21*st September* 1866.

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

2509. THOMAS MOLINEUX, John Dalton-street, Manchester, "Pianoforte actions."—11*th September*, 1862.

2514. JOHN ROBERT JOHNSON, Stanbrooke Cottage, Hammersmith, Middlesex, and JOHN STAINES ATKINSON, Red Lion-square, London, "Printing types."—12*th September*, 1862.

2481. WILLIAM HIRST, Halifax, Yorkshire, "Paper or linen spool tubes."—9*th September*, 1862.

2506. WESTLEY RICHARDS, Birmingham, "Fire-arms and cartridges."—11*th September*, 1862.

2520. GEORGE BEDSON, Manchester, "Rolling wire, &c."—12*th September*, 1862.

Notices of Intention to Proceed with Patents.

1344. WILLIAM BURNET ROBINS, South Molton-street, London, "Improvements in hand pumps or syringes, and in other pumps suitable to be used for watering flowers and for other similar purposes."

1346. JONAS PRIESTLEY BALM, Halifax, Yorkshire, and ROBERT NEWTON, Providence Mill, near Keighley, Yorkshire, "Improvements in worsted spinning frames."—1*st May*, 1869.

1353. PATRICK BARRY, Lombard-street, London, "An improved mode of and means for delivering sheets of paper to the feeding apparatus of a printing machine."

1355. SAMUEL HORATIO HODGES, Bristol, Gloucestershire, "Improvements in the construction of apparatus for the manufacture of heels for boots and shoes."

1357. JAMES BLAIR NIMMO North Bank-street, Edinburgh, Midlothian, N.B., "An improved lever compensation door and gate spring or closer."

1359. DAVID PITCAIRN WRIGHT and CEPHAS BUTLER, Birmingham, "Certain improvements in lamps for burning paraffin and other hydrocarbon oils."—3*rd May*, 1869.

1364. CHARLES TOPHAM, Coleman-street, Bunhill-row, London, "Improvements in machines for mincing meat, vegetables, and other similar substances requiring to be minutely divided."

1366. THOMAS COCKROFT, Bridge Lanes, Hebden Bridge, Yorkshire, "Improved means and method of hanging window sashes."

1386. JAMES EDWIN PHILLIPS, Grantham, Lincolnshire, "Improvements in sewing machines and in tables for the same, parts of which improvements are applicable to other machinery."—5*th May*, 1869.

2259. TIMOTHY WINTER, Wiveliscombe, Somersetshire, "Improvements in machinery for combing reeds."—*26th July*, 1869.
2333. FERDINAND CONSTANT COLNEY, Boulevart Bonne-Nouvelle, Paris, "Improved mechanism for the propulsion of vehicles."—*4th August*, 1869.
2425. JAMES LEWIS, Fenwick-street, Liverpool, "Improvements in extracting copper from its ores."—A communication from Thomas Sterry Hunt, Montreal, and James Douglas, jun., Quebec, Canada.—*13th August*, 1869.
2443. JOHN GALLEMMORE DALE and EDWARD MILNER, Warrington, Lancashire, "An improved method of producing white pigments from lead."—*16th August*, 1869.
2457. ROBERT FRANCIS FAIRLIE, Victoria-chambers, Westminster, "Improvements in locomotive engines and carriages, and in the mode of coupling the same together."—*17th August*, 1869.
2486. WILLIAM ROBERT LAKE, Southampton-buildings, London, "Improvements in screw propellers."—A communication from Frederick Wittram, San Francisco, California, U.S.—*19th August*, 1869.
2490. WILLIAM BYRNE, Belfast, Ireland, "Improvements in the process of distilling alcoholic liquors, and in apparatus for that purpose."—*20th August*, 1869.
2507. THOMAS WHITEHEAD, Holbeck, Leeds, Yorkshire, "An improved shackle and roller end for hardening machines for felting."—*23rd August*, 1869.
2527. THOMAS COLEY, Bower Farm, Maidstone, Kent, "Improved means or appliances to be employed in the cultivation of hops."—*25th August*, 1869.
2537. WILLIAM ROBERT LAKE, Southampton-buildings, London, "Improvements in machinery for carding and spinning fibrous materials."—A communication from John Goulding, Worcester, Massachusetts, U.S.—*26th August*, 1869.
2544. BRISTOW HUNT, Serle-street, Lincoln's-inn, London, "Improvements in machinery or apparatus for hulling, cleansing, and polishing or preparing coffee, rice, and other berries or grain."—A communication from James Fowle Baldwin Marshall and Augustus Jones, Boston, Massachusetts, U.S.—*27th August*, 1869.
2556. JOHN HOLDSWORTH, Kingston-upon-Hull, "Improvements in apparatus for loading or discharging grain, coals, ballast, or other materials."—*28th August*, 1869.

All persons having an interest in opening any one of such applications should leave particulars in writing of their objections to such application at the office of the Commissioners of Patents, within fourteen days of its date.

List of Specifications published during the Week ending 11th September, 1869.

3759, 8d.; 19, 4d.; 20, 10d.; 36, 10d.; 38, 1s. 6d.; 65, 2s. 10d.; 70, 10d.; 80, 1s. 2d.; 86, 6d.; 87, 6d.; 99, 8d.; 104, 8d.; 105, 8d.; 111, 10d.; 113, 1s. 4d.; 114, 1s. 6d.; 117, 1s. 6d.; 118, 1s. 4d.; 121, 1s. 6d.; 122, 1s. 8d.; 126, 8d.; 137, 1s. 4d.; 140, 1s. 6d.; 141, 1s.; 142, 8d.; 144, 8d; 146, 10d.; 147, 2s. 6d., 154, 10d.; 157, 8d.; 159, 1s. 4d.; 160, 1s. 10d.; 162, 10d.; 163, 1s.; 165, 6d.; 166, 10d; 167, 1s.; 169, 10d.; 170, 8d.; 172, 10d.; 174, 1s.; 175, 8d.; 176, 10d.; 177, 1s. 4d.; 178, 10d.; 179, 1s. 4d.; 184, 10d.; 188, 10d.; 193, 10d.; 195, 1s. 2d.; 199, 1s. 2d.; 207, 10d.; 210, 1s. 4d.; 215, 1s. 6d.; 219, 1s.; 220, 10d.; 228, 8d.; 229, 8d.; 233, 10d.; 239, 10d.; 243, 6d.; 245, 10d.; 255, 4d.; 256, 6d.; 277, 10d.; 310, 4d.; 313, 4d.; 314, 4d.; 316, 4d.; 322, 4d.; 323, 4d.; 325, 4d.; 326, 6d.; 327, 4d.; 328, 4d.; 330, 4d.; 333, 4d.; 334, 4d; 336, 6d.; 337, 4d.; 338, 4d.; 339, 8d.; 341, 4d.; 342, 4d.; 343, 4d.; 344, 4d.; 345, 4d.; 346, 4d.; 348, 4d.; 349, 4d.; 350, 4d.; 352, 8d.; 353, 4d.; 357, 6d.; 358, 4d.; 364, 4d.; 365, 4d.; 371, 4d.; 373, 4d.; 376, 4d.; 377, 4d.; 379, 6d.; 381, 4d.; 382, 4d.; 385, 4d.; 386, 4d.; 390, 4d.; 399, 8d.; 404, 4d.; 422, 4d.; 500, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

The following descriptions are made from Abstracts prepared expressly for THE ENGINEER, *at the office of her Majesty's Commissioners of Patents.*

Class 1.—PRIME MOVERS.

Including Fixed Steam and other Engines, Horse, Wind, and Water Mills, Gearing, Boilers, Fittings, &c.

481. J. B. *and* R. WOOD, *Sowerby Bridge*, "*Steam engines.*"—*Dated* 17*th February*, 1869.

This consists in the application of a separate small steam cylinder and piston with ordinary slide valve; the piston rod thereof is connected with another rod in communication with and giving motion to the spindle of the cut-off valve. The valve rod is provided with two collars or shoulders, between which are two cams mounted upon a hollow spindle, within which works a sliding rod connected to the governor by a bell-crank lever and connecting rod. In the sliding rod are fixed two projecting studs or pins passing through slots cut or formed in the hollow spindle parallel to its axes, and made to enter into oblique slots formed in the cams respectively, so that when the sliding rod is moved in either direction in the hollow spindle the projecting studs or pins will move the cams thereon, altering their position, and thus giving motion to the piston in the cylinder, and thereby move the spindle of the cut-off valve, and by the varying action of the governor causing the steam to be cut off sooner or later, and the action of the governor being quick the cut off is quickly effected.

490. H. ALAND, *Surrey*, "*Rotary blowing fans.*"—*Dated* 18*th February*, 1869.

This consists in introducing a vertical partition or partitions with central openings in one fan case, thus forming separate fan chambers with inlet openings into their respective fans.—*Not proceeded with.*

500. T. W. MARTIN, *Swansea*, "*Piston tightener.*"—*Dated* 18*th February*, 1869.

This consists in an improved mode of tightening the piston rings of pistons so as to make them fit more exactly in the cylinders, thereby keeping their places better and exerting more power than hitherto. This improved method is accomplished by placing a movable valve or valves in the body of the piston, which valves are opened and closed by the working pressure (of whatever kind, whether of air, steam, water, or gas, or of other fluids or liquids) on either side of the piston, thereby causing a continual pressure (equal to the working pressure on either side of the piston), to act against the inner sides of the metallic rings composing the piston, thus continually pressing them against the sides of the cylinders whilst the engine (to which the piston is attached) is at work.

513. J. LOADER, *Finsbury*, "*Steam generators.*"—*Dated* 19*th February*, 1869.

The inventor leads the steam pipe or tube through the main body of the water in the steam generator or boiler.

516. J. DAVEY, *Wisbeach*, "*Motive power engines.*"—*Dated* 19*th February*, 1869.

The inventor causes what may be considered the cylinder head to travel with the piston until it approaches the initial point. It will then rest, and steam being admitted between it and the piston, the piston will be caused to act in the ordinary manner.—*Not proceeded with.*

519. H. T. *and* T. JENNINGS, *Sydney-street, City-road*, "*Steam engines.*"—*Dated* 19*th February*, 1869.

In addition to forming the cylinder with two passages leading one to each of its ends, through which steam is alternately admitted to and allowed to escape from the ends of the cylinder by means of a slide valve worked by an eccentric as heretofore, the inventor also forms another opening at each end of the cylinder, which opening or passage is only employed for allowing steam to escape from the cylinder. The opening and closing of these passages he effects by means of a slide valve, worked by preference by cams on the crank shaft or by tappets from the piston of the engine, so that as the piston is moving towards one end of the cylinder not only will the ordinary exhaust passage be open to allow steam to escape from that end of the cylinder, but in addition there will be a second outlet for the steam, and this second outlet will be kept open until the piston has all but completed its stroke.

325. J. D. GAULDIE *and* T. A. MARSHALL, "*Steam engines and boilers.*"—*Dated* 20*th February*, 1869.

It is proposed to use high pressure steam in cylinders of comparatively small size, and working at a comparatively quick rate, with valve gear which can be varied or adjusted by means of a governor so as to keep the engine at a nearly uniform rate, notwithstanding considerable variations in the load.—*Not proceeded with.*

537. R. FOSTER, *Buxton, Northampton*, "*Boilers.*"—*Dated* 20*th February*, 1869.

Upon brickwork is a number of fire-bars, and upon this brickwork are secured a number of metal bearers upon which stand three separate hollow castings. Two of these castings are placed parallel with the fire-bars and stand upon the bearers, one of their ends being placed close to the casting or framing to which the furnace door is hung. This frame or casting has a door to close the front of the ash-pit below the fire-bars. The other ends of the two parallel castings lie close to one side of a third casting which forms the back, and has its top side somewhat higher than the tops of the two parallel castings.—*Not proceeded with.*

544. W. R. LAKE, *Southampton-buildings*, "*Locomotive heating.*"—*A communication.*—*Dated* 22*nd February*, 1869.

The apparatus consists of a vessel fixed to the fire-box, which serves as a reservoir for the coal. This reservoir is filled from the tender through a tube. The reservoir is closed at the top by a conical cover to prevent the falling in of the ashes from the grate-bars; the ashes fall upon the cover, and from the cover pass to the ash-pit.

