REMARKABLE ENDURANCE OF A COMPOUND ARMOUR PLATE.

The standard of excellence attained by our armour is a most important matter at the present time. We have been recently furnished with the particulars of the Government trial of a compound plate of Wilson's, made at Cammell's, which has manifested such remarkable powers of endurance as to deserve a full record.

The Admiralty conditions of test are the following:—"A test piece not less than 8ft. by 6ft. nor less than 9in. in thickness, shall receive a 9in. chilled cast iron projectile fired from the service 12-ton gun with 50 lb. of powder, at a range of ten yards without cracking through, and, provided it be surrounded by a frame, no one of three such projectiles shall be capable of getting through, there being a fair distance between each two shots, say 2ft., as in the trials of the Inflexible turret armour."

This test is a very severe one; a projectile thus fired has a velocity of about 1420ft. and a striking energy of about 3658 foot-tons, being about a match for $11\frac{5}{8}$in. of unbacked iron. Now the Sub-committee on Plates and Projectiles considered that a good compound plate between 9in. and 10in. was equivalent to a 12in. wrought iron plate for a single blow, but not for repeated blows. The fact, then, of plate—we understand that the plate was taken off and refixed end for end after two rounds, so that in the first two rounds right and bottom become left and top. Penetration, 4·45in., five slight cracks produced on surface.

No. 2 struck 2ft. 1in. from right edge, 2ft. $6\frac{1}{2}$in. from bottom of plate. Penetration, 5·8in.; four additional fine cracks produced on the surface.

No. 3 struck 2ft. 1in. from left edge, 3ft. 2in. from bottom of plate. Penetration, 4·9in.; one additional fine crack produced.

On removing the plate, the back was found bulged slightly in rear of all impacts, but no cracks were found in the back of the plate. No. 1 bulge rose to a height of $\frac{1}{2}$in. over a surface of $19\frac{1}{2}$in. diameter, No. 2 bulge $\frac{7}{8}$in. over 24in., and No. 3 bulge $\frac{1}{2}$in. over 20in. One crack—No. 5—extended $5\frac{1}{2}$in. in from the surface of the plate. The projectiles were all broken up into small pieces.

The plate was considered to have stood excellently, and it was determined to try how it would bear the blows of 10in. projectiles. Consequently the 10in. muzzle-loading Woolwich gun was brought against it, firing a Palliser chilled shot with gas check—weight about 400 lb., velocity about 1364ft., probably giving about 5160 foot-tons energy, or 165·6 foot-tons per inch circumference, equivalent to the penetration of about 13·6in. of unbacked iron. The fol- description, it might become a necessity to increase the proportion of steel in the plate, which would give hardness at the expense of cohesion. At the present time the power to hold together, coupled with a considerable measure of surface hardness, seems to be the best, and these conditions have never been more strikingly exhibited than in this plate.

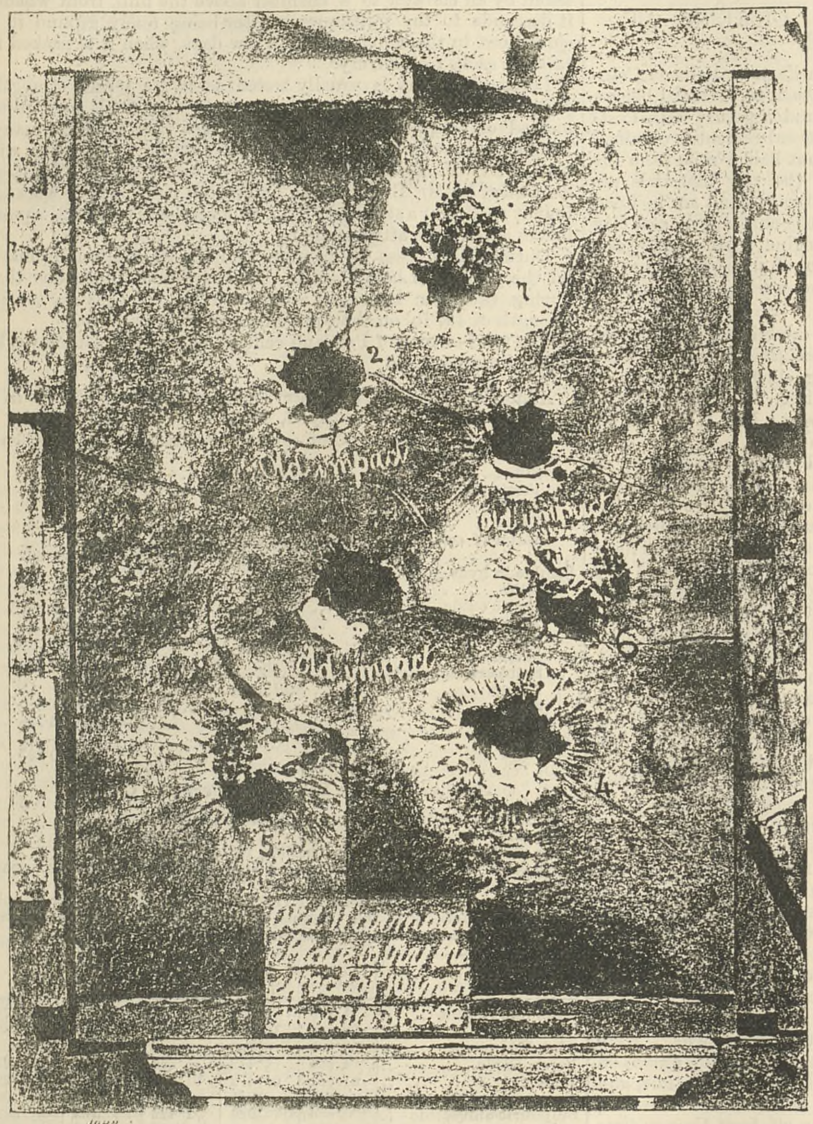


Fig. 1.—FRONT OF COMPOUND ARMOUR PLATE.

Fig. 2.—BACK OF COMPOUND ARMOUR PLATE.

that a compound plate, even considerably over 9in. thick, should bear the above test, is really due to the circumstance that chilled projectiles are employed, which break up against the steel face. The plate could not be expected to stand at all in the same way against a steel shot. That the plate should not exhibit even a crack at the back shows what excellent material compound iron is. Some chilled 9in. projectiles in the competitive trials at Shoeburyness got their heads completely through 12in. of iron. The repeated blows constitute another severe test for a compound plate; and we may feel great confidence in the armour which has endured it—as in the case of our Inflexible turret plates, from which samples were taken.

Figs. 1 and 2, reproduced from photographs, show the front and back of the plate to which we now call attention. It is a test plate from the compound armour for the Collingwood. Its dimensions are 8ft. by 6ft., with a thickness of 11in., the steel face plate being $3\frac{3}{4}$in. thick. The first test was the firing of three rounds from the 9in. 12-ton gun, according to the conditions above detained. It must not be supposed that the rounds thus fired produced the effects, apparently due to them, shown on Fig. 1, such as radial cracks. These are developed by the subsequent rounds. Very trifling effects are apparent after one or two rounds, as would be seen if we gave a complete series of photographs taken. The steel is more affected than appears, undoubtedly; but, nevertheless, its powers of resistance are not greatly injured until the plate begins really to break up. A remarkable paper on the behaviour of steel in plates has recently been contributed by Major O'Callaghan, R.A., Experimental Department, Shoeburyness, which we cannot here take up. Among other things the facts given in this paper go to show that a photograph taken after several rounds had been fired gives a more true picture of the actual state of the plate than would be given of a plate after only one or two rounds had taken effect. The following is the detail of the results of each shot fired, we believe, on gang 6, as reported officially by the captain of H.M.S. Excellent:—

No. 1, 2ft. 6in. from right edge, 4ft. 6in. from bottom lowing were the results obtained by firing on May 30th last:—

No. 4 struck 2ft. from right edge, 2ft. 3in. from bottom of plate. Shot broken up; small head remained in; two cracks in addition to those made by previous test; penetration, 4·4in.

No. 5 struck 1ft. $8\frac{1}{2}$in. from left edge, 2ft. from bottom of plate. Shot broken up; head remained in; four additional cracks produced.

No. 6 struck 1ft. $6\frac{1}{2}$in. from right edge, 3ft. 8in. from bottom of plate. Shot broken up small; head remained in; head of projectile in No. 1 shaken out; two slight superficial cracks.

No. 7 struck 2ft. $6\frac{1}{2}$in. from right edge, 1ft. 4in. from top of plate, and 1ft. 8in. from each of the old impacts. Shot broken up; head remained in; two fine superficial cracks.

On removing the plates the back was found slightly bulged in the rear of all four impacts, but no cracks. In rear of No. 4 to a height of ·4in. over a bulge of 16in. diameter; No. 5 to ·65in. over 24in.; No. 6 to ·75in. over 21in.; and No. 7 to ·75in. over 20in.

Fig. 1 shows the appearance of the plate at the conclusion of this severe trial. In no instance was the plate cracked deeper than the steel face. On the plate being taken down it appeared that the bulges made by the 9in. projectiles in rounds No. 1, 2, and 3 were about $\frac{5}{8}$in. high, while those produced by the 10in. shot were $1\frac{1}{16}$in. The indents made by the 9in. shot were about 4·7in. deep, while those of the 10in. were rather less, being only 4·4in.

Mr. Wilson is specially to be congratulated on the results of this trial, because the plate has shown its powers under continued fire, which is the test which the Sub-committee on Plates considered the most trying one for it.

This may be taken as a sample of the best description of armour we know of to resist artillery fire at the present time. Should the power of projectiles to hold together intact be so much increased as to enable them to carry bursting charges through steel-faced armour of this

VISITS IN THE PROVINCES.

THE FARNLEY IRONWORKS.

Some of the members of the Institution of Mechanical Engineers will no doubt be inclined to visit these well-known works, where iron of a very high character is made from Black Band ore, found chiefly in thin layers in carbonaceous shale, and smelted with coke from an unusually pure coal. This coal is found over a limited area, and the Bowling, Lowmoor, and Farnley Companies are the chief, if not the sole, owners of all the available beds. There is at all events only a small quantity of iron made in Yorkshire which has all the characteristics of that made at these works, and its purity is largely due to the freedom of the coal from iron pyrites and consequently from sulphur. It is known as the Black-bed and Better-bed the latter being the lower. It is exclusively used in the manufacture of the coke employed in smelting. At Farnley it is smelted in blast furnaces 42ft. in height, fed by trucks on a railway arranged by Mr. T. Gillot, the engineer of the works, so that the loaded trains being brought by locomotives to the crest of the incline and there stopped and held by brakes or sprags, need no further locomotive assistance until the completely empty trains are taken away to the mines. From the crest of the incline of the railway leading to the furnace tops there is a slight gradient to the furnaces, so that the furnace attendants have only to separate truck by truck as required for these to run by gravity to the furnaces. From the furnaces the empty trucks run down an incline on the line leading to the mines. The coal used at Farnley would not pay to work alone, but being found in association with a bed of fire-clay, both beds are worked to advantage. The same remark applies with reference to the iron ore, and thus the Farnley Company has a large quantity of fireclay at its disposal. This is used by the company in the manufacture of fire-clay retorts, and high-class plain and ornamental glazed bricks, for which purpose Mr. Gillot arranged a set of plant which is now turning out 30,000 bricks per week. As engineers are aware, the Farnley Works have long been celebrated for boiler-plates of high quality and large sizes, and the flanging of very large plates with holes for furnace flues has been long a speciality. As this flanging is difficult work, especially when four holes are flanged very close together, and thus need good materials and presumably special machinery, some visitors will be surprised to see this work, after the circular holes are cut out by a simple drilling machine, performed by means of a common steam hammer and an upper and lower die and ring. With hydraulic presses and dies arranged to hold the plate with absolute firmness on an annular lower die, this work could probably be effected cold with soft boiler steel if not with high-class iron. The material round one of these flanged holes has, of course, to elongate itself during the process of flanging; a hole bored about 3ft. diameter, say for a 3ft. 6in. flue, having its circumference increased by about 15 per cent. to 20 per cent. This, if performed at a slow speed, would not put a strain on the material greater than its ductile strength, as proved by the numerous tests of boiler steel which have given an extension before rupture of 30 per cent. These tests are made on small pieces it is true, but there is no reason why the same steel should not be called upon to give an extension as above mentioned. Large furnace flues are made in the works with flanged and with plain ends, but the corrugated form of flue has not yet been made there, although at the wish of the proprietors Mr. Gillot has given a little attention to the subject, and has patented machinery for the purpose of performing the corrugation. He does not, however, seem to attach much importance to corrugation, and appeals to some experimental experience he had some years ago in support of his opinions. From a manufacturing point of view, one of the chief difficulties in forming corrugated flues is that which attends the rapidity with which the plates cool during the process, only from three to three and a-half minutes being available for the work.

Siemens' gas furnaces are employed in these works, but all were rebuilt a second time before they could be got to act satisfactorily. In the open-hearth steel furnace employed in these works for the production of steel boiler plates, &c., experiments are being made by Mr. Gillot in the employment of a basic lining, but at present we are not at liberty to publish anything more than the fact. Part of the railway running round the works, and up to the blast furnaces, is laid with steel rails, and here those interested may see how rapidly some steel rails, at least, corrode out in the open air and under fairly constant traffic. Mr. Gillot has not yet accurately tested the loss of weight on one of these rails during a given length of time, but it is apparently enormous, and the presence in the steel of but 3 per cent. of manganese seems to be the only distinctive characteristic with which the phenomena may be connected. Mr. Gillot has every facility for making an experiment on this corrosion, and for this purpose might follow the lines upon which Mallet conducted his experiments on the relative corrosion of iron rails in use and out of use, as described in his report to the British Association in 1850.

The Farnley Works extend over a very large area, not including the coal and ironstone mines, and there is much to interest the visitor. We have only touched upon a few salient points, and now leave them to visit

THE LEEDS FORGE COMPANY'S WORKS.

When we visited these works only four years ago, to witness the experiments carried out to ascertain the strength of Mr. Samson Fox's corrugated furnace flues, the premises covered little more than one-fourth their present area. The works, as shown in the map given in our impression for the 21st July last, are situated on a large piece of land off the Armley-road, which formerly constituted the Armley House estate. Like many other country residences round old Leeds, this has gradually come within the rapidly-growing circle enclosing manufacturing Leeds.

The leading feature in these works is the manufacture of boiler plates, especially of very large sizes, most of which are worked up into plain and corrugated flues, flanged or plain at one or both ends, and into boiler fronts flanged ready for the receipt of furnace flues of marine and other boilers. The place has been specially laid out for this work, and upon it it has grown with amazing rapidity. Hitherto the corrugation has been effected by means of a steam hammer and an upper and lower die, but now a very large corrugating machine, made under Mr. Fox's patent, and referred to in our remarks on Messrs. Tannett, Walker, and Co.'s works, has been completed and fixed, together with a fine pair of compound reversing engines, similar to those with 34in. and 60in. cylinders which will be seen next week at Messrs. Tannett, Walker, and Co.'s works. The corrugating mill has an upper and lower corrugating roll and side supporting rolls, the upper roll being carried as a cantilever on the end of a strong shaft working in a hydraulic cylinder in line with the roll. In working, the upper roll is withdrawn, the heated flue placed between the side rolls, water pressure turned on, upper roll forced into place, and the mill started, arrangements being made for keeping the flues hot by means of gas. These flues are first bent from the plate by ordinary rolls and then welded up. This welding has hitherto been effected by means of the ordinary forge fire, a moving steam hammer made under Mr. Fox's patent, and a beck anvil; but plant has now been fixed for welding by means of a gas furnace, and with a fixed or movable hammer, the flue being placed in a cradle on rails and provided with hand gear by which its position may be rapidly and easily adjusted to the flame and under the hammer. Besides the iron plates made in these works, large quantities of steel plates are used hitherto from Landore. For the purpose, however, of supplying the works with this steel, a complete set of Siemens' steel-producing plant is now being constructed, and the masonry work is being erected at the works. Visitors will also be interested in the arrangement of the heating furnaces recently erected in the works, with a special arrangement of flues and side furnaces, fires being used for this purpose instead of gas, as more easily and completely controllable, one of these furnaces being 13ft. by 11ft. by 7ft.

Besides the works in and near Leeds to which we have now drawn attention as being open for the inspection of the members of the Institution of Mechanical Engineers and their friends next week, there are others of which we should have been glad to make some remarks, but space and time are now both limited, and we can here give only the names of the works. The Hunslet Road Engineering Works, Jack-lane, see map—speciality, tank and other small locomotives for all purposes and gauges; Messrs. Manning, Wardle, and Co., Boyne Engine Works, Jack-lane—speciality, small locomotives and tramway engines; Messrs. Hudswell, Clarke, and Co., Jack-lane, small locomotives and wrought iron pulleys; Messrs. Maclea and March, machine tools, Dewsbury-road, very near Messrs. Hathorn Davey and Co., and Messrs. Buckton and Co.; Messrs. Lawson and Sons, Hope Foundry Mabgate; Messrs. John Fowler and Co., steam ploughs and traction engines; Messrs. Taylor Brothers, Clarence Works, Hunslet; the Kirkstall Forge Company, Kirkstall, where the process of cold rolling of shafting will be seen, and the Kirkstall Abbey may be visited; S. T. Cooper and Co., Leeds Iron-works, Hunslet; Fairbairn, Kennedy, and Naylor, Wellington Foundry, textile machinery (Wednesday only); Joseph Whitham and Son, Perseverance Ironworks, Kirkstall-road; Marshall and Co., Flax Spinning Mills; John Barran and Sons, Wholesale Clothing Manufactory; W. Ingham and Sons, Fire-brick Works, Infirmary-street; J. and J. Flitch and Co., Leather Works; Wilson, Walker, and Co., Leather Works; T. R. Harding and Son, Tower Works, Globe-road, Holbeck; Pollock and Pollock, Longclose Works, Newtown; Scriven and Holdsworth, Leeds Old Foundry, Marsh-lane; Hargreaves and Nussey, Woollen Manufactory, Wortley; and Joshua Tetley and Son, The Brewery, Hunslet-road. Almost all these works will be open on Tuesday and Wednesday only, and not throughout the meeting, as was at first supposed.

Buckton's 11ft. Shearing Machine.—By a typographical error it was stated in our account last week of this fine machine that "there are two overhung wheels about the machine." This should have been "there are no overhung wheels about the machine."

THE MANUFACTURE OF CEMENT AT FOLKESTONE.

In the new harbour works of the South-Eastern Railway Company, now in course of execution at Folkestone, artificial blocks, made of pebbles from the sea beach, bound together with Portland cement, are largely used. The Portland cement is obtained from the Folkestone Cement Works, about half a mile from the harbour; and at the cement works the raw materials are obtained close at hand. The works stand upon an inclined plane; chalk is brought to them from the cliffs above, and clay is wound up to them by a stationary engine from a clay-pit a hundred or two yards from the place of manipulation. A correspondent, who recently visited the works, sends us the following:—

The Folkestone Cement Works were established and carried on for two or three years as a private speculation; in 1873 they were bought up by a company consisting chiefly of residents in the neighbourhood; at the present time Mr. John Minter, solicitor, is the chairman of the company; Mr. J. B. Judge, secretary; and Mr. Charles Spackman, manager.

The materials for the manufacture of Portland cement vary in different districts. On the Thames, white chalk and alluvial mud found in the marshes adjoining the Medway are used; on the Medway, grey chalk and the same mud; in the Lias districts, the limestone shales and clays of the deposits furnish the most suitable materials. At Folkestone grey chalk and the gault clay which underlies the grey chalk, as already stated, are the raw materials.

At Folkestone the different beds of both substances vary considerably in composition. When free from water the chalk contains from 84 to 95 per cent. of carbonate of lime, the rest being clay; and the clay, in a dry condition, contains from 10 to 30 per cent. of carbonate of lime. The chalk upon an average contains 20 per cent. of water, the clay 25 per cent. The first object to be attained is to reduce these substances to a fine state of division, and at the same time intimately mix them together in such proportions that when deprived of water the mixture shall contain from 75 to 76 per cent. of carbonate of lime. This is done by what is known as the wet process. The raw materials are fed in measured proportions into a wash-mill, which is a circular trough in which a number of harrows revolve, driven by a steam engine of 14-horse power. A stream of water is constantly flowing in, and the action of the harrows, aided by the attrition of the particles against each other, reduces the whole to the state of "slurry" or slip, which contains from 60 to 70 per cent. of water; in this state it flows into the settling tanks or "backs," each of which contains sufficient slurry to make 800 tons of cement. Here it is allowed to subside, the supernatant water being drawn off from time to time. One settling tank is filled at a time, and then left for six or seven weeks for the solid matter to settle, the surface water meanwhile being drawn off from time to time by a small sluice. The bottoms of the tanks are of the natural porous earth of the locality, and help a little to drain off the water by absorption.

To return to the wash-mill. No coarse particles of chalk must be allowed to pass into the backs, as their presence would endanger the cement. To guard against this the slurry is caused to flow away from the wash-mill through strainers of fine copper wire gauze. Catch-pits are placed between the strainers and the backs to intercept any coarse particles that may have escaped. The process is a continuous one, a stream of water with successive charges of chalk and clay constantly going in, and a stream of slurry continually flowing out. The rate of flow has to be carefully regulated, so as to secure a proper mixture. Some of the beds of clay are easily washed down, while others are most tenacious and difficult to break up. Some of the chalk is soft and is easily washed; other beds, notably that called the "burr chalk"—which is a kind of junction bed between the upper and lower chalk deposits—are harsh and gritty in the breaking up. The mechanical condition of the slurry is continually examined during the process of washing, by washing a small known quantity through a fine sieve, and drying and weighing the residue. The composition of the raw materials being known, their accurate mixture in the required proportion is simply a matter of calculation. To guard, however, against possible error, the percentage of carbonate of lime in the slurry is constantly determined. If the percentage is not correct the proportions are altered, while occasional stirring of the backs ensures a uniform product. Many methods of analysis may be adopted. The lime may be determined directly, but the operation involves much time and tedious work, especially where as in a cement works many determinations have to be made. For all practical purposes a determination of carbonic acid in a dried and gently ignited sample of the slurry is sufficient. From this the percentage of carbonate of lime can be readily calculated. A form of apparatus which will give the required result in from fifteen to twenty minutes, and involves only one weighing, viz., that of the quantity taken for the determination, is that of Dr. Scheibler. The carbonic acid is collected over water, its volume read off, and the weight calculated with the usual corrections for temperature and atmospheric pressure. Another method, which is very accurate, is to absorb the carbonic acid in a U tube filled with potash, pumice, or soda lime, the tube being weighed before and after the operation. There are several forms of apparatus by which carbonic acid is determined as loss, that known as Parnell's being one of the most useful. When sufficiently stiff to be dug out, the slurry, still containing from 40 to 50 per cent. of water, is removed from the backs in wagons to the drying floor. This is heated by the waste gases from a range of coke ovens, in which just sufficient coal is coked to dry sufficient slurry in twenty-hours to load one kiln. The kilns are seven in number, from each of which 18 tons of cement clinker are drawn. The process of burning is an intermittent one. The kiln is charged with alternate layers of coke and dry slurry, lit at the bottom by means of thirty baskets of coke laid upon brushwood faggots. These kilns are subject to great wear-and-tear, which are materially lessened by coating their sides with slurry before each charging. A charge is usually burnt off in thirty-six hours, after which it is allowed one or two days to cool. The charge is then drawn. The fuel and slurry are distributed in the kiln according to the judgment of the burner. At these works one ton of cement is burnt with 20 bushels of coke.

It may be mentioned here that slurry prepared with a somewhat lower percentage of carbonate of lime than that previously mentioned, say from 72 to 73 per cent., would require less fuel to burn it, and the resulting clinker would be more easily ground, but the cement would have a low tensile strength. On the other hand, a higher percentage would largely increase the quantity of fuel required, give a dense hard clinker very difficult to grind, and the cement would be liable to crack and fly when used. The product from the kilns is a hard blue-grey clinker, from which all underburnt portions are carefully picked out. The clinker is crushed by one of Hall's multiple action stonebreakers, taken by an elevator to a chamber above the mill, from whence it descends to the millstones. After being finely ground it is spread out in the warehouse for a few days, when it is packed in casks or sacks for delivery.

Portland cement is usually tested as to its tensile strength, and every English engineer who buys it applies his own tests, instead of adopting one general and fixed rule, as in Germany. At Folkestone the manager tests what strain the cement will bear after being kept for seven days under water. The test demanded by Mr. Brady at the Folkestone new harbour works is that it shall bear a strain of 810 lb. on a sectional area of 2¼ square inches seven days after moulding.

During the process of grinding samples are continually taken for the purpose of being tested. Mr. Spackman informs us that during the year 1881 the average of the tests gave a tensile strength of 497 lb. on the square inch of sectional area.

The total output of Portland cement at the Folkestone works is 120 tons per week.

Analysis of a Sample of Slurry taken from the Backs in April, 1882.

The slurry dried at 100 deg. Cent. contained:—Insoluble in hydrochlori acid:

Silica	14·956	
Ferric oxide	1·943	
Alumina	5·167	
Lime	·173	
Water of combination and organic matter	1·203	
		23·442
Soluble in hydrochloric acid:		
Silica	·230	
Ferric oxide	·493	
Alumina	·230	
Carbonate of lime	75·357	
Magnesia	·201	
Sulphuric anhydride	·057	
Potash	·070	
Soda	·127	
		76·765
		100·207

Analysis of some Samples of Portland Cement.

No. 1. The Folkestone Cement Company's, March, 1880.
,, 2. ,, ,, ,, September, 1881.
,, 3. From a works on the Thames, 1881.
,, 4. A sample which possessed a strength of 500 lb. on the square inch, made from a mixture of blue lias limestones.

No. 5 is especially interesting. The cement was made by Mr. Spackman from refuse from the Channel tunnel boring at the end of 1881, and possessed a high tensile strength.

	1.	2.	3.	4.	5.
Insoluble residue	1·260	2·566	2·894	4·909	1·674
Silica	20·990	18·917	21·307	18·583	23·832
Alumina	8·869	8·763	6·593	7·226	6·058
Ferric oxide	4·998	4·412	5·386	5·108	3·127
Lime	61·351	62·472	61·459	61·040	63·129
Magnesia	·669	·841	·449	1·565	1·206
Sulphuric anhydride	·886	·929	1·422	·763	·398
Potash	·978	1·100	·437	·754	—
Soda	—	—	·429	·271	—
	100·000	100·000	100·376	100·219	99·424

Important Discovery of Iron Ore.—What promises to be a rich and extensive deposit of hematite ore has just been found by the Askam and Mouzell Iron Company on their Mouzell royalty in Furness, the position of the find being close to the new tramway which transports the mineral to the Askam furnaces. Four years ago the Barrow Hematite Steel Company, under the impression that the ore was exhausted, abandoned the Mouzell Mine, and Mr. Clegg, the owner of the royalty, bought up the mine, has sunk four new shafts, and altogether carried it on very successfully.