551. W. E. NEWTON, *Chancery-lane*, "*Screw wrenches.*"—*A communication.*—*Dated* 22*nd February*, 1869.

This consists, First, in constructing the hole through the sliding jaw for the shank to pass through sufficiently large to admit of the jaw being readily disengaged from the screw or be thrown into gear therewith, so that the adjustment of the jaw on or along the shank may be effected either by an independent sliding movement of the jaw along the shank, or by or through the intervention of the screw, at the pleasure of the operator and as circumstances require.—*Not proceeded with.*

557. J. T. GAZE *and* J. HYMAS, *Erith, Kent*, "*Grate-bars.*"—*Dated* 23*rd February*, 1869.

The inventors cast or form the grate-bars together in sections or groups of three, by preference with spaces between for the admission of air, so that they form three ribs connected at intervals by narrow strips.—*Not proceeded with.*

558. A. JOBSON, *Darlington*, "*Coke ovens.*"—*Dated* 23*rd February*, 1869.

The coke ovens are built on pillars of fire-brick or stone in such a manner as to allow of space beneath them for the application of an improved system of unloading or discharging them, and no door is formed in front of the oven. The bottom, instead of being constructed in the ordinary manner, is formed either wholly or principally of a movable bottom or door, opened and closed, and supported when shut by means of toothed arcs or segments. The framework of the door is of iron, which may be cast, but it is preferred that it should be malleable iron, the bottom part being one piece of plate, secured to the surrounding angle iron in such a manner as to bind the whole securely together, and to exclude the air as far as practicable. On the plate iron are supported fire-clay quarries, of suitable thickness, bedded in ground fire-clay to protect the iron from the action of the fire, and to maintain the lower part of the coke oven as hot as possible. To still further prevent the radiation of heat a stratum of any non-conducting substance may be interposed between the fire-clay quarries and the bottom iron plate.

560. J. JOHNSON *and* W. GILL, *Unstone, Derby*, "*Rotary engine pumps.*"—*Dated* 23*rd February*, 1869.

This consists of a cylinder secured on a foundation and having a central shaft working in bearings at each end or side of the cylinder. On this shaft is mounted a circular piston revolving eccentrically around and within the cylinder, at the top of which the inlet and exhaust pipes are applied.

569. J. WHITEHEAD, *Oldham*, "*Furnaces.*"—*Dated* 24*th February*, 1869.

This consists principally in the application of a perforated block of brickwork or fire-clay of any length, which is placed above or in the place of the ordinary bridge at the back end of the fire-bars. This block of brickwork or fire-clay rises from the level of the fire-bars up to the top of the flue in fluid bodies, and up to the boiler in fire-places for egg-end or any other kind of boilers which are fixed underneath.—*Not proceeded with.*

572. J. COOKE *and* G. HIBBERT, *Richmond*, "*Steam jet vacuum power.*"—*Dated* 24*th February*, 1869.

In applying this invention to a steam engine the inventors connect the exhaust pipe from the steam cylinder to a vessel into which water flows or is injected, and a jet of steam is caused to act on the water as it is passing to the discharge pipe. The nozzle of the steam pipe is tapered off, and fits into an enlarged portion of the discharge pipe, the action of the steam inducing a powerful current which draws the air and water from the steam cylinder and produces the desired vacuum therein.—*Not proceeded with.*

Class 2.—TRANSPORT.

Including Railways and Plant, Road-Making, Steam Vessels, Machinery and Fittings, Sailing Vessels, Boats, Carriages, Carts, Harness, &c.

486. F. H. COLLINS, *Kensington-gardens*, "*Permanent way.*"—*A communication.*—*Dated* 17*th February*, 1869.

It is well known that railroad rails have sometimes been made double or reversible, so that in the event of the upper or bearing surfaces of the rail becoming worn and unsafe the rail could be turned over and a new bearing surface brought into use. But such reversible rails have been usually made in the shape of a double T—that is, like two ordinary T rails having their bases joined together. The invention consists in a form of rail, which, while avoiding all the obvious disadvantages of the double T rail, yet possesses all its valuable properties.

498. R. PYNE, *Wellington-street, Strand*, "*Carriage steps.*"—*Dated* 18*th February*, 1869.

Upon the bottom end of the carriage door is affixed a stirrup or suspender, turning freely with the door. Attached to this is a step of wood or metal, so arranged that when the door is shut it projects underneath the carriage, but when the door is opened it radiates from the stirrup and projects in front of the door in a line with the carriage, so as to form the step. A guide bar underneath serves both to guide and support it.—*Not proceeded with.*

503. W. DAINES, *Gravesend*, "*Anchors.*"—*Dated* 18*th February*, 1869.

This consists chiefly in constructing the stock with inclined pieces, which extend inward from each end of the stock at an angle of about fifty-five degrees to the shank. The latter is provided with chocks or abutments to receive the ends of the pieces, which are held in place laterally by a small pin passed through the arms and stock or by a collar or other suitable fastening.—*Not proceeded with.*

517. A. M. CLARK, *Chancery-lane*, "*Increasing tractive power.*"—*Dated* 19*th February*, 1869.

This consists in producing a series of flat independent bearing surfaces, each attached at its centre to the periphery of the traction wheel. These flat bearing surfaces are provided with cheeks embracing the rim of the wheel in the manner of a skid brake, and form horizontal surfaces bearing in succession upon the road, in lieu of the circular surface of an ordinary wheel to which the flat surfaces are tangential.

522. M. MACLENNAN, *Liverpool*, "*Permanent way.*"—*Dated* 19*th February*, 1869.

This consists, First, in making the joint sleepers on which the rails are fixed of iron secured at the joints by "monkey plates," and fastened by bolts and nuts in a similar manner to the fish-plates now in general use. The rails and sleepers thus become united as one piece throughout, the sleepers being so formed as to keep the rails in gauge. Secondly, in making the immediate sleepers of iron, on which the rails are fixed by means of bolts, washers, and nuts, sufficient provision being made for expansion and contraction of the rail, and also in so forming the sleepers like the joint as to keep the rails in gauge.

529. J. EBERHARD, *Tolmer-square, Hampstead-road*, "*Propelling ships.*"—*Dated* 20*th February*, 1869.

At that part of the vessel where the propelling blade or blades protrude a hole is formed or cut, and each hole thus formed is fitted with a movable filling piece hung vertically on pivots. Each movable filling piece is of the external form of a segment of a circle, so that during the portion of the revolution which it is permitted to make it exactly fits and fills the hole, and makes a watertight joint. Each filling piece is also formed with a longitudinal slot of the size of the propelling blade, so that the blade can pass in and out therethrough.—*Not proceeded with.*

538. J. E. LUCAS, *All Hallows Chambers, E.C.*, "*Floating velocipede.*"—*A communication.*—*Dated* 20*th February*, 1869.

This consists in obtaining the requisite buoyance in a velocipede for navigating the water by means of the propelling wheels and rudder. For this purpose the rudder and wheels are each constructed with one or more air-tight chambers or compartments.

545. G. A. FALL, *Hoboken*, "*Propelling vessels.*"—*Dated* 22*nd February*, 1869.

The object is to avoid the friction of a vessel sliding endwise through the water. This is accomplished by making the buoyant power a series of revolving cylinder floats, arranged in pairs on shafts, so as to roll over the water and sustain a flat form between four or more such floats, or these floats may be arranged one behind the other.

550. J. H. JOHNSON, *Lincoln's-inn-fields*, "*Velocipedes.*"—*A communication.*—*Dated* 22*nd February*, 1869.

A wheel is employed in which is a circular opening concentric with the periphery of the wheel, and in this opening is an annular rib, on each side of which a flange of a driving wheel fits snugly, but so as to move freely the peripheries only of the two flanges of the driving wheels bearing against the inside of the annular opening in the main wheel. The driving wheel is secured to a spindle which passes through and has its bearing in the opposite sides of a seat or saddle at one end of the same, the opposite end of the saddle having a spring carrying a flanged roller adapted to the circular rib of the main wheel.—*Not proceeded with.*

553. R. MELDRUM, *Pittimore Cupar*, "*Stopping locomotives.*"—*Dated* 22*nd February*, 1869.

This consists in making communication from the steam boiler, air, gas, or water chamber, directly to or about that part of the cylinder whence the steam air, gas, or water escapes after having done its work in the cylinder.—*Not proceeded with.*

564. A. V. NEWTON, *Chancery-lane*, "*Locomotive fire-boxes and ash-pans.*"—*A communication.*—*Dated* 23*rd February*, 1869.

This relates First, to the use in locomotive engines of fire-boxes with solid or pan-like bottoms (that is, without grate-bars or openings through the bottom), whereby the live coal will be retained in the fire-box until wholly consumed, and any scattering of coals or fire upon the track will be prevented. Secondly, to the arranging of the draught flues and dampers, so that the air will pass over the fire-pan or ash-pan, and feed the fire from the four sides of the furnace, and at a convenient distance above the bottom of the pan, which arrangement secures a very effective feed or supply of the air to the fire. Thirdly, to a combination of angle plates with a fire-box having a close or solid bottom, whereby the fuel is made to slide down and press together in close contact as it is being consumed.

556. R. P. WILLIAMS, *Great George-street, S.W.*, "*Railway crosses and switches.*"—*Dated* 22*nd February*, 1869.

In constructing railway crossings where two lines cross each other, the inventor forms one of the crossing lines of a continuous rail, and the other crossing line in two parts—one on each side of the continuous rail. Each part, where it meets the continuous rail, is bent round at an angle to come parallel with this rail, and is securely fixed thereto. The bent round end of the rail which comes up to the inner side of the continuous rail is retained at the requisite distance from it to allow of its bent round end serving as a guard rail. The continuous rail and the bent end of one of the parts of the crossing rail are notched out to the requisite depth, for the rail which forms the guard rail is thus notched, but in case of an acute crossing then the bent end of the other rail is notched out.

568. J. MYERS, *Spa-road*, "*Railway warnings.*"—*Dated* 24*th February*, 1869.

Inside, and longitudinally with the ceiling of each carriage, the inventor uses cord, rope, or chain connected with a screw and nut, or hook and eye in each compartment, so as to form a continuous line capable of being disconnected at will in each division of the carriage. One end of this cord, rope, or chain is fastened inside to one end of the carriage, and the other is connected with a weighted lever (with or without a spring), fixed and working a movable shaft or spindle in suitable bearings on brackets projecting from and fixed to one end of each carriage outside. The shaft or spindle at one of its ends has a projection at a right angle, similar to a half-crank or fork, with or without a wheel or roller to diminish friction connected thereto; the underside of the cranked part or fork is levelled sharply off to form a steep incline.—*Not proceeded with.*

Class 3.—FABRICS.

Including Machinery and Mechanical Operations connected with Preparing, Manufacturing, Dyeing, Printing, and Dressing Fabrics, &c.

497. C. BROOK, L. BARKER, *and* M. THOMPSON, *Halifax*, "*Looms.*"—*Dated* 18*th February*, 1869.

This relates to the take-up motion in looms for weaving, or the means or apparatus to be employed for effecting the regular winding on to a beam or roller of the woven fabric as produced, and so that when occasion requires, either by the breakage of the weft or when it is used up, such taking-up may cease at the proper place or the beam turn back to it, and at any time the turning back of the beam or roller may readily be effected. For this purpose the inventors apply a short shaft gearing at one end with either the crank shaft or the tappet shaft as most convenient, by suitable wheels to produce the required rotary motion, and at the other end gearing by means of worm and wheel with the ordinary taking-up gear wheels or a new arrangement of similar wheels, and so that this end of the shaft may be readily lifted or removed out of gear. To effect this it is attached to a lever fixed on one end of a rod or shaft extending across the loom under the breast-beam, and supported in the loom ends, and on the other end is fixed another lever projecting up through the breast-beam, and so set that when the weft-fork lever is acted upon it will act upon this lever, and thus lift the shaft out of gear with the taking-up wheels, and an adjustable slip catch is also applied to the ratchet wheel for holding the take-up, constructed with a slot, so that it may be set by an adjusting screw to let slip or expand to any desirable extent, and thereby allow the beam to turn back the required distance.

502. I. NEWTON, *Leeds*, "*Spinning flax.*"—*Dated* 18*th February*, 1869.

In place of making the supports which carry the saddles with projecting pins, to enter into slots in the saddles, as described in the above-mentioned specification, the inventor forms the support with two parallel cheeks between which the centre portion of the saddle is received. A pin carried by these cheeks, and passing across the space between them, enters a slot in the sadale, and the saddle is thus supported. The saddle is formed with parallel sides, which fit between the two parallel cheeks of the support, consequently the cheeks may be formed to fit against the sides of the saddle for any desired portion of its length, whilst the central portion of the saddle in which the slot is made, and which fits between the cheeks, may also be made of sufficient depth to give steadiness. By thus constructing the saddles, and their brackets or supports, a large bearing surface is obtained to prevent any lateral motion of the saddle, and in addition, as the sides neither of the saddle nor the brackets have any projections from them, they may be fitted by grinding or filing at a very small cost.

509. T. TUNSTALL *and* J. DODGEON, *Burnsley*, "*Looms.*"—*Dated* 19*th February*, 1869.

The inventors employ ordinary friction pulleys and chains, belts, or cords to each end of the beam, and also an ordinary "vibrator" or shaft with a vibratory crank-bar, which they invert; that is to say, they place the crank underneath or betwixt the shaft and the warp beam, so that the warp will first pass under the crank bar and thence over the shaft to the healds. The friction chain or cords are each attached to separate levers, each lever being hinged at one end to one of the loom ends respectively. The other ends of the levers projecting towards each other are connected by a T-formed lever bar, or by chain, belt, or cord and pulley attached equidistantly from the fulcrums of the levers to a weighted lever hinged at one end to the cross rail of the loom, the other or weighted end of this lever being connected by a chain, belt, or cord to a pulley or lever fixed on the vibrator shaft, so that the pull or stretch of the warp will always lift the weighted lever, and release or remove the pressure from the warp beam, and thereby let off the proper quantity of warp required.—*Not proceeded with.*

547. J. *and* T. LEACH *and* J. GOODYEAR, "*Wool winding.*"—*Dated* 22*nd February*, 1869.

In guides at the upper part of two side frames the inventors place slides carrying discs, forming the flanges of the bobbin, there being a central hole in one of the discs for the bobbin to pass through, and a central hole in the other disc for a pin which passes through a hole in the centre of the bobbin. In one of the slides is formed a seating of the same radius as the bobbin, and central with it, and in the other slide there is a central hole corresponding with the hole in the disc for the bearing pin to pass through. Below the slides there is a shaft carrying a toothed wheel or pulley for working the machine; also a surface drum, for causing the bobbin and lap to revolve, and a pinion for giving motion, by means of the gearing, to a wheel placed at an angle for working the traversing lever. On the shaft is also fixed a ratchet and a loose cam, having at one side a catch and arm and tappets, the catch gearing with the ratchet wheel when revolving motion is required to be given to the cam and tappets for working a lever and plate used for pushing off the bobbin and lap when the winding on is completed, and to prevent the catch gearing with the ratchet wheel. Until required, the arm of the catch is held back by a finger on the front slide.

515. T. SMITH, *Manchester*, "*Treating woollen cloth.*"—*Dated* 19*th February*, 1869.

The inventor spreads over the cloths spermaceti, paraffin, or other such matters, either alone or in combination with wax. The arrangement of apparatus employed for applying the material in a cold state, to be subsequently heated, consists of three cylinders made of wire gauze, or otherwise provided with fine perforations. Beyond these are steam cylinders, such as are ordinarily used for drying woven fabrics, and there are tension rollers, as well as a roller upon which the goods to be thickened are placed; also another roller which receives the goods when so treated. The thickening substance, having been reduced to a powder, is placed in the first-named cylinders, and the goods are caused by the tension rollers to pass in contact with the surfaces of the gauze cylinders, and subsequently in contact with the steam or second-named cylinders, after which they are wound upon the roller last named.

530. H. W. WHITEHEAD, *Holbeck*, "*Wool-combing machinery.*"—*Dated* 20*th February*, 1869.

This relates to Noble's combing machine. The object of these improvements is to effect the clearing of the fibre from the noil and other impurities, and this is done by causing the teeth of an inverted circular comb (which may be called a noil intersecting comb) to work between the inner and smaller circular comb and its drawing-off rollers.

540. W. IBOTOM, *New-inn, Strand, and* W. WYKES, *Ladelle-Uraysburg*, "*Paper manufacture.*"—*Dated* 22*nd February*, 1869.

The inventors feed the materials in order to secure regularity, either by hand or by a revolving roller or rollers or other apparatus, into one end of a revolving cylinder, and at the same time feed into the other end water, or such chemical solutions as may be desirable (the same being either hot or cold), and make the materials pass through in one direction, while the water or other solutions pass through in the other, the two being alternately beaten and rubbed together and squeezed apart during their passage by the action of rollers and strainers, or of either of them.

543. J. W. REID, *Bayswater*, "*Paper pulp apparatus.*"—*Dated* 22*nd February*, 1869.

This consists chiefly in subjecting the wood or other vegetable fibres to the action of heat and alkali, and at the same time protecting them during the whole process by keeping them covered by the liquor from the deleterious action of the steam necessarily generated by the heat.

573. B. HUNT, *Serle-street*, "*Bobbin friction regulator.*"—*A communication. Dated* 24*th February*, 1869.

The object of this invention is to remedy this defect by rendering automatic the displacement of the small friction cords above mentioned, which

may be effected in the following manner:—First, by making the notched bar over which the cords pass advance longitudinally, and thus increase the contact of the cords with the bobbins. In this case the points of attachment of the friction cords to the bobbin rail remain fixed. Secondly, by leaving the notched bar a fixture, and causing a bar which carries all the points of attachment of the friction cords to travel longitudinally.

579. E. A. V. Leroi, *Paris*, "*Carding engines.*"—*Dated 25th February*, 1869.

This consists, First, in producing, by means of ordinary cards or carding apparatus, madding pieces and slivers of horse or other hair, of a description similar to those produced from cotton. Secondly, in obtaining, on the card or carding apparatus, products of various textile materials laid one upon the other.—*Not proceeded with.*

Class 4.—AGRICULTURE.

Including Agricultural Engines, Windlasses, Implements, Flour Mills, &c.

492. J. Darlington, *Moorgate-street-chambers*, "*Drilling apparatus.*"—*Dated 18th February*, 1869.

This consists in a peculiar combination and application of certain known mechanical forms and movements towards simplifying and rendering more effective the action and consequent force applied to the drill used for boring rocks or mineral substances. The improvements consist in the use of a screw or of a rod having spiral slots in connection with certain wheel gearing, the whole being so arranged and combined that if rotary motion be given to the screw a simultaneous and similar motion is communicated to the drilling bar.

512. L. G. Moore, *Erith*, "*Windmill feather sails.*"—*Dated 19th February*, 1869.

The opposite arms are made extending from the extreme end of one sail to the extreme end of the other and opposite sail, thereby having the two sails opposite to each other. On one arm the two sails are fixed at right angles to each other, and the arm is held in such a manner on the axis that it can partly revolve, and the sails move with it, so that when one sail is in position to catch the wind the opposite sail coming against the wind is edgewise, and offers little resistance. The arms are fixed on the sails at a point a little above the centre of gravity, and stops are provided to prevent the arm turning more than required for feathering the sails, which are under the control of a governor worked by the wind.—*Not proceeded with.*

514. S. Myers, *New Bond-street*, "*Churns.*"—*Dated 19th February*, 1869.

In a cylindrical or otherwise shaped vessel containing the cream, egg yolks, or other matter to be treated is an axis or shaft free to revolve when turned by hand or otherwise, and communicating motion to a fan, wheel, or screw, or a contrivance consisting of blades, vanes, or plates, placed in any desirable position with respect to the shaft. For instance, in one arrangement this wheel or fan may consist of segments, sections, or interrupted portions of discs or circular plates, which, if completed (or the plates of which) would intersect each other at right angles or other angle. Two of the vanes may be in a line with—that is to say, longitudinally of the shaft—and two may be at right angles thereto, or they may be at various angles to the shaft and to each other. They may be straight or curved, plane or helical, and they may form portions, segments, or sections of a screw. They may be perforated or not. Rotary motion, on being communicated to this shaft or axis, transmits such motion to the blades, vanes, or plates mounted in the vessel, and the necessary action is thereby produced on the cream or other substance to be treated in the vessel.

552. J. B. Rushbrook, *Bury St. Edmunds*, "*Sheep-fold hurdles.*"—*Dated 22nd February*, 1869.

This consists in constructing an iron hurdle with two openings capable of being adjusted wider or narrower at will to suit the size of the lambs and sheep that have to pass through them. Another feature of novelty consists in providing the top and sides of such openings with rollers, to prevent injury to the lambs, and also to enable them to pass freely through the said openings. It is proposed to use one of these hurdles at each side of the pen or fold, and to connect wooden hurdles of the ordinary kind with the metal hurdles above mentioned in the construction of the fold.—*Not proceeded with.*

554. J. Blyde, *Sheffield*, "*Gardeners' scissors.*"—*Dated 22nd February*, 1869.

The inventor affixes a spring to one of the blades of the scissors or apparatus, which spring is secured to a piece or holder situate at the side of that one of the blades above referred to, such piece extending beyond the edge of the same, and having a broad part which acts against the other blade of the scissors or apparatus, by which arrangements the desired action of the scissors will be obtained.—*Not proceeded with.*

541. S. Osborn, *Sheffield*, "*Reaping and mowing knives.*"—*Dated 22nd February*, 1869.

This consists in making the knife-bar in the form of a clip by folding a long strip of malleable iron or steel or other suitable metal along a longitudinal line. If preferred, the clip may be folded along a line more or less on one side of the centre line, so that one edge may project beyond the other. The folding of the strip of metal may be effected in any convenient manner, but it is preferred to first bend or partially fold it between a pair of dies in a suitable press, the upper die being a narrow, angular piece, which bears upon the longitudinal centre line of the strip or bar, whilst the lower die is in the form of a groove with inclined sides. The strip or bar being suitably heated is laid upon the grooved die, and is forced and bent down into the groove by the descent of the upper die. The partially-folded strip is then reheated, and is placed between a pair of flat-faced dies, which compress the two edges of the strip together. The faces of the second dies are slightly inclined towards each other, and they compress the edges of the strip together, whilst leaving the inner parts of the recess or groove at a distance apart corresponding to the thickness of knife to be inserted.

577. J. T. Griffin, *Fleet-street*, "*Harvesting machines.*"—*Dated 24th February*, 1869.

The finger beam and cutters are connected to bars or supports, which pass through one of the main driving-wheels, which is supported upon rollers attached by bars to the main axle. The main axle is rigidly fixed to the frame. The driving-wheels are each made with an internal rib or feather; the collars bear upon or against the rib of one of the wheels. The insides of the rim of the wheels are formed with teeth for pinions to work in, which drive or operate the cutters. The bars or supports for the finger beam are jointed to the main frame, so that they can be raised and lowered by means of a chain and lever placed within reach of the driver, in order to regulate the height of cut, the lever being held in place by a bolt passed into holes in a quadrant. The axle on which the pinions are mounted is furnished with two clutches, the forks of which are connected to one hand lever, so that both can be thrown into and out of gear simultaneously.

518. E. Hewett, *St. Leonards-on-Sea*, "*Chimney cowls.*"—*Dated 19th February*, 1869.

The inventor forms the cowl of a tube of considerable height and of about the same diameter as the chimney itself, above which it is mounted, so as to turn on a vertical pivot. The top of this tube may either be closed and provided with an aperture on one side for the exit of the smoke, or it may be of curved form, like an ordinary cowl, and is in each case provided with a suitable vane. The top of the chimney is closed, with the exception of a central opening for a smoke-tube for about half the diameter of the cowl, mounted on the top of the chimney, and passing about half way up the cowl.

528. A. Jacob, *Bromley*, "*Sewer ventilating.*"—*Dated 20th February*, 1869.

This consists in purifying the effluvia in their escape to the surface of the ground, and by facilitating the disposal and removal of charcoal or other material having the property of destroying the injurious effects of sewer gases on health by means of manhole covers.

548. B. J. B. Mills, *Southampton-buildings*, "*Artificial stone.*"—*A communication.—Dated 22nd February*, 1869.

This consists in the production of an artificial stone by combining fragments, chips, or powder of stone or other mineral substance with calcined magnesia and bittern water.—*Not proceeded with.*

570. W. A. Ives, *Newhaven, Connecticut, U.S.*, "*Tenon and mortise machines.*"—*Dated 24th February*, 1869.

This consists of a table in which is laid the woods to be tenoned and mortised. This table has appropriate machinery for imparting to the wood intermittent reciprocating movements back and forth, as well as laterally, like a planing machine, for the purpose of feeding the wood up to a mortising expansive bit and tenoning hollow expansive auger, which are held in position by a tool-holder and holders being sustained in bearings on the stand, and having toothed wheels on their inner ends, which engage with a wheel on the driving shaft carrying a pulley and belt, through which the combination is operated.

Class 5.—BUILDING.

Including Brick and Tile Machines, Bricks, Tiles, Drain Pipes, and House Fittings, Warming, Ventilating, &c.