Technical Education.—In 1873 a scheme was formulated by Messrs. Mather and Platt, of the Salford Ironworks, assisted by Mr. T. Jones, the head draughtsman, for the purpose of enabling their apprentices to study sciences allied to their trade. Instruction was during the first session, which commenced in 1874, given simply in elementary machine drawing. In the second session practical geometry was added, and very soon one of the students passed with honours. Applied mechanics was subsequently added to the list of subjects taught, and some of the apprentices who were examined by the Science and Art Department in that subject passed, during the first session, in the advanced divisions. When the session of 1881-2 commenced classes were formed for the study of steam and the steam engine, mechanical engineering, and building construction; the mechanical engineering class being in connection with the City and Guilds of London Institute, the others being subject to the examinations instituted by the Science and Art Department, South Kensington. It is in contemplation to enlarge the list of subjects by adding mathematics, theoretical mechanics, art geometry and perspective, and the principles involved in the manufacture of iron and steel. Instruction has been given to the apprentices during two evenings in the week in the Queen-street Institute, a building erected by Mr. Mather some years ago for a Kindergarten School. In this way Messrs. Mather and Platt have quietly conferred a great boon on their apprentices, and set a good, easily followed example. As showing that the students at this place do real work, we may mention that at the recent examination under the City and Guilds of London Institute, in mechanical engineering they took a higher place than those from any other single establishment. Honours grade, second class, D. Agnew; ordinary grade, first class, W. Alcock; third prize, £2 and bronze medal, H. J. A. Hermann; fifth prize, bronze medal, A. Hilton, E. H. Roylance, R. H. Unsworth, J. Sharp; second class, C. Beckett, F. G. Dixon, A. Grimshaw, W. H. Mellor, J. C. Sidebottom, L. Whyatt.

RAILWAY MATTERS.

THE *Scientific American* says the fastest regular time known to be made by the passenger trains from Jersey City to Philadelphia, ninety miles, was one hour fifty minutes.

A TRAMWAY has been laid down from Athens to the Piræus, which serves the whole of the city, passing by the Parthenon and the Acropolis. The constructors are M. M. V. Demerbes et Cie, of the Jemappes Rolling Mills, Belgium; and the manager is M. B. Wauthy.

IN view of the meeting of the Institution of Mechanical Engineers, at Leeds, next week, the Midland Railway has issued a special time-table showing the service of express trains between London and the South, Bristol and the West, and Scotland, Carlisle, and Leeds, with information respecting saloon carriages and engaged compartments.

ON Monday evening a heavily-laden tram-car, drawn by a steam engine, toppled over whilst descending a steep gradient on a sharp curve over Ewood Bridge, Blackburn, and nearly thirty men were more or less seriously injured. Twenty were taken to the Blackburn and East Lancashire Infirmary, where one died two hours later. The driver, William Robinson, has the character of being a steady driver.

THE Department of Public Works of the Belgian Government has just issued a map of Belgium, showing the home and international passenger traffic on the State Railways during 1880. The passengers carried are represented by bands, differently coloured according as the traffic was within the country or international, and whether the journey was effected by single or return ticket. A circulation of from 500 to 50,000 passengers is shown by a band half a millimetre thick, the mean thousands of passengers from station to station being added in figures; while arrows show the direction.

A RECENT *Railway Review* says:—"We have to report two terrible accidents this week. Last Saturday on the St. Paul, Minneapolis and Manitoba-road, near Stewart, a construction train of an engine, twenty-two flats and a caboose left the rails on a 10ft. embankment while running at the rate of eighteen miles an hour. The wreck was precipitated into a pond 8ft. deep and thirteen men were killed or drowned, eight were seriously injured and three were fatally injured. Of the forty odd men on the train not one escaped without some injury. The cause of the derailment is unknown."

THE famous antique tunnel of Posilipo has now a rival. On Saturday the perforation of the largest modern tunnel in Europe, as regards breadth and height, was completed, that of the tramway under Posilipo, it being more than 30ft. wide by 36ft. high. Within the year a steam tramway will connect the modern representatives of the ancient cities Neapolis and Putcoli. A broad causeway will accommodate pedestrians. The Naples correspondent of the *Standard* says Syndics of Naples and Puzzoli waiting on opposite sides for the fall of the last partition met, congratulating each other amid enthusiastic acclamations from their respective councillors and others invited.

THE activity which has prevailed among locomotive builders for the last year still continues, and orders for all sorts and sizes of engines for Indian, colonial, and foreign railways as well as for home lines, fill the factories, so that it is now difficult to make contracts for delivery earlier than next spring. The prosperity of this branch of trade is shared by continental makers also; and in America the demand for engines is so great that prices have nearly doubled within the last two years. Railway carriage and wagon builders, though freed from the distressing competition which has prevailed up till a year ago, are not yet fully occupied, and can only command moderate prices.

ACCORDING to "Poor's American Railway Manual" the year 1881 was one of extraordinary activity in railroad affairs. "Within the year 9358 miles of railroad have been built, the greatest number for any one year. The greatest mileage for any previous year was 7379 miles, in 1871. The cost, at 25,000 dols. per mile, of the lines constructed during the year was 233,750,000 dols. In addition, at least 75,000,000 dols. were expended on lines in progress, and 100,000,000 dols., which is at the rate of only 1000 dols. per mile, on old roads, in improving their tracks, in building new stations, and in adding to their equipments. The total amount expended in construction, during the past year, was, in round numbers, 400,000,000 dols. It now seems probable that the mileage to be open in 1882 will equal that of 1881. Up to the 1st of June, 1882, 3677 miles of line were opened, against 1734 for the same period in 1881. The same rate of increase will not be maintained for the remainder of the year, but the aggregate for it of new mileage is not likely to be much short of 10,000 miles.

AT the North Staffordshire Railway Company's half yearly meeting held in Cannon-street a few days ago, Mr. C. M. Campbell, the chairman, remarked that the directors had never before been able to present so good a report. The expenditure on capital account had been only about £6000, of which £2000 had been received from the sale of surplus lands, and there had been an addition of £800 to the working stock of the company, so that £4111 represented the working expenses. The canal traffic receipts for the half year showed a considerable increase. The same remark was made as to the goods traffic, other than mineral, of the railway. The receipts from mineral traffic were £2000 less than in the first half year of last year. The engineer had effected a decrease of £4820 on the maintenance of works, and the chairman affirmed that this had not been done by starving the line. The company had run 50,000 miles more than in the previous six months. Through improvements in their engines they were working with a less consumption of coal than any other line.

AT a recent meeting of the American Master Car Builders' Association the President suggested for discussion: "Is it safe to run a journal under passenger trains after it has been heated sufficiently to burn out the packing and cooled off with water?" Mr. Bissell said: It is usually the case that new cars running out of the shop will run warm if ever. Sometimes it will be so warm as to discolour the paint on the box and spoil it. I think it is very seldom the case that they take those journals out that heat up. The President said: Car-builders, as a rule, pack their boxes very shabbily, and they almost always get hot; but they are very seldom allowed to get hot enough to burn the packing out and to be cooled off with water. I have taken great interest in trying to learn what was the cause of journals breaking off at the shoulder, showing no fracture, while the centre of the axle would show a remarkably good quality of iron. A few days since I was testing some axles, and during the test I put under a few old axles, and at the second blow on one of them the journal flew off into the air I should say 10ft. or 15ft., simply with the jar of weight dropping upon the axle. The axle was tested with a 1600-lb. drop, and, in order to find out the quality of iron in the axle, I concluded to break it, and if my memory serves me, I would drop that 1600-lb. weight 15ft., reversing the axle each time seven times before we broke the axle. Now the journal showed no fracture of any description. It was completely crystallised, and I am very strongly of opinion that that was caused by meeting, in the first place, a cooling off with water under load, and I am so thoroughly satisfied on that point that my instructions are to remove every axle that has been heated sufficiently hot to be cooled off with water. I have seen several instances where the journal dropped off and was found in the box and the car came in safely. In fact one or two of the Pullman cars have come in with the journal lying in the oil-box. While I don't doubt that the axles were of good material, I firmly believe that an axle, after it has been heated sufficiently hot to burn the packing out and cooled off under load, is an unsafe axle; and by microscopic examination of the journals that drop off in that way, you will observe that there is a yoke very often the whole distance round the axle at the shoulder, showing that under load the journal bent as it revolved.

NOTES AND MEMORANDA.

THE total production of zinc in Europe amounted to 203,330 tons in 1880, of which Germany produced 99,405 tons, or nearly half, two-thirds coming from the Upper Silesian districts. After Germany comes Belgium, with 65,010 tons; then England, with 22,000 tons; France, 13,715 tons; and Austria-Hungary, 3200 tous.

THE South Australian Government Artesian Well-boring Company have erected apparatus at Government Gums, and will bore, if necessary, 200ft. for water. Twenty-four thousand pounds' worth of machinery, the *Colonies and India* says, has recently been purchased for the Government in England, the bulk of which is intended for the construction of surface reservoirs and the drainage of swamps in the south-east.

ALTHOUGH beer is said to have been first produced at Pelusium, on the Nile, some 400 years B.C., Egypt is no longer a great beer-producing country, but in the villages a crude kind of barley beer is still produced and consumed. In Alexandria, we believe, says the *Brewers' Guardian*, there was no brewery, but should a similar fate await Cairo, one of the most perfect breweries in the world will be destroyed. This brewery is owned by the Société Genevoise, and is constructed and worked entirely upon the German system. It contains a splendid ice machine by Raoul Pictet and Co., and is capable of producing about 400 barrels of excellent beer per week. We believe there is also a pneumatic malting on Galland's principle attached to the brewery.

A CORRESPONDENT, writing to the *Times* on a journey from the Missouri to the Yellowstone, says:—"Forty miles from the Missouri is Blys Mine, a valuable lignite bed, 7½ft. thick, with 200ft. of soil and clay superimposed, but readily and inexpensively worked by a heading run in almost on a level from the side of the hill; a second ingress has been made to secure ventilation. Shale forms a stout ceiling, which requires little propping. Over the shale are 4ft. of fire-clay, of which no use is yet made. The coal is got out and run down a convenient incline to the railroad cars at a cost of 90c. per ton. It burns brightly without much ash, and its wider distribution must prove an incalculable boon in a region where wood is scarce and dear, and the thermometer for four months frequently falls below zero. One ton yields 7000ft. of gas of 15-candle power. The seam is found to extend for eight miles, probably it reaches much further; it is the same deposit which occurs on the Canadian Pacific road 350 miles north."

TWO inventors in Bohemia have patented a process for enamelling cast iron water pipes, which can be applied to other hollow castings that are made with cores. It consists, the *Building News* says, in simply covering the sand core with the enamel and then pouring in the iron as usual. The heat of the melted iron fuses the enamel, which attaches itself firmly to the iron, and detaches itself so completely from the sand that the enamel is said to be all that can be desired for water pipes and other industrial purposes. In casting sinks, basins, urinals, &c., the enamel can be applied to the sand on that side of the mould which is to form the inside of the basin. The composition of the new enamel is kept a secret, but is said to differ from the old form in the simplicity of its preparation and the extraordinary cheapness of the materials used. In colour this new enamel is grey. It will be useful for gas pipes and soil pipes as well as water pipes, because it will make the pipes absolutely tight by a glassy lining.

A MODIFICATION of the punkah is thus described:—Attached to the frame of the punkah is an endless blind, passing round rollers at the top and bottom. The bottom roller is in a trough, which contains a solution of a caustic alkali. At every swing of this punkah a wheel and ratchet arrangement causes the rollers to revolve, thus drawing the sheet or blind through the solution. The wet sheet swinging to-and-fro takes up from the air the sulphurous and carbonic acid gases, as well as some organic matter. Brought to the test of experiment this plan appears to work successfully. In a small room, 18ft. by 15ft., and only 8ft. high, fifty jets of a gas stove were set burning for an hour, with the windows and doors of the room closed; and to make it still further unfit for animal life, a quarter of an ounce of sulphur was burnt in it. The punkah, charged with caustic soda, was here set to work, and in ten minutes the temperature was reduced from 85 deg. to 70 deg., and the air was made sufficiently fresh and pleasant for twenty persons crowded in the room.

THE whole of the south-western part of Ceylon is covered with tanks, with rice fields under them. They were originally built by the Singalese kings, but have been allowed to get breached, and the water went to waste, and it is only of late years that the Government took the matter up and began repairing them. The system is very good, all the overflow water from one tank running into another; but the people are so lazy that when an Ella is breached they do not take the trouble to repair it. One of these tanks—Kala Balawewa—has a bund seven miles long, with the face all stone-pitched. It is breached now, but if repaired would have a head of water of 24ft. Stones most marvellously carved with images of the god Buddha, elephants, and other animals and reptiles, are found near these tanks and in the jungle, and some of the edges and outlines of the figures are as sharp as if they had been cut yesterday. The life of a public works officer in this part of the country is most unhealthy, and few stand it for more than six months at a time, and the worst of it is that when the fever has once entered a man's system it can never be entirely eradicated.

THE following figures relating to Egypt are from the "Dictionnaire de Villes, Villages, Hameaux, &c., de l'Egypte," a statistical work of repute, by F. Amici-Bey, and published at Cairo. The figures give the area in Feddans—a Feddan is nearly an acre:—

	Total area.	Cultivated.	Population.	Villages.
Kalioubieh, Lower Egypt	193,770	185,677	205,380	511
Ménoufieh ,,	372,303	338,893	484,550	509
Béherah ,,	401,224	398,127	238,390	1424
Gharbieh ,,	1,342,454	812,886	678,979	2804
Dakahlieh ,,	509,817	453,617	531,954	930
Charkeih ,,	519,533	420,512	414,470	1725
Ghizeh, Upper Egypt	207,909	174,446	270,072	241
Beni-Souef ,,	219,085	227,142	140,848	270
Fayoum ,,	293,459	194,009	173,655	316
Minia ,,	431,273	368,614	333,616	473
Assiout ,,	430,046	413,245	461,679	314
Guerga ,,	355,067	320,426	417,869	646
Kena ,,	305,924	273,200	310,257	554
Esna ,,	156,480	133,562	281,593	616
Towns ,,	—	—	569,115	—
Totals	—	4,714,356	5,517,527	11,333

GLASER'S *Annalen fuer Gewerbe und Bauwesen* describes a new system of melting iron, and at the same time incorporating in it scrap wrought iron, &c. The cupola is supplied with blast through two sets of tuyeres, one above the other, there being eighteen in each set. The tuyeres or ports, which have the form of a vertical slot, are directly connected with a circular tuyere belt. The particular feature of the cupola is, that the bottom is a slightly inverted arch which is pierced by two openings, through which both blast—or rather imperfectly consumed gases of combustion—and the fluid iron can flow. Below it is a small chamber in which the iron collects. It is heated by the gases forced down from the cupola above, which are supplied with the necessary air for combustion by a special tuyere leading from the main blast-pipe. This chamber at the same time serves for preheating scrap, &c., which need only be pushed into the bath for dissolving it. Considerable quantities of scrap can be used by directly charging in any ordinary cupola; but it is claimed that in this case there are economy of fuel and a greater facility in making sharp, strong castings, and a purer metal. The best iron for this purpose is said to be inferior pig, like No. 3 Middlesbrough, holding considerable silicon and little manganese. To it from 40 to 50 per cent. of scrap, &c., may be added. The total consumption of fuel is stated to be 10 per cent. of the weight of the product.

MISCELLANEA.

THE opening of the Ghent Exhibition of Ancient and Modern Industrial Art is definitely fixed for 28th August.

AN American Commission recommends irrigation by means of astesian wells as a means of reclaiming the "arid region" east of the Rocky Mountains.

THE Largs Harbour Company have now agreed to rebuild the breastwork of the harbour with whin blocks pointed with cement in preference to concrete.

THE 120-ton shear legs at the East Quay of the Kattendyk basin, Antwerp, have just put two big guns, of 52 tons and 60 tons, on board the steamer O. B. Sulvi.

AT Ramleh good water has been found by means of the Abyssinian tube wells at a depth of 16ft. The water difficulty is thus solved as far as concerns the troops.

THE list of certificates awarded by the examiners of the students of the Crystal Palace School of Engineering will be awarded to-morrow at one p.m. at the school lecture-room, Sir James N. Douglass, C.E., in the chair.

HERR KRUPP, of Essen, has patented a new system of floating battery for defending the coast and mouths of rivers. Its peculiarity is absolute immobility while firing; and a load of ballast below the vessel permits of regulating the water-line to suit the line of fire.

A COPY of the "Indispensable Bicyclist's Hand-book" has reached us. It is by Mr. H. Sturmey, and published at the *Cyclist* office, Coventry, as well as at 152, Fleet-street, London, and elsewhere. It contains information on every detail of bicycles and their use.

ON the recommendation of the Ambassador for the Netherlands and the Executive Committee, the Lord Mayor has appointed Mr. P. L. Simmonds. F.R.C.I., to act as British Commissioner for the Amsterdam Colonial International Exhibition to be held next year.

ON the 3rd inst. a deputation of magistrates and councillors waited upon Mr. E. Melville Richards, late borough surveyor, and presented him with an address handsomely illuminated and engrossed in vellum, expressive of their high appreciation of his past services as their borough surveyor.

AT a meeting of the Town Council on the 8th inst., Mr. Thos. Howard, M. Inst. C.E., announced his intention of resigning shortly his appointment of engineer to the Bristol docks, and Mr. J. W. Girdlestone, Assoc. M. Inst. C.E., was appointed as his successor. Mr. Howard will still be retained as consulting engineer.

IT would, perhaps, be as difficult to make a small pocket-book selection of notes and formulæ to suit all engineers as it would be to make a universal medicine; but the collection, waistcoat-pocket size, of "Tables, Memoranda, and Calculated Results," by F. Smith, published by Messrs. Crosby Lockwood and Co., may be looked upon as a successful attempt to provide for a great many.

THE Select Committee which, on the 3rd inst., passed the Bill authorising the Marquis of Bute to construct a new dock at Cardiff, have also sanctioned another Bill empowering the Alexandra (Newport) Dock Company to extend their works at Newport by the construction of a dock 2200ft. in length and 600ft. in width. The proposed dock, which is within twelve miles of that at Cardiff, will have a water area of twenty-seven acres, and is estimated to cost £389,680.

THE new Act of Parliament on boiler explosions is now in operation, and all users of steam boilers should take knowledge of the fact. The law, as amended, now requires that notice of all explosions in the United Kingdom shall be given within twenty-four hours to the Board of Trade. Primary and formal inquiries are to be made, the latter to take place in open court. A penalty of £20 may be enforced in case default is made in giving notice of an explosion.

IT is a lamentable fact, the *Chemical Review* says, that workmen employed in the lead trade neglect—we might almost say refuse—to avail themselves of the precautions devised for the protection of their health. They will not drink the sulphuric lemonade which is given them to counteract the poison; they lay aside the respirators which would prevent the dust and fumes from being inhaled; and, after all, a certain class of newspapers persist in blaming the employers, and in denouncing modern science for not devising a remedy.

THERE are two schemes for the improvement of the Strand, one of which is to widen the street by taking down the houses on the south side of Holywell-street, and making a new street through Newcastle-street on to Holborn, or by the way of St. Clement's-lane, and in this case the Board of Works, it is expected, will give the land required. The Holywell-street improvement has been too long promised to be imminent. The *City Press* says the Strand on the south side of the new Law Courts and Carey-street on the north side is to be paved with wood without delay.

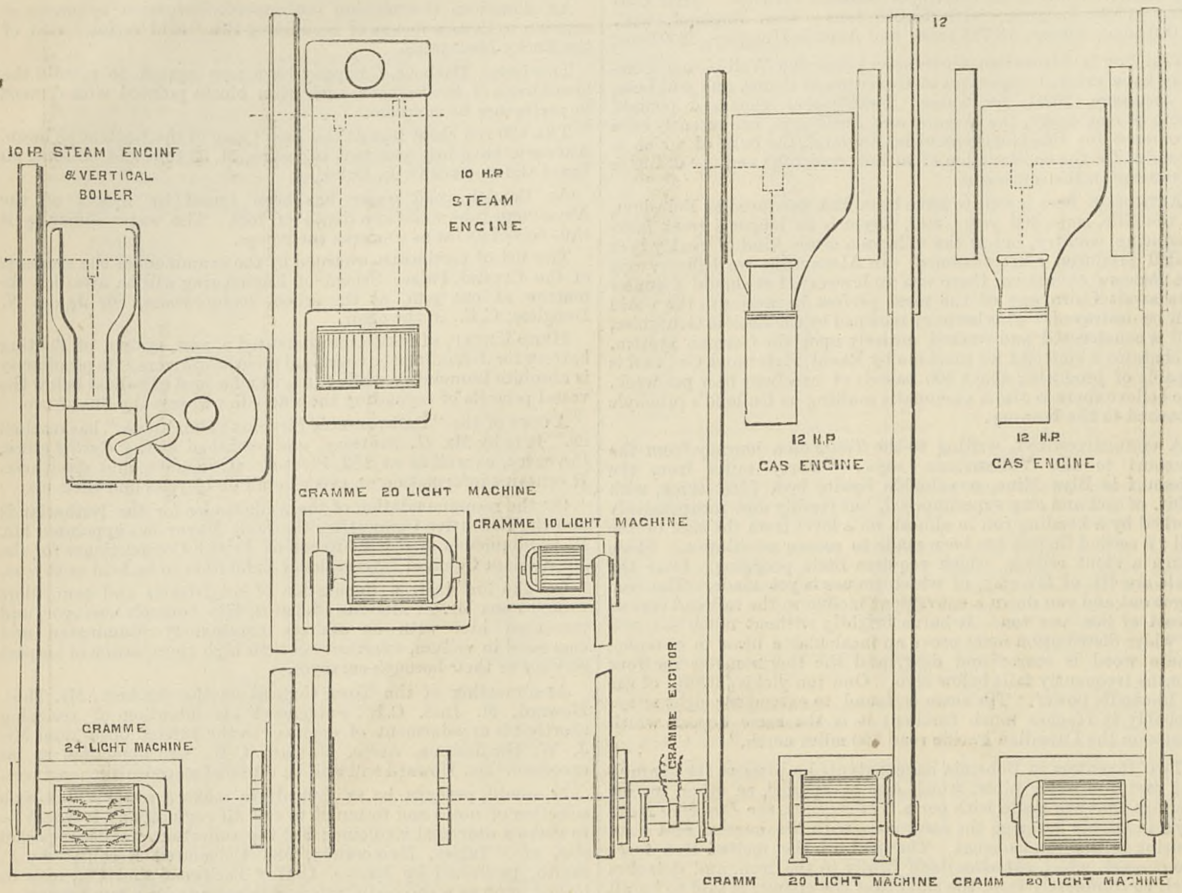
THE journal, *La Ville de Paris*, announces that the negotiations between the Municipality and the *Compagnie Parisienne du Gaz*, have led to a new convention, by which the company will lower the price of gas from 30 to 25 centimes for domestic illumination and to 20 c. when used for motive power, and at the end of a certain period, not yet fixed, they will allow consumers half the profits. In this way the price of gas will fall, before the expiry of the present concession, to 20 c. for lighting and 15 c. for motive power. In return the company's monopoly is to be extended for a further period also not yet fixed.

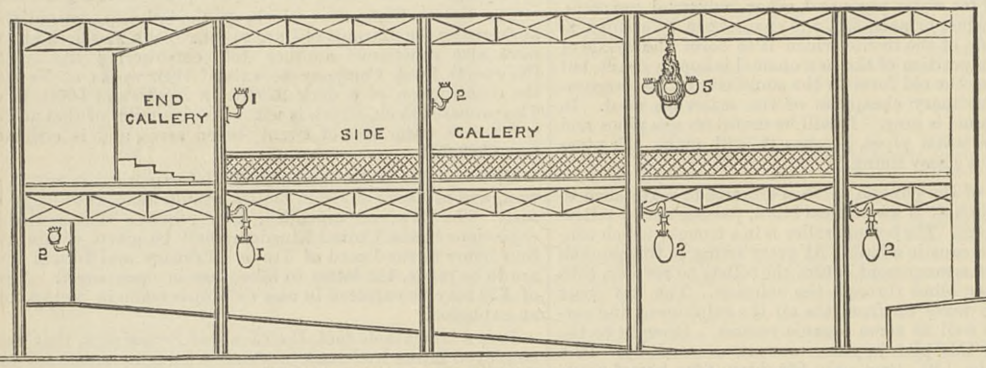
A MEETING of the Mining Institute of the North of France took place on Monday at Sangatte, the site of the Channel Tunnel operations on the French side. The party, numbering nearly two hundred, arrived from Calais and Boulogne. They were lowered down the shaft 267ft. in depth, and first visited the gallery where the Brunton machine was working, but which was removed after driving a distance of five yards. The party then descended to the lower gallery, where the Beaumont machine was shown in operation, cutting at the rate of thirty yards per day. The amount of water hitherto met with has been one-fifth of a gallon for each yard of gallery opened; but this is likely to be diminished now that machinery is substituted for the explosives hitherto used. The pumps keep the water down, working only occasionally.

ACCORDING to Mr. C. Möller's *Steamship Circular*, there has been a good deal of excitement in the steamship business during the past month, caused by the chartering of steamers by the Government for transport service to Egypt. Between thirty and forty ships, mostly of large size, have been engaged up to the present time, at rates varying from 15s. to 27s. 6d. per ton gross, according to their respective qualifications. Although the total tonnage may not exceed 150,000 tons, yet it has imparted a firm tone to the market. Otherwise there has not been any material improvement in freights. Owing to the hostilities with Egypt, and the danger overhanging the Suez Canal, the Indian freights, both out and home, have to a great extent been paralysed; but for September shipment tonnage is in good demand, at fair rates.

THE Paris correspondent of the Liverpool *Journal of Commerce* says the French iron and steel trades continue to be exceedingly busy. Bar iron in Paris, however, is generally selling at 200f., and material for floors at 210f., the recent attempt by leading merchants to secure an advance having failed, in face, apparently, of Belgian competition. Great activity prevails in Belgian centres. An improved tone characterises the market for finished goods in all the hardware branches, fresh orders flowing in from old customers, and raw material is better supported than for some weeks past. English pig has been selling, on an average, at 65f., as compared with 75f. for Belgian foundry pig, grey pig being quoted at 62f. 50c., and mixed at 52f. 50c. The basis price for iron is advancing towards 135f., 130f. being accepted only in the case of large orders. Some firms have even secured contracts at 135f., and others, being well furnished with orders, have asked 140f. Girders and angles are in good demand at 145f. and 150f. Sheets are scarcer. Boiler-plates quoted at 205f. and 210f., and fine sheets at 270f. and 280f.

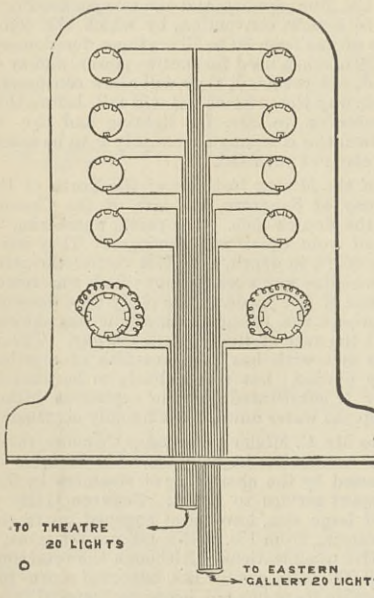
THE JABLOCHKOFF LIGHT AT THE CRYSTAL PALACE.





LONGITUDINAL SECTION OF OPERA THEATRE

Although man is proverbially of a very fickle character, he sometimes clings to his impressions and opinions. With regard to the electric light there are large numbers who gave their allegiance to the Jablochkoff light, and they still continue to look upon it with great favour, thoroughly impressed with its advantages. On the Continent it probably holds its own against all comers, but in England it is less used than some other arc lights. Whatever may be its future, we are quite sure it is not a competitor to be despised. It is admitted that the most costly part of electric light apparatus is to be found in the carbon consumed. Great efforts have been made to cheapen the carbons, and with success; for in the course of about five years the price of the carbons used by Mr. Jablochkoff has been reduced to one-



tenth of what it was when his experiments on a large scale commenced. It is not, however, our intention to describe the Jablochkoff candle over again, but to describe the arrangement adopted at the Crystal Palace during the recent Exhibition, believing that much is always to be learnt from a careful consideration of any complete installation, just as much is to be learnt from an inspection of a well-arranged factory. The leading idea of the exhibitors at the Crystal Palace was to show the adaptability of this light to various purposes—the lighting of stations, of large halls, theatres, rooms, &c. Hence the Low Level Station, the opera theatre, the eastern gallery, passages, &c., were lighted with a sufficient, but not a dazzling, amount of light. The current required for the lamps was obtained from Gramme machines, driven in the case of the station by a 10-horse power engine, by Messrs. Marshall, Sons and Co. This engine, with the two dynamos driven by it, was placed at the end of the long gallery entering the Palace. The lamps in the eastern gallery, twenty in all, were of two kinds—one designed for street purposes, the other for shops, &c. A 12-horse power Otto gas engine, with a 20-lamp Gramme dynamo, was used. Another Gramme driven by a 10-horse power engine, by Messrs. Hindley and Co., supplied the current for the lamps over the iron gates and in the passages adjoining the theatre. while another 12-horse power Otto gas engine driving a Gramme machine was used for lights in the opera theatre. More than one hundred lamps were exhibited. The plan shows the arrangement of engines and dynamos. Below it is a section of the opera theatre with lamps arranged on brackets singly, or in pairs, or in clusters. The small engraving shows the arrangement of wires to the gallery and theatre respectively.

THE LYTTELTON, NEW ZEALAND, GRAVING DOCK.

This dock was undertaken by the Lyttelton Harbour Board to meet the wants of a very rapidly growing trade, amounting at present to about 312,000 tons per annum, and continually increasing with the settlement and cultivation of the Canterbury Plains and the development of the railway system all over the country. The port of Lyttelton was originally a shallow bay in an arm of the sea. This bay has been enclosed by breakwaters and the enclosure dredged out, making a secure harbour of about 113 acres, which will have a depth of 18ft. to 22ft. at low water when the dredging is completed. The entrance to the graving dock is within this port, and the site on which it is built was a high rocky bluff, which has been cut down to cope level, and about six acres of valuable land are reclaimed with the material. The entrance to the dock was fixed just where the rapidly shelving rock gave sufficient depth for the sill. The space beyond high water in front of the dock was enclosed by a cofferdam of main and sheet piles 4ft. apart, and the interval between the piles was filled with mud dredged out of the harbour.

The excavation for the dock was in volcanic tufa in which were many springs, but none were of serious magnitude, although, taken altogether, great quantities of water had to be lifted by 6in. centrifugal pumps. The dock is 450ft. long, 82ft. wide between the copes, 62ft. width of entrance, and 23ft. depth on the sill at high-water spring tide. The floor and lower altars are faced with stone ashlar on a backing of concrete; the upper altars are entirely concrete; the inner and outer sills and return walls at the entrance are also faced with ashlar; the cope, steps, and timber slides are stone backed with concrete. While setting the concrete in the floors and lower altars numerous springs were conducted to a central drain through 3in. tile drains, and the central drain has a 4in. glazed pipe. Over these drains the concrete was laid. In the floor of the dock, near the sill, a rudder well is provided 13ft. deep and 10ft. long; into this all the drains under the foundations are conducted, but the glazed tile drain terminates in about 18ft. of 4in. cast iron pipe, to which a sluice is attached. This stands on a corbel in the corner of the rudder well, and with a key the valve can be closed and the water under the foundation is thus shut in, being about 22ft. pressure of water on the floor. When this sluice is closed the concrete altars are found to sweat slightly, but without any definite leak, the stonework being perfectly watertight. The drainage of the dock is provided by a culvert which branches out into two main wells, and a 12in. iron pipe leads into a leakage well. The wells are about 36ft. below high water, and the water in the rock came into them with considerable force. The risk of placing concrete in such a position was overcome by scoring the rock and placing tile drain pipes in the channels thus formed. The springs were collected into a swamp or pit which was continually pumped until the concrete set, and finally, when everything was finished a small iron pipe was placed in the swamp, and concrete being filled in, the water still found its way through the pipe, which was easily plugged when the work was completed. The wells were lined with 2ft. of concrete and a facing of hard bricks, through which, in spite of the great pressure, no water can find its way. The ledge against which the caisson rests, as well as all the rubbing faces of the sluices to the culverts, are made of hard stone polished, and the sluices are closed by greenheart doors with brass screws for lifting them. There is a sluice on the main pumping culvert, and one on each branch, and a manhole is provided for access to these culverts. The filling culvert is also provided with a sluice of the same kind. The discharge culverts from the pumps are provided with greenheart flaps and a sluice for closing them. Outside the caisson ledge there is a check in the masonry suitable for fitting a temporary dam, and a groove is provided in the entrance of the filling culvert for the same purpose. All this abundance of sluices, flaps, and checks for temporary dams are costly, but they are well worth the cost, as they render every part accessible regardless of any emergency that may occur. One pump may be worked and the other removed, or both pumps may be repaired while the dock is full of water; and thus every contingency is provided for. The discharge and filling culverts are placed on the same side of the dock and close together, so that one man can look after all the sluices, and at the entrance there is a strong wharf built, to which the caisson may be moored, and any ship entering the dock may be handled orsecured.

The dock is emptied by two 5ft. horizontal submerged centrifugal pumps of Messrs. Easton and Anderson's patent, driven directly from the engines by cog wheels and pinions. The leakage is drained by two plunger pumps placed in a well and worked by a small independent engine. The engine beds are blocks of concrete moulded in one piece with the floor, with long holding down bolts bedded in it, to which the bed-plates of the engines are bolted. The type of centrifugal pumps used in this dock combines many advantages over the common form of vertical discs. The fans are easily accessible, and may be removed at any time without disturbing the machinery; they do not require to be charged, and they can lift any reasonable weight without a supplemental lift, and require no foot valve or air pump to assist in starting them. There is no friction of the water through pipes, as it merely rises in the well when the fans are set spinning and discharges through its outlet culvert.

The dock is closed by a floating ship caisson with bearing surfaces of greenheart. The caisson, when out of use, is moored alongside its wharf or inside the dock. The keel blocks are of best Australian iron, back bolted to the floors of the dock; but the upper pieces are dog-spiked to each other. It is remarkable that shortly before the dock was finished a heavy earthquake occurred which shook down masses of the cliff of the hill above the dock; but neither the concrete, the masonry, nor chimney were disturbed in the slightest degree. The dock was built from the designs of Mr. Charles Napier Bell, M. Inst. C.E., engineer to the Harbour Board, Messrs. Bell and Millar, M.M. Inst. C.E., of London, being the engineers for the caisson, machinery, and pumps, which were made in England. The contract was ably carried out by Messrs. Ware and Jones, who were previously contractors for the Auckland Graving Dock. The total cost was about £79,000, exclusive of the cost of cutting down the bluff from which the reclaimed land was formed. The dock is illustrated on page 101.

UNIVERSAL MACHINE TOOL.

The old adage, "Jack of all trades, master of none," is apt to suggest itself when a machine is put forward to perform all the operations of planing, slotting, boring, turning, milling or shaping, drilling and cutting the threads of screws and teeth of wheels. It is not, however, claimed that the machine we illustrate an page 104 will perform all these various operations so economically as can be done by tools specially designed for their respective purposes. What is advanced is that in a small shop and on board a steamer, where it would be impossible to erect machines adapted to every requirement, this universal machine tool will perform any mechanical work that can reasonably be required of it. It also possesses this additional advantage, that when once the work is faced on one side and securely clamped down on the table, it may be turned, bored, planed, drilled, &c., without its position being shifted, thus ensuring mathematical accuracy.

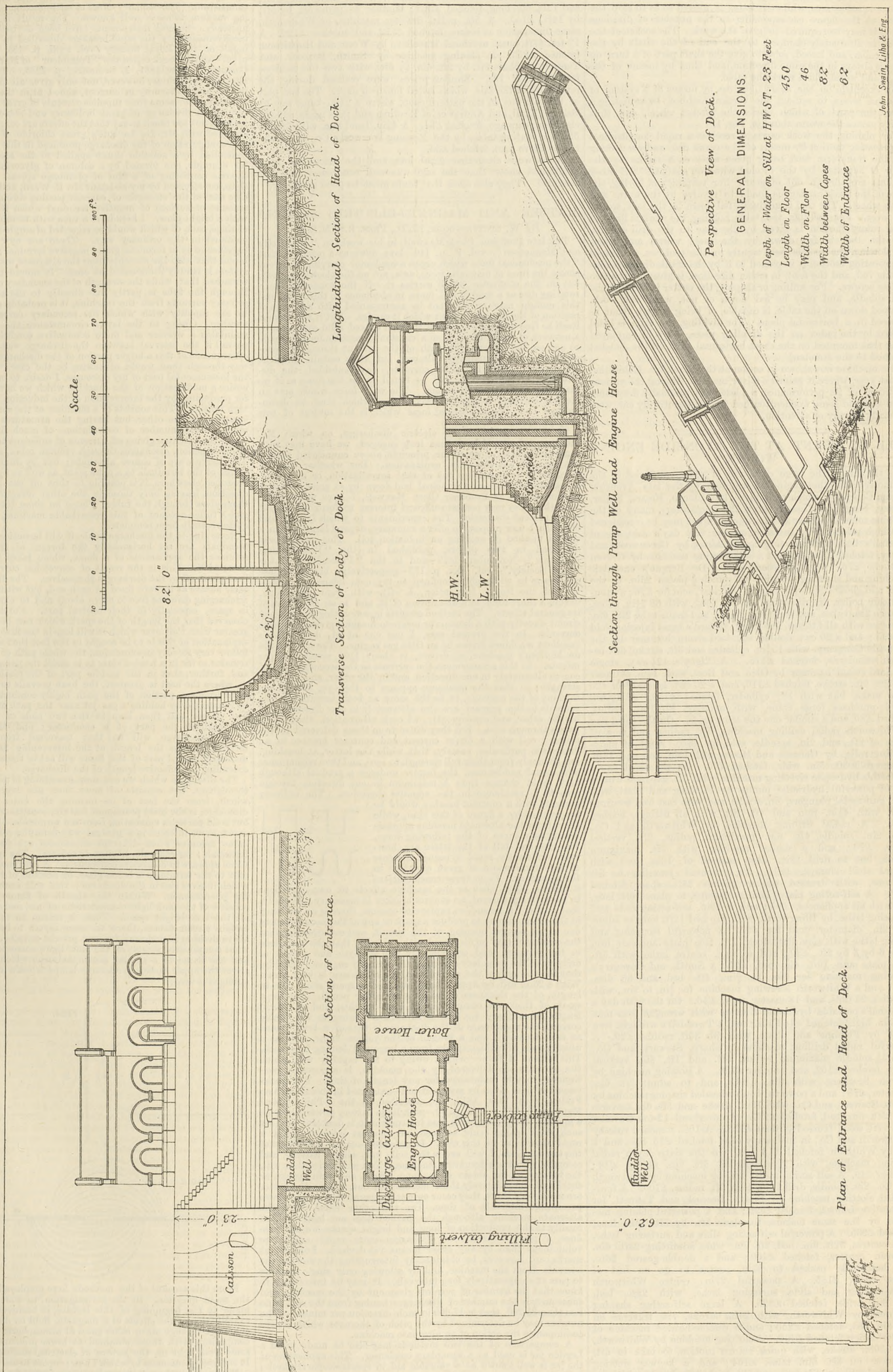
The machine is shown by Figs. 1, 2, 3, and 4, page 104. Motion is communicated from a countershaft by a belt to the cone pulley at the back of the machine; it is then turned into two separate channels, viz., to the tool-holder in the standard, and to the table for holing the work. The motion is transmitted to the former by the pinion A—Fig. 2—fast on the cone pulley shaft, the spur-wheel keyed on to the second shaft B, the spur pinion C, capable of being thrown in and out of gear, the mitre wheels D and E, and the spur-wheels F and G, the cotter of the latter sliding in the groove of the drill spindle, so as to permit the latter to rise and fall. The cone pulley shaft also carries the bevel wheel H, gearing with the pinion J, which through the bevel pinion K communicates motion to the crank disc L, placed between the two portions of the standard. This disc is provided with a radial groove for varying the throw, the connecting-rod M being made in two parts for the same purpose. The latter is jointed to the work carriage, to which it gives a reciprocating motion for planing. The carriage is also made to traverse longitudinally, in either direction, by means of the screw N, which may be worked by hand, or self-acted by the gear to be described further on. The upper part of the carriage is also capable of traversing, like the slide-rest of a lathe, in a direction at right-angles to the former, either automatically or by hand, by means of the screw O, Fig. 1. Furthermore, the table, provided with grooves for clamping the work, is capable of rotating in a horizontal plane by means of the worm-wheel and worm on the shaft P, Fig. 1.

When planing, the two parts of the nut of the longitudinal screw N are separated, so as to be clear of it, by the cam shown at Figs. 6 and 7, worked by a box key; they are brought together by the same means when it is required to traverse the carriage in a longitudinal direction. Motion is given to the screw N by a belt from the horizontal shaft Q—Fig. 1—which, in turn, derives its motion from the cone pulley shaft, by the intervention of the intermediate shaft R—Fig. 1—carried by a bracket on the side of the standard. This shaft Q also serves to communicate the automatic transverse and rotary movements to the table. It carries a mitre pinion, which, by a train of wheels shown, causes the screw O, and the shaft P, carrying the worm, to revolve. The screws N and O and the shaft P carry on their ends, besides the handles, screw brakes for clamping the loose pulley and spur pinions fast against the collars. The other end of the shaft P carries the dividing plate and index, enlarged views of which are given at Figs. 3 and 4. The plate is fast on the fixed bearing of the shaft, and the latter may be clamped fast,

GRAVING DOCK, LYTTELTON HARBOUR, NEW ZEALAND.

MR. C. NAPIER BELL, M. INST. C.E., ENGINEER.

(For description see page 100.)



when occasion requires, by the set screw shown, so as to keep the table perfectly steady. The plate has a circular groove in which a couple of stops, S and T, Fig. 4, may be clamped. The former is set at zero, while the latter is moved so as to stop the index at the figure corresponding to the number of divisions which it may be required to give the work. The socket of the index is alternately clamped to the end of the shaft by the screw collar, and loosed, so as to give the shaft part of a turn on its axis always in the same direction, and thus by means of the worm and worm-wheel work the table.

An excentric on the shaft L serves, by means of a system of rods and levers, to self-act the vertical tool-box by actuating a lever, the pawl of which works the ratchet wheel, and thus slowly moves the worm above it, Fig. 1.

For planing, the work carriage receives a rapid longitudinal reciprocating motion by means of the crank disc and connecting rod, the transverse feed being given after each stroke by the screw O actuated by the ratchet wheel on shaft Q. All other motions are thrown out of gear. For turning and boring, the table of the work carriage is made to revolve by the worm and worm wheel. The tool is gradually fed down by the rack, worm, and lever. For drilling, the table holding the work is fixed, a rapid rotary motion is given by the gear to the drill spindle, and the tool is fed down by the rack, worm, and lever. For slotting, the tool is held tightly in the tool-box. A rapid reciprocating motion is imparted to it by the crank disc and connecting rod, and the feed, in either direction, is given by the two endless screws. For milling or shaping, the cutter is fixed on the drill spindle, and may be fed down or not, while the work, clamped down on the table, is capable of being moved about as required in a horizontal plane. For dividing, the table is hand worked by the index on the dividing plate, the tool employed being that mounted on the short horizontal shaft on the bracket attached to the standard.

The machine was shown in action at the Frankfort Exhibition of last year, where it gained a silver medal. Among the various specimens of its performance, a plate with gradually deepening spiral slot and some wooden toothed wheels, beautifully cut, were especially worthy of attention.

SALE OF PLANT AT THE AVONSIDE ENGINE WORKS.

At the sale of the large collection of plant employed in the locomotive and other engine construction by the late Avonside Engine Company, which took place last month, Messrs. Fuller, Horsey, Sons, and Cassell being the auctioneers, many of the machine tools and other articles fetched what may be considered very high prices. For instance, on the first day's sale, one of Horsfall's bolt and nut forging machines, by Greenwood and Batley, fetched £194 5s., and a bolt forging machine by Craven Brothers £76. On the second day a De Bergue's excentric punching and shearing machine to punch ⅝ plates 26in. in the clear, and shear 10in. wide 18in. in the clear, sold for £76; a tubular steam boiler, 6ft. diameter, 9ft. 6in. long, with 68 2¼in. tubes, thirteen 3in. tubes, and eight 4in. tubes, and main tube 2ft. 6in. diameter with all fittings, including Giffard's brass injector, sold for £95; and a 20 cwt. double standard steam hammer by the Avonside Company, with 15¼in. cylinder and 3ft. stroke, 6ft. between standards, fetched £175. A Rigby's 12½ cwt. single standard steam hammer by Glen and Ross, with 14in. cylinder and 2ft. 6in. stroke, fetched £110, and a 20 cwt. hammer of the same make, but with 18¾ cylinder, fetched £130. A 10-ton double-purchase forge crane, with wrought jib 16ft. radius, fetched £80, and a similar one the same price. On the third day a Whitworth radial drilling machine, 5ft. radius, and vertical range of 2ft., and 2in. spindle, sold for £70. A set of plate-bending rolls, by Garnett and Moore, with 13in. top and 14in. bottom rolls 8ft. 5in. wide, fetched £70. On the third day a Garforth's hydraulic rivetting machine, with 5ft. gap, and with a pair of powerful hydraulic pumps by Fielding and Platt, with 1⅜in. gun-metal plungers, 5in. stroke, and with cast iron accumulator, with 4½in. ram and 4ft. lift, with all fittings, fetched £250. A radial drilling machine, by Whitworth and Co., with 2in. spindle, 4ft. 6in. maximum radius, 2ft. vertical range, £70; and a similar machine, with 5ft. maximum radius, but to drill 12in. deep instead of 10in., and with several drill clumps, £81. An overhead traveller to lift 12 tons, with trussed timber girders 38ft. span, fetched £125. A self-acting plate-planing machine, to plane 16ft. long, and with all appliances, £95; and a 10in. self-acting slide and surfacing lathe, by Illingworth, with gap bed 12ft. long to admit 3ft. 2in. diameter, sold for £47. A powerful surfacing and boring lathe with 45in. headstock, 7ft. face plate and cast iron table 6 by 3 by 2ft., £80; and a 30in. centre lathe with 5ft. face plate and 10ft. 4in. bed, £52; a Smith and Coventry's screwing machine for ⅜in. to ⅞in., 4ft. bed, and 38 dies, £34; and a Whitworth screwing machine for ½in. to 2in., with 136 dies, 26 taps, and 18 master taps, £56. On the fifth day a Tweddell's portable hydraulic rivetter with wrought iron man 2ft. 5in. high, fetched £142 10s.; and a Tweddell's wrought iron crane by Fielding and Platt, with jib 30ft. radius, £29. A powerful radial drilling machine by Sharp, Stewart, and Co., with 3¼ spindle maximum radius, 5ft. and 1ft. 8in. vertical range, fetched £152, and another £160. A slotting machine by Craven Brothers, with 9in. stroke, and to admit 3ft. 6in. diameter, £78; and a powerful double-headed shaping machine by Sharp, Stewart, and Co., with 15in. stroke and 5ft. 6in. traverse and 15ft. 6in. bed, fetched £230. An overhead 12-ton traveller with 47ft. wood trussed girders, £156. A 10ft. standard rule by Whitworth and Co., in mahogany case, fetched £15 10s., and a 9ft. by Whitham fetched £13 10s. On the sixth day a radial drilling machine, with 2⅛in. spindle, 5ft. 6in. radius, £48; another £49. A self-acting radial drilling machine by Whitworth and Co., 2in. spindle, drill 12in. deep, 5ft. radius, £100. A four-headed slotting machine by Smith, Beacock, and Tannett, for locomotive frames, fetched £395; and a powerful planing machine by the same makers, to plane 5ft. by 5ft. 10in. long, fetched £255. A powerful self-acting slide and surfacing lathe, 25in. centres, 32ft. 6in. bed, 2ft. 9in. wide, admitting 23ft. 6in. between centres, fetched £400; and a double-geared 26in. fast headstock, packed to 29in. centre to go on bed of above lathe, £185. A powerful 27in. centre Whitworth screw-cutting and slide surfacing lathe, with 22ft. bed, 2ft. 8in. wide, fetched £325. A large self-acting shaping machine, by Whitworth, with 24in. stroke, 7ft. traverse on 9ft. 8in. bed, fetched £250; and a double-headed machine of similar design fetched £400. A slotting machine by Whitworth, with 30in. stroke, with quick return motion, to take in 6ft. diameter on 3ft. 6in. table, £104; and a keyway slotting machine by Sharp, Stewart, and Co., with two heads with 3in. spindles, and to admit 1ft. 6in. diameter, and heads traverse 3ft. 6in. on bed 12ft. long, £180. On the seventh day a Whitworth wheel-turning lathe, with 8ft. 6in. surface plates and to admit 11ft. 6in. long, and wheels 8ft. diameter, on a 22ft. bed, fetched £405; while a self-acting planing machine by Collier and Co., to plane 11ft. by 10ft. by 18ft., with table 19ft. 4in. by 9ft. 5in. wide, in two parts, on bed 25ft. 6in. long, and 4⅜in. leading screws, tables to be worked separately or together, fetched £730. A similar smaller machine to plane 7ft. 6in. high, 9ft. wide, and 12ft. 6in. long, fetched £305; another to plane 5ft. by 5ft. by 14ft., £155. A 5ft. radial drilling machine, by Whitworth, same dimensions as before, fetched £112, and another £122. A 12-ton 47ft. span overhead traveller, by Wren and Hopkinson, fetched £255. A planing machine by Smith, Beacock, and Tannett, to plane 3ft. by 2ft. 6in. by 6ft., with two tool holders, fetched £147 10s. Similar prices were realised during the remainder of the sale, which lasted fourteen days. The last part of the sale was in the pattern shop, where a 24in. band saw by Barrett, Exall, and Andrewes, of Reading, and thus made at least eighteen years ago, fetched £34. A 42in. band saw, with 5ft. by 3ft. 5in. canting table, by the Reading Ironworks Co., successors to the above firm, fetched £36.

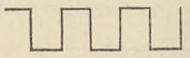
There were altogether 2290 lots, and the prices we have mentioned show that the sale was well conducted and well attended. They also show that trade must be good generally.

MATTER AND MAGNETO-ELECTRIC ACTION.*

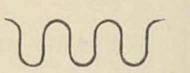
By W. Spottiswoode, LL.D., Pres. R.S. M.R.I.

The late Professor Clerk Maxwell, in his work on "Electricity and Magnetism"—vol. ii. p. 146—lays down as a principle that "the mechanical force which urges a conductor carrying a current across the lines of magnetic force, acts, not on the electric current, but on the conductor which carries it. If the conductor be a rotating disc or a fluid it will move in obedience to this force, and this motion may or may not be accompanied with a change of position of the electric current which it carries. But if the current itself be free to choose any path through a fixed solid conductor or a network of wires, then, when a constant magnetic force is made to act on the system, the path of the current through the conductors is not permanently altered, but after certain transient phenomena, called induction currents, have subsided, the distribution of the current will be found to be the same as if no magnetic force were in action. The only force which acts on electric currents is electromotive force, which must be distinguished from the mechanical force which is the subject of this chapter."

In the investigation on electric discharges, on which Mr. Moulton and myself have been long engaged, we have met with tome phenomena of which the principle above enunciated affords she best, if not the only, explanation. But whether they be regarded as facts arising out of that investigation, or as experimental illustrations of a principal laid down by so great a master of the subject as Professor Clerk Maxwell, I have ventured to hope that they may possess sufficient interest to form the subject of my present discourse. The experiments to which I refer, and of which I now propose to offer a summary, depend largely upon a special method of exciting an induction coil. This method was described in two papers, published in the "Philosophical Magazine"—November, 1879—and in the "Proceedings of the Royal Society,"—vol. xxx. p. 173—respectively; but as its use appears to be still mainly confined to my own laboratory, and to that of the Royal Institution, I will, with your permission, devote a short time to a description of it, and to an exhibition of its general effects. The method consists in connecting the primary circuit directly with a dynamo or magneto-machine giving alternate currents. In the present case, I use one of M. de Meriten's excellent machines driven by an Otto gas engine. The speed of the de Meriten's machine, so driven, is about 1100 revolutions per minute. In this arrangement the currents in the secondary are of course alternately in one direction and in the other, and equal in strength; so that the discharge appears to the eye, during the working of the machine, to be the same at both terminals. The currents in the primary are also alternately in one direction and in the other, and consequently, at each alternation, their value passes through zero. But they differ from those delivered in the primary coil with a direct current and contract breaker in an important particular, namely, that while the latter, at breaking, fall suddenly from their full strength to zero, and then recommence with equal suddenness, the former undergo a gradual although very rapid change from a maximum in one direction through zero to a maximum in the opposite direction. The ordinary currents with a contract breaker would be represented by a figure of this kind,



while those from the alternate machine approximately by a curve of the following form.



The rise and fall of the latter are, however, sufficiently rapid to induce currents of high tension and of great quantity in the secondary. From these considerations it follows, First, that as the machine effects its own variations in the primary current, no contact breaker is necessary; secondly, that as there is no sudden rupture of current, there is no tendency in the extra current to produce a spark or any of the inconveniences due to an abrupt opening of the circuit, and consequently that the condenser may be dispensed with; thirdly, that the variations in the primary, and consequently the strength and period of delivery of the secondary currents, are perfectly regular; fourthly, that the strength of the currents in the secondary is very great. With a 26in. coil by Apps I have obtained a spark about 7in. in length, of the thickness of an ordinary cedar pencil. But for a spark of thickness comparable at least to this, and of 2in. in length, an ordinary 4in. coil is sufficient. Owing to the double current, the appearance of the discharge is that of a bright point at each terminal, and a tongue of the yellow flame, such as is usually seen with thick sparks from a large coil, issuing from each. This torrent of flame—which, owing to the rapidity with which the currents are delivered by the machine, is apparently continuous—may be maintained for any length of time. The sparks resemble those given by my great coil—exhibited in this theatre on Friday, April 13th, 1877, and described in the "Philosophical Magazine," 1877, vol. iii. p. 30—with large battery power and with a mercury break; but with that instrument it is doubtful whether such thick sparks could be produced at short intervals, or in a rapid shower, as in this case. In order to contrast the effects of the two methods, I will excite the coil, first with a battery, and secondly with the alternating machine. You will notice that with the battery we can obtain either long, bright, and thin sparks, or short and comparatively thick discharges; but, unless the latter are made very short, they occur only at comparatively long and even perceptible intervals of time. On the other hand, with the alternate machine, although the method does not lend itself so readily to the production of long and bright sparks, we can produce a perfect torrent of discharges more rapid and more voluminous than by any other means yet devised. Long bright sparks can, however, be obtained by interrupting the flow of the currents from the machine, and by allowing only single currents to pass at comparatively long intervals. It may be interesting to know that the number of currents given out by the machine, and consequently the number of discharges issuing from the coil, is no less than 35,200, that is 17,600 in each direction per minute. The number may be determined by the pitch of the note which always accompanies the action of an alternate machine.