494. A. Munro, *Arbroath*, *and* W. B. Adamson, *Glasgow*, "*Masons' tools.*"—*Dated 18th February*, 1869.

This consists in the construction of conical tubular tools. The tools under the first modification constitute a hollow truncated cone or short conical tube. The tools are fixed in the holders of the machine for cutting stone, slate, marble, rock, or other substances, preferably by means of a bolt, which passes into or through the hollow or tubular part of the tool, on or in the other end of which a nut, spring, or collar is placed, or the bolt may be made to tightly fill the hole in the socket, in which case the nut, spring, or collar is dispensed with. The bolt, on being tightened, draws the tool firmly into the recess formed in the socket or holder to contain it. Under a second modification the tool is made hollow for a certain length only, the after part forming a solid shank or bar, which passes into a correspondingly formed hole in the socket or holder, and by which it is held therein. The tools constructed under the first modification are to be formed of chilled iron steel, forged or pressed into the requisite shape, or of chilled or forged compounds or alloys of iron or steel. The tools constructed under the second modification are to be made of chilled iron or of chilled compounds or alloys of iron or steel.

499. J. A. Wade *and* J. Cherry, *Hornsea*, "*Brick press.*"—*Dated 18th February*, 1869.

A suitable frame, mounted on wheels or otherwise, carries the fixed die or mould (for forming the sides of the brick, tile, or other article) to which is hinged the movable upper die or lid. The lower die or loose bottom, which works vertically inside the fixed die or mould, and by which the pressure is given, is supported upon two eccentrics keyed upon a shaft capable of revolving in bearings fixed to the frame, and having a hand lever keyed at one end thereof. The hinged upper die or lid when closed is held down by a catch, but when released by a cam on the eccentric shaft or a pin on the lever is thrown back by means of a spring.

493. A. Bartholomew, *Glasgow*, "*Sliding windows.*"—*Dated 18th February* 1869.

The inventor applies a plate or plates, or surface or surfaces, to the side or sides of the upper sash, with holes tapped to receive a screw with a square or other head adapted to receive a loose key, by which such screw is placed in position, and when in position, by acting on the upper part of the lower sash, to prevent the one from being raised and the other from being lowered beyond a suitable distance, which may be varied by the position of the screw in the upper sash.

Class 6.—FIRE-ARMS.

Including Guns, Swords, Cannon, Shots, Shells, Gunpowder, Implements of War or for Coast Defence, Gun Carriages, &c.

511. A. Henry, *Edinburgh*, "*Breech-loaders.*"—*Dated 19th February*, 1869.

This consists in the first place in arranging the breech-piece lock and extractor in such a manner that on lowering the breech-piece after the discharge of the fire-arm the lock is cocked in readiness for the next discharge, and the spent cartridge case extracted. These actions are effected in the following manner:—In the rear end of the breech cavity an opening is made through which protrudes one end of a bent lever, which is carried upon a centre bearing stud or shaft. The lower end of the lever projects downwards behind the breech cavity, and in an opening in the stock, wherein the lock is also contained. On depressing the lever to which the sliding breech-piece is connected, the breech being thereby lowered, its underside comes into contact with the projecting end to the lever before referred to, which is therefore depressed whilst its outer end is elevated, and in being so elevated it comes into contact with a projection attached to the tumbler, which is therefore also raised until it is thrown into "full-cocked" or "half-cocked" position, in which it is retained by a pall falling into notches or catches made in the lower edge of the tumbler piece.

Class 7.—FURNITURE AND CLOTHING.

Including Cooking Utensils, Upholstery, Ornaments, Musical Instruments, Lamps, Manufacture of Dress, &c.

482. E. T. Hughes, *Chancery-lane*, "*Washing machines.*"—*A communication.—Dated 17th February*, 1869.

The machine is composed of a frame supporting the vessel in which the process of fulling or washing takes place, and which consists of a case resting on the ribs of the frame. The vessel, at the bottom of which are the heating tubes and the discharge orifice, is lined on the interior with a layer of marble, hard slate, or other stone, or porcelain, and the beaters pivoting on the axle are also covered with a layer of such material, so that the linen shall only come in contact with perfectly clean and unchangeable surfaces. The point on which the levers operating the beaters oscillate is placed between the said beaters and the crank or eccentrics working in close proximity to the beaters, as usual in the present time. For single-action washing machines, where the crank is placed laterally, this would not be inconvenient, but in double-action washing machines it is necessary that the cranks and the mechanism generally should be arranged in the interior of the casing, which renders access to these parts difficult, so that stains caused either by drops of oil or (in case of insufficiency of lubrication) by particles of rust from the bearings become inevitable.

483. J. Atkins, *Birmingham*, "*Metallic furniture.*"—*Dated 17th February*, 1869.

This consists in improvements in manufacturing the head and foot rails or ends of metallic bedsteads and other articles of metallic furniture. The head and foot rails are usually made of rods joined together by cast or other junctions, or of panels inserted in a framing of tubes. In making the head and foot rails according to this invention the inventor constructs a framing of a rectangular figure by means of flat bars, which framing may be divided into smaller rectangular divisions by parallel flat bars. The rectangular spaces thus formed are filled by straight strips of sheet metal, arranged either diagonally or parallel with the sides of the framing, or the strips may be interlaced. Where the strips cross each other, and where they join the flat bars of the framing, he connects them together by plain or ornamental rivets or otherwise. Any required ornaments may be attached either at the crossings of the strips or in the open spaces. The flat bars and strips described may be ornamented with surface or other ornaments.

489. H. D. Bowyer, *Ripley*, *and* J. L. Norton, *Belle Sauvage-yard, E.C.*, "*Wheaten flour.*"—*Dated 17th February*, 1869.

This consists in subjecting wheat to the action of steam or moisture, to such an extent that it takes up sufficient moisture to permeate the husk or bran, after which the wheat is dried in order to cause a contraction of the grain, with the object of loosening the husk or bran, so as to cause it to separate more freely from the farina or flour, or the moistening of the grain may be omitted and the wheat simply be passed through a drying machine to dry it. After the wheat has been dried it is then crushed by being passed through rollers of metal or other material, either fluted or plain. The wheat is delivered to the rollers in an even stream or thickness by a shaking screen feed motion, which screens the wheat and frees it from dust and small seeds before it enters or passes into the crushing rollers.

491. F. I. Knewstub, *Westminster*, "*Writing cases.*"—*Dated 18th February*, 1869.

The inventor constructs the leaves or partitions separately and distinctly from a despatch box, and he applies them or the case containing them to cases, boxes, drawers, or receptacles of any description; the leaves or the case with the leaves may be made in such a manner that they may be used in an upright position separately, or may be made so as to lie flat upon a table, with or without the alphabet, numerals, symbols, or devices impressed, printed, or fitted thereon, so as to be observable from above. In order to facilitate the leaves being moved the inventor arranges them upon wires or bars fitted inside the case, or in a frame or tray.

527. J. Mabson, *Norwood*, "*Corkscrew and wax receptacle.*"—*Dated 20th February*, 1869.

This consists in the employment of a lever for lifting the stem or shank of a corkscrew after the ordinary spiral has been inserted into the cork. This lever is hinged to the top of a barrel passed over the bottle neck; one arm of the lever is a curved loop, which embraces the stem, and the other arm forms a handle.

532. J. Moil, *Cambridge*, "*Hair-cutting machines.*"—*Dated 20th February*, 1869.

The inventor mounts the drum or axis on which helical knives are fixed in spring bearings, so arranged as to allow these knives, which are rotating, to recede slightly from the fixed knife when cutting an unusual thickness of hair.

533. T. H. Simmonds, *Great Mitchell-street, St. Luke's, and* E. B. Moreland, *Bartholomew Close*, "*Paper collar finishing compounds.*"—*Dated 20th February*, 1869.

The proportions in this compound are as follows:—Starch in solution, about twenty-five parts; satin in solution, about twenty-five parts; size in solution, about twelve and a-half parts; glue in solution, about twelve and a-half parts. The ingredients, after being reduced to a liquid condition by the addition of a sufficient amount of hot water, are mixed together, and in this condition applied in any suitable manner on the material to be glazed or finished.—*Not proceeded with.*

555. H. F. Freutal, *Kingsland-road*, "*Hats and caps.*"—*Dated 22nd February*, 1869.

The inventor proposes, instead of applying a lining or body of cork, gossamer, hair, or other usual fabric, to employ a body or lining of paper, which is to be caused to adhere to the outer fabric or covering by means of solution of caoutchouc, gutta-percha, shellac, or other suitable adhesive solution, or any combination of the same.—*Not proceeded with.*

559. J. Breeden, *Birmingham*, "*Taps and stop-cocks.*"—*Dated 23rd February*, 1869.

The body of the tap is made in two halves or parts, joined together by flanges, the body having internally the general figure of a hollow cylinder. The entrance pipe opens into the lower half or part, and the exit pipe into the upper half or part of the body. A circular disc of strong and hard leather is inserted and fixed between the flanges of the two parts of the body of the tap, the disc constituting a diaphragm extending across the middle of the said body. This diaphragm has one or more perforations in it, through which the liquid or fluid passes, and on the lower side of the diaphragm is fixed a metal strengthening plate having an opening in it coincident with that in the diaphragm. In the upper half of the body is a plug, the lower portion of which is of the same diameter as the body, and works closely but freely therein. The upper end or stem of the plug passes out at the top of the tap, and is provided with a handle or with a lever for giving a rotary motion to the plug. The lower end of the plug bears upon the upper side of the leather diaphragm, and has a hole in it similar in size, shape, and position to that in the diaphragm.

563. J. Neilson *and* J. Marshall, *Glasgow*, "*Metallic capsules.*"—*Dated 3rd Februarz*, 1869.

This consists in coating the end or other part of the metallic capsule with varnish or resin; in pressing thereon paper which has had the trade mark, name, or device printed on it on the face or side that is applied to the capsule; in washing away the paper; and in finally protecting the trade mark, name, or device which remains on the capsule with a thin coating of glue or varnish.

561. B. W. Farey, *Bermondsey*, "*Gas valve facings.*"—*Dated 23rd February*, 1869.

A groove is formed in one or both of the seatings or faces of the valve, in to which groove is introduced by any suitable means, water, oil, or other fluids, which must be at a pressure exceeding that of the gas for which the valve is employed to regulate or stop the flow. It will be readily understood that should the seatings or faces of the valve not be tight, a leakage of water, oil, or other fluid will take place, thus effectually preventing all escape of gas between the seatings or faces. Any water or oil or other fluid so leaking through can be taken off by syphons, one on each side of the diaphragm or slide of the valve, or by any other convenient method.

562. W. F. C. Monkie, *Southampton-row*, "*Pianofortes.*"—*Dated 23rd February*, 1869.

This consists in the addition of one or more strings to the scale of the ordinary pianoforte now in use, when by means of any convenient mechanical arrangement the player can at will alter the pitch from that in ordinary use to a lower one, or, if he should desire it to a higher one.—*Not proceeded with.*

Class 8.—CHEMICAL.

Including Special Chemical and Pharmaceutical Preparations, Fuel and Lighting Materials, Preparation and Preservation of Food, Brewing, Tanning, Bleaching, Dyeing, Calico-Printing, Smelting, Glass, Pottery, Cement, Paint, Manures, &c.

510. E. Dorset, *London-street, E.C.*, "*Furnaces.*"—*Dated 19th February*, 1869.

This consists in the employment of liquid hydrocarbons for the purpose of producing an intense heat in furnaces, chambers, or kilns used for heating, smelting, or working metals and other substances. In carrying out the invention the inventor first evaporates and distributes in the evaporised state, under pressure (as described in a patent granted the 18th January, 1868, No. 176), the liquid hydrocarbons through a pipe or series of pipes from which the vapour issues in the form of jets. As this vapour escapes from the holes in the pipe it mixes with the air necessary for its combustion (the air being previously heated if required), and the hydrocarbon vapour thus mixed with air (or in some cases with steam or other gases) enters the chamber or furnace through an opening or openings formed therein wherever it may be found most convenient, such openings being provided with doors or other means of regulating the quantity of air or gas as required to feed the flame, or to modify its action upon the metal placed in the furnace to be heated, melted, or converted, as the case may be.