A comparison of the two methods may also be made when a Leyden jar is used as a secondary condenser. This application of the jar is well known as a valuable aid in spectroscopic research; and the employment of the alternating machine so materially heightens the effects that, judging from some experiments made in the presence of Mr. Lockyer, and from others of a different character in the presence of Professor Dewar, I am led to hope from it a further extension of our knowledge in this direction. In order that you may form, at all events, some rough idea of the nature of such discharges, I venture, at the risk of causing some temporary inconvenience from the noise, to project the spectrum of this spark. I will detain you with only one more instance of comparison. The ordinary effect of an induction coil in illuminating vacuum tubes is well known. The result is usually rather unsteady. Several instruments have been devised to obviate this inconvenience, *e.g.* the rapid breakers described in the "Proceedings" of the Royal Society—vol. xxiii. p. 455, and vol. xxv. p. 547—or the break called the "Trembleur" of Marcel Deprez—see *Comptes Rendus*, 1881, I. Semestre, p. 1283. The use of the alternating machine, however, not only gives all the regularity in period, and uniformity in current, aimed at in these instruments, but also at the same time supplies currents of great strength. The result is a discharge of great brilliancy and steadiness, and it is perhaps not too much to say that the effects are comparable to those obtained with Mr. De La Rue's great chloride of silver battery. The configuration of the discharge produced in this way can also be controlled by a suitable shunt applied to the secondary circuit; for example, one formed by a column of glycerine and water, or the one consisting of a film of plumbago spread upon a slab of slate, constructed by my assistant Mr. P. Ward, and here exhibited. One test of the strength of current passing through a tube is the amount of surface of negative terminal which it will illuminate with a bright glow. I here have a tube with termimals in the form of rings, each of which would be regarded of ample size for currents obtained in the ordinary way. These are now all connected together so as to form one grand negative terminal; and it will be found that with the currents from the alternate machine the whole system is readily illuminated at once. It should perhaps be here remarked that, while the strength of the secondary currents passing through the tube is partly due directly to the strength of the primary currents from the machine, it is probably also in part due to the rapidity with which the secondary currents follow one another. Owing to the latter circumstance the column of gas maintains a warmer and more conductive condition than would prevail if the interval between the discharge was longer; and in consequence of this a larger portion of the discharges can make its way through than would otherwise be the case. Before leaving the instrumental part of my discourse, I desire to bring under your notice a modification of the machine which we have thus far used for producing, by the intervention of the induction coil, currents of high tension. This consists of a machine of the same general construction as the other, but having the armatures wound with a much greater number of convolutions of much finer wire. The result is a machine giving off currents of sufficient tension to effect, by direct action, discharges through vacuum tubes, and even in air. The currents are of course alternate; but by diminishing the size of one of the terminals to a mere point, as well as by other methods described elsewhere, it is possible to shut off the currents in one direction, leaving only those in the other direction to discharge themselves through the tube. I hope on some future occasion to give a fuller account of this remarkable machine, which has only quite recently been completed.

Returning to the discharge in air, it will be noticed that when the terminals are set horizontally the torrent of thick discharges assumes the appearance of a flame, which takes the form of an inverted V. This is the result of convection currents due to the heat given off by the discharges themselves. The discharges are by their nature as it were fixed at each end, but within the limits of discharging distance free to move about and to extend themselves in space, especially in their central part. Further, it may be observed that the length of the spark which can be maintained is greater than that over which it will leap in the first instance. The explanation of this is to be sought in the fact that when the sparks follow very rapidly in succession, the whole path of each discharge remains so far in a heated state as to assist the passage of the next; and, further, that in the middle part of the discharge or apex of Λ, where the heat is greatest, the heat prevails to such an extent as to render a portion of the path highly conductive. This may be illustrated by holding a gas jet near the path of the discharge. The flames will then leap to the two ends of the jet, which will perform the part of a conductor; and the real length of the discharge will be that traversed from terminal to terminal, minus the length of the intervening flame. The permanently heated part of the flame will act in the same manner in extending the effective length of the discharge.

The discharge which we are now examining is not homogeneous throughout, but consists of more than one layer. The flame, which, from the fact of its forming the outer sheath of the discharge, is the most prominent feature, consists mainly of heated but solid particles emanating from the terminals. That this is the case may be inferred in a general way from the colours which the flame assumes when different substances are placed upon the terminals; for example, lithium or sodium. The spectrum of the flame appears to be always continuous. A convenient substance to affix to the terminals is boron glass, on account of the brilliancy to which it gives rise in the discharge; this will enable us to project the phenomenon. Within this sheath of flame, the discharge consists of the pink light characteristic of air, and in the centre of all the true bright spark. There is reason to think that, under certain circumstances, there are more layers to be seen; but the above division is sufficient for our present purpose. In this somewhat complicated structure, the pink light corresponds to the arc, and the flame to a similar accompaniment which is seen playing about the upper carbon in electric lamps when a current of great strength is used.

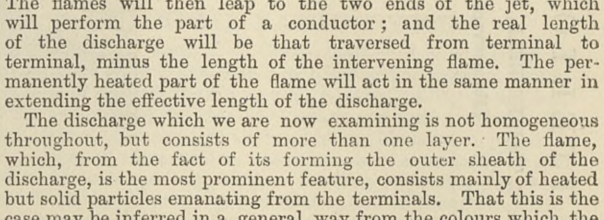
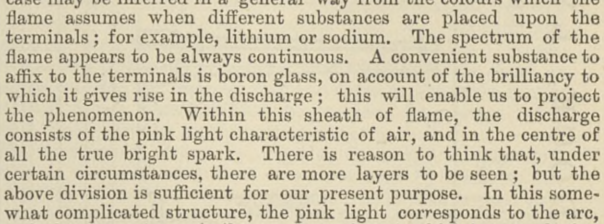


FIG. 1.

FIG. 2



From this account of the methods here employed I now turn to the main question. In the investigation, to which allusion was made at the beginning of this lecture, it occurred to us that an examination of the effects of a magnetic field on discharges of this character through air or other gases at atmospheric pressure, and a comparison with those obtained at lower pressures, might throw some fresh light on the nature of electrical discharges in general. It is these phenomena to which I now propose to ask your attention.

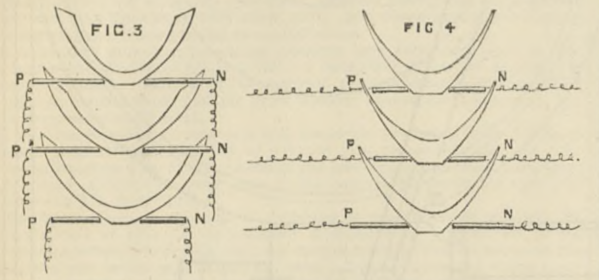
When the discharge, originally in the form of a vertical spindle, is submitted to the action of a magnet whose poles are horizontal, it spreads out into two nearly semicircular discs, one due to the discharges in one direction, and the other to those in the opposite direction. As the magnetism is strengthened, the flame retreats towards the edge of the discs, and ultimately disappears. The disc then consists mainly of the pink discharge; but with a still stronger magnetic field, it is traversed at intervals by bright

* Paper read before the Royal Institution.

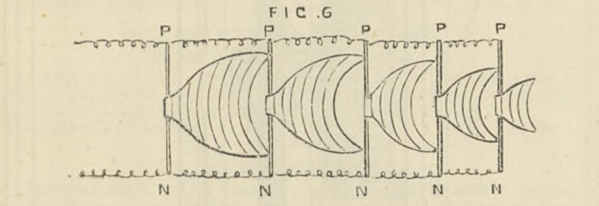
semicircular sparks at various distances from the centre. In every case, bright sparks pass directly between the terminals at the opening of each separate discharge.

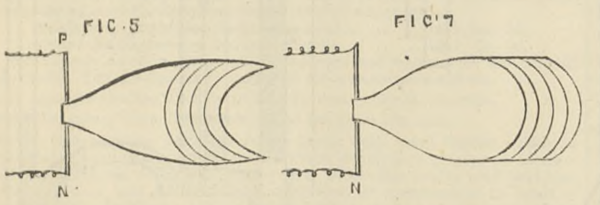
In order further to disentangle the parts of this phenomenon, recourse was had in the original experiments to a revolving mirror. The light in the discs is insufficient to allow of a projection of the effects, but the accompanying diagrams represent the appearances seen in the mirror. Fig. 1 shows the arrangement of the terminals and the magnetic poles; Fig. 2 the appearance of the discharges in a plane at right angles to that of Fig. 1; Fig. 3 the appearance of three successive discharges—in the same direction—with a weak magnetic field and a slowly revolving mirror; Fig. 4 the same, with a slightly more rapid rate of revolution; Fig. 5 a single discharge, with a stronger field and greater speed of mirror; Fig. 6 a single discharge in a strong field, with a still greater speed of mirror. It should be mentioned that in all these figures the images to the left are to be regarded as anterior to those on the right, and that they represent various phases of the left-hand discharge in Fig. 2.

If, however, we observe the right-hand discharges with a mirror revolving in the same direction as before, it is clear that the actual curvature of the discharge will be turned in the opposite direction—with reference to the motion of the mirror—to that in the case of the left-hand discharges. The consequence will be that the appearance in the mirror, when the rate of revolution is not too great, will be something like Fig. 7, instead of Fig. 6. As the speed of the mirror is increased, the convexity will diminish, and ultimately be replaced by a concavity of the same kind, although not so marked as that in the case of the left-hand discharges.



These diagrams show that each coil discharge commences with a bright spark passing directly between the terminals; that this spark is in general followed by the pink light or arc discharge, which passes first in the immediate neighbourhood of the initial spark, and gradually extends like an elastic string in semicircular loops outwards; and that the flame proper is a phenomenon attendant on the close of the entire discharge. It should be added that observations with a mirror revolving on a horizontal axis, and with a horizontal slit in front of the discharge, show that the disc is not simultaneously illuminated throughout, but that it is a locus of a curvilinear discharge which moves outwards and expands in its dimensions from the centre.





The mechanism of the discharge would therefore seem to be as follows: In the first place, as soon as the tension is sufficient, the electricity from the terminals breaks through the intervening air, but with such rapidity that the fracture is like that of glass or other rigid substance. This opens a path, along which, if there remains sufficient electricity of sufficient tension, the discharge will continue to flow. During such continuance the gas becomes heated, and behaves like a conductor carrying a current; and upon this the magnet can act according to known laws. As long as the electricity continues to flow, the heat will at each moment determine the easiest although not the shortest path for its subsequent passage. In this way the gas, which acts at one moment as the conductor of the discharge, and at the next as the path for it, will be carried further and further out until the supply of the electricity from the coil fails, and the whole discharge ceases. We are, in fact, led by these experiments to the conclusion that it is the gas in the act of carrying the current, and not the current moving freely in the gaseous space, upon which the magnet acts.

This explanation of the magnetic displacement of a discharge receives strong support from the phenomena represented in Figs. 5, 6, and 7. The successive bright lines there shown must be due to successive falls and revivals of tension within a single coil discharge. The existence of such alternations in coil discharges of large quantity is otherwise known. When the fall in temperature is such that the conductivity of the gas is insufficient to maintain the arc, the discharge can make its way through the air only by a fresh rent of the same kind as the first fracture. But how can this be reconciled with the fact that the tension can never reach its original degree, and must, on the whole, be gradually falling, and that, in addition, the paths represented by these various sparks are successively longer and longer? The answer to this question is to be found plainly written in the phenomena themselves. Any irregularity in one of these bright lines is always found to be accurately repeated in all of the same series. Now, it is scarcely to be conceived that, at successive instants of time and in different portions of space, irregularities in the discharge itself, and in the distribution of the gas, so precisely the same, would constantly and for certain recur; and we are therefore driven to the conclusion that it is the same portion of gas which at first occupied the centre of the field, with its same yet unhealed rent, which is moved outward under the action of the magnet. If this be so, we have in this repetition of minute details nothing more than what would necessarily follow from successive reopenings of the weak parts of the gas, which would be surely found out by the electricity in its struggle to pass.

The view here taken of the material character of the luminous discharge is further borne out by the fact that the spindle of light is capable of being diverted by a blast of air. When the blast is gentle, the discharge becomes curvilinear, approximately semicircular, and the yellow flame may be seen playing about the outer edge, in the same way as in a weak magnetic field. When the blast is stronger, the sheet of light becomes irregular in form, and it is traversed by a series of bright lines, all of which follow, even in their minute details, the configuration of the sheet. The analogy between this and the phenomena produced in a strong magnetic field needs no further remark. If the strength of the blast be still further increased, the flame and the sheet of light both disappear, and nothing remains but bright sparks passing directly, and undisturbed, between the terminals. In this case the air is both displaced and cooled so rapidly by the blast, that it no longer offers a practicable conductive path for the remainder of the electricity, coming from the coil, to follow. Of this a succession of disruptive sparks is a necessary consequence.

The effect thus produced by a very strong blast is in fact similar to that observed when a jar is used as a secondary condenser. In this case the electricity, instead of flowing gradually from the coil, passes in one or more instantaneous discharges with finite intervals of time between them. Each of these has to break its way through the air; and, that done, it ceases. Hence, neither a magnet nor a blast of air will have any effect in diverting such a discharge. As a last stage of the phenomena it may be mentioned that, if the interval between the terminals be near the limit of striking distance, either a blast of air or the setting up of a magnetic field will alike extinguish the discharge. Our experiments have been thus far carried on in air at atmospheric pressure; but there is nothing in this pressure which is essential to them or to the conclusions to which we have been led. We may therefore repeat them in air, or any other gaseous medium, at any pressure we please. This consideration leads us into the region—so fertile in an experimental point of view—of discharges in vacuum tubes. Commencing with a tube of moderate diameter and of very slight exhaustion, we at once recognise our former phenomena slightly changed. Proceeding to another tube, of larger diameter and of moderate exhaustion, and placing it axially or equatorially in a magnetic field, we see not only that the discharge—or rather the conductor carrying it—is displaced, but also that the displaced part is spread out into a sheet of ribbon, showing that the discharge is affected gradually, exactly in the same way as was found in the open air. When the exhaustion is carried further, the phenomena become rather more complicated. At an early stage there is a distinct separation between the "negative glow" and the rest of the luminous column; and at a more advanced stage the column itself is broken into separate luminosities or striæ. When this is the case, it is usually said that the negative glow follows the lines of magnetic force, while the luminous column distributes itself according to Ampère's law. It will, however, be found that when completely analysed the action of the magnet upon the striæ, taken individually, is the same as that upon the negative glow, due allowance being made for the differences in local circumstances subsisting between the one and the other. We have elsewhere shown that the negative glow is in reality as truly a stria as any other individual member of the luminous column; but with this difference, that it is anchored to, and dependent for its form on, a rigid metallic terminal, whereas each of the others is dependent on the variable form and position of the stria immediately next in order, reckoning from the negative end of the tube. The action of a magnet in throwing the negative glow into a sheet of light, which is the locus of the lines of force passing through the terminal, and which consequently varies with the position of the tube in the field, is a phenomenon so well known that we need repeat only a single experiment by way of reminder. Although it is not altogether so easy to show that the other striæ are directly affected by a magnetic field in the same way as is the anchored stria, we may still satisfy ourselves that it is the fact, from the consideration that when the striæ are well developed and the magnetic field is strong, it is quite possible to form a magnetic arch at any part of the column. In this experiment it will be noticed that for the formation of the arch in mid-column it is necessary that both poles of the magnet should act upon one and the same stria. This, in fact, means that the pole nearest the negative end anchors the stria, and thereby brings it into conditions similar to those of the negative glow. When this is effected the two exhibit similar modifications in the magnetic field. In support of this view we may adduce another and quite independent method of anchoring a stria, and of thereby producing a magnetic arch elsewhere than at the negative terminal. It was noticed by Goldstein and others that if the negative terminal of a tube be enveloped by an insulating surface of any form pierced with a number of holes, or if a diaphragm similarly pierced be placed anywhere in the tube, that the pierced surface will act as a negative terminal. He also found that the finer and closer the holes, the more complete the resemblance to the action of a negative terminal. But even when the substance is metallic, and when the holes are neither very small nor very numerous, a perforated diaphragm will so far act like a negative terminal as to serve as a point of departure of a stria. There is, however, this difference, that the blank space immediately adjoining the diaphragm, as it is usually called, is not generally so large as that at the true terminal; and the striæ thus artificially formed always lie close up to the holes. The diaphragm, in fact, anchors the stria, and renders it susceptible of the same magnetic effect as was shown in the cases studied before. The action of a diaphragm in a magnet field gives rise to many other interesting and remarkable results, some of which would further illustrate the views now submitted for your consideration. But these must be reserved for another occasion.

In the foregoing experiments, and in the remarks which have accompanied them, I have endeavoured to illustrate, by reference to gaseous media, the principle enunciated at the outset, that in the displacement of the discharge in a magnetic field, the subject of the magnetic action is the material substance or medium which conveys the discharge. I have shown also that, even when the discharge takes place in media so attenuated as to produce the phenomena of striæ, the same principle applies not only to the discharge as a whole, but also to each component stria or unit; and, lastly, that the apparent diversity of effect on the various striæ is due to local circumstances, and not to any fundamental difference between the "negative glow" and the members of the "positive column." Seeing now that the magnetic displacement of the luminous discharge means displacement of the matter in a luminous condition, and that a crowding of such luminous matter involves an increase of luminosity, may we not infer with a high degree of probability that the striæ are themselves aggregations of matter, and that the dark spaces between them are comparatively vacuous?

It is true that such a view of the case would seem to imply that, in gaseous media, the better the vacuum the more easily can the electricity pass; and that this might at first sight appear to be at variance with the known fact that the resistance of a tube decreases with the pressure until a minimum, determinate for each kind of gas, and then increases. But it has been suggested by Edlund—"Annales de Chemie et de Physique," 1881, tom. iii. p. 199—that the resistance of a tube may really consist of two parts—first, that due to the passage of the electricity through the gas itself; and, secondly, that due to its passage from the terminals to the gas; and also that the former decreases, while the latter increases, as the pressure is lowered. On this supposition the observed phenomena may be explained without assigning any limit to the facility with which electricity may traverse the most vacuous space. We may even carry the suggestion of a resistance of the second kind a little further, and suppose that there is a resistance due to the passage of electricity from a medium of one density to that of another, or from layer to layer of different degrees of pressure. And from this point of view we may regard the striæ as expressions of resistance due to the varying pressure in different parts of the tube. Into the question, whence this variation of pressure, I am not at present prepared to enter; it must suffice for this evening to have shown that the conclusions which we have drawn from our experiments are not in disaccordance with other known phenomena of the electrical discharge.

LETTERS TO THE EDITOR.

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

THE SEVERN TUNNEL.

SIR,—Having been favoured with a permission to view the works of the Severn tunnel, I send you a few particulars of my visit of last week. The engineer's offices are situated on the Monmouthshire side of the river, and here, after a conversation with the resident engineer, I was shown the extensive machinery, which comprises pumps of great power, a ventilating engine, brick machines, air compressors, and an electric light generator. Numerous cottages have been built for the workmen, a school for their children, and an infirmary in case of sickness or accident. I next descended the shaft, which is about 200ft. deep, and walked a quarter of a mile along an old heading before coming into the main tunnel. A few minutes more and I was at the lowest point of the works, situated under the Shoots, a depression in the bed of the river. This channel is half a mile wide, and about 60ft. deeper than the rest of the estuary. Although at this point there is only 40ft. of rock above the crown of the arch, the amount of water coming through is almost *nil*, and it is a remarkable fact that land springs on the Monmouthshire side have caused far more trouble than any infiltration from the river into the heading beneath. The section under the Shoots was the only part of the work where any great difficulty was felt to exist. As this section is now complete, all doubts as to the practicability of the tunnel have been set at rest. Continuing my exploration, I passed a drill at work, and went through a heading a mile long, at the end of which was a descent of 20ft. into the full-sized excavation. Beyond a splendid sight suddenly presented itself—half a mile of the tunnel finished and brilliantly illuminated with the electric light; the long perspective of the arch and line of lights, extending farther than the eye could reach, had a very fine appearance. This lighting continued to the shaft on the Gloucestershire bank of the river, where I reached the surface, having passed completely under the estuary. The following details may be of interest:—The Severn tunnel Railway commences by a junction with the Bristol and New Passage line at a distance of $2\frac{1}{2}$ miles back from the river. It descends with a gradient of 1 in 100 until under the Shoots, where the tunnel is level for a length of 10 chains. A long gradient of 1 in 90 brings the line above ground, and extends almost to the junction with the South Wales Railway near Portskewet. The tunnel will be $4\frac{1}{2}$ miles long, $2\frac{1}{4}$ miles being under the tidal river. Six shafts will be used in its construction, two on the Gloucester side, and four on the Monmouth side. All the drainage of the tunnel and its approaches will be led by a return culvert from the lowest point to the Sudbrook shaft on the river bank, where permanent pumping machinery is already erected. The Severn tunnel will shorten the journey between London and South Wales by nearly an hour, and no doubt will assist in the development of the magnificent harbour of Milford Haven.

C. G. ETHELSTON.

London, August 7th.

SEWAGE AND AIR.

SIR,—In "A. F.'s" interesting letter on the sewage question, in your impression of the 4th inst., reference is made to the closets "introduced by the late Rev. Mr. Mould" and a certain amount of credit given to him for his invention. My object in writing this is to show that whatever credit is due to the inventor of the dry sewage system should be given to my esteemed friend and client, the late Dr. J. H. Lloyd, of Llangefin, North Wales. Dr. Lloyd's first public papers on the system of dry sewage were read by him before the British Association in Dublin in 1857, and published *in extenso* by you, Sir, in THE ENGINEER of February 26th and March 5th and 12th, 1858, accompanied on the latter date by a leading article favourably commenting on the plan, the said article, by the way, being referred to by Dr. Lloyd in his pamphlets as "the first public recognition of my dry system of sewage." Now Mr. Moule's specification was not published until 1863, nearly six years after the date of Dr. Lloyd's patent and of his paper read before the British Association. Dr. Lloyd was undoubtedly the first to advocate the system of separating the urine from the fæces, and the only difference between the Rev. Mr. Moule and Dr. Lloyd was the filtering medium employed, Dr. Lloyd using the freshly burned ashes from the fire-grate, accompanied occasionally by the admixture of a little fresh lime, while Mr. Moule employed earth for the same purpose. Dr. Lloyd always complained that Mr. Moule was a deliberate imitator and appropriator of the original principle of his plans for purifying towns' sewage by dryness, and as constantly maintained that he had altered them for the worse by substituting earth for ashes and lime, alleging that the former simply buried the sewage, without thoroughly deodorising it. The truth of this is borne out by your correspondent "A. F.," who says he has had to employ sand in lieu of earth. Had he tried the original plan of all, Dr. Lloyd's, and used the screened ashes from his fire-grates, with the addition of a little lime, he would not have had to complain of offensive exhalations, and would, moreover, have had the manure in a drier and more fossilised form. Dr. Lloyd relates how, in one case, for the sake of experiment, he turned out the contents of some pails, consisting of both fæces and urine treated with ashes and lime, loose on the boards of a garret, and left them there for two or three years, and that there was no emanation from the mass whatever—that, in fact, the persons in the house were not even sensible of its presence by any smell or odour, and most were not even aware of its existence. I showed in 1877, at the Sanitary Exhibition here, some closets on Dr. Lloyd's plan, with the pails full of excreta, just as they had been taken from use. In spite of the tumbling and knocking about they would get on the journey from Anglesey hither, there was no offensive smell from them; and one or two of the pans are here yet, still full as sent, and I will undertake to say that not one person out of every hundred that has passed them for the last five years even now knows what they contain.

I have written this in justice to the memory of Dr. Lloyd, who spent much time and money in expounding his views for the benefit of his fellow-creatures, for he certainly never made any profit from them, or expected to do so. In fact, he himself relates how Sir R. J. Griffith, C.E., then chairman of the Board of Works, Ireland, persuaded him to patent his plans, or other parties would appropriate them, when he himself had only intended to publish them as a scientific paper. How this was attempted after all by Mr. Moule and other followers of his is now matter of history.

I do not at all agree with "F. A." that the cost of collection and removal of deposits on the dry system will prove an insurmountable difficulty. A modification of Dr. Lloyd's plan is now being extensively used in a town in Yorkshire, and is giving great satisfaction. The sanitary inspector speaks highly of its advantages, and says there is a clear saving of 35 to 40 per cent. in the cost of emptying these pails over the ash-pit and closet systems. The matter to be removed being also dry and inodorous, may be taken away at any time of the day, and so save the men night work. I feel convinced that this or some similar system of dry sewage arrangement will eventually be generally adopted, and that the days of water flushing are doomed.

G. SEPTIMUS HUGHES.

40, Lingard-street, Manchester, August 8th.

BREWING IN ENGLAND.

SIR,—The vague general statements contained in Messrs. Corcoran, Witt, and Co.'s letter published by you last week do not prove anything.

If we claim more than we are entitled to let it be disproved. We know they—Messrs. Corcoran, Witt, and Co.—are familiar with a correspondence in the *Brewers' Journal* upon the subject of the first users of two-floored malt kilns in Britain. They state now that they made double kilns long previously to ourselves, thereby implying that the said kilns were used for malt. This inference is a flat contradiction to a statement made by Mr. Witt in our office in April last. Until we have undoubted evidence of malt having been successfully dried upon a two-floor kiln in this country previously to that used by Mr. Tasker, manager for Messrs. Tamplin and Son, Brighton, we shall continue to assert that we were the first to do it practically.

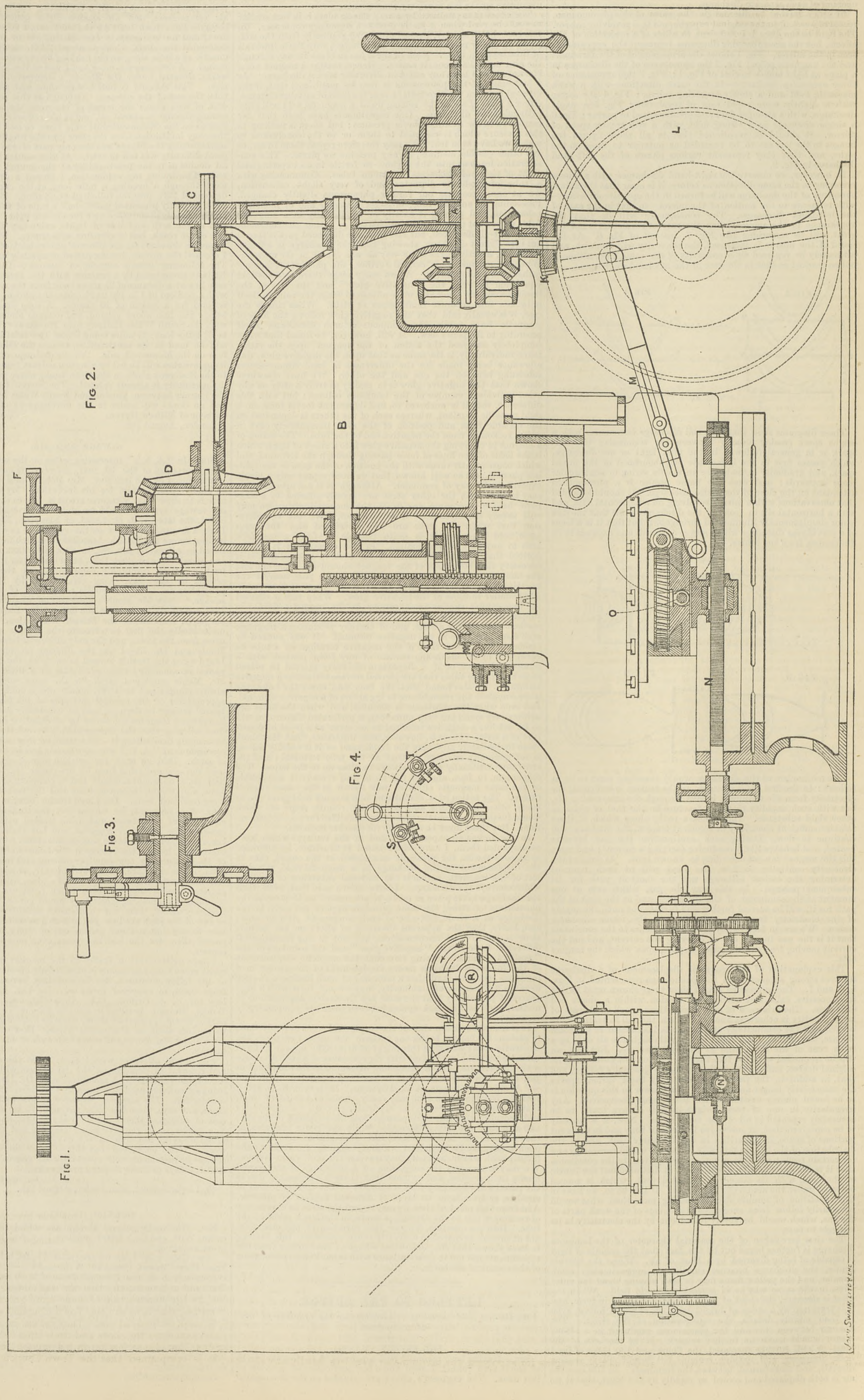
H. STOPES AND CO.