524. G. Green, *Aberystwith*, "*Buddles for separating ores, &c.*"—*Dated 20th February*, 1869.

The improved apparatus comprises a stationary conical table with its centre depressed and its outer circular rim in a horizontal plane. A vertical shaft passes up through a central aperture and is made to revolve slowly by any convenient motive power. A tubular arm is carried by the revolving shaft, and receiving the ores in a pulverised condition and mixed with some water, by a central duct in connection with the shaft, delivers them from its outer end round near the outer edge, and upon the higher part of the conical table. The shaft also carries a water pipe, which is furnished with small perforated branches, each with an adjusting cock, the series of branches being disposed in the form of a spiral, the outer end of which is a little behind the end of the arm that delivers the ore.—*Not proceeded with.*

539. J. *and* W. Weems, *Johnstone, Renfrew*, "*Malting, heating, and drying apparatus.*"—*Dated 22nd February*, 1869.

This consists in having a series of discs or floors arranged one above the other, and passing through the centre of these floors is an upright revolving shaft, with radial arms, on which are fixed directing blades or conveyers. These floors have openings at their centre and periphery for the passage of the grain from floor to floor. The barley or malt being fed on to the top floor at the centre, is distributed over it in layers by the directing blades, and descending on to the next floor at the outer openings, passes from thence to the centre, and falling through the central opening, and so on, until, by the action of the blades, all the floors are covered.

546. T. S. Blair, *Pittsburgh, U.S.*, "*Iron and steel.*"—*Dated 22nd February*, 1869.

This relates to a previous patent, dated the 23rd November, 1868, No. 3565. The inventor now employs manganese, and takes any of the various oxides of that metal, according to economic advantage, and reduces the one chosen to about the same degree of fineness to which the iron or other oxide has been reduced that is to be employed in the manufacture of the conglomerate or "pig bloom," by the process. It may be in the form of powder, but as it it important that it should be well and evenly mixed through the ore, it will be found desirable to have the two materials of about an equal degree of fineness.—*Not proceeded with.*

565. S. Holroyd, *Newton-heath, Manchester*, "*Recovery of waste from gas purification.*"—*Dated 23rd February*, 1869.

The inventor takes the substance which is commonly employed for abstracting sulphur from the gas—oxide of iron, for instance—and places it within a suitable vessel, to which steam or air is admitted, and the temperature thereof being raised, the sulphur is detached from the iron and may be recovered for the manufacture of sulphuric acid or other ordinary purpose.—*Not proceeded with.*

566. H. Bessemer, *Queen-street-place, Cannon-street*, "*Making cast from pig iron.*"—*Dated 23rd February*, 1869.

The inventor prefers to place two or more converting vessels in such a position with reference to each other that their respective axes are in a straight line with the axes, being at a distance of three to four feet above the general floor level. Beneath each vessel a small pit is formed, and an arched passage passes from one pit to the other in the line of the vessel's axes and terminating beyond the building, so that by means of a line of rails laid in the passage the ashes or other *debris* of the operation may be readily removed on trucks moving on three rails. An incline or a lift may be employed to raise the trucks up to the general ground level.

574. J. I. Vaughan, *Kensal-green*, "*Utilising waste liquors from tin-plate works.*"—*Dated 24th February*, 1869.

A quantity of crude magnesite is broken or pulverised and placed in a receptacle containing copperas or sulphate of iron, which is allowed to filter through it, by which means the free sulphuric acid is neutralised. The filtrate is then heated with a further quantity of pulverised magnesite and subjected to heat, whereby the sulphuric acid of the copperas or sulphate of iron contained in the liquor is expelled therefrom and absorbed by the magnesia, the iron being left in the form of oxide. This process may be varied by treating the filtrate with calcined magnesite or magnesia so as to throw down the iron, the supernatant liquid being cleansed and boiled down, and the precipitate oxide of iron treated as may be required by drying or roasting to render it applicable for polishing, the manufacture of colours, and other useful purposes.

576. G. Rees, *Holloway*, "*Designing on glass, &c.*"—*Dated 24th February*, 1869.

The object is to produce ornaments or devices by vitrifying pounded glass upon glass and glazed ware, or by cementing together fragments of coloured glass or glazed ware arranged in patterns, or not, by vitrifying a layer of pounded glass on to and amongst such fragments. The glass after it is pounded is sifted through sieves, the meshes of which correspond to the size of the particles of glass intended to be used on the surface of the glass or glazed ware. By way of example the inventor takes a sheet of glass, whether polished or not, and prepares the surface by brushing or otherwise, applying a gummy or other adhesive liquid thereon. He then sprinkles pounded glass over the gum, which adheres to it. The glass thus prepared is placed in a furnace, or under heat in any suitable manner, in order to vitrify the pounded glass upon the surface of the sheet glass. The pounded glass may be of one or a mixture of colours, or the sheet glass may be of a white or other colour.

Class 9.—ELECTRICITY.

Including Electric, Magnetic, Electro-Magnetic Apparatus, Electrical Apparatus, and Galvanic Batteries.

501. D. G. Fitz-Gerald, *Battersea*, "*Telegraph voltaic batteries.*"—*Dated 18th February*, 1869.

This consists in the insulation of a signalling urrent, not as hitherto, by means of a dielectric or insulating material properly so termed, but by means of good conductors of electricity (metals and electrolytes), so arranged as to generate an electro-motive force which opposes the escape of the signalling current when the latter is transmitted in a particular direction, or, in other words, the inventor prevents the passage or escape to earth of the signalling current by generating an electro-motive force which is made to oppose such passage or escape of the signalling current,

thus allowing it to complete the line circuit. This mode of insulating the signalling current he terms "electrolytic insulation" to distinguish it from the ordinary mode of or from "dielectric" insulation.

531. M. GRAY, *Highbury-hill*, "*Electrical conductors.*"—*Dated 20th February*, 1969.

The conducting copper wire, or the strands of fine copper slightly twisted to cause them to hold together, are enclosed first in pure india-rubber in the ordinary way of insulating conducting wires. This insulated core is overlain with a plastic compound of india-rubber and sulphur of any required thickness, the same being applied by means of the machine shown and described in the specification of the patent granted to the present inventor, Frederick Hawkins, dated 11th August, 1868; or any other suitable machinery may be employed for the purpose. The inventor next laps or coils helically around this coating of india-rubber and sulphur compound—while still in a green or uncured state—a tape or strip of cotton or other suitable fibre, measuring, say, an inch, more or less, in breadth. This cloth covering he pays over with a solution of the rubber compound, and he prepares the face of a second tape or strip of cloth of similar quality and breadth with the like solution. He then laps this coated cloth or tape (the prepared surface inwards) around the coated wire, laying it, however, in the opposite direction to that of the first cloth covering.

Class 10.—MISCELLANEOUS.

Including all patents not found under the preceding heads.

484. E. ROUND, *Sheffield*, "*Cooling and warming vessels.*"—*Dated 17th February*, 1869.

This consists in constructing vessels with an inner vessel or receptacle, and leaving a space or spaces between them, into which ice, or a cooling matter or mixture, may be introduced, for the purposes of cooling, and hot water, or a warming matter, for the purpose of warming any fluid or material that may be put in the inner receptacle, and be kept distinct therefrom; and in furnishing the outer vessel with a false or double bottom, and leaving a space between them. The false or upper bottom is furnished with suitable holes or outlets for inserting the cooling or warming material, and for drawing off the water or liquid from the ice or cooling matter when necessary, and so keeping the ice or cooling matter, when applied to the space between the outer vessel and its receptacle or inner vessel, free from wet or too much moisture, whereby it and a low temperature is longer preserved.

485. W. E. NEWTON, *Chancery-lane*, "*Stamps.*"—*A communication.—Dated 17th February*, 1869.

This consists chiefly in constructing the stamps with a hole or holes through the body of them, and covering or backing the same with tissue or other thin bibulous paper, made to firmly adhere to the body and the rear surface of the stamp, with its bibulous paper covering, to the hole or holes, coated or backed with mucilage or other adhesive substance.—*Not proceeded with.*

487. A. RANSOME, *King's-road, Chelsea*, "*Wood-cutting machinery.*"—*Dated 17th February*, 1869.

This relates to the planing part of the machine, in which the inventor employs two rotary adze blocks provided with cutters. One block is intended to plane the upper surface of the wood, and the other to plane the under surface. The wood rests upon and is drawn or pushed along a table, in which is made an opening for the lower rotary planing tool or cutter to act on the wood. The spindles on which these cutter blocks are fixed or secured are distinct from the saw-spindle, and are actuated from the driving shaft by means of separate gearing consisting of bands and pulleys, so that either the planing tools or the saw may be worked or stopped without interfering the one with the other. When required the rotary planing adze, blocks, and cutters may be removed from their spindles, and tenoning blocks may be substituted for them and secured on the spindles. Cutters may be secured to the planing blocks for cutting single or double mouldings.

488. W. R. LAKE, *Southampton-buildings*, "*Extracts from coal-gas.*"—*A communication.—Dated 17th February*, 1869.

This consists in placing coal gas in contact with substances which act as solvents for the benzole and homologues contained therein, without at the same causing them to undergo any chemical change, and while it has been found that all known solvents of benzole will effect this purpose the inventor prefers to place coal-gas in contact with certain hydrocarbons, such as petroleum schist and mineral oils, and the higher boiling varieties of coal-tar naphtha, as these hydrocarbons are easily procurable, and interfere little if at all with the illuminating power of coal-gas, and by mere distillation the benzole and its homologues may be separately obtained from their solution therein, and the solvent rendered again fit for renewed application.

495. A. GARRISON, *Birmingham*, "*Pendant string holder.*"—*Dated 18th February*, 1869.

This consists in forming them, by preference of a spherical form, in two parts, principally from wire gauze raised into the desired shape, each part or half being bound by a tinned or other metal rim, and united together in any convenient portable way, such as by a hinge and catch; and on the apex of the one half, or semi-sphere, a strong ring or collar is applied for the convenience of portable suspension.—*Not proceeded with.*

496. J. D. NICHOL *and* J. ECKERSLEY, *Edinburgh*, "*Paper apparatus.*"—*Dated 18th February*, 1869.

This consists in the combination and arrangement of hollow drums, heated by steam or otherwise, over and under and in contact with which the printed sheets of paper are separately passed, and thence through a pair of pressing rollers, whence they pass successively into a suitable box or receptacle.

504. F. W. MALLETT, *Newhaven, U.S.*, "*Needle machine.*"—*Dated 18th February*, 1869.

The wires or blanks being cut to the desired length for two needles are thrown into a hopper which has in connection with the same a feeding device. This device conveys one blank at a time to the first set of a series of progressive carrying rollers, which take up the blanks in turn and carry them from one to the other; while being so carried by the rollers the needle blanks are stamped, the eyes punched, and the eyes tested by a feeler, which will detect a blank not properly eyed and will stop the feed mechanism for its removal.—*Not proceeded with.*

505. M. VARY, *Scarborough*, "*Ornamenting surfaces.*"—*Dated 18th February*, 1869.

The inventor takes a piece of paper or other suitable material as above, and coals or prepares it with size made in any convenient manner, and allows the same to dry. On the surface so prepared he prints, draws, stencils, paints, or otherwise makes any design, device, or character, in or of any colour or colours or material required, or he cuts, stamps, or perforates out any design, device, or character, or he partly paints and partly cuts the design or character required. The cutting, stamping, or perforating may be effected either previously to the sizing or subsequently thereto, or subsequently to the printing.

506. F. DELHEIL, *Versailles*, "*Utilisation of excrement.*"—*Dated 18th February*, 1869.

The inventor proposes to make use of a locomotive engine suited to run on common roads, for the purpose of conveying any convenient number of wagons to the spot at which they are to be loaded with sewage or other similar matter, and transporting such matter to appointed depôts. These wagons should be so constructed as to suit the special service for which they are intended; an enclosed wagon having a body built in the form, for example, of a barrel would be well adapted for carrying sewage matter in a liquid state.—*Not proceeded with.*

07. T. FORSTER *and* P. B. COW, *Streatham*, "*India-rubber pipes.*"—*Dated 18th February*, 1869.

In manufacturing suction and other pipes the inventors substitute for the galvanised iron wire coil used in the manufacture of ordinary suction and other hose, alternate rings or spirals of rubber having two different quantities of sulphur in them, so that after the operation of steam vulcanising every alternate ring or spiral will be hard, while the intermediate ones will be flexible. In manufacturing india-rubber hose, buckets, bags, and such like vessels the inventors substitute for the cotton or linen fabric ordinarily used for giving strength, a material composed of rubber and fibre.—*Not proceeded with.*

508. W. M. COCHRANE, *Surbiton*, "*Water vessels.*"—*Dated 19th February*, 1869.

This consists in the use of a bottle or vessel of glass, glazed pottery, or other suitable material (but by preference of ebonite), protected by a covering of felt or other non-conducting material, which also serves for maintaining the temperature of water or other liquid contained in the bottle or vessel.

520. J BARTON, *Birkenhead*, "*Water heater.*"—*Dated 19th February*, 1869.

This consists in bringing steam into direct contact with the water to be heated in a closed vessel, when the supply of water to such closed vessel is controlled by mechanism, operated automatically from or by the water level in the closed vessel or heater.

521. W. R. LAKE, *Southampton-buildings*, "*Ice apparatus.*"—*A communication.—Dated 19th February*, 1869.

The inventor first constructs a box or case of wood, of which the first thickness is about eight-tenths of an inch, more or less, according to the size of the box to be made. The interior of this first thickness is furnished with another one inch and six-tenths or more of some bad conducting material, such as powdered wood-charcoal or tan after it has served in the tannery. This bed or thickness is covered with an envelope of wood of slight thickness, so as not to make the apparatus too heavy. This envelope s fixed to the first in such a manner that the non-conducting material or bed cannot escape or be displaced, the sides of the case having altogether a thickness of about two inches and three-quarters. The whole is covered internally with sheet metal, well soldered at the corners, to prevent any communication with the non-conducting bed.

523. G. G. HAIRS, *Little Distaff-lane*, "*Burning combustible liquids.*"—*Dated 20th February*, 1869.

The inventor places over a gas burner a vessel or generator of a double cup-like form, which he sometimes surrounds by a chimney. Petroleum, or the combustible liquid to be vaporised, is placed in the inner cup, which is closed air-tight. Gas is admitted by a pipe to the upper part of the cup-formed generator, and after passing over the surface of the petroleum or other liquid (which, being heated, gives off vapour freely) it passes away to the burner beneath by a pipe descending through the bottoms of the double cup generator. Other pipes may also be connected with the double cup generator, to lead off the gas or vapour to other burners, as may be required.—*Not proceeded with.*

526. J. T. WILBERLEY, *Leicester*, "*Winding apparatus.*"—*Dated 20th February*, 1869.

On the ordinary sliding shaft, which carries the right and left-handed nuts, the inventor places an arm extending to the top of the machine, and fixed to a tube which works loose on the ordinary sliding shaft, carrying at each end the right and left handed nuts. The inventor also employs two stays extending through a fixed plate on the top of the machine head, and connected to a slide working in guides or recesses in the fixed plate. On the top of the stays the inventor fixes a plate which supports another movable plate working in recesses, and carrying at each side a slide-catch spring, and adjustable screw, and near each end of the movable plate there is a pin projecting from underneath and working in a slot in the under plate.—*Not proceeded with.*

534. B. F. WEST, *Rochester, New York*, "*Double-jointed butt hinge.*"—*A communication.—Dated 20th February*, 1869.

The improved hinge consists of four plates or levers—two long plates and two short ones. One of the long plates is secured to the door, and the other to the post or joint. The two long plates are each jointed at the opposite sides of each end to one of the short plates, and when the hinge is close the two long plates lie parallel to each other with the short plates between them. The two short plates are placed end to end, and their opposite edges carry the two joint pins of each end of the hinge, each end of the long plates or leaves of the hinge being connected to the joint at opposite edges of the short plates.—*Not proceeded with.*

BIRMINGHAM AT WORK.

(From our Correspondent.)

WITH the earlier history of Soho—the cradle of the steam engine—everybody is more or less familiar, but comparatively little is known as to the present extent and capabilities of the world-famed laboratory of Boulton and Watt. By the courtesy of Mr. Gilbert Hamilton, the grand-nephew of Watt, and one of the present proprietors of the works, I was enabled the other day to take a complete survey of Soho, and jotted down in my note-book such items as I judged would interest your readers.

The Soho Works are carried on in the name of James Watt and Co., but the actual proprietors are Mr. H. W. Blake (London), Mr. Gilbert Hamilton (Leamington), Mr. Charles Barclay (London), and Mr. James Brown (Birmingham). The establishment occupies an area of about twenty acres, and it struck me as a peculiarity of Soho that all the workshops are on the ground floor. Branches of the London and North-Western Railway and of the Birmingham Canal intersect the works. The establishment is divided into two leading portions—the Mint, and the engineering departments, which combined are capable of affording employment to some 1200 work-people.

Accompanied by Mr. Hamilton, I first visited the Mint, so renowned amongst the coining establishments of the world. The copper store is the first spot of interest. A large underground cellar dimly lit by torches, and securely fortified against possible invasion, is used for this purpose. On either side are piles of copper ingots in five-ton stacks, the total stock sometimes amounting to 1000 tons. Contiguous to the store is what is called the "mixing shop," wherewith the utmost nicety the materials forming the bronze for coinage are apportioned. The English bronze coin is composed as follows:—Copper, 95 per cent.; zinc, 1 per cent.; tin, 4 per cent. The bronze coins made for Italy slightly differ in this respect, the zinc being left out and one part of copper substituted. Mr. Hamilton tells me that bronze has entirely superseded copper for coins, the last of copper being for India; but nothing in that way has been done at Soho for nearly seven years. The casting shop was next visited. In this shop are thirty pot furnaces and three air furnaces. The furnaces differ from those in ordinary brass casting shops by being level with the floor, instead of being raised above it. For melting the mixture Stourbridge crucibles are used, each holding 120 lb. The total produce of these furnaces is about twelve tons per day. When sufficiently melted, the metal is cast into slabs or strips about two feet long by four inches wide and one inch thick. This is performed in the usual manner by horizontal iron moulds. The process of rolling follows. The slabs are here first "broken down," as it is called, or pressed out sufficiently to enable them to pass easily through the four pairs of rolls by which they are gradually reduced to the required gauge. All these rolls are accurately adjusted, especially the last, or "finishing" rolls, which are made of highly polished steel, and which can be regulated to the ten-thousandth part of an inch. Every strip as it emerges from this roll is accurately gauged. During the process of rolling the strips have to be annealed two or three times in adjacent furnaces, besides being scoured and washed in vitriol. When finished the metal strips present a beautifully bright and polished surface, and they are at once transferred to the "cutting out" room. There are eight steam presses busily at work cutting out round blanks of metal at an astonishing rate, each machine producing with four or five dies as many as 450 to 500 blanks per minute. The blanks are then taken to the milling machines, of which there are fourteen, where by a simple and very rapid process the edges of the coin are raised. The milled coins are then placed in iron pots hermetically sealed, and placed in an oven to be annealed again prior to the marking or "coining." The pots, which contain 28 lb. each, resemble loaves in the furnace, which latter reminds one exactly of a huge baker's oven. They are again "pickled" and washed, and afterwards shaken in a steam-propelled barrel until they are perfectly bright. The picking or assorting is the last process in the manufacture of blanks. The picking machine has a revolving surface on which the coins are exhibited, and as they pass rapidly along some half dozen quick-sighted girls detect and pick out any coin that may prove defective either in form or colour. The blanks are then packed in half-hundred weight bags, ten of which are placed in strong casks, and they are then ready for shipment. The blanks are marked abroad by the Government authorities in the countries for which they are destined, unless the English Government will undertake the responsibility of superintending the operation and guaranteeing its efficiency and correctness. This the Government will not do, and it is unreasonable to expect it. In Belgium, however, "they manage things better." There the executive will undertake the duty of superintending the production of coins for other nations, and in consequence of this paternal Government policy it happens that a large order for coins on account of South America are only being produced in blank at Soho, the marking having to be done in Belgium. The cost of transit to and from the latter country will be a serious item in the estimate. The Home Government has sufficient confidence in Soho to entrust it with the production of the bronze coin in its finished state, and so have the colonial executives. When the entire coining is done the operation succeeding the completion of the blank is that of preparing the dies. The pair of dies is engraved, technically called "matrices." From these two impressions are taken, which of course are the reverse of those on the "matrices," and from these the working dies are made. The English Government supplies its own dies, and those produced here for foreign powers have to be sent with the coins on the completion of the contract. The dies are of course of finest steel forged, turned, and annealed, and are used in an ordinary medal press. The "coining room" at Soho is 120ft. long by 30ft. wide, and down the centre are ranged twelve coining presses worked upon the pneumatic principle as invented by Matthew Boulton towards the close of the last century. Each of these presses will mark eighty to one hundred and fifty coins per minute. As many as two hundred small coins have been marked in that time. The extent of Soho Mint will favourably compare with the leading Government Mints of the world, at which the number of coining presses is as follows:—London, eight; Calcutta, twenty-four; Bombay, sixteen; Madras, fourteen; Brazil, four; Russia, eight; Hong Kong, four; Portugal, four. As many as a million pieces of bronze coin have been packed and sent away from Soho in a single day. The first contract for the bronze coinage of our own country was entrusted to Messrs. Watt, and the specification was as follows:—720 tons of pence, 48 to 1 lb., avoir., 880 tons of half-pence, 80 to 1 lb., and 120 tons of farthings, 160 to 1 lb. It will be noticed that the number of pence per lb. was out of proportion to that of the other coins. The Government gave no explanation of this difference, although oy course they got an extra "pull" to the extent of 8 lb. in every 48 lb. in consequence. The coins made at Soho include, as may be supposed, not a few curiosities. Amongst the smallest bronze coins made is the "baui" of the new kingdom of Roumania, about the size of a threepenny bit. Perhaps the largest coin is one made for Honduras (8 ps.), on which is stamped the tree of liberty and other emblems of the kingdom, among which the pyramids and the sun are conspicuous. The Turkish paras are inscribed with Turkish characters setting forth the glories of the Sultan. The Chinese "cash," made very extensively in Birmingham for the Celestial Government, are beneath the quality Soho produce. These coins have a square hole in the centre and a few Chinese characters around it. This "cash" is the commonest coin made, being composed chiefly of the refuse metal discarded by the Birmingham manufacturers. The Chinese Government beat down the producers so much in price that this deficiency in quality is the natural result, and the "cash" of the Celestials made here is almost as much a byword in the trade as the tinsel "Brummagem buttons."

I have not space this week to do justice to the engineering department of Soho, in which several interesting works are now in progress, and therefore reserve my notes on that subject for another paper.

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

(From our own Correspondent.)

SLIGHTLY BETTER TRADE IN IRON: *More time being run*—KINDS IN DEMAND: *Sheets: Plates (for India): Hoops: Rounds; Bars*—RAILS AND THE FIRMS MAKING THEM—PRICES OF FINISHED IRON: *They keep low*—PIG IRON: *Steady of sale: The varieties in use: Remarks on mixtures*—THE MOVEMENT FOR A RISE OF IRONWORKERS' WAGES: *Memorials being presented: What will be the issue? The arbitration question*—COAL: *Brisk inquiry for thick*—SHORT WEIGHT: *Will it be general? Effect upon the iron trade*—COLLIERS' MOVEMENT FOR A RISE: *Remarks upon it*—THE GREAT MEETING OF IRON AND STEEL MASTERS TO COME OFF AT MIDDLESBOROUGH: *What is thought of it here*—HARDWARES: *The customers and the markets for which the goods are destined.*

THE iron trade of this district is in a slightly better condition than it was a week ago. Hardly any one department displays a conspicuous improvement; but, taken altogether, the advance is perceptible. It is seen in some works beginning operations slightly earlier in the week than has been the practice recently, and here and there it is observed in a for sometime disused mill being put again into gear.

Sheets are most in request; and the makers of singles are generally well employed where they do not stickle for too high prices. The iron is to be used chiefly by the galvanisers alike at home and in Scotland, but intended eventually for export. The very thin gauges sell actively.

Plates are in fair request where makers have been successful in obtaining contracts in competition with other districts. The best export market just now for such iron is India. The buyers are the Government; the quality is good throughout, but the sizes vary. Great care is taken that they shall not oxidise on their way out.

Hoops are not less in demand.

Three-eighth rounds are being made in large total quantities, but in small individual lots, the number of works capable of producing this denomination being many.

Bars, of what is termed the fancy class, are well to do where makers have a good connection in the district with the makers of fencing. Plain bars, of the class which tells most in our export returns, are not proportionately busy; for the North Staffordshire ironmasters can roll these at a cheaper rate than their *confrières* in South Staffordshire, and they are nearer to the port from which they have to be shipped to our chief customers.

Firms who have stood aloof from the rail trade during what may be termed the current excitement in this branch, are nibbling. In a few instances they have taken dabs embracing two or three score tons of kinds much less valuable than those which, in the early history of the rail trade, were made at the same works.

Prices keep low, but with perhaps a tendency to strengthen without there being a positive rise. The makers of rounds, of the gauge mentioned above, complain that though they ought to be getting 10s. a ton more than the price for list bars, yet they have to sell them at 10s. under list bars. Excepting in a very few first-class instances, there is not perhaps a firm by whom the list price is being got for any kind.