London, August 9th.

UNIVERSAL MACHINE TOOL.

MR. EDOUARD DELAMARE-DEBOUTTEVILLE, ROUEN, ENGINEER.

(*For description see page* 100.)



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

TO CORRESPONDENTS.

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

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

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

W. M. P.—*In most colonies the patent can only be legally obtained by the original inventor or his agent. Consult "The Patentee's Manual," by Johnson, and published by Longmans.*

G. B. L. (Plaistow).—*We can only suggest that the sensitised paper you employed was not accurately prepared. Read the description of the process given in* THE ENGINEER, 19*th April*, 1878. *You may obtain paper already prepared from Waterlow and Sons, and others.*

AN AMERICAN SUBSCRIBER.—*Many attempts have been made both in this country and the United States to make a bisulphide of carbon engine, but without success. The cost of the material, the impossibility of preventing leakage, the foul smell, and the great danger, have defeated inventors, up to the present at all events.*

W. G.—*One pound of furnace coke will evaporate in a good boiler* 9·5 *lb. of water from* 212 *deg., while* 1 *lb. of gas coke may evaporate under the same conditions from* 6 *lb. to* 8 *lb. London gas coke will not do much more than the lower figure, but from some of the country gasworks the coke will evaporate* 8 *lb. from* 212 *deg.*

A READER.—*There is no way of becoming a civil engineer without the expenditure of time in the practical acquisition of information in the branches intended to be followed. By careful study of the best works on the subjects you would wish to take up, these being such as would utilise your present practical experience, and by keeping your eyes open generally, you might prepare yourself to embrace any opportunity which might present itself in a mechanical branch of civil engineering.*

PIN-MAKING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers kindly inform me who are the makers of machinery for the manufacture of pins? M. P. B.
London, August 3rd.

RICE MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Would any of your readers kindly inform me through THE ENGINEER who are the makers of small rice machinery for colonial purposes? R. L. K.
Manchester, August 5th.

FOUNDRY CUPOLAS AND LADLES.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give us the names and addresses of makers of cupolas to melt from 1 to 6 tons metal per hour on the most economical principle; also makers of foundry ladles? J. E. AND Co.
Manchester, August 7th.

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MEETING NEXT WEEK.

INSTITUTION OF MECHANICAL ENGINEERS.—LEEDS MEETING.—In accordance with previous announcements, the summer meeting of the Institution will be held at Leeds, commencing Tuesday, 15th August. The following papers have been offered for reading and discussion:—"On the History of Engineering in Leeds," by Mr. A. H. Meysey-Thompson, of Leeds. "On the Working of Blast Furnaces of Large Size at High Temperatures, with special reference to the Position of the Tuyeres," by Mr. Charles Cochrane, of Stourbridge, Vice-President. "On Mining Machinery," by Mr. Henry Davey, of Leeds. "On a Single-Lever Testing Machine," by Mr. J. Hartley Wicksteed, of Leeds. "On Governing Engines by Regulating the Expansion," by Mr. Wilson Hartnell, of Leeds. "On the Fromentin Automatic Boiler Feeder," by Mr. John Hayes, of London. Cards for the *conversazione* on Wednesday, 16th August, and ladies' cards, may be obtained by members by application to 10, Victoria-chambers, Westminster. Dinner tickets for members and friends can be obtained on application, accompanied by remittance of 25s. per ticket. The following is the outline programme of the meeting:—Monday, August 14th: The Secretary's office will be open from 3 to 7 p.m. at the Reception Room, Town Hall (adjoining the Meeting Room), for the registration of addresses, issue of detailed programmes, cards, &c. The office will also be opened on Tuesday, Wednesday, Thursday, and Friday at 9 a.m., for the same purpose. Members' letters may be addressed to the Institution of Mechanical Engineers, Town Hall, Leeds. Tuesday, August 15th: At 10.30 a.m., reception in the Civil Court, Town Hall, by the Mayor of Leeds, Mr. George Tatham; 10.45 a.m., address of the President, Mr. Percy G. B. Westmacott—the reading and discussion of papers will follow; 1.0 p.m., luncheon in the Victoria Hall, Town Hall, by invitation of the Local Committee; 2.0 p.m., visits to works in Leeds and the neighbourhood—members only admitted, except by special permission of the Local Commitee. Wednesday, August 16th: At 10.30 a.m., general meeting in the Civil Court, Town Hall, for the reading and discussion of papers, Mr. Percy G. B. Westmacott, President, in the chair; 1.0 p.m., luncheon in the Victoria Hall, by invitation of the Local Committee; 2.0 p.m., visits to works in Leeds and the neighbourhood—members only admitted, except by special permission of the Local Committee; 8.30 p.m., *conversazione* in the Philosophical Hall, by invitation of the Local Committee; 9.0 p.m., a lecture will be given by Mr. Thomas R. Crampton, on his "Automatic Hydraulic System for Excavating the Channel Tunnel." Thursday, August 17th: At 10.30 a.m., general meeting in the Civil Court, Town Hall, for the reading and discussion of papers, Mr. Percy G. B. Westmacott, President, in the chair; 1.0 p.m., luncheon in the Victoria Hall, by invitation of the Local Committee; 2.0 p.m., excursion to Bradford in special train, provided free by the kindness of the Midland Company. The Exhibition of Textile Industries will be visited, and also the works of Messrs. Daniel Illingworth and Sons, Messrs. S. C. Lister and Co., Messrs. Thwaites Brothers, and others; at 7.30 p.m., the annual summer dinner of the Institution will be held in the Victoria Hall (evening dress). Friday, August 18th: An excursion will be made to Hull, by special train, provided free by the kindness of the North-Eastern Railway Company. At Hull, visits will be paid to the works of the Hull and Barnsley Railway and Dock Company, by kind invitation of Messrs. Lucas and Aird; also to those of Earle's Shipbuilding and Engineering Company, the Hull Hydraulic Power Company, &c. The members will be entertained at luncheon by Messrs. Lucas and Aird. The return will be made to Leeds by special train, also provided by the North-Eastern Railway Company. Arrangements will be made for enabling members to leave the return train at the various junctions, so as to take ordinary trains going north and south. The principal works in Leeds and the neighbourhood will be thrown open to the members in the course of the week. Some of these we have described, and of the others a list will be found on page 98.

THE ENGINEER.

AUGUST 11, 1882.

THE INSTITUTION OF MECHANICAL ENGINEERS' VISIT TO LEEDS.

THE visit of the Institution of Mechanical Engineers to Leeds, though not very inviting as a summer excursion, will have many attractions from a technical point of view. The town itself contains very little that will interest a visitor in fine hot weather, though its neighbourhood presents some attractive scenery within a few miles radius. From an engineering aspect, however, the visit ought to prove attractive and instructive to engineers, for Leeds has grown by such rapid strides as an engineering town during the past twenty years, that it promises to rival Sheffield in the number of its tall chimneys and its smoky atmosphere. Not that engineers are to be interested in chimneys and smoke, but where these abound in the iron districts they are usually significant of furnaces, engines, machinery, processes, and dodges worth knowing. Leeds is one of the centres of the engineers' tool-making industry, and, as machine tool makers are bound to use tolerably good tools and gradually come to believe in tools, visitors may expect to see plenty of the best, not only in course of construction but in use. Leeds machinists have, moreover, a high appreciation of the value of plenty of tools, and so they use them in very large numbers and for every purpose. Visitors may thus gather some notions on the use of cutting tools in preference to file and chisel, and ample lifting machinery as a means of saving a great deal of time, and avoiding the need for the employment of semi-idle labourers for occasionally moving heavy articles from place to place. The Employers' Liability Act has made it necessary to be more careful in the work of this kind done by men, and hence the dangerous practice of moving fly wheels and large traction engine wheels from place to place by a handful of men is almost discontinued in Leeds, though in several works in the south of England it is still done, and not infrequently at very great risk. There is no doubt that where work has to be performed, and especially lifting and moving work, money invested in machine tools, and lifting and transporting apparatus, is well spent. Only two afternoons are set apart especially for visiting the Leeds engineering works next week, but there is no doubt that as there are no papers which are likely to excite long discussions, and none that are of vital importance, some of the works will be visited at times other than these two afternoons. It is not to be suggested that everything is done in the best way or by the best means in the Leeds shops, and there is no doubt that some engineers will be able to say that in several instances they saw things that suggest the necessity for improvement, rather than show how improvements have been made. As an instance, we may refer to the way in which boiler front plates are flanged for receiving the furnace flues, of which we have spoken elsewhere. There is little doubt that those who have used Piedbœuf's flanging presses will think Leeds has something to learn, and no doubt this is so. Except in a few instances, cutting tools do not seem to be employed on their work at a higher speed than in works less accustomed to experiment on the possibilities in machine tool working, but in a few cases cutters will be seen working at a high speed with a constant stream of water to keep them cool, and nowhere will small drills be seen running at a speed that could be easily counted by the eye, a thing not uncommon in works near London. The small drills, which we mentioned last week as running at twenty thousand revolutions per minute in brass, are, of course, an exceptional case, but this gives an idea of what may be done with tools of this kind, the cutting speed of which does not, after all, reach 200ft. per minute. In Leeds, as elsewhere, there is, as far as the eye can tell in walking through the works, considerable difference in the speeds at which cutters working on similar materials are employed, and there is no doubt that attention to this subject so as to secure the highest practicable speeds might be advantageously bestowed. There is room for a good deal of experiment on this subject, especially as the published information upon it is meagre, and the tables of speeds compiled by Mr. P. Kierayeff, of the Obouchoff steel works, though more complete than any others published, leave a great deal to be desired, and show great and unnecessary diversity. Those who have not recently visited ironworks will notice in several cases that higher class engines are being made for and employed in the manufacture of iron, but the engineer not accustomed to ironworks management and reasons will still think that there is yet much room for a reduction in the heat lost from furnaces, and in the re-heating of blooms and billets. In the last few years much less of the latter is done, but there is yet room for further reduction. The use of hydraulic machinery is rapidly extending in iron and engineering works, and there is no doubt that it will continue to do so, for it is economical and easy of application; while the small engine for supplying the accumulator requires hardly any attention. In some places, moreover, the public water supply may be used, as at Messrs. Hathorn, Davey, and Co.'s works, where the cupola hoist is worked in this way, the water afterwards passing to the boilers; and where the water is pumped on the spot, the waste is, of course, available for the same purposes. In visiting Hull—that is, if the Institution goes there as at first proposed—will be seen a length of about sixty miles of railway, with unusually heavy cuttings and embankments, all in course of progress, and at a rate which far exceeds anything of the kind done in this country before. When the Bill for this line was in committee one of our leading railway engineers said in evidence that the cuttings alone would take six or eight years. Two years have elapsed, and more than half of the work is done, and two and a-half miles of line on an embankment, a great deal of which reaches 35ft. in height, has been completed in six months. About 250,000 cubic yards of material are being moved per month in tunnels and cuttings, some of which latter are 83ft. in depth, most of the work being in chalk, though oolitic beds are reached in one part, and magnesian limestone in another. Beneath the limestone the coal measures have been cut into, and a Beaumont diamond rock-boring machine is at work on Lord Beaumont's property near the line, with the object of testing the measures for coal. Considerable progress is now being made with the Alexandra Dock at Hull. The dock is 2300ft. in length and 1000ft. in width, and though on a slight curve in plan, is roughly rectangular with three jetties, besides the two jetties formed by the sides of the entrance lock, which is within the dock area, and which is 550ft. in length, in two parts, with three gates 85ft. in width, one part being 325ft. and the other 225ft. in length. There are two graving docks in connection with the dock, one being 500ft. and the other 550ft. in length. About 100,000 cubic yards of this dock are being excavated per month. Along one side of the dock next the railway are to be seven large coal hoists.

None of the papers to be read, of which we give the titles in another column, promise to be descriptive of anything strikingly new, nor are they likely to announce any new discovery or departure from known engineering theories or methods. Mr. Meysey-Thompson's paper "On the History of Engineering in Leeds," which is properly first on the list, will be found of considerable interest, and will afford several suggestions respecting the places to be visited, and will help to show that the home of Murray, Priestley, Smeaton, Fairbairn, and Greenwood, all masters in the paths they took, has long been and remains a leading centre of great industrial activity. Mr. Cochrane's paper "On the Working of Blast Furnaces of Large Size at High Temperatures," ought to excite a discussion, and Mr. Wicksteed's paper "On a Single-Lever Testing Machine" will probably elicit some expression of opinion on the use of one heavy weight on one lever instead of a smaller weight with a combination of levers. The lesser inertia of a heavy weight on a short lever as compared with that of a smaller weight on what is practically a long lever will probably be a point in Mr. Wicksteed's paper upon which something may be said in the discussion.

THE FORESHORE AT HASTINGS.

THE fishermen of Hastings are in a state of great dissatisfaction and alarm with regard to the foreshore of that ancient borough. Visitors to Hastings in years gone by have been accustomed to admire the splendid sweep of shingle which lay in front of that part of the town where the fishing interest was chiefly represented. There was a symmetry of line, and a singular gradation of colour, as if every pebble had been arranged with a view to effect. There was a long stripe of the big pebbles—large boulders of a bluish tint, and then a stripe equally long of beachstones somewhat smaller and of a ruddy hue. Thus were the pebbles ranged in curvilinear rows from the verge of the carriage road down to the very sands. There was no lack of beach in those days, and nobody thought there ever would be. Fishing boats and coasting vessels made their ballast of the pebble stones, and the house builders carried off increasing quantities to make concrete for their foundations. Every garden path was gravelled with the finer sort of pebbles, and the country lanes for miles inland were repaired with shingle transported from the shore. This abstraction of the beach took place not only where the fishing boats were accustomed to land, but more or less along the entire sea front of the borough, for a distance of a mile or two westward of the fishermen's landing place. Hastings grew more and more "fashionable," and as the houses and parade walls extended along the shore, so it was found desirable now and then to erect a groyne to protect some particular point where the sea showed a tendency to make itself troublesome. But somehow or other it seemed that things grew worse instead of better. The more the town protected itself with groynes, the more the sea raged against it. Whether matters would have been still worse had no groynes been constructed was a moot question with some parties. As a general rule, everybody seemed to be of opinion that groynes were good, providing these structures were put in the right place. The difficulty consisted in deciding where the right place was to be found. Nobody cared to have a groyne just to windward of his property, and as everybody could not be on the right side of the groyne, so there was a great diversity of opinion as to the proper mode of proceeding.

The controversy to which we allude was greatly intensified by an alarming irruption of the sea which befell the town about seven years ago. The damage was serious, and for the time being the mischief was most severe in what may be called the fashionable part of the sea front. Hence arose a loud demand for protection in those quarters which had suffered most, and this cry was met, as a matter of course, by the construction of some more groynes. But the authorities, that is to say the Town Council, were wise enough to seek skilled advice. They called in Sir John Coode, who examined the shore and drew up a long report, showing the Town Council what in his opinion they ought to do. It is complained that the Town Council failed to carry out the plan of Sir John Coode in its entirety, and proceeded to protect the wealthier part of the town, while leaving the fishing interest to the mercy of the waves. As the groyning went on, so occasionally there were high tides, in which the sea came dashing in at various points with mischievous results, and always with an indication that it was quite possible, with a certain combination of causes, for something very much worse to happen. There was an inexplicable disappearance of shingle, and a consequent increase in the depth of water. Rocks unseen before were laid bare by the denudation of the beach, and the very sands were reduced in their area. It was argued by some intelligent observers that the Town Council had committed a serious blunder by commencing with their new groynes at the extreme west of the sea front, at the outer border of the contiguous township of St. Leonards. Thus, it was alleged, the beach was prevented from having sufficient freedom of access to the entire front. It was contended that the new groynes should have been erected in the first instance at the eastern extremity of the borough, where there was nothing to leeward but a range of cliffs. The terms "windward" and "leeward" are used in our remarks as conveniently expressing the fact that the beach generally travels in one direction along the shore. That is to say, it obeys the impact given to the pebbles by the waves under the influence of the prevailing winds. On the south coast —and very decidedly at Hastings—the shingle travels from west to east, except during brief periods when the winds happen to be easterly. The average direction of the wind is from the south-west, and the general tendency of the waves is to drive the shingle to the eastward. As the Hastings Fish Market occupies the extreme east of the sea front, the formidable array of groynes studding the whole foreshore of the borough to the westward is evidently calculated to deprive the fishermen's quarter of its natural protection.

Be the exact explanation what it may, those who remember the eastern beach of Hastings in its former beauty cannot but be shocked at its present appearance. Its aspect now is hideous—we might almost say ghastly. Instead of the beautiful slope which formerly charmed the eye, there is now a precipitous descent, bristling with stakes and faggots, like *chevaux de frise* intended to keep out some besieging force. Were it not for this rude defence, the sea would attack the solid earth and cut its way into the foundation of the road which runs parallel with the shore. In such a case the adjacent property would be in imminent danger, and could scarcely escape destruction in the event of a high tide, such as occasionally visits this part of the coast. The faggots, we may observe, are by no means secure. Every high tide, though only moderate in its degree of violence, carries away whole masses of the basket work, as it may be termed, and no small expense must be incurred in keeping up this miserable fortification. The Hastings fishermen have lately held a meeting on the subject, and despairing of effectual help from the local authorities, have drawn up a memorial to the Board of Trade, a copy of which has been sent to the Home Secretary. It is also proposed to petition Parliament, and in other ways to bring the subject before the notice of the public. The question is one of more than local importance, seeing that a large supply of fish has been furnished by the Hastings boats in years gone by. The value of this supply is stated to be as much as £50,000 per annum. The boat-owners and fishermen state in their memorial that the strand is in such a condition as to prevent them from pursuing their occupation in a proper manner. Their net and rope houses are being washed away, and their boats have holes stove in them by the faggots and stakes. The secretary to the Fishermen's Society, in addressing the Home Secretary on the subject, says:—"The condition is a lamentable one, and it is hoped that you will think fit to take steps necessary to protect the fishermen, or in the coming winter their dwelling-houses will probably be destroyed, and there will be some lives lost."

There can be no doubt that, not only the fishermen's quarter at Hastings, but a part of the town adjacent to it, are both alike in considerable danger from the sea. The shingle has disappeared to an extent which justifies the most lively apprehension. The crisis may pass without a catastrophe; but, if so, the authorities can thus far claim very little credit. We do not like to impute blame, but it would certainly seem as if the Corporation had begun at the wrong end, giving protection to what we term the windward part of the borough before attempting to guard the leeward part. Time may repair the mischief. The beach shows some signs of creeping along from the western groynes to the eastern; but until the process is complete, the eastern part lies exposed to the fury of any storm that may come. Unfortunately, there are signs of something going wrong which may baffle the best engineering skill. This, however, supposing it to be true, offers no excuse for blundering, or for neglect. If the sea, independently of groynes and building operations, is really threatening a portion of the southern coast, there is the more reason for the exercise of sound judgment in meeting the difficulty. The Hastings Town Council may have erred and made things worse, and if so, it is a serious and grievous matter. But they cannot be charged with causing the sea to encroach outside their western boundaries. As a matter of fact, the sea is running in between Hastings and Bexhill after a fashion which suggests some curious reflections. This is a purely natural action, and has resulted in the destruction of Martello Towers and other landmarks, so as clearly to show that the sea is overleaping its former limits. The phenomenon has been lately referred to in a petition from Earl Delawarr in the Chancery Division of the High Court of Justice. His lordship is described as possessing a life interest in certain land at Bexhill, about three miles to the westward of St. Leonards, on which area he is desirous of building. It is stated that at this place the sea has of late made encroachments, and it is proposed to erect a sea wall and groynes to stay the inroads which thus occur. These works will cost a considerable sum, but evidence is adduced to show that unless the land is thus protected there is danger of its being inundated by the incursions of the sea. Vice-Chancellor Bacon, before whom the petition came, approved of the building and other schemes contained therein, and the project is therefore to be carried out in accordance with the provisions of the Settled Estates Act. But supposing these works to be constructed, there arises the usual "windward" and "leeward" question. Hastings is to leeward of Bexhill, and its supply of beach will be intercepted by the Bexhill groynes. St. Leonards, as being nearer than Hastings to the spot in question, will suffer more. Immediately to the westward of St. Leonards is a marshy flat protected by a "full" of beach, and here there is the greatest possible chance of an irruption of the sea, such as will seriously inconvenience the South Coast Railway and absorb a large area of land.

We might say very much more on this subject, and, unfortunately, it is more easy to point out the peril than it is to specify the remedy. One thing, it seems to us, the Hastings Town Council should have done long ago. They should have restricted, if not absolutely prevented, the removal of shingle from the foreshore. The quantities taken away by builders and others have been enormous. Even if removed solely from the eastward the effect is mischievous. So great is the greed for appropriating the shingle, that even under the restrictive regulations recently adopted, as many as 2200 cartloads have been removed in six weeks. Some further restrictions are now being put in force, and none too soon. Another question is that of erecting a large stone or concrete groyne at the extreme east of the town, as recommended by Sir John Coode. Instead of this powerful bulwark, the fishermen complain that only "a paltry wooden" groyne has been erected, which is "of very little service." Of course when this is put up, if ever it is, there will be mischief done to the eastward of that point. As yet that part of the shore is uninhabited. But the beach is getting very bare, the cliff is falling, and the sea has run in so as to compel the removal of the coastguard station. So the process goes on, and we only hope that Hastings—which in the last seven years has lost some thousands of pounds by the attacks of the sea—will escape the peril which still besets it. The fishermen, as a class, are popular, and it will be a matter for much regret if they should be driven from Hastings by the destruction of their landing place. They may reappear elsewhere, but their banishment, should it occur, will be a source of suffering to themselves, and, we believe, of permanent injury to the town.

THE THEORY OF WELDING.

The operation of welding is one of so much importance in metallurgy, and one around which so much mystery may be said to have accumulated, that any attempt to investigate and explain it on rational principles deserves to be welcomed. To some such attempt we propose now to direct attention. An opinion has lately been gaining ground on the Continent that difficulty in welding is entirely due to the influence of foreign substances, and not to any differences in the condition of the iron itself. Professor Ledebur is the latest exponent of this idea. He tested a number of specimens of rolled iron, both easy and hard to weld, and found that the total percentage of silicon, sulphur, phosphorus, oxygen, manganese, copper, &c., was on the average 70 per cent. higher in the latter than in the former. He also found that the presence of oxygen in chemical combination up to 0·7 per cent. was less injurious than a larger quantity of manganese, silicon, or phosphorus; but that if the oxygen exceeded 1 per cent. welding became impossible. On these experiments he based the theory that all foreign elements, equally with carbon, have an injurious effect upon the welding capacity of iron; and this in two ways—first, by lessening its ductility; and secondly, by lowering the welding point. The first evil prevents the molecules at the surfaces to be welded, from flowing into intimate contact with each other under pressure; the second makes the iron so nearly liquid at the welding heat that it flies to pieces under the hammer.

This interesting theory has been partially adopted—but partially only—by another worker in the same field, Herr Reiser, of the Kapfenberg Ironworks in Styria. While admitting that phosphor and manganese, as well as carbon, have a hardening effect upon iron, and thus lessen its ductility, he points out that Ledebur's specimens were after all wrought iron, not steel; that they were therefore far more ductile, for instance, than ingots from open-hearth steel containing 0·08 to 0·1 per cent. of carbon; and yet such steel is easily welded. The want of ductility cannot therefore play more than a secondary part. With respect to the melting point, this is no doubt lowered by the presence of silicon, of sulphur, and—especially with a high percentage of carbon—of phosphorus. Manganese, however, even in small quantities, raises rather than lowers it; for steel which, on account of a high proportion of silicon, is red-short, may be cured by an admixture of manganese. Chromium and tungsten have a similar effect, so that the elements enumerated by Ledebur do not all act in the same direction. It seems then that other causes for the unfavourable influence of such elements upon iron must be sought for, and these may be found, according to Reiser, in their capacity for oxidisation, their own capacity for welding, and their tendency to crystallisation.

With regard to the first, or oxidisation, it is well known that steel, if heated too long or too highly in the presence of air, becomes weak, and loses its steely properties. This is no doubt due to a partial oxidisation of the material. Some kinds of steel are more easily damaged than others; and it is feared that such steels contain higher proportions of elements, such as chromium and tungsten, which oxidise easily at high temperatures, and thereby lose their hardening properties. Now it is well known that oxidisation of the surfaces is fatal to good welding, and the only advantage derived from the various welding nostrums, such as borax, lies in their rendering fluid, and therefore easy to remove, any scale of oxide which may have accidentally formed. But supposing the surface thus to be cleaned, yet, if there be oxidised elements deeper down in the mass, their tendency will be to cause the oxidisation to spread again to the surface, and hence we see why the presence of easily oxidised elements is injurious to welding. With regard to the second point, the presence of a metal, even in small quantities, which cannot itself be welded, must of course have *pro tanto* a bad effect on the welding of the entire mass. This applies to copper—which can only be welded by special methods—and no doubt also to such brittle and oxidisable metals as manganese, chromium, and tungsten, though direct experiments on these are wanting; nickel and cobalt, on the other hand, are easily welded. With regard to the third point; iron, to weld easily, must be in a plastic and coherent condition; and this is characteristic, not of crystalline, but of amorphous structure. Steel is harder to weld the higher its proportion of carbon; but at the same time it becomes so much the more liable to crystallise, and at lower temperatures. This tendency reaches its maximum in the well-known crystals of spiegeleisen. The effect of crystallisation, according to Reiser, is two-fold. In the first place, the polar forces, whatever they are, which give the form to the crystals, seem to concentrate, as it were, the attraction of the molecules, and prevent them from exercising that attraction freely on other molecules which may come into their neighbourhood, as they do when in the amorphous condition. In the second place, the effect of crystallisation is to bind up in intimate connection with each minute crystal a portion of some foreign substance which melts at a lower temperature than the iron itself; when a welding heat is reached these foreign substances are apt to liquefy, and in so doing to destroy the cohesion throughout the whole mass.

It will be seen that the general conclusion reached by Reiser, equally with Ledebur, is that all foreign substances—except the special fluid silicates, which are known to assist the removal of scale—are an obstacle to welding; and consequently that we may lay down the general principle that the purest iron is the easiest welded. The reasons, however, why these substances exercise a deleterious influence are of high importance, not so much to the theorist as to the practical ironworker, since it is only by knowing the reasons, and knowing them thoroughly, that he can hope to devise means for removing or diminishing the evil effects. Herr Reiser's conclusions are at once practical and scientific, and deserve the attention of all who are interested in the using or making of iron. They add another argument to the conclusion which most engineers will be prepared to endorse, namely, that wherever iron has to be worked, hot or cold, or to be used for any but the most ordinary purposes, it is worth while to spend very great pains in manufacture, in order to reach the highest practical standard of purity. We do not mean by this that it should reach the excellence of Swedish or best Yorkshire, but that it should at least be as good as the best Staffordshire of former days—iron that a blacksmith or an engineer can take up and use as it comes to hand, secure that it will answer well to any fair test that is put upon it. To take only the present instance of welding, the cost of a bad weld that is discovered will many times outweigh a saving even of some pounds per ton in the prime cost of the iron, while the cost of a bad weld that is undiscovered may be almost incalculable, not only in hard cash, but in human life. From this point of view even the carbon of steel must be considered an impurity, since it undoubtedly diminishes, to some extent, the welding ability of the metal. As a matter of fact, however, there is no real difficulty in welding, at any rate, the "mild steel" or "ingot iron" of which we now hear so much. It is true that Dr. Siemens has been charged with committing himself to the opinion that "steel will not weld;" but if his speech on the subject—which was delivered many years ago—be examined, it will be found that he was merely referring to the question whether white-hot fragments of steel, such as a mass of scrap, will close up into a solid and firm mass under the hammer, as iron scrap is known to do. In a word, he denied that steel would weld itself; he did not say it could not be welded. In any case the welding of mild steel is now a simple and every-day fact of the workshop; and steel may even claim a pre-eminence over iron in this particular, inasmuch as, if richer in carbon, it is far purer as regards the more hurtful ingredients than any but the costliest forms of wrought iron can be. Practically, a smith dealing with steel has nothing but carbon, and possibly manganese, to think of; he need not trouble his head about sulphur, phosphorus, arsenic, and other materials, whose influence on welding Herr Reiser has done his best to set forth in detail. No difficulties as to welding will be likely seriously to hinder the advance of mild steel as the metal of the future.