Pigs are steady of sale, with a little more doing at prices slightly less in favour of buyers. Considerable variation is seen in the descriptions now purchased at mills and forges, where, not long ago, the transactions were confined to very few sorts. Happily this is seen as well in regard to the very best qualities of pigs, as in respect of those which may be had at low prices. For instance, cold blast iron is selling in fresh quarters. The transactions indicate the possession by the buyers of orders for the finished article from consumers who will have nothing but the quality upon which the original fame of South Staffordshire was built up. Then, Westbury and Wellingborough iron is finding favour with people who have previously used some of the cheaper Cleveland samples, together with the kindred of irons of this district. A wider variety of qualities are at this time leaving the finished ironworks of South Staffordshire and East Worcestershire than at any other period in the history of the district. The scarcity of orders has led makers of long standing and world-wide trade fame to accept specifications for qualities much under that with which they have hitherto had most to do. But whilst selling the goods at as low a figure as is accepted by manufacturers of less note, they, as a rule, are producing a superior quality.

There is not now much iron going out of the country from this district in an unmanipulated condition, but the tendency is to increase; and even when the rail trade of the season is over it is believed that there will be a gradually improving inquiry on account of our leading colonies.

During the week many masters have been served—for that is the best term to use—with the memorials determined upon at a meeting of ironworkers who solicit an increase in their wages to the extent of 10 per cent. What they will do with them remains to be seen. We have our own views of the course which will be taken, but we don't care to express them at this juncture. It is pretty certain that the masters are unable to give the rise, so long as they can get only the present prices. A maker expressed his conviction to us only yesterday that there are very few ironmasters now in South Staffordshire and East Worcestrshire who are doing more than make two ends meet. How then, they ask, can they give an advance? If they should be forced to do what the men require they must try to recoup themselves by putting up prices, a course which, it is believed, would prove disastrous alike to masters and to men, for it would encourage continental makers to

increase their means of production, and have a similar effect upon the proprietors of mills and forges in the United States. The memorial has not been universally presented, but even in instances in which it has not been received men have hinted that the time has come when they ought to have more money. This shows a return of that uneasiness upon the question of wages which was manifested just a twelvemonth ago. It would be gratifying if the men should, as at that time, be open to the conviction that, neither in its present nor in its prospective state, will the trade warrant any alteration. If assured of this truth, the men should be content to allow the present slight improvement to go on developing itself; the better pay for which they are asking may prove to be within their reach in a few months' time. It is true they ask for arbitration if the masters will not give them the advance. And rather than put up prices, we hope that if the applicants should persist in this request that it will be conceded; for we are sure that even as the books of most of the masters in the Cleveland district showed that the advance of 5 per cent. there might perhaps be given, so those of the masters here would demonstrate that not even half of what is now being asked for could be accorded.

The coal trade keeps steady and prices unaltered. Mr. Frederick Smith, on behalf of the Earl of Dudley has sent out a circular intimating that after the current quarter all coals will be weighed over the machine, whether the mineral is taken away in boats, in railway wagons, or in carts, and that the ton will be that of 2240 lb., which, it will be remembered, is short weight. Commencing with the 1st of October, the prices will, therefore, be, for thick coal into boats, railway trucks, or carts, for works' purposes, best, 11s. 6d.; common (or seconds), 7s. 8d.; lumps, 6s. 8d.; black coal, 6s.; screenings, 4s. 8d.; black screenings, 3s. 10d.; and engine slack, 3s. Heathen coal will be, large, 11s. 6d.; lumps, 6s. 8d.; screenings, 4s. 8d. Brooch coal, mixed, 8s. 6d.; screenings, 6s. The coal weighed into carts for household use will be charged for on a higher scale. The advance will range from 1s. 6d. to 6d. It has been explained that the prices charged for works' coal upon the new weight, as compared with the old of 2640 lb. to the ton, will be a reduction in price relatively of about one-seventh. Ironmasters who use this coal exclusively assert that the alteration will run up their costs nearly 5s. upon every ton of iron which they send out of their mills. It remains to be seen to what extent the example set by the Earl of Dudley will be followed. It is true that the thick coal is in only a few hands, and that his lordship is the chief holder. Eventually the alteration will be adopted, but the change may not come about immediately.

It would be a happy thing for the iron trade if there were no impediment to the universal adoption throughout the district of this standard of weight; and the looseness of the practice which has hitherto prevailed has no doubt tended to check a rigidness of economy at the ironworks and the collieries, which has worked evil for the district. Now, however, that the competition elsewhere is so severe, every arrangement which goes to increase the ironmaster's expenses is to him a serious matter.

The movement with a view to a rise in colliers' wages is not understood to have reference mainly to other than the thin coal men, who, it is understood, were at the last drop reduced in a larger proportion than customary; and it is asserted that opposition is being displayed in some quarters to the levy of contributions towards the payment of agents to continue the agitation.

The great meeting of iron and steel masters, to begin at Middlesborough next Wednesday, is regarded by the best men in this district as a matter of great importance to the future of the trade in its scientific aspect. Out of the 200 members of the Iron and Steel Institute who will then assemble there will be a few from this part of the world, but not so many as those who wish most good to the district could desire. The occasion will be eminently an educational one. Consequent upon the fact that the next quarterly meeting of the North of England iron trade begins on the Tuesday, that meeting will be of more than universal interest, and will exercise a commensurate amount of influence upon the immediate condition of the iron interest of the country generally.

Alike in Birmingham and throughout the surrounding townships the general manufacturing industries are in scarcely any case more than steady. As has been the case for some weeks past most is being done in heavy goods; but in the miscellaneous kinds there are evidences of an improvement in certain of the export markets. The Southern States of United America are forwarding better specifications, accompanied with advices of an increasingly cheering character in reference to the probabilities of the future. There is activity with Brazil in all cases in which goods can be got into that country before the beginning of next year, at which time the new and advanced tariff comes into operation. The River Plate trade is quiet just now, but it is believed that it will soon be active again now that certain disturbers of the peace thereabouts have been brought into subjection. The advices received by the last mail from Australia, with those also from New Zealand, have been alike cheering in respect of the probable future demand; and they cannot reasonably be described as unsatisfactory in the number of orders enclosed. Altogether the prospects of the home and foreign trade are not, in view of the near approach of winter, so depressing as they were at this time last year.

WALES AND THE ADJOINING COUNTIES.

(*From our own Correspondent.*)

The Iron Trade: *Reports favourable as to present position of the trade: Hands busily engaged in completing contracts for the United States and Russian Empire: Fears entertained by some of a reaction setting in at the close of the Baltic season: Foreign inquiry for rails remarkably good: Probability of the demand being sufficient to keep the works fully employed: Increase in exports during the past month: Contracts still on the books for several thousand tons for Russia and the United States: Probability of Russian contracts not being completed this season: Several home contracts for rails in the market: Gradual increase in the home demand confidently looked forward to*—The pig iron trade—The tin-plate trade—Steam and house coal trades—The Cheltenham and Swansea Railway Carriage Works: *Directors' recommendation to close one of the works*—The Monmouthshire Railway and Canal Company's Meeting—Trade of the South Wales Ports.

Latest reports from the principal iron making establishments characterise the trade as continuing in a favourable state of activity, and the hands employed at the rail mills are now busily engaged in completing contracts for the United States and Russian empire. Fears are entertained by some few makers that at the close of the Baltic shipping season a reaction will set in, but it is satisfactory to find that the foreign inquiry for railway iron keeps remarkably good, and it is becoming pretty evident that when present contracts are completed the demand will be sufficient to keep the works well employed. Last month the total quantity of iron exported from this district reached 50,177 tons, being an increase of 3978 tons as compared with the previous month, and 12,159 tons over the corresponding month of last year, being satisfactory and conclusive proof that the trade is recovering from the depression which so long prevailed, and hopes are entertained of a further improvement shortly taking place. There are still contracts on the books for several thousand tons for Russia and the United States, and it is now pretty generally believed that the whole of the Russian contracts will not be completed this season. Last month the exports to Russia reached 12,602 tons, being an increase of 915 tons over the previous month, when the exports reached 11,687 tons. Several home contracts for rails, ranging from 1000 to 5000 tons, are in the market, and a gradual increase in the home demand is confidently looked forward to, not perhaps to be fully realised until next spring. Within the past few days exporters are purchasing bars more freely, which it is hoped will lead to a revival in this branch. There is a better demand for pig iron, and prices are stiffening.

Tin plate makers report a slight falling off in the demand during the past week, and several orders expected from foreign markets have not yet arrived.

The improvement referred to in previous reports as having set in in the steam coal trade is now fully corroborated by the returns for the past month, there being an increase in the exports at all the local ports. The improvement set in after the month had somewhat advanced, otherwise the returns would have been still more favourable. Large quantities were sent to the mail packet stations, and the purchases of French houses were considerable. The arrival of vessels at the local ports has been somewhat checked by the heavy gales which prevailed in the early part of the week, but this in all probability will be of short duration, and it is generally believed that a permanent increase in the demand may now be looked forward to. The house coal trade is not characterised with any degree of vitality, the shipments coastwise being about the average.

The arrangements in progress for placing the affairs of the Denbigh, Ruthin, and Corwen Railway on a more satisfactory footing are making good progress, and under the honest and able management of Mr. Ashbury and his co-directors there is a probability of the company being shortly extricated from its chief difficulties. The net receipts are now it appears more than sufficient to cover the rent charges and the debentures, so that there is a prospect of the preferences coming in for something by and by. For the ordinary capital there is no hope, at least for many years to come. The opening of the Mold and Denbigh and other lines will, it is expected, bring additio nal traffic on the railway.

The directors of the Cheltenham and Swansea Railway Carriage Works (better known as Shackleford, Ford, and Co.), in their report to be presented to the shareholders at their ordinary meeting, regret that the amount of business obtainable during the continued depression in the carriage and wagon building trade being quite inadequate to meet the expenses of two large establishments, there has been a loss on the workings for the year, and that, in consequence, they will at the meeting have to recommend the shareholders to forthwith close either the Cheltenham or the Swansea Works, with a view to the disposal thereof. The directors account for the loss by a want of orders for new work during the first six months, and during the second six months there was only sufficient business to keep one of the works partially employed, and even this, unfortunately, had to be executed in the face of several difficulties, prominent amongst which was the petition of Mr. Johnson for winding up the company, which, although dismissed, had had a most damaging effect upon the company.

On Wednesday the half-yearly meeting of the shareholders of the Monmouthshire Railway and Canal Company was held at the company's offices, Newport, Lord Tredegar in the chair. The chairman moved "That the statements of the capital and revenue accounts for the half-year ending June 30th, 1869, as circulated among the proprietors, be passed." Mr. Cartwright proposed amendments to the effect that the dividend, instead of being 4 per cent., as recommended by the directors, should be 4½ per cent., and that £4000 should be transferred to the relaying account instead of £6000. He contended that the half-year's account fully warranted a distribution of 4½ per cent., and the net revenue was sufficient to declare a dividend at the rate of 6 per cent. A division took place, and the amendments were declared to be lost. Mr. Cartwright demanded a poll, the result of which has not yet been made known.

The following are the returns of the trade of the South Wales ports for the month of August and the corresponding month of last year:—

Exports of Steam Coal.

	August, 1869. Tons.	August, 1868. Tons.
Cardiff	206,336	183,892
Newport	30,406	28,913
Swansea	59,405	48,541
Llanelly	10,747	9,275

Shipments Coastwise.

	August, 1869. Tons.	August, 1868. Tons.
Cardiff	73,676	77,559
Newport	72,082	65,170
Swansea	21,911	21,004
Llanelly	16,778	12,563

Cardiff also exported 28,511 tons of iron and 5018 tons of patent fuel; Swansea exported 1567 tons of iron and 8872 tons of patent fuel; and Newport exported 20,009 tons of iron. Of the iron sent from Cardiff, Cronstadt took 5424 tons; New York, 10,337 tons; Mobile, 1550 tons; New Orleans, 1000 tons; Galatz, 1000 tons; Stettin, 1133 tons; Pesco, 519 tons; Vordingborg, 905 tons; Kijoge, 892 tons; Praca, 519 tons; and the remainder was principally bars sent to the continental markets. Of the iron sent from Newport, Cronstadt took 6793 tons; New York, 3126 tons; Quebec, 1264 tons; Alicante, 900 tons; Boston, 1312 tons; Baltimore, 1000 tons; Genoa, 1839 tons; Galatz, 900 tons; Malaga, 875 tons; New Orleans, 1000 tons; Riga, 385 tons; Brest, 61 tons; and Rio de Janeiro, 644 tons. The iron exported from Swansea was all bar, and was sent to Genoa, Messina, Nantes, and Palermo.

NOTES FROM THE NORTHERN AND EASTERN COUNTIES.