The facts we have been considering may be looked at from another and not less interesting point of view, namely, as throwing some light on the meaning and nature of the process of welding itself. What has happened when two masses of iron have been welded together? Simply, we believe, that the forces of cohesion, which were previously in action on either side of the bounding surfaces, have now crossed those surfaces, and formed the two masses into one coherent whole. With a perfect weld any signs of the former division should be completely obliterated, and the cohesion over the original surfaces as strong as anywhere else within the mass. Probably this is never quite the case. Recent German experiments are said to have shown that, even with thoroughly satisfactory metal, there was a diminution of cohesion to the extent of about 17 per cent. This average diminution is doubtless due merely to the fact that at certain points of the welded surfaces the causes which prevent the cohesive forces from asserting their action have not been entirely removed. These causes have been already indicated. They fall under two heads—(1) the presence of any coating, whether consisting of a foreign element or an oxide upon the surface of the pure iron; (2) the presence of any crystalline structure in the iron itself. The exact way in which these causes act we cannot hope to determine, until we come to know much more than we do as to the forces of cohesion; but that they do act to the prejudice of welding cannot be doubted. Conversely the two great requisites for a successful weld are (1) to ensure that the surfaces shall be perfectly clean, and (2) to bring the iron into an amorphous but not into a fluid condition. It only remains to use a moderate pressure, such as shall force the molecules at the surfaces into close and intimate junction with each other, and thus introduce them within the sphere of each other's cohesive action.

On the other hand, any attempt to cement the pieces together by means of a film of fluid metal interposed between the surfaces, is known to be useless, probably because the molten mass oxidises more rapidly than it sets, and thus takes the form of a scale, instead of uniting itself firmly to the surfaces on either hand. It may be suggested to physicists, in this connection, whether the interesting phenomenon known by the name of regelation —in which two pieces of ice, when pressed together, form themselves into a single mass—is, after all, anything more than a case of welding. It has generally been supposed that the union is due to the freezing of a film of moisture enclosed between the surfaces of junction; and much ingenuity has been expended to explain why this freezing takes place, even when the mass is at a temperature of 32 deg. Fah. It seems at least worthy of inquiry whether this film of moisture really freezes at all—whether it is not, as a fact, driven out by the pressure, either at the edges or into the porosities within the mass; and whether the regelation is not merely the junction, by true welding or cohesion, of the still solid material on either side of the surface of junction.

THE PORT AND TRADE OF SUNDERLAND.

IN the statement of the tonnage of vessels, &c., of the receipts issued by the River Wear Commissioners, there are some facts that indicate the movements in the trade of the northern ports. A rather curious table is given showing the fluctuations in the tonnage of the vessels using the port in the first half of the present year, and in the corresponding half of last year. The small decreased very greatly in the year bridged by the comparison. There were 111 less vessels under 150 tons register in the six months; 67 less between 150 tons and 250 tons; whilst above the latter tonnage there was a not inconsiderable increase. And a detailed comparison of the average tonnage of the vessels used in the port may be summarised in the statement that in the year compared the average tonnage of the vessels has increased 3·8 per cent. Another table is also curious—one showing the kind of trade done by the vessels frequenting the port in the first half of last year and of the present. Last year 69·2 per cent. of the whole of the vessels were in the coasting trade; this year the proportion has fallen to 66·5 per cent. On the other hand, the vessels in the European trade rose from 26·8 per cent. of the total to 30·1 per cent.; but the proportion of the vessels engaged in the trade beyond Europe fell from 4·0 per cent. to 3·4 per cent. The total trade of the port shows a declension in the half year of 103 vessels, but owing to the larger average tonnage, the total is about 10,000 tons above that of the past year. The financial results are not so satisfactory. The inward tonnage rates show a slight increase, but the outward, and several other items of the receipts, show a declension. The coal shipped is 50,000 tons less for the half year, and the receipts are thus effected, and the total shows a decrease in the receipts for the half year of £2769 15s. 5d. It is said that in part this is due to the mild winter. There is a little to the south of Sunderland the small port of Seaham Harbour, which is in rough weather not always obtainable by vessels, but which has this year shipped considerable quantities of coals that would otherwise have gone to Sunderland. How far this explanation may be the correct one cannot be said, but possibly that and the comparatively high charges may have something to do with the declension of trade. The latter, however, may be temporary, and indeed ought to be, because there are few of the north-eastern ports that have the advantages possessed by Sunderland in being on the very verge of the Durham coalfield, and in furnishing ample facilities for the shipment of coals in certain classes of vessels. It has not magnificent works on its banks like those on the northern river, the Tyne, nor has it the splendid lock accommodation that West Hartlepool can afford; but it ought to be able to attract a very large and a growing tonnage of vessels and to enter into the supply of London with seaborne coal. The fact that it is the second in the ports that enter into that supply is an indication of the possibilities that are before it in this respect, and these possibilities it ought to turn into facts by judicious continuation of its river works, and by the adoption of newer modes of shipping coal wherever they can be brought into use advantageously.

LITERATURE.

Worked Examination Questions in Plane Geometrical Drawing for the use of Candidates for the Royal Military Academy, &c. By F. E. HULME, F.L.S., F.S.A. London: Longmans, Green, and Co. 1882.

A BOOK of this kind always conjures up a host of thoughts, most of which, however, are but indirectly connected with the special work under notice. Is our education a failure? and is the Caucasian played out? Bret Harte may be able to answer these questions, but we doubt if that ubiquitous author could satisfactorily solve the problem of examinations. Are examinations real tests? Do they discriminate the chaff from the wheat, or is there ever a natural tendency for the examined who best satisfy the examiners standing in the forefront in the battle of life? No doubt there is much to be said in favour of examinations, yet we all feel an inkling that they are a little overdone. One effect of examinations has been to increase scholastic books to a startling extent, many being written from the narrow-minded standpoint of the mere crammer; others by men of wide culture as well as deep insight into the special subject they treat. The former may be tolerated because of the latter. The work before us necessitates the question, Is it desirable to put solved or worked questions into the hands of the student? and to this we are inclined to emphatically answer yes, provided the worked questions are selected with judgment. We have again and again heard a mathematical master explain a new rule, and seen four-fifths of his class fail to apply the rule to the solution of a problem. The student may in his fashion know, say, the whole of Euclid's first four books, and yet fail to solve a question requiring but the application of a few of these problems. Indeed, it was not the fashion till the era of examinations commenced to attempt to apply, but only to learn the bare letters of Euclid. How many students have read Todhunter's first chapters in his "Differential Calculus," and failed to answer his first example? and so on. A worked-out and thoroughly dissected question frequently throws a flood of light into the student's mind. Holding these views, we are inclined to look with considerable favour upon books such as the one now before us; and we could have wished that Mr. Hulme, in his preface, had dealt more with the educational than the examination idea. Do not tell a boy that his be-all and end-all is to pass a certain examination. His purpose is to gain knowledge of natural laws, and apply such knowledge to the benefit of himself and his fellow beings. Mr. Hulme has given the solutions to two hundred questions, and, as an exercise to the student, has asked another hundred questions. The questions solved are fairly selected, and as a rule the solutions are well indicated. More details of the method of procedure should have been given in a few of the earliest examples in each branch, and less knowledge assumed. The space for this could easily have been obtained, and we might have been spared such irrelevant remarks as, "The paper from which this question was taken was a particularly easy one," &c. Mr. Hulme's book is good and useful; but if he were to cut out in a second edition all reference to examinations it would be even more useful than it is now.

Electric Lighting. By LE COMTE TH. DU MONCEL. Translated by R. ROUTLEDGE, B.Sc. London: George Routledge and Sons. 1882.

THIS is a translation of the second edition of Comte du Moncel's "L'éclairage Electrique." The Comte du Moncel is well known to us as one of the most prolific, and at the same time one of the most painstaking, of French authors. This work is intended for the general reader, hence it is more descriptive than analytical. While generally agreeing with the matter and method of the book, the nature of the contents of which we shall indicate directly, we may say that readers will have some little difficulty in reconciling sentences to be met with on various pages. Thus, on page 4 we read, "In the first place an *electric current* is, in fact, nothing in itself but a dynamical action or motion resulting from the destruction of electrical equilibrium in a conducting system, its effect being a tendency to the re-establishment of the disturbed equilibrium through the medium of another conductor;" while on page 7 we read, "The resistance of a conductor represents the magnitude of the obstacles offered by its material particles to the free passage *of the fluid*." The italics in the latter sentence are ours.

The first part of this book discusses certain definitions, also what the electric light is and how it differs from other lights, describing the electric arc and its peculiarities. The second part deals with generators—following the historic plan and commencing with voltaic generators, passing to thermo-electric generators, giving due credit to Seebeck, Farmer, Bunsen, Becquerel, Chamoin, and Noé. Magneto-electric generators next claim attention. Under this head most of the electric light machines are briefly described. A large amount of very interesting information is given, which, so far as we know, is to be found in no other book, but if wanted had previously to be sought scattered through volumes of technical papers. The same may also be said of that portion of the work devoted to lamps. The various lamps, arc, and early incandescent, are briefly described, their specialities mentioned, and frequently their value estimated. We have reason to suspect that considerable alterations will be made in the next edition, inasmuch as Edison's work, for example, has gone far past the point described in the book; in fact the lamps described are those of his early and long given up patents. In the body of the work, again, there is no mention of the lamps of Swan and Maxim, a void which the translator has endeavoured to fill by the addition of two or three pages as an appendix. The information given in this appendix is of the most meagre description, and altogether unsatisfactory. The value of the book would have been greatly enhanced had its information been brought down to date; as it is, the information is at least two years old, and the greatest strides in incandescent lighting have been made during these two years.

There is, no doubt, a great desire in the public mind to obtain information about the electric light, and to a certain extent they cannot do better than read this book. It is, of course, unfortunate that the English edition, issued in 1882, is not brought down to date, and is therefore lacking in much that is of interest. It is unfortunate, too, that the translator did not take more pains to ascertain a few facts about the present condition of incandescent lighting. Had he done so, he would hardly have spoken of Fox-Lane's lamps, but rather have reversed the components of the name. We notice, too, that Higgs goes lamely as Higs. Just fancy, too, an author saying, "The resistance of Edison's lamp is about the same as that of Maxim's, while the resistance of the Fox-Lane lamp is less than that of the Swan." This is popularising with a vengeance. We advise the reader to stop at page 313. The book is fairly illustrated, printed, and neatly got up, for which thanks are due to the publishers.

WIND WATER-LIFTS.

THE facility with which steam power can now be applied in civilised countries has led to the gradual abandonment of the motive force of wind. The unvarying regularity with which the former can be applied, and the improvements which have been made in the various forms of the portable steam engine, have resulted in an economy with which in but rare instances windmills can compete. There do occur constantly, however, within our colonies, and even in districts at home remote from railway communication, instances where wind power might be usefully employed if the required machinery could be readily obtained and at a moderate cost. The drainage of submerged lands is a question constantly arising in newly-settled countries, and on all farming lands at home, if the cultivator were in the possession of means whereby the water might be got rid of, thousands of acres in all countries at present uncultivatable might be recovered. In days gone by, and, in fact, from the earliest ages, men gave much attention to utilising the power of the wind for such operations, and our ancient histories prove how the greatest minds, including that of Archimedes, devoted their energies towards the construction of machinery for raising water. Colonists, as well as many of our own smaller farmers, have a dread of employing machinery which renders necessary skilled attendance, and hence steam power, even in cases where it may be readily obtained, is resorted to with reluctance; but we venture to think that if it were generally known by what simple means wind power can be applied to drainage purposes, it would be extensively used. For centuries the inhabitants of the Low Countries have employed windmills in their great draining operations, but these have gradually been superseded by the use of steam power for the reasons we have named above. Our reference to the prejudice existing among colonists and small farmers against the employment of steam machinery extends also to all kinds of pumps, the valves of which readily choke when used for the raising of foul water, and need labour of a skilled kind to keep them effective and in repair. To one class of water-raising machinery this objection cannot apply, any more than it can to windmills of simple construction. We allude to the water screw invented by Archimedes. The combination of this with a windmill affords the simplest form of water-lift with which we are acquainted, and its construction in a rough-and-ready form is within the limit of the powers of any village blacksmith and carpenter, or even of any emigrant possessed of common sense and a fair elementary knowledge of the use of ordinary tools.

A mill may be constructed for draining purposes at a cost not exceeding £5. In one case the conditions worked under were very similar to those which we have described above, and with the most crude materials and workmanship. The lift was to be 4ft. and a screw 12ft. in length set at an angle of 45 deg. was proposed. The axis upon which it worked was a pole of wood of the required length and 5in. diameter. Circular plates of stout zinc were cut having a hole for the axis pole, which had the edges turned up as a flange, by which the plate, when extended on the pole in the line of the proposed thread or pitch, could be screwed to it. A similar turned edge on the circumference of the plate gave a flange, to which the staves forming the barrel could be attached; the diameter of the screw was 3ft. After the zinc plates were screwed to the axis pole, their edges were united by soldering, so forming a continuous thread. The barrel was made of wood staves very roughly united, as it is a condition of the working of such screws that they should not be cased in air-tight, and very imperfect cooperage work was therefore well suited. These staves as they were laid on were screwed to the zinc flanges of the screw, and the whole was roughly hooped together. The windmill was 8ft. in diameter, and consisted of two stout poles crossing one another at right angles on an iron centre pin, the blade being formed of lighter pieces of wood nailed together, on which light canvass was tacked. Two bearings of hard wood mounted on a frame of the required height, and set at a slight upward angle, carried the axis of the mill, which was joined to the pole axis of the archimedean screw by a clutch universal coupling, such as any village blacksmith can make. By this means all difficulty as to union of the differing angles of the mill and screw were overcome, the power of the former being transmitted to the latter without irregularity of motion. On the extended base of the framework was placed a hard wood block, drilled to receive a pin fixed in the end of the axis pole of the screw, and having a small iron plate at the bottom to receive the principal wear. The whole machine was therefore on one base, and its framework could be readily taken to pieces for removal. When *in situ* the whole could be readily shifted by handspikes to face any quarter from which the wind was blowing. Of course it would be easy, were it desired, to add means by which this could be self-effected, as in the case of more elaborate mills; but in the colony where that we have described was used, the wind always blew steadily from one quarter for months together, and shifting was, therefore, but seldom necessary. The action of this machine, roughly constructed as it was, was to all intents and purposes perfect. During the whole time that we saw it in operation it was never once stopped for repair, and the splashing of the water over all its parts, the coupling joint included, gave sufficient lubrication. It raised from 50 to 100 gallons per minute, according to the speed given to the mill by the varying force of the wind.

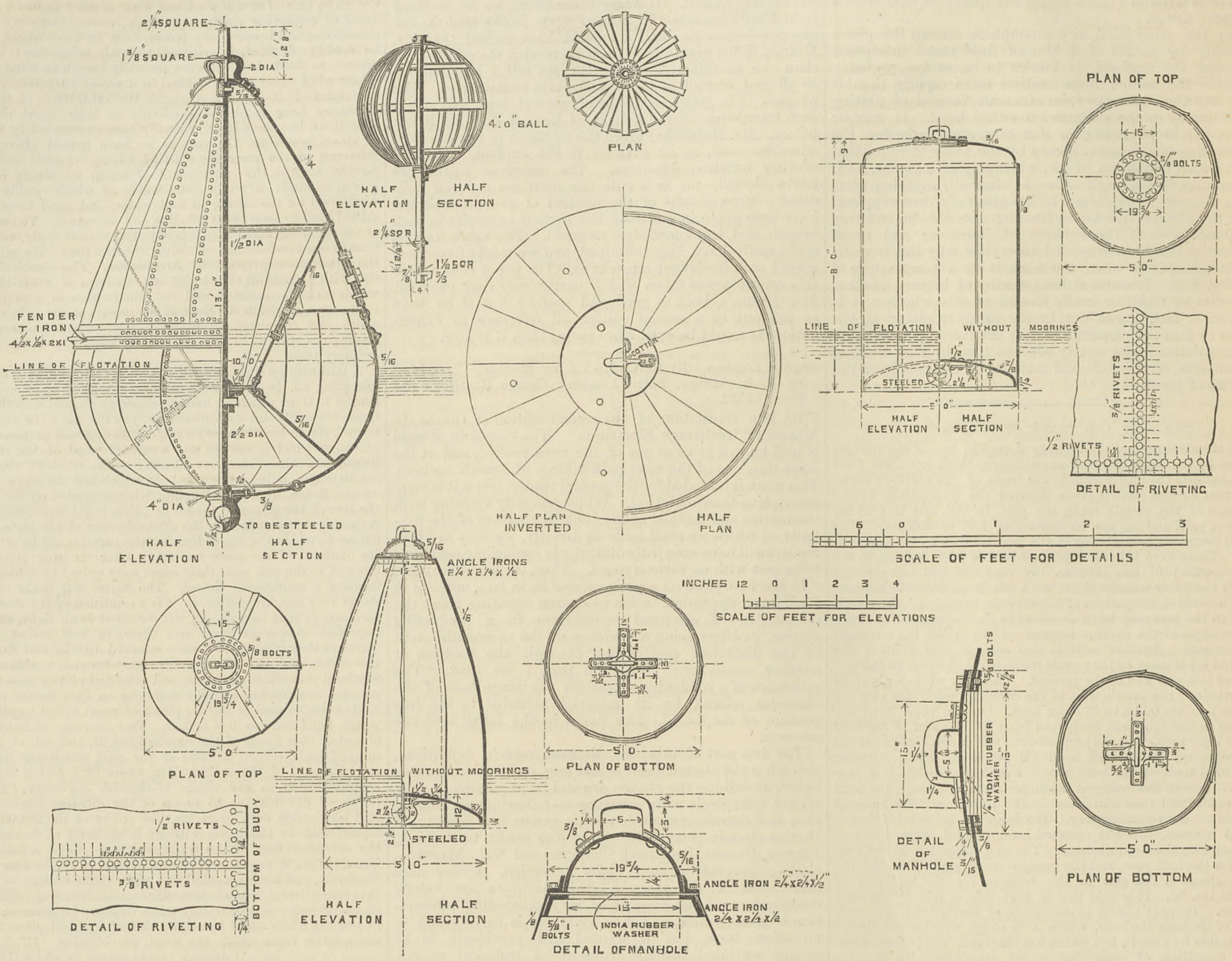
We admit that the archimedean screw in this form cannot be relied upon for lifts exceeding 6ft.; but this, in the majority of the cases we have supposed, would be sufficient. Were greater lifts demanded, a succession of such machines might be used; but we hold that in such instances their employment would be uneconomic. We only desire to point out to readers in the colonies and elsewhere, where it is difficult to obtain skilled mechanical aid or more complete mechanical means, how readily they may in such cases help themselves, and to an intelligent man, aided perhaps by the reading of some elementary work on the construction of windmills, the construction of such a machine as we have briefly described should present no difficulties, and the mill might be made useful for many other purposes when not required for water lifting.

LAUNCH AT WORKINGTON.—On Saturday the Aigburth, sister ship to the Grassendale, was launched from Messrs. Williamson and Co.'s yard, the christening of the boat being performed by Miss Williamson. The new boat has been built for Messrs. Leyland and Co., Liverpool, and is intended for colonial traffic. The Aigburth drove a few of the ways before her, and landed on the beach, where she stuck, but was got off without damage on Sunday morning.

GERMAN SUBMARINE MINING EXPERIMENTS.—The German Government are prosecuting a series of important torpedo and submarine mining experiments in the Baltic. Two hulks have been fitted up for the purpose at Brunhausen, near Baudor, the German torpedo depôt. 300 pioneers and five officers have been detailed to assist in carrying out the experiments, which consist in coast defence and ship attack drills. These commenced on the 20th of July, and are to terminate on the 23rd of August. The results of the experiments are being kept perfectly secret.

THE WINTER ELECTRIC EXHIBITION, ROYAL AQUARIUM: AWARD LIST.—The list of subjects, supplementary to that we gave at page 85 last week, for which prizes will be given, and amount of each prize, will be shortly issued. Meanwhile two of the more important, *i.e.*, for storage batteries—No. 2 on list—and for incandescent lamps—No. 21—have been arranged at £100 each. In conditions of latter, 100 lamps on a single chandelier will be requisite, with separate driving power. To replace broken lamps during course of Exhibition, the chandelier will be lowered once a day in presence of the authorities of the building, and such lamps replaced as may be requisite, and number recorded of broken ones, &c. The chandeliers must be lit and maintained alight for the full period the Exhibition is proposed to be kept open. This, with the records kept of breakages and the tests from time to time of power absorbed by the machine and light given by any selected lamp on the chandelier, will go far to make a fair comparison of interest to the public amongst the many competitors for favour in incandescent lighting.

CONTRACTS OPEN—TRINITY HOUSE BUOYS.



CONTRACTS OPEN.

Tenders are invited for the construction of ten iron buoys for the Corporation of Trinity House, addressed to the Secretary and marked "tender for iron buoys," on or before the 17th inst. The following extracts from the specifications give the principal particulars.

13-*ft. Iron Buoy* (*Water Ballasting*).—This contract is to include all the works necessary in the construction and delivery at the Trinity Buoy Wharf, Blackwall, of three 13ft. iron buoys —water ballasting. The ironwork to be of the best and toughest quality of S.C. Stourbridge iron, or other of equal and approved quality; to bear a tensile strain of twenty-two tons per square inch of original sectional area. All rivets to be of Bradley's charcoal iron, or other of equal and approved quality. The gun-metal for the bosses of the ball to be in proportion of 14 oz. of copper to 1 oz. of tin and 1 oz. of zinc. The buoy to be formed as shown above; to be 13ft. high, and 10ft. diameter at the line of floatation; to be fitted with two bulkheads, forming three water-tight compartments. The buoy to be surmounted by a wrought iron mast socket and mast, and four-foot ball as shown. The plating of the buoy to be lap-jointed, and close rivetted with strong-headed rivets, snapped externally. The plating to be of the following thicknesses, viz., lower tier of outside plates and lower bulkhead $\frac{5}{16}$in., upper tier of outside plates $\frac{1}{4}$in., upper bulkhead $\frac{3}{16}$in., dome plate on top $\frac{5}{16}$in., centre plates of bottom and lower bulkhead $\frac{3}{8}$in., centre plates of upper bulkhead $\frac{5}{16}$in. The internal centre plate attached to the bottom plate of shell to be 15in. diameter by $\frac{1}{2}$in. thick, to be securely rivetted to the centre plate of bottom with 1in. rivets. The laps of the plating of the shell of the buoy, and lower bulkhead to be $1\frac{7}{8}$in. wide, with rivets $\frac{5}{8}$in. diameter, and $1\frac{5}{8}$in. apart, centre to centre; the laps of the upper bulkhead to be $1\frac{1}{4}$in. wide with rivets $\frac{3}{8}$in. diameter, and $1\frac{1}{4}$in. apart, centre to centre; the laps of the centre plates to be 2in. wide, rivetted with $\frac{3}{4}$in. rivets, $1\frac{3}{4}$in. apart, centre to centre. The centre plates of the bulkheads to be securely rivetted together with $\frac{3}{4}$in. rivets. The lower bulkhead to be connected to the side of the buoy, and rivetted to it with $\frac{3}{4}$in. rivets, $1\frac{3}{4}$in. apart, centre to centre. The upper bulkhead to be connected to the side of the buoy, and rivetted to it with $\frac{5}{8}$in. rivets, $1\frac{5}{8}$in. apart, centre to centre. Forged wrought iron circular sockets are to be securely rivetted to the centre-plates of bulkheads and dome-plate, and fitted with a $1\frac{3}{4}$in. by $\frac{1}{2}$in. key, for securing it to the mooring bars, as shown. The mooring bar and eye to be forged to the form and size shown, the eye to be steeled. The bar to be clenched, while hot, over the centre plates of the bulkheads and inner centre plate of the bottom of the buoy. A T-iron fender, $4\frac{1}{2}$in. by $\frac{1}{2}$in. by 2in. by 1in., weighing about $12\frac{1}{2}$lb. per lineal foot, is to be in one length and welded and double-rivetted to the shell of the buoy, with $\frac{13}{16}$in. rivets, 2in. apart, centre to centre, to bear fair and solid on the plating. The iron for this purpose is to obtained of Messrs. Moser and Sons, Borough, S.E. An oval manhole, 17in. by 13in. in the clear, is to be formed in the upper tier of plating of the shell of the buoy, and in the upper and lower bulkheads, as shown; each manhole to be provided with a cover $\frac{1}{2}$in. thick, secured by $\frac{5}{8}$in screws, $2\frac{1}{2}$in. apart, centre to centre. The edge of each manhole to be thickened on the inside by a ring $2\frac{1}{2}$in. by $\frac{1}{2}$in., close rivetted with $\frac{5}{8}$in. rivets, countersunk for the cover. The joint of each manhole to be made water-tight, with a vulcanised india-rubber washer, $1\frac{1}{2}$in. by $\frac{1}{4}$in. The words "Trinity House, London," in 2in. letters, are to be deeply cut in cover of the manhole in the shell of buoy; also the number of the buoy as shall be directed. For the purpose of testing each compartment a plate 6in. diameter and $1\frac{1}{4}$in. thick is to be rivetted on the inside of each manhole cover, into which and the cover is to be tapped a 2in. screwed plug. Eight holes, 1in. diameter, to be made in the bottoms, as shown, for filling the lower compartment with water ballast. The sharp arrises of the holes to be taken off, and each hole to be fitted with an English oak plug. A ball and spindle to be furnished of the form and size shown. The ball to be formed of twenty 2in. by $\frac{1}{4}$in. vertical staves of ask, rivetted to three horizontal hoops of iron, $1\frac{1}{2}$in. by $\frac{1}{8}$in., to the gun-metal bosses $\frac{3}{8}$in. thick, fitted to the spindle. The iron spindle to be 8ft. long, $2\frac{1}{2}$in. diameter at the collar under the ball, and tapering to 2in. diameter at the top; to be secured to the ball by a split pin, $\frac{1}{2}$in. diameter, and fitted through the top of spindle. The lower end of spindle to be squared, and tapered to fit the socket, to which it is to be secured with a $1\frac{1}{2}$in. by $\frac{1}{4}$in. split cotter. The buoy, after being completed, to be weighed on the contractor's premises, and tested with water. The shell of the buoy to be tested to a pressure of 20 lb. per square inch, and each bulkhead to a pressure of 10 lb. per square inch. The necessary holes for attaching the pressure gauge to be drilled, and tapped in the buoy, as shall be directed, and afterwards to be fitted to a screwed plug, and rendered perfectly water-tight. The weighing and testing to be done in the presence of the superintendent. The buoy, after being tested and proved to be perfectly water-tight throughout, is, after approval, to be thoroughly cleansed and free from rust. In this state it is to be slightly and uniformly heated, and, while warm, to be coated externally and internally with boiled linseed oil; and, after the work has cooled, and the coat hardened, to be painted three coats in pure red lead paint. The specifications for the 8ft. iron drum buoy, and for the 8ft. iron conical buoy, are similar to the foregoing, except as to dimensions, which will be found on the drawings, which we give herewith.

Stack Cooling or Drying by Artificial Means.—At a recent meeting of the Carse of Gowrie Analytical Association at Inchture, a paper by Mr. Watson, Inchcoonans, on "Stack Cooling or Drying by Artificial Means," was read, in the course of which the author described what he had found by experience to be a practical and simple plan, and one which was tried by the late Lord Kinnaird and Mr. M'Laren about forty years ago, viz., by applying smiths' blowers or bellows in blowing cold air into a meadow hay stack, by which the hay was much improved, although the actual results obtained he could not then give. About twenty years ago his Lordship and the writer, along with Mr. M'Laren, tried to devise a method of safe harvesting the crops in late or damp seasons; and, at his Lordship's request, the writer erected on the home-farm of Castlehill what was termed a hot-air kiln, its dimensions being about 14ft. square, and something similar in construction to that of an ordinary corn mill drying kiln, with the furnace placed about $2\frac{1}{2}$ft. above the ground, and the fire fed in the same way as these kilns, and containing a number of bent pipes 5in. to 6in. in diameter, placed internally all round under the second floor, for heating the air by the furnace, and so placed as to admit of the fire playing fully upon them all round, on nearly the same principle as that for heating water for vineries or similar erections. The air was admitted by ventilators from the outside into the furnace of the kiln, as well as into the pipes. While passing through these pipes the air got heated from the furnace, the fuel used being coke. The flooring over and above the fire and pipes was made of perforated bricks, which also partook of the heated air, the same as the pipes, and also permitted the heated air to pass through them. A fan blast was then placed on the upper floor or second storey in an air-tight room, to draw the heated air from both pipes and furnace, and discharge the same through common clay drain pipes or wooden boxes into the stacks, which pipes or boxes were introduced into the bosses, or other vacant spaces, purposely made and left in the stacks at suitable parts for drying. After being tried several times, the experiment was found to be practicable, and generally served the end in view, although it was more particularly tried for the curing and drying of meadow hay in the stack or sow. The heated air entered into the centre or boss, and ultimately discharged itself near the top of the stack, still, however, leaving some wet parts where the hay was very green and damp, causing it to "sit" close together, which prevented the heated air getting properly in at the part most required, and these parts becoming overheated, moulded and rotted. This I consider could be remedied if faucit-jointed pipes were laid down from the fan similar to that previously suggested, having the joints carefully cemented to be as near air-tight as possible, to convey the wind produced by the fan out into the stackyard or where wanted—means being provided whereby a hose-pipe could be attached in the same way as is done in the case of a fire engine to a water-pipe conductor. This would in all likelihood get over the difficulty experienced at Castlehill, because the person in attendance could conduct the wind or air produced by the fan through the agency of this flexible tube or pipe, and introduce it to any part of the stack requiring it the same as conducting water in the case of fire. I consider it would be better that a little air be introduced at the bottom of the stack to carry the damp or foul air out at the top, where a pipe or tube full of holes placed in the centre while building would act as a funnel for that purpose. This pipe, if desired, might be taken out when the grain in the stack was found to be in proper order, and used in another while building. This would give the foul air a free current of escape. When the funnel or opening is not required, a "feal" or some straw might be placed on the top thereof, so as to prevent the rain getting in and doing injury to the stack. I would further suggest that this tube or pipe already mentioned might be useful in an emergency in the event of fire breaking out in the premises, to be used in the same way as applying water from the hose of an engine, or at all events blowing back the flame or smoke, and preventing the fire from spreading or getting so quick a hold. This could be done by a person directing the mouth of the conducting pipe similar to that before mentioned. In many cases where the wind is blowing contrary to the burning material the further spread of the fire is hindered or prevented. If the wind was favourable to the spread of fire, this pipe could be applied as a powerful opposing agent, and perhaps be the means of at least assisting in putting an end to destruction, more particularly where water was scarce, or could not be got. The hot-air kiln previously referred to—like many other similar improvements when followed with a few good seasons—was not required for some time, and it therefore got a little out of order, and was afterwards converted into an hospital, with Turkish bath for beasts.

NEW WORKS AT CALAIS HARBOUR.

No. II.

THE sluicing lock forms a dam capable of resisting the pressure of a head of water of about 7 metres. This dam is built upon a foundation of sand naturally liable to be undermined and permeated by water, and the depth of the concrete foundations is such as to effectually prevent the bursting up of subterranean springs through the sand; hence the necessity for very prolonged aprons before and behind the sluicing lock. To strengthen the floor of the lock, properly so called, there are two *parafouilles* of concrete, each between two lines of piles and sheeting piles. The positions of the aprons and *parafouilles* are like those in the locks at Dunkirk, and are the result of experience gained through accidents at Calais, Gravelines, and Dunkirk. The thickness of the piles has been fixed at 3·5 metres, but it has been reduced to 2·5 metres to the right of the recesses for the caissons. The floor of the lock proper has a thickness of 3·5 metres at the sill and 3·25 below. It is formed of a layer of concrete 1·75 metre thick, covered with a bed of masonry 1·75 metre or 1·50 metre thick. The concrete rests upon the sand, into which 685 piles are driven in rows, with a space between each row of 2 metres. These piles are 4 metres long and ·3 metre in diameter; their heads protrude ·5 metre into the layer of concrete above. This piling is necessary also to sustain the heavy portion of the lock in the event of springs tending to undermine even that part of the work.

The *parafouilles* between which the lock is included are formed of a layer of concrete 2 metres thick and 5 metres below the sill, placed between two continuous ridges of piles driven to a depth of 8 metres, and sheet piling driven in 7·5 metres. The aprons at the two ends form an essential part of the lock, and the inadequacy of works of this nature has caused all the accidents to sluicing locks which have hitherto been known. The currents of the sluice produce channels the depth of which might amount to 8 or 10 metres. If sufficient care is not taken to lengthen the protecting portions, the sand on which the constructions rest falls little by little into the water-worn channels, the slope extends under the foundations of the lock, the lock gives way as at Calais before proper precautions were taken, as at Dunkirk, to make it safe in times of danger. The water-made hollows most to be feared are those which form below the lock during the sluicing; they cannot be prevented, but they should be made to form as far as possible from the lock.

The lower apron is made in three parts: (1) The first part is absolutely fixed and solid to prevent all slipping which might be produced at the sides even of the construction, and to receive the first shock of the sluice. It consists of a platform of concrete the whole width of the canal, and is connected with the stone pitching of the banks. The concrete is protected by a layer of stones. The total thickness of the apron is 1·8 metre; its length is 30 metres. It is bounded at the upper end by the *parafouille* of the end of the lock, and at the lower end by a series of piles and sheeting piles driven to a depth of 7 metres. The apron before and behind is of superfluous thickness, and forms a sort of *parafoulle* to a depth of 4 or 5 metres. (2) The second part is flexible in its vertical aspect, and is intended to protect the first apron of which mention has been made; it should be joined on to it to secure a firm foundation. The second apron should be movable, to press at all points like a carpet on the loose sand, to prevent the latter being washed away at once by the sluicing current or by the returning water. This apron should be composed of a first layer of clay ·8 metre thick, covered with straw to ·3 metre, on which is a layer of stone blocks ·6 metre thick, and on these ·7 metre of masonry composed of isolated artificial blocks, one with another forming a kind of pavement. This apron is 30 metres long. (3) This should be followed with stone blocks, forming an inclined plane disposed with care over a certain area. These blocks are intended to fill water-worn excavations, and to prevent them from getting larger; they have to be continually watched, and fresh supplies have to be added from time to time.

Above the lock is the same system of aprons, but on a less extensive scale. The first apron above the lock, made like the one below, is only 20 metres long; the second 30 metres. They are followed by stone blocks in proportion until equilibrium is established.

The total length of quays for the wet dock is 1640 metres; for a length of 1035 on the east side the walls are solidly formed of rubble stones from quarries in the neighbourhood, and rest upon a bed of concrete; along the remaining 605 metres on the west side the quay wall is channelled to allow the passage of drainage waters from the graving dock, and the waters from the lock connected with the interior navigation, and the overflow water of the Canal de Calais. It contains an aqueduct with an elliptical roof, 3 metres wide and 4·5 metres high. The arch is built of bricks and is one metre in thickness; the walls supporting the arch and the floor are of ordinary rough hewn stone; all the interior surface is coated with Portland cement in a layer ·03 metre thick. The quay wall will be crowned with a granite coping, 1·10 metre wide and ·04 metre thick. The face of the wall on the side of the basin follows a straight line inclined 1 in 10, sweeping tangentially to the base in a curve of 8 metres radius. The pavement of the quay grounds will be formed of rough stone blocks, which have the advantage of being very economical, and of forming with the rest of the masonry a homogeneous whole of all the solidity desirable, thanks to the employment of Portland cement as mortar.

The excavation of the dock was finished in 1879, at which date the foundations of the quay walls were commenced. The concrete bed of the side of the dock has been cast in a mould formed by a line of piles and sheeting piles, and on the side of the quay grounds by a simple boundary formed of deal planks driven into the ground with great facility by the water injection process, and withdrawn again after the concrete has set. Iron ladders to the number of seventeen are fixed and soldered in holes made in the coping of the quay walls. Three sets of stone stairs are built in the entrance angles of the dock.

The plan of the works ordered to be executed by the law of August 3rd, 1881, includes the dredging of the entrance channel of the port of Calais outside the jetties, to increase the depth of water over the bar. The Chamber of Commerce obtained authority to begin this work before the law was passed, by offering the State, for this purpose, 300,000f. The work was begun on the 20th June, 1881, with the funds of the Calais Chamber of Commerce, and it has been continued to this day. Between June 20th and December 15th the amount dredged was 150,000 cubic metres. Up to November 15th three dredgers worked at the entrance channel of the port; they consisted of one dredger with a centrifugal pump, which dredger carried away its own clearings, and of two centrifugal pump dredgers which turned the sand raised into barges. After November 15th the last two dredgers ceased to work. The following is the total dredged during six months of work.

Date. 1881.	No. of days of effective work.	Cubic metres dredged.	Observations.
20th to 30th June	8	10,147	
1st to 31st July	14	28,514	Three dredgers to November 15th, 1881.
1st to 31st August	12	24,531	
1st to 30th September ..	14	36,114	
1st to 31st October	3	4,745	
1st to 30th November ..	16	32,679	A single dredger after Nov. 15th.
1st to 17th December ..	16	14,270	

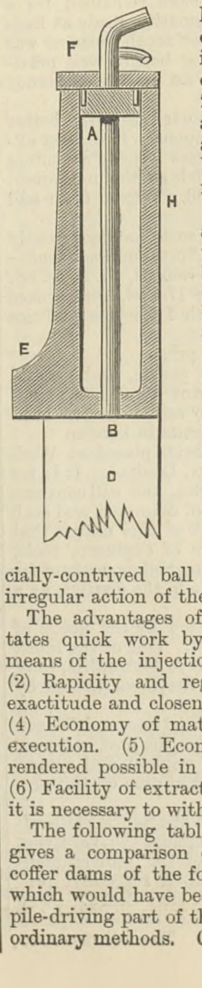
When the work was begun the depth of water at the highest part of the bar was only one metre below the low water level of spring tides; at the end of last year it was 2·5 metres, so that a depth of 1·5 metre had been gained in six months by dredging and sluicing combined.

All the harbour works of the new port of Calais have been executed in an area of fine sand. This sand, which is so easily excavated, offers to pile-driving a resistance which is very difficult to overcome by ordinary methods. The difficulty was particularly felt during the driving of the line of piles and sheeting piles, which was to form the base of the pitching of the sluicing basin, alongside the practice ground of the Artillery Commissioners. The piles were driven on the sea beach when the tide was out, on an area exposed to the action of the successive tides; the sand thus exposed to the tidal action was so compact that it opposed almost absolute resistance to pile driving. Sheeting piles only 2·5 metres long and ·08 metre thick were broken under the repeated blows of the monkey, and their thickness was increased first to ·12 metre and next to ·15 metre.

The idea then occurred to Mr. Stoecklin and Mr. Vétillart, resident engineer of the works, to try the effect of water under pressure to facilitate the pile driving. At first great water pressure was applied, but it was discovered that the remarkably good results obtained from the first were due, not to the pressure of the water, but to the establishment of a continuous current along the piles. Great pressures were then abandoned; little garden hand pumps were used with great success, and subsequently a fire-engine. After several days' experimentation with the fire-engine it became possible in fourteen minutes to drive in panels of sheeting piles 2·5 metres long and 1·7 metres wide, instead of taking eight or ten hours to do so as at first.

The water from the fire-engine first passes into a forked tube, to which two lengths of india-rubber hose are attached. These lead to various iron tubes, 27 to 35 millimetres in diameter, and of variable length. The pump is worked by hand on the sea beach. The india-rubber tubes pass over pulleys carried by the framework of the pile-driver; the injection tubes are disposed vertically, one before and one behind the pile or sheeting pile, on which the monkey of the pile-driver rests with all its weight. While the blows are being given a slight lateral movement is given to the nozzles to keep up a continuous current of water all round the pile and to prevent the scattering of the sand below. The piles are often driven in a little by their own weight, after which it is necessary to apply the monkey; the sheeting piles which have grooves and tongues, and which form the panels squeezed in between the piles, generally require several blows of the monkey to overcome the friction of the neighbouring sheeting piles. This method has since been applied on a large scale to drive in piles for the foundation stones of the more massive harbour works. It has been employed with advantage for the lock boundaries of the sluicing basin and for the foundations of the quay walls.

For the locks of the dock, and for nearly all the works necessary to be executed at a little distance from the central part of the sea-wall of the sluicing basin, the necessary water for the injections has been obtained by fixing in the drain pipes from the embankment a relay pump, which raises also some of the water from the excavations into a reservoir 15 metres above the level of the works in progress. This reservoir has a conduit formed of galvanised sheet iron ·2 metres in diameter, in which water-plugs are fixed at various places. By the aid of this conduit the piles and sheeting piles of the outer part of the foundations of the locks reached a total of 600 metres driven up to the end of last year. Some of the wood employed in this work is 7 to 8 metres long. To work the injection process properly, the driving can never be altogether renounced, especially when placing grooved and tight-fitting sheeting piles. The pile-drivers which have given the best results under these special conditions are the automatic steam ones of Lacour. The hammer, weighing 1200 kilogrammes, is driven constantly with its piston rod resting on the end of the pile and keeps it well down, so that the blows of the monkey—20 a minute—utilise all their force. With any other system elm piles, when driven in a certain depth begin to spring up at each blow, so that the efficacy of the blows is notably diminished.



In Lacour's system, illustrated by the accompanying cut, the piston A B rests on the head of the pile D, and the monkey E F H, while running up and down the piston, never has its weight removed from the pile. For the enceintes of the foundation of the quays, which are a kilometre and a-half long, a pipe of large section could not be laid from the machines by the sea-side, so on each pile-driver a little steam pump on Tangye's system was fixed, which plan has answered well, and is at present in use in the pile-driving work of the sluice. It is a small direct-action pump; it occupies little space, and gives a relatively large result with a pressure of 2 kilogrammes per 9 centimetres. A specially-contrived ball safety valve prevents accidents from any irregular action of the pump.

The advantages of this mode of working are:—(1) It facilitates quick work by making a hole for the pile or batten, by means of the injection stream, before putting the pile in place. (2) Rapidity and regularity of driving. (3) Almost absolute exactitude and closeness in the position of the foundation piles. (4) Economy of material resulting from the great rapidity of execution. (5) Economy of wood, because of the reduction rendered possible in the thickness of the piles and sheeting piles. (6) Facility of extraction in those cases in which from any cause it is necessary to withdraw the piles.

The following table in relation to the quay walls of the dock gives a comparison of the expenses actually incurred over the coffer dams of the foundation, with the amount estimated, and which would have been without doubt insufficient at least in the pile-driving part of the work, if it had been necessary to do it by ordinary methods. Over an estimated expense of 442,162·59f., the saving effected has been 288,051·49f., the total expense not having been more than 154,111·10f.:—

Cost of the Coffer Dams of the Quay Walls of the Floating Dock.

1. PROJECTED WORKS.

	Francs.
Elm for pile $\left(\frac{\cdot 25}{\cdot 25}\right)$, 303·89 cubic metres, at 88·35f. per cubic metre, deducting rebate	26,848·68
Ditto for sheet piling (·1), 730·933 cubic metres, at 102·3f. per cubic metre, deducting rebate	74,774·45
Ditto for piles $\left(\frac{\cdot 12}{\cdot 12}\right)$ for coffer dams, 32·442 cubic metres, at 88·35f. per cubic metre, deducting rebate	2,866·25
Grooving and tonguing, 49,228 metres, at ·21f. per metre	10,337·88
2. WORKS IN CONSTRUCTION.	
Deal planking road for the pile-driver, and for various works, 12·813 cubic metres, at 79·05f.	1,102·87
Cost of a Lacour pile-driver	9,500·00
Cost of a Tangye pump, india-rubber hose, iron tubing, and accessories	4,344·04
Manual labour, including working the points, 10·79f. per cubic metre driven	11,172·73
Maintenance, 3·08f. per cubic metre driven	3,188·14
Fuel, oil, &c.	693·20
Deal for small piles, 44·842 cubic metres, at 79·05f. per cubic metre	3,544·76
Manual labour and divers expenses	5,620·10
Fuel, &c.	208·00
Total	154,111·10

This sum includes all the expenses of 1472 metres of quays and 36 metres of aqueduct.

Expenses which it would have been necessary to incur over the same work without the water injection process.

	Cubic metres.		Francs.
For 1472 metres of quays ..	887,616	Elm for piles $\left(\frac{\cdot 3}{\cdot 3}\right)$ ·603 cubic metre, courant, at 88·35f. per cubic metre ..	78,420 87
Ditto	1,589,760	Elm for sheet piling (·15) 1·08 cubic metre courant, at 102·3f. per cubic metre ..	162,632·45
For 36 metres of aqueduct.	21,708	Elm for piles, ·603 cubic metre, courant, at 88·35f. per cubic metre	1,917·90
Ditto	38,880	Elm for sheeting piles 1·08 per metre, courant, at 102·3f. per cubic metre	3,977·42
Cubic total	2,537,964		
Total for pile shoes for 1472 metres of quays + 36 metres of aqueduct = 1508 metres × 38·18 kilogs. = 57,575·440 kilogs., at ·28f. per kilog.			16,121 12
Grooving and tonguing 100,864 metres, at ·21f. per metre			21,181·44
Deal for roadways for three pile drivers and other purposes 15 cubic metres, at 79·05 per metre			1,185·75
Cost of three Lacour's pile drivers, at 9500f. each			28,500·00
Iron pipes for water			1,327·44
2,537 964 cubic metres completed in manual labour, maintenance, fuel, 50f. per cubic metre—minimum..			126,898·20
Total			442,162·59
Actual cost			154,111·10
Saving effected by the injection process			288,051·49

The works for the improvement of the port of Calais were begun in 1876. The expenses incurred to December 31st, 1881, amounted to 11,500,000f. in all. The plans have been revised and the work executed under the direction of Mr. Stoecklin, chief engineer of the seaports of the Pas-de-Calais, and by Mr. Vétillart, engineer of the port of Calais, 1875 to 1879—Plocq, 1879 to 1881—and Guillain, 1881. Messrs. Varinot and Caville have constructed, as contractors, the embankments and the quay walls of the floating basin. The locks of the floating basin, and the sluice, are constructed directly by the Government, without any contractor.

In the month of February last an accident occurred to the embankment of the sluicing basin, which was broken down for a length of 100 metres by an extraordinary high tide and wind. The sea has been dammed out again, and everything is now in order, except that the sluice floor partially constructed has to be cleared of the sand washed in.

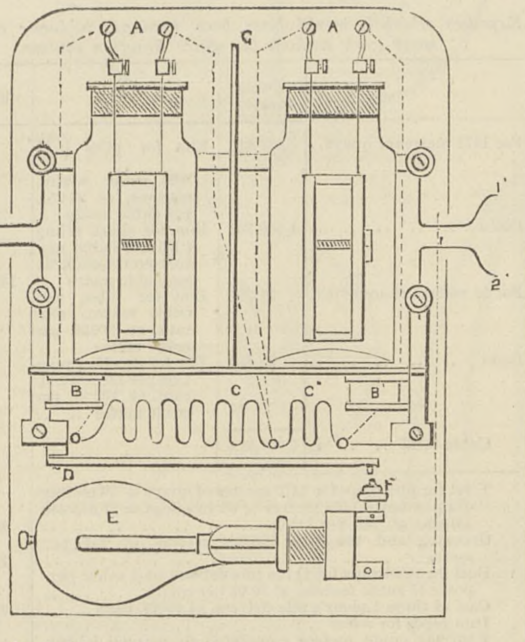
ELECTRIC LIGHT METERS.

A NEW industry requires new tools. The introduction of electrical appliances generally, whether for light or power, requires that the current used should be measured. In our description of Mr. Edison's work, we incidentally referred to the means he adopted for measurement. Since then a few modifications have been made in his apparatus, and since then the work of Mr. Sprague has become more prominent, and the two systems may well be compared. The principles underlying the apparatus of both these inventors are the same, viz., the laws of electrolysis. The art of electro-deposition "may," says Smee, "be said to have its origin in the discovery of the constant battery by Professor Daniell, for there the copper was constantly reduced upon the negative plate." De La Rue, in a paper in the *Phil. Mag.*, 1836, relating to experiments on this battery, says, "the copper plate is also coated with a coating of metallic copper, which is continually being deposited." Professor Jacobi, in St. Petersburg in 1838, announced that he could employ the reduction of copper, by galvanic agency, for the purposes of the arts. It was, however, due to the work of Mr. Spencer, of Liverpool, that definiteness of direction was given to the utilisation of electro-deposition. He executed medals, &c., in copper, and described the process in a paper printed in the "Journal of the Polytechnic Institution of Liverpool," 1839. The subject was investigated by Faraday, and we know that experimentalists have continually found this a fruitful field of investigation. One of the most recent and valuable papers was last year read at the Birmingham Philosophical Institute, by Dr. Gore, F.R.S., which paper showed the directions in which error of measurement was possible, and by showing this, suggested the how to avoid such errors.

It will not be necessary here to more than state that the same quantity of electricity, that is, the same electric current, whether passing the circuit in a shorter or longer time, performs the same work of chemical decomposition. If, therefore, the work of the current is to deposit copper, from a sulphate of copper solution, upon a copper plate, the same weight will be deposited by x units of current, whether those x units traverse the circuit in one hour or two hours, or two weeks, months, or years. Mr. Sprague says the principles underlying all these apparatus are "the production of motion in a set of wheels by the agency of plates of metals alternately dissolved and deposited on." This alternate deposition and dissolution is obtained by reversing the direction of the current, so that what is a positive pole at one time becomes a negative pole when the direction of the current is reversed. Suppose now we have the two plates in a solution of sulphate of copper ($Cu\ SO_4$). When an electric current is sent through the cell, one plate is positive and the other negative, the $CuSO_4$ is decomposed, and the Cu deposited upon the negative plate. As we have said, a definite current always deposits one and the same quantity, all other conditions being the same, such, *e.g.*, as temperature constant. On reversing the direction of the current, the same definite current will deposit an equal weight of Cu upon the other plate, and at the same time cause a chemical action whereby the Cu previously deposited is dissolved off, leaving the first plate in its initial condition as regards weight. If now each reversal of the current is shown by any means, we have a system of measurement, the only objection to which is that some of the current generated is utilised for the purpose of measurement, and not directly for the purpose for which it is generated.

This objection is met by saying that the current used in measuring is small compared with the total current. One of the best known laws of electricity is that the current is inversely as the resistance, and by making the branch measuring circuit of high resistance compared with the main circuit—say as 1999 : 1—then only $\frac{1}{2000}$ of the total current goes through it or is lost in the measurement.

The most recent form of Mr. Edison's meter is shown in the accompanying figure. It is divided into two compartments. The



one on the left-hand is called the monthly cell, the other the quarterly, the latter being used to check the former. The plates in the first cell are weighed every month, those in the second being weighed quarterly, and the deposit in the latter case must bear a certain proportion to the sum of the deposits in the former. A is the monthly, A^1 the quarterly cell, B and B^1 are compensating resistances for temperature. C and C^1 are shunts or branches, from which the cells receive their currents. The shunt C has a resistance of ·01 ohm, C^1 has a resistance of ·0025 ohm; so that one cell receives, according to the above law, four times the current of the other. D is a heating arrangement, devised to prevent the freezing of the solution used, viz., a solution of sulphate of zinc consisting of 90 parts of pure sulphate of zinc and 100 parts of pure water, with a specific gravity at (18 deg. C.) (64 deg. Fah.) of 1·33. The plates used in this solution are amalgamated zinc. The thermo-arrangement consists of a strip of brass and steel rivetted together. As these metals expand or contract differently with the rise or fall of temperature, and the strip is so adjusted as at a temperature of about 42 deg. Fah. to make contact at the point F, this puts the lamp E into the circuit. The heat from the lamp raises the temperature and contact is broken, and the lamp is out of circuit till the temperature falls. It will be seen at once that there is no great fluctuation of temperature if the meter is properly situated, that is, in a place where the temperature never rises greatly beyond about 42 deg. or 43 deg. Fah. The partition G divides the cells from each other. The use of this meter necessitates the periodical visits and weighings of an overseer, but Mr. Edison has other devices which we have before referred to, by means of which when one plate has received a certain weight from deposition a contact is made, a train set in motion, the current reversed, and a record made.

Mr. Sprague, working on the same principles, uses the alteration in specific gravity of a moving electrode. This electrode is simply made to float in the liquid, connection being made to it by a tube containing mercury in which a wire dips, so that the only resistance to motion is the viscosity of the mercury and of the liquids in the cell. The weight of the electrode itself has no longer to be supported, and the metal, as it deposits, merely alters the specific gravity of the electrode, which acts like a hydrometer, and when this addition has sunk it to the defined level, the circuit of the reverser is closed, the metal re-dissolves, the electrode rises to its upper limit, again actuates the reverser, and so continues the process *ad libitum*. Mr. Sprague has also devised a heating arrangement. His heater is constructed of two glass tubes placed vertically in the liquid, and enclosing between them a wire which, being heated by the current, warms the liquid.

In a recent pamphlet describing the Edison meter Mr. F. Jehl enters somewhat fully into the discussion of the principles and practice of such measurements. Mr. Jehl has had ample opportunity of obtaining a thorough knowledge of this subject, as he was Mr. Edison's laboratory assistant, and carried out the investigations made at Menlo Park. The method of calculation employed is simple, and we think effective, as will be seen from the following example taken from the pamphlet referred to. "Suppose one set of zincs, before sent out, weigh as follows:—monthly zinc, 92,800 milligrams; quarterly zinc, 92,600 milligrams. Now after being in a house for about one month, having about twenty lights, and using them about four hours a day, we find when the zincs are taken back to the station and weighed they have the following weights:—Monthly zinc, 95,317 milligrams; quarterly zinc, 93,229·2 milligrams. Now taking their original weight and subtracting it from the latter, we find the gain in the one case to be 2517 milligrams; in the other 629·2 milligrams." It will be seen that the gain on one side is about four times that of the other, showing that the meter is all right. The constant 1·336 has been ascertained to be correct for the finding of the current per hour with the small Edison meters. Thus, $\frac{\text{Gain in milligrams}}{1\cdot336}$ = Amperès per hour. Hence in the above case $\frac{2517}{1\cdot330}$ = 1883 Ampères, and the householder would be charged so much per Ampère current, just as he is now per thousand feet of gas.