(*From our own Correspondent.*)

Launch at Liverpool—Derbyshire coal at Hull—State of trade at Sheffield—North-eastern topics: *Tyne Improvement Commission: Sanitary matters at Hexham: Death of Mr. E. Potter: Crusade against smoke at Gateshead*—The Cleveland iron trade—Glasgow Union Railway—State of trade in South Yorkshire—Coal in Nottinghamshire.

Messrs. Bowdler, Chaffer, and Co., launched on Saturday from their yard at Seacombe an iron sailing vessel of 1100 tons register, built for Messrs. W. J. Myers, Son, and Co., of Liverpool, and intended for the Australian and San Francisco trade. The ship was named the Van Dieman; she is the third vessel built for Messrs. Myers by Messrs. Bowdler and Chaffer during the current year.

A good deal of coal has been sent to Hull from Derbyshire, *vid* New Holland, from which place it is lightered across the water.

The old staple trades of Sheffield fail at present to show any improvement; indeed, if anything, they are more languid than hitherto. An average trade is being done in iron, and the demand for almost all descriptions of railway *matériel* is active. The file trade is languid, but the saw and edge tool trades have experienced an increased demand from Australia and some other colonies.

The revenue of the Tyne Improvement Commission to June 30th this year shows the slight increase of £250 over the revenue for the corresponding six months of 1868. It is proposed to reduce the expenditure on the river improvement works during the next two years to £60,000 per annum. Of this annual sum dredging will alone absorb £40,000, The following official report has been made with regard to the Tyne piers:—"The breach in the sea wall, originally 200ft. at the bottom, and 410ft. at the top of the wall, has been closed from the foundation up to the level of high water, where the gap has been reduced to 55ft., the masonry having been raised from the top of the divers' work 2ft above low water spring tides. In the upper part of the rebuilt work a length of 83ft. of the masonry has been raised from 2½ft. to 20ft. above high water spring tides. For the protection of the rebuilt and uninjured portions of the sea-wall fifteen of the large foreshore blocks, weighing thirty-six tons, have been placed in front of the foot of the wall." A visit has been paid to Hexham by Mr. Hewlett, principal officer of health for the city of Bombay, who has been commissioned by the Duke of Argyle, Secretary of State for India, to inspect several towns in England, and examine their sanitary arrangements and water supply, with the view of applying the best methods of providing Bombay with water, and adapting the most scientific and successful schemes of drainage to that city. Mr. Hewlett inspected Hexham, in company with Mr. Rubb, chairman of the Local Board of Health, and other gentlemen. Hexham was sewered and water supplied some years since under the superintendence of one of Mr. Rawlinson's pupils. The northern coal trade has lost a rather prominent member by the death of Mr. E. Potter. A large number of convictions for non-consumption of smoke took place at the Gateshead police-court on Friday. The Mayor told one of the parties summoned that if he really wished to consume his smoke he had better read the minutes of the Mining Institute of Newcastle for 1858, in which were details of experiments made in that year by Sir W. Armstrong, Mr. J. A. Longridge, and Dr. Richardson, which proved that by the system of Mr. C. W. Williams (which consisted of admitting air in small streams at the fire-door or at the bridge, or at both) it was possible to consume the smoking coal of the northern counties without making any smoke at all; and that the northern coal could be used to greater advantage than the Welsh anthracite coal, for which the Admiralty had shown so decided a preference, to the great injustice of the northern coal. The North-Eastern Railway Company and the Newcastle and Gateshead Railway Company were amongst the parties summoned, but as it was considered that they were doing all in their power to abate the nuisances complained of, the hearing of the cases against them was adjourned for a month. It was stated on behalf of the North-Eastern Railway Company that they had spent over £1000 in trying to abate the nuisance complained of.

The Cleveland iron trade still presents great activity, large quantities of iron having been shipped to the Continent during the last few days. The returns which have been made up for the past month show that the production of pig in the Cleveland group, although very considerable, is still unequal to the demand, the stocks in makers' hands and in the warrant stores at Middlesborough still showing a tendency to decline. There is still a great inquiry for rails, and other branches of the manufactured iron trade show great activity. The local foundries are well off for orders, and the mechanical works are well employed. Shipbuilding prospects are, perhaps, scarcely so good, but at present the shipbuilders are pretty well employed.

A fair business has continued to be done at most of the South Yorkshire ironworks, rails, plates, and sheets being in tolerably good request. The demand for coal has improved considerably of late in South Yorkshire. There has been rather more doing in steam coal to Grimsby, shippers sending off in anticipation of the closing of the Baltic.

A coal seam has been struck at Clifton, near Nottingham, on the estate of the late Sir R. J. Clifton. The seam was struck at a depth of about 70ft.

The screw steamship Essex, recently launched by Messrs. Humphreys and Pearson, of Hull, for Messrs Bailey and Leetham, has made a favourable trial trip. The Essex attained a speed of over eight knots per hour, although she had on board nearly 1000 tons of her first cargo. In the course of a few days she will leave Hull for the Baltic, having been built specially for the St. Petersburg and Baltic trade. By the addition of the Essex, the fleet of screw steamers belonging to Messrs. Bailey and Leetham has been increased to twenty-six vessels of an average registered burthen of about 800 tons. The Essex is 240ft. long, 32ft. beam, 17ft. in depth, and her burthen is 1000 tons, builders' measurement. Her engines are of 120 horse-power.

PRICES CURRENT OF METALS AND OILS

	1869. £	s.	d.	£	s.	d.	1868. £	s.	d.	£	s.	d.
Copper—British—cake and tile per ton	72	10	0	74	0	0	73	0	0	74	0	0
Best selected	75	0	0	76	0	0	74	10	0	76	0	0
Sheet	78	0	0	79	0	0	78	0	0	80	0	0
Bottoms	82	0	0	0	0	0	82	0	0	83	0	0
Australian, per ton	76	0	0	77	0	0	77	0	0	80	0	0
Spanish Cake	71	0	0	72	0	0	0	0	0	0	0	0
Chili Bars	67	10	0	0	0	0	67	0	0	67	10	0
Do. refined ingot	72	0	0	73	0	0	71	0	0	72	0	0
Yellow Metal, per lb.	0	0	6⅝	0	0	7	0	0	6¼	0	0	7¼
Iron, pig in Scotland, ton	2	12	1½ cash				2	13	10 cash			
Bar, Welsh, in London	6	12	6	6	15	0	6	10	0	6	15	0
Wales	6	0	0	6	5	0	5	15	0	6	0	0
Staffordshire	7	5	0	7	7	6	7	5	0	7	7	0
Rail, in Wales	6	2	6	6	5	0	5	15	0	6	0	0
Sheets, single in London	9	5	0	0	0	0	9	5	0	0	0	0
Hoops, first quality	8	5	0	8	7	6	8	5	0	0	0	0
Nailrods	7	5	0	7	10	0	7	7	0	7	10	0
Swedish	9	15	0	10	5	0	9	15	0	10	0	0
Lead, Pig, Foreign, per ton	18	10	0	0	0	0	18	0	0	18	5	0
English, W.B.	20	7	6	20	10	0	21	0	0	21	5	0
Other brands	19	0	0	19	5	0	18	15	0	19	0	0
Sheet, milled	20	0	0	0	0	0	20	0	0	0	0	0
Shot, patent	22	0	0	22	5	0	22	10	0	22	15	0
Red or minium	20	0	0	20	5	0	20	15	0	0	0	0
White, dry	26	0	0	28	0	0	27	0	0	28	0	0
ground in oil	26	0	0	29	0	0	26	0	0	29	0	0
Litharge, W.B.	24	0	0	0	0	0	24	0	0	0	0	0
Quicksilver, per bot.	6	17	0	6	18	0	6	17	0	0	0	0
Spelter, Silesian, per ton	20	10	0	20	12	6	20	0	0	20	2	6
English V & S	20	10	0	20	12	6	20	0	0	0	0	0
Zinc, ditto sheet	25	0	0	0	0	0	25	0	0	25	10	0
Steel, Swedish faggot	0	0	0	0	0	0	0	0	0	0	0	0
Keg	15	0	0	0	0	0	14	15	0	15	0	0
Tin, Banca, per cwt.	6	15	0	6	16	0	4	12	0	0	0	0
Straits, fine—cash	6	11	0	0	0	0	4	12	0	0	0	0
For arrival	6	9	0	6	10	0	4	12	10	0	0	0
English blocks	6	6	0	0	0	0	4	15	0	4	16	0
Bars	6	7	0	0	0	0	4	16	0	4	17	0
Refined, in blocks	6	14	0	0	0	0	4	17	0	4	18	0
Tinplates, per bx of 225 sheets												
IC coke	1	3	0	1	6	0	1	1	6	1	3	6
IX ditto	1	9	0	1	12	0	1	7	6	1	9	6
IC charcoal	1	8	0	1	11	0	1	8	0	1	9	0
IX ditto	1	14	0	1	17	0	1	14	0	1	15	0
Coals, best, per ton	0	18	9	0	19	3	0	18	0	0	18	9
Other sorts	0	15	0	0	16	6	0	15	3	0	17	6
Oils, per tun, Seal, pale	40	0	0	0	0	0	36	0	0	0	0	0
Brown	33	0	0	34	0	0	31	0	0	31	10	0
Sperm, body	90	0	0	92	0	0	88	0	0	89	0	0
Whale, South Sea, pale	39	0	0	0	0	0	37	0	0	36	0	0
Yellow	38	0	0	0	0	0	36	0	0	0	0	0
Brown	34	0	0	35	0	0	33	0	0	34	0	0
E.I. Fish	32	0	0	0	0	0	31	0	0	0	0	0
Olive, Gallipoli	58	0	0	0	0	0	68	0	0	0	0	0
Spanish	55	0	0	56	0	0	64	10	0	66	0	0
Palm	43	0	0	0	0	0	40	0	0	0	0	0
Linseed	31	10	0	0	0	0	31	0	0	0	0	0
Rapeseed, English pale	42	0	0	42	10	0	33	0	0	33	10	0
Brown	39	10	0	0	0	0	31	0	0	31	5	0
Foreign pale	43	10	0	44	0	0	35	0	0	0	0	
Brown	40	0	0	0	0	0	31	10	0	0	0	0
Lard	76	0	0	0	0	0	64	0	0	66	0	0
Tallow	35	0	0	0	0	0	37	0	0	0	0	0
												0

PRICES CURRENT OF TIMBER.

Per load	1869. £	s.	£	s.	1868. £	s.	£	s.
Teak	10	10	11	10	11	0	12	10
Quebec, red pine	12	15	4	15	3	8	4	10
yellow pine	3	5	4	10	2	13	4	0
St. John's N.B., yel	0	0	0	0	0	0	0	0
Quebec, oak, white	5	10	6	0	5	0	5	10
birch	4	5	5	0	4	0	4	15
elm	4	5	5	1	4	0	4	15
Memel	0	0	0	0	0	0	0	0
Dantzic, oak	4	5	6	5	4	0	5	10
fir	2	10	4	0	2	8	3	15
Memel, fir	2	10	3	10	2	15	3	10
Riga	2	15	2	17	3	0	3	3
Swedish	2	5	2	11	2	0	2	10
Masts, Queb. rd. pine	4	0	6	0	4	10	6	0
yl. pine	4	10	6	0	4	10	6	0
rd. pine	0	0	0	0	0	0	0	0
Lathwood, Dantz. fm.	4	10	8	0	6	0	7	0
St. Peter's	5	10	6	11	7	10	8	10
Deals, per C., 12ft. by 3ft. 9in.								
Quebec, wht. spruce	12	0	17	10	13	0	18	10
St John, wht. spruce	12	0	15	0	13	0	15	0

Per load—	1869. £	s.	£	s.	1868. £	s.	£	s.
Yel. pine, per reduced C.								
Canada, 1st quality	18	10	19	10	17	0	18	10
2nd do.	13	0	13	10	11	10	12	10
Archangel, yellow	10	10	13	0	11	0	12	10
St. Petersburg, yel.	11	0	12	0	10	0	12	0
Finland	6	0	6	10	6	10	7	10
Memel	0	0	0	0	12	0	13	0
Gothenburg, yel.	8	0	9	15	8	0	9	10
white	7	10	8	10	8	0	8	0
Gefle, yellow	9	0	10	10	9	10	10	10
Soderhamn	8	10	10	0	9	0	10	10
Christiana, per C. 120ft. by 3 by 9 in. yellow	10	0	12	10	0	0	0	0
Deck plank, 1 in. per 40ft. 3in.	0	0	0	0	0	0	0	0
Staves, per standard M.								
Quebec pipe	70	0	0	0	67	10	0	0
puncheon	18	10	19	0	22	10	0	0
Baltic, crown	100	0	150	0	135	0	150	0
Pipe								