It will be seen that the consumer is in this case wholly in the hands of the office, and we have no doubt it will be found more advantageous to all parties to use meters that register the current used, which means simply arranging for the reversal of the current under given conditions. Although the meters at present described are based upon electrolytic principles, there is no reason why meters altogether different should not be designed, meters in which none of the current is used for other than the purpose for which it is generated, and thus become as economical as gas meters.

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

(*From our own Correspondent.*)

The hot weather and the local holidays have somewhat disturbed mill and forge work, but have not interfered with the promptitude in deliveries which many customers are just now requiring at makers' hands. The system, too, which has become more general of late, of having weekly "pays" at the works, is likely to favourably operate in minimising the restlessness of the men, which a spell of unusual heat in summer nearly always occasions. At works, however, where monthly "pays" and fortnightly "draws" are still in vogue, managers will have to exercise their patience.

On 'Change in Birmingham this afternoon, and in Wolverhampton yesterday, trade fully maintained its former satisfactory aspect. Most of the finished ironmasters announced a fairly brisk demand, and prices all round were firm. The galvanisers in particular were vigorous in their declarations that a statement which has in some quarters obtained publicity, that prices of galvanised sheets are down, is inaccurate. They assert that there is no giving way, and the price of the majority is £14 10s. for 22 w.g. to 24 w.g. at the outports. A few makers quote £15. Their order books are well filled on Australian, New Zealand, South American, South Africa, and Indian account.

Ordinary sheets in the black keep very active. This afternoon prices were, singles, £8 5s.; doubles, £8 15s. to £9; and lattens, £10 to £10 5s. The two last gauges are the favourites with producers, and where a contract embraces plenty of these sizes, singles will be accepted at a lower figure than where the contract is made up of singles chiefly.

Best steel firms—such as manufactured tin-plates—also announce that they find no difficulty in running full time, but that they would like to see orders on their books further ahead. The antipodes and the European Continent, together with India, are customers. General market prices may be gathered from the following, which are those of Messrs. E. P. and W. Baldwin, "Severn" brand, £12; B., £13; B.B., £14; and B.B.B., £15.

The demand for tin-plates is unimproved, and orders are rather badly wanted. Ordinary cokes remain at 18s. at outports, while best I. C. cokes are quoted as high as 20s. per box, and best charcoals as high as 24s. to 25s. per box. At this last figure there have been a few recent sales for delivery in London.

Merchant sections of manufactured iron, such as bars, hoops, strips, and nail rods, are in brisk inquiry. A proof of this activity is found in the very different picture which presents itself to the eye of, for instance, the traveller by rail at night between Birmingham and Wolverhampton now as compared with some months ago. As early in the week as Monday night he will, as he passes, see the red glare in the numerous mills and forges, indicating an activity that at the former period was mainly conspicuous by its absence. Prices of these sections of iron are—Marked bars, £8 2s. 6d. to £7 10s.; medium bars, £6 15s. to £6 10s.; and common ditto, £6. Hoops are £6 10s., as a minimum, to £7, and gas strips £6 5s. to £6 7s. 6d.

The steel trade is without new features of note, but it was rumoured on 'Change this afternoon that we shall soon have before us the prospectus of the proposed company for manufacturing steel-iron from common native pigs by the Thomas-Gilchrist process.

The foreign pig iron trade keeps time as regards new business. Nevertheless, Leicestershire pigs are this week quoted up between 1s. 6d. and 2s. 6d. per ton, making the quotation 50s. delivered. The figure was, however, too high to permit of business. Indeed, vendors did not attempt to hide the fact, but their principals being well sold forward, they prefer to stand at the advance.

Derbyshire pigs were generally 48s. 6d. at consumers' works, and Northampton sorts 47s. 6d. Thorncliffe—South Yorkshire—pigs were quoted 60s.—a figure at which they have remained for a considerable time past. Ashton Vale part hematite, made at Bedminster, near Bristol, were priced at 55s. Not much business was done in any of these sorts, consumers having bought well previously; but inquiries for brands that showed an upward tendency were certainly more numerous.

Native pig makers here and there reported a little better demand, but the alteration was not conspicuous. Hot blast all-mine sorts were 65s. to 67s. 6d.; and cold blast 85s. Part-mines were 55s.; and cinder pigs 42s. 6d. to 38s. 9d. as the minimum. Hematites were quoted: Blaina sorts, 62s. 6d.; Wigan, 65s.; and Barrow and Tredegar each 67s. 6d.

Ironstone was quiet, but vendors of foreign sorts having recently made some capital sales, did not complain. Northampton stone—of which great quantities are consumed here—was 5s. 4d. to 5s. 8d. delivered. South Wales washed cokes were 17s. 6d. for furnace and 21s. to 23s. for foundry sorts, best. South Yorkshire qualities were 15s. 6d. delivered.

Coal is unimproved alike in demand and in price.

The Australian trade in iron, galvanised sheets, and general hardwares is becoming increasingly important to this district. Certain of our local merchant houses, who do an Australian business, are about to establish branch establishments in London.

A big contract for wrought iron tubes has been placed at Wednesbury with Messrs. James Russell and Sons, Limited. It is for water conveyance at Kimberley, in South Africa, and will consume some 500 tons of iron. The mains are of 14½in. diameter, and each one weighs 5 cwt. This is the second contract of this nature that the firm have received. In the manufacture of engineers' tools, engineers' brasswork, tubes for land and marine boilers, makers are also very busy. The wrought iron tube trade in the district, as a whole, is, however, flat.

Our manufacturers continue to be benefitted by the needs of Government in carrying on the war in the East. One of the latest of such orders is for spikes for urgent shipment to Alexandria, to be used in making good some of the damage to the town caused by the bombardment.

The directors of the Birmingham Railway, Carriage, and Wagon Company have declared an interim dividend for the past half-year at the rate of 5 per cent. per annum on the original and second issue shares, and at the rate of 6 per cent. per annum on the preference shares.

The Great Western Railway Company and the South Staffordshire Waterworks Company have appealed against the valuation recently made by the Assessment Committee of the Wolverhampton Board of Guardians of those portions of their respective properties which lie within the jurisdiction of the Board. The grievance is stated to be unfairness in these assessments compared with those of other assessments of the union. The railway company demands a re-valuation of all property outside its own. The matter will be considered by the Board on the 11th inst.; but as a re-valuation would cost from £3000 to £4000, it is likely that some compromise will be made.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is very little change of importance to notice in the iron trade of this district during the past week. Inquiries still come in only slowly, and for no great weight of iron, as a rule; but makers being mostly well sold—in some cases having large deliveries before them, which will carry them well over the year—they are not at all anxious sellers. Prices for makers' iron consequently remain firm, with comparatively very little underselling, even amongst second-hand holders of iron.

Lancashire makers of pig iron are still making very fair deliveries against contracts, and their quotations remain at about 46s., less 2½, for both forge and foundry pig iron, delivered equal to Manchester; but new business only to a small extent is at present coming in.

District brands of pig iron coming into this market still rule high in price as compared with the local makers. Lincolnshire iron in exceptional cases might be bought at 47s. 6d., less 2½, but the average price asked is 47s. 10d. to 48s. 10d., less 2½; whilst for Derbyshire makers are asking 49s. to 50s., less 2½; and for g.m.b. Middlesbrough quotations range from 51s. 10d. to 52s. 10d. net cash, delivered equal to Manchester. These figures, however, are only being obtained as a rule for small parcels.

Finished iron makers are generally kept well employed on specifications, and there are fair inquiries for shipments, but on home accounts sales only to a limited extent are at present being effected. In exceptional cases bars can be bought at as low as £6 5s. per ton delivered into the Manchester district, but the average quotations are £6 7s. 6d. to £6 10s., and at these figures makers generally are firm.

The engineering branches of trade throughout this district are kept well employed on orders in hand, but I still hear complaints that new business is not coming in at all satisfactory.

The members of the Manchester district of the Amalgamated Society of Engineers, which is composed of twenty-one branches, with a total membership of about 4000, held a festival at the Belle Vue Gardens, Manchester, on Saturday. It is ten years since a similar festival was held, and the proceedings were very successful, about 2000 members and friends being present. There was, of course, the usual procession through the principal streets and at the gardens, and after tea had been disposed of a meeting was held under the presidency of Mr. R. Austin, the local representative of the executive committee, and an address was delivered by Mr. J. Burnett, the general secretary of the society, who urged more energy and zeal amongst the younger members in carrying out the objects of the society, and in securing for themselves the social and political influence which, as workmen, they ought to exercise.

A month or two back I referred to an exceptionally heavy pair of combined rolling mills for roughing out and finishing iron or steel tires, which Messrs. Wm. Collier and Co., of Manchester, had in hand for an ironworks in Belgium, and as the work has now been completed, I am able to give a few additional details, which will be of interest. The mills are constructed to roll tires from 1ft. 6in. up to 9ft. diameter. Two sets of rolls are provided, one set for roughing out the blooms as they come from the hammer until they are within a few inches of the size required, and the other for finishing the tires to the size and section required. The operation is carried through all the same heat, and the scale being removed from the blooms in the roughing process. The finishing rolls are kept clean for their work. The machine consists of a large frame, cast in two pieces, weighing thirty tons, with two upright shafts in the centre for carrying the rolls constructed of Bessemer steel, and ranging from 10in. to 12in. in diameter. These shafts are driven by powerful gearing, consisting of bevel wheels upon the roughing roll shaft 12in. wide and 4in. pitch, which by spur wheels also 12in. wide on the teeth and 4in. pitch and flanged on both sides, drive the finishing rolls. The roughing-out slide carries a vertical steel shaft 8in. diameter with rollers at the top, and held in at the bottom by an adjustable foot-stop, whilst to take up the wear in the centre there is a friction clip keyed on, and made in halves so to be readily removed. Facing-up rolls are carried on horizontal slides. At the finishing end there are in addition to the large and small rolls a pair of side rolls carried on swing brackets, which are brought out to their work by worms and worm quadrants. The swing brackets also carry two small adjustable rolls to keep the tire in position as it is being rolled, whilst the side rolls keep the tire rigid and true between the large rolls as it expands in diameter. There are also five horizontal rolls, two at each side of the machine and one in the centre, on which the tire rests. These rolls are set at one level, and are carried on brackets with brass steps and adjustable bearings, the centre roll being carried in a bracket which is attached to the horizontal slide by set screws, and when this slide is moved the roll is carried with it, so that as the tire expands in diameter the roll moves further off. The main roll shafts are carried on powerful brackets, and at the bottom are supported on foot-plates, with gun-metal bearings adjustable by wedges and screws. The half-finished tires are moved from one set of rolls to the other by means of a small hydraulic crane, and the moving rolls at each end of the machine are actuated by hydraulic pressure. An hydraulic steel-lined cylinder of 15in. diameter and ram of 12in. diameter is attached to each of the roll slides—the water passing through the centre of the rams—for keeping the pressure on the rolls, and smaller hydraulic cylinders are also attached to bring back the roll slides and take out the tires. The hydraulic power is obtained by a pair of pumps with large and small plungers, the large ones being used only for the rapid motions of the slides, and throw themselves out of gear when the pressure comes on. The slides are then moved forward to their work by the small plunger. These pumps are worked by a pair of steam cylinders attached to the side of the pump cistern. Above ground and by the side of the engine are placed the hydraulic valves, by means of which the slides carrying the moving rolls are rapidly moved backwards and forwards. The steam valves for working the large and the small engines are also placed close to the hydraulic valves, so that the whole machine is under the control of one man. All the rolls are also put in operation by one man by means of a large hand-wheel at the side, and both roughing out and finishing can be carried on simultaneously by the machine. The engines for driving the mill consist of a pair of horizontal compound condensing engines, with variable expansion gear. The construction of the engines is of the box form, with cylinders bolted on at the end of the engine beds, with the whole pair of engines carried on one foundation plate. One cylinder has a bore of 26in., and the other 20in., with a stroke of 3ft. 6in. The small cylinder works on a double-throw crank, and the other on a cast iron crank hinged on to the end of the engine shaft. The condenser is of the ordinary type with a 10in. plunger, and worked by a pair of levers. The rolling mill itself weighs nearly 70 tons, and with engines and condensers the total weight is about 100 tons.

The coal trade continues very quiet, without any alteration in prices, except so far as odd sales are made at very low figures to move away stocks. The demand shows no material change, house fire coals still moving off very slowly, with a moderate inquiry for iron-making and steam classes of fuel, but with supplies all round plentiful and pits not working more than about four days a week in most cases.

In the shipping trade there has been rather more activity during the last week or two, and in coastwise cargoes, chiefly to Ireland, there has been a fair business doing. Vessels, however, continue scarce, and low prices have still to be taken, steam coal delivered either at Liverpool or Garston being obtainable at from 6s. 6d. to 7s., and seconds house coal at 8s. 3d. to 8s. 6d. per ton.

The strike in the St. Helens district continues and shows no indication of any early termination. In the Oldham and Ashton districts, where the sliding scale for the settlement of wages has now been adopted at all the collieries, the arrangement has been renewed for another twelve months, the only alterations being that in future the scale will oscillate 2½ per cent. for every rise or fall of 3d. per ton in coal instead of 4d.

Barrow.—Owing to bank holiday, business has been interfered with to a considerable extent, and prices have remained stationary in consequence. The amount of business done, however, goes to show the healthy state of the market, and the outlook at present indicates pretty plainly, I think, a brisk winter's trade. Prices have a tendency to advance, and it is expected that quotations will be 1s. per ton higher all round at the beginning of next week. The deliveries of metal increase weekly, and as a consequence stocks are being reduced very considerably. The demand for mixed samples of pig iron is well maintained, and although there is no new feature in connection with business this week, I am able to say that makers are asking 60s. for No. 1 Bessemer; and if the inquiries are kept up on the same scale as at present, they will, in a very short time, ask higher values, as the demand outstrips the supply. Second-hand parcels are scarce. Steel makers are busy, and their position is unchanged. Prices are firm, and the demand fully maintained. Iron ore in better request, at last week's prices. Iron shipbuilders, engineers, ironfounders, boiler-makers, and others, steadily engaged, although shipbuilders might be better supplied with orders. The demand for coal and coke is good.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE largest turret ever made at the Atlas Works—Messrs. John Brown and Co., Limited—has been completed this week for H.M.S. Ebinburgh—formerly the Majestic. It is the first of two ordered for that vessel, and is entirely constructed of compound—steel-faced—plates, on the principle patented by Mr. J. D. Ellis, the chairman of the company. There are seven plates in each turret—one 16in. thick, equal to 20in. of iron armour, with two portholes 3ft. 11in. by 2ft. 7in.; the other six plates are 14in. thick. The diameter of the turret—outside measurement—is 28ft. 6in., the height 7ft. 2½in., and the finished weight is 152 tons, so that in the two turrets alone, exclusive of the ordnance to be mounted in them, there will be a weight of 304 tons. The turret is a splendid specimen of Sheffield manufacture, and is strong evidence of the perfection to which compound plates have been brought, not only in securing a perfect weld between the two metals, but in the uniformity of surface and quality of material throughout. Messrs. Brown and Co. are at present full of work in armour-plates, and have completed important extensions and additions to facilitate their production. These include a new planing shop, 190ft. by 60ft., where Messrs. Shanks, of Johnstone, near Glasgow, have fitted up several fine machines. One of these weighs 170 tons, and will take in plates 14ft. by 10ft. A new press is also being constructed, in which it is intended to flange marine boiler fronts of 18ft. diameter in two plates.

The Sheffield Chamber of Commerce have had their attention seriously directed to the conditions of commercial relations between this country and Spain. At present the Spanish tariff is even more prohibitory than the French. Spain, nettled at what she considers the undue favour shown in the admission of French wines, has carefully arranged the tariff to operate oppressively on English goods. At present the Spanish duties on British manufactures are higher than on those of all other European countries by from 15 to 300 per cent. Common cast iron is 22 per cent. higher, finer iron wares 48 per cent. higher, and steel, ordinary and better, 20 and 30 per cent. higher respectively. Under these circumstances it is scarcely surprising that the Chamber should have moved "that a memorial be presented to the Prime Minister pointing out the probable destruction of English trade with Spain by reason of the admission into that country of French goods at very much lower rates than English manufactures, and praying the Government to take steps immediately as they may deem expedient, to remedy this state of things."

A statement has been published to the effect that Messrs. Charles Cammell and Co. have given out a contract for the erection of their new works at Workington, and that it amounts to something like £50,000. I have authority for stating that this statement is not correct. Additions and extensions are contemplated at Workington, but no contract has as yet been given to any builder, nor will it amount to much more than one-fourth of the sum named.

Messrs. Samuel Fox and Co., Limited, present a most satisfactory report for the year ending 30th June last. They have made a profit of £43,381, which, added to the balance from the previous year, gives a total of £48,442. It is proposed to pay a dividend of 15 per cent per annum, towards which an interim dividend at the rate of 10 per cent. per annum was paid on the 1st of March last. This will leave £12,442, of which it is proposed to carry £11,780 to the reserve fund, increasing that fund to £45,000, and carrying forward the balance, £662, to next year's account. This company has a private line from Deepcar station to its works at Stockbridge. The company took up all the ordinary shares and guaranteed payment of principal with interest, and dividends on the debentures and the preference shares which were issued to the public. The debentures for the most part fall due on the 30th September next, and the company is gradually acquiring them, being already in a position to hold £12,000 of the railway debentures in addition to the ordinary shares. Mr. Frederick Bardwell retires from the directorate by rotation, and is recommended for re-election. Very important extensions have been made at the works during the last few years, and as the next meeting is to be held on the premises, the shareholders will have an opportunity of seeing what has been done.

The Sheffield Wagon Company, Limited, in its annual report issued on the 9th inst., state that the defalcations of its late secretary, Mr. J. M. Wing, entirely preclude the possibility of a dividend. A careful examination of the company's books shows the loss thus sustained to be £30,302 15s. 6d., and this is believed to be the total amount. At present, however, the amount has been carried to a suspense account.

A very great improvement has latterly taken place in the South American demand for sheep-shears, and from Australia the call for both sheep-shears and edge tools has recently been remarkable. For edge tools several very heavy orders have also been received from the Continent. In fact, the leading makers of sheep-shears and edge tools in Sheffield assured me this week that they had not been so busy for years as they are now, and that the orders from the markets named are larger than at any period since 1872-3.

The Midland Railway Company, in its half-yearly report, states that during that period the mileage of passenger trains has been 6,159,417; of goods and mineral trains, 9,267,142—a total of 15,426,599 miles, showing an increase, when compared with the corresponding period of last year, of 127,386 miles. During the half-year the renewals have been 39 engines, and there have been laid 51 miles and 57 chains of steel rails, and 60 chains of renewal with cross-bed sleepers. The total revenue receipts are £3,451,839; the working expenses are £1,790,882—including interest on debentures, &c.—and there is available for dividend £1,248,317, which admits of £2 15s. on each £100 consolidated ordinary stock, and the other stocks as usual, leaving a balance of £11,878 to be carried forward to the current half year.

The Cutlers' Company met on the 8th inst., when Mr. Albert A. Jowitt, of the Scotia Steel Works, was chosen Master Cutler elect, as successor to Mr. J. E. Bingham, silver and electro-plate manufacturer—trading as Walker and Hall—who retires in September.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was but a poor attendance at the Cleveland iron market held at Middlesbrough on Tuesday last, attributable partly, perhaps, to a prolongation on the part of some, of the Bank Holiday of the previous day, and partly to the Redcar races which may have tempted others. The tone of the market was quiet, with a tendency to weakness. The war with Egypt helps to produce a certain amount of hesitation and uncertainty as to the future, and discourages speculation. Again, the occurrence of Stockton races next week will lay off completely nine manufactured ironworks, consuming collectively from 8000 to 9000 tons of pig iron per week, and accumulations to that extent must then take place either in makers' or in public stores. There was, therefore, some solid ground for the tendency to weakness discernible on Tuesday. The price asked by makers for No. 3 g.m.b. for prompt delivery was 44s. 6d., f.o.b., and for No. 4 forge, 1s. per ton less. Merchants were willing to sell at 3d. per ton under these prices, and in some cases, and for forward delivery, at 6d. under. Warrants were quite a drug. The nominal price was 44s., but little business was done. The stocks of iron in Connal's store are still decreasing a little, but next week the position will probably be reversed. Shipments continue to be very brisk, owing no doubt to the fine weather, and the gradual approach of the less favourable seasons.

The manufactured iron trade is in about the same condition as pig iron, viz., steady and quiet. The increase of ironworkers' wages by 2½ per cent., which took place from the 31st of July, has handicapped employers to the extent of about 9d. per ton, and they have to face the prospect of another 9d. per ton in six weeks, in accordance with Sir J. W. Pease's award. Inasmuch as their selling prices have gone down steadily since that award was given, they find it rather hard to have to pay increased prices. They have, therefore, given, through their secretary, notice to the ironworkers' secretary that they will require a substantial reduction of wages at the termination of the award in October, the exact amount of reduction to be fixed later, or according to the then position and prospects of the trade.

Ship plates were on Tuesday still quoted at £6 15s. for large and favourable specifications, and £7 for small lots delivered Middlesbrough, less 2½ per cent discount. Bars and angles were £6 5s.

The half-yearly meeting of the Board of Arbitration was held at Darlington on Thursday week, Mr. William Whitwell in the chair, and Mr. Cullen in the vice-chair. The report which was read showed that twenty firms and 9861 ironworkers were now in membership. There is a cash balance in hand of £580 18s. The notice for a reduction of wages at the termination of the Pease award, which was decided on before and delivered during the meeting, produced, as might have been expected, a considerable commotion among the delegates. The vice-chairman said he should advise the men to claim a rise of 15 per cent., instead of submitting to any reduction whatever; and Mr. Trow, the operatives' secretary, sarcastically alluded to the excellent balance-sheets which had been issued recently, hinting especially at the annual report of the Consett Iron Company. It was urged on the other hand by the employers that the price of manufactured iron had fallen considerably, and that at least three firms had recently failed, and that the strike of a fortnight in May against the Pease award had caused them a heavy loss, which they were entitled to recover by lower wages. They had thought it wise and right, however, that the award should be absolutely respected during its continuance. A long and wearisome discussion took place on the question of compensation to two firms whose men had carried on partial strikes to carry particular points. Although resolutions were passed that the men were entirely in the wrong, and that the employers were entitled to compensation, the operative members of the Board flatly refused to vote for any compensation whatever being paid to the aggrieved employers out of the funds of the Board. By a narrow majority, and in face of numerous abstentions, it was ultimately carried that the employers might, if they chose, fine the offending workmen a small amount each. This, however, was as good as non-suiting them, for the men will certainly refuse to pay the fines, and the Board has shown itself almost completely powerless to enforce its own decisions. A claim from the workmen for 6d. extra for every half-pig of hematite worked in each puddling furnace heat was declined by the employers, and finally referred to Mr. David Dale to decide.

Messrs. Bolckow, Vaughan, and Co. have issued a circular to their shareholders, asking for an increase of capital to the extent of £350,000. Of this £250,000 is to be raised as ordinary share capital, and the remainder as preference stock. The need is occasioned by a scheme for developing the now nearly-unoccupied site of their old works in Vulcan-street, Middlesbrough. They say their present plant is equal to an output of 5000 tons of finished steel per week, and they wish to increase this. They also are improving their blast furnaces, and intend to develope a trade in salt, which underlies their premises.

Apropos of the salt trade, Messrs. Bell Brothers have now actually commenced to make salt at Port Clarence; and it is said that Messrs. Allhusen, of Newcastle, are anxious to acquire a site in the same district for a similar purpose.

A meeting of the creditors of Mr. C. E. Muller, iron merchant, of Middlesbrough, and late owner of the Erimus Steelworks at South Stockton, has been held. The liabilities to unsecured creditors amount to £62,963 9s. 6d., and the available assets to £11,705 5s. 6d. This shows a dividend of 3s. 9d. in the pound, and there is a probability that the creditors will actually recover 2s. 6d. It was decided to wind up the estate by arrangement, and not in bankruptcy. Mr. W. B. Peat was elected trustee, and Messrs. Whitwell, Gjers, Rogerson, Bell, and Thompson a committee of inspection. A resolution was then passed to grant the debtor his immediate discharge, and he was even highly complimented on his personal merits, and on his past services to the district.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

AFTER the breakdown in the warrant market early last week the tone of business has been steadier, and a fair amount of transactions have taken place chiefly among dealers. The unsettled state of affairs consequent upon the Egyptian war seems to preclude speculation on the part of the public. But the legitimate departments of the iron trade are busy. The past week's shipments of pig iron aggregated 13,579 tons, as compared with 13,116 in the preceding week, and 12,669 in the corresponding week of 1881. Large consignments are being made to Canada and the United States, whilst a fair business is being done with the Continent. In the course of the week the stock of pig iron in Messrs. Connal and Co.'s Glasgow stores has been reduced by 980 tons, but two extra furnaces having been lighted up during the past week or so, the output is increased by about 380 tons weekly.

Business was done in the warrant market on Friday forenoon at from 50s. 5d. to 50s. 6d. and down to 50s. 3d. cash, and from 50s. 7d. to 50s. 5d. one month, the afternoon quotations being 50s. 4½d. to 50s. 6d. cash and 50s. 7d. to 50s. 8d. one month. Monday being a bank holiday no market was held. On Tuesday forenoon business was done at 50s. 6d. to 50s. 10d. cash and 50s. 4d. to 51s. 0½d. one month. The market was strong in the afternoon, with business at 50s. 10d. ten days to 51s. 1d. cash and 51s. to 51s. 3d. one month. The market was firm on Wednesday, with transactions between 50s. 11d. and 51s. 3d. cash, and 50s. 6d. to 51s. 2d. one month. To-day—Thursday—business was done at 51s. 4½d. to 51s. 3d. cash, and 51s. 6d. one month.

The quotations of makers' iron are firm as follows:—Gartsherrie, f.o.b. at Glasgow, per ton No. 1, 62s. 6d.; No. 3, 55s. 6d.; Coltness, 66s. and 56s.; Langloan, 64s. 6d. and 56s.; Summerlee, 62s. 6d. and 54s. 6d.; Calder, 62s. 6d. and 54s.; Carnbroe, 56s. and 52s. 6d.; Clyde, 55s. and 52s. 6d.; Monkland, 52s. 6d. and 50s. 6d.; Quarter, 52s. 6d. and 50s. 6d.; Govan, 52s. 6d. and 50s. 6d.; Shotts, at Leith, 63s. 6d. and 56s.; Carron, at Grangemouth, 53s. — specially selected, 56s. — and 52s.; Kenneil, at Bo'ness, 52s. and 51s.; Glengarnock, at Ardrossan, 56s. and 52s. 6d.; Eglinton, 53s. and 51s. 6d.; Dalmellington, 53s. and 52s.

The past week's arrivals of Middlesbrough pigs at Grangemouth were 3825 tons, against 4690 in the preceding week and 4790 in the corresponding week of last year, and there is a total decrease on these imports from Christmas to date of no less than 46,254 tons.

At Glasgow very large imports of minerals are taking place, the arrivals of iron ore from Bilbao alone, in the course of four weeks, amounting to about 23,000 tons. Notwithstanding this activity the demand for hematite is a little easier at the moment, the price being 56s. 6d. per ton f.o.b. Cumberland.

The export department of the coal trade, though not showing quite so well as it did a week ago, is still active, and large despatches are expected in succeeding weeks. At Glasgow 17,252 tons of coal were shipped; Burntisland, 16,789; Ayr, 7110; Greenock, 7175; Grangemouth, 6105; Leith, 6228; and Troon, 5737 tons. The inland demand continues satisfactory for the season, and prices are firm, although not materially improved.

A strike has occurred of about 150 miners at the Elgin and Wellwood Collieries, Dunfermline, the reason assigned by the men being that Messrs. Spowart and Co., their employers, have introduced a new method of weighing the coals which they consider disadvantageous.

Mr. David Richmond, of the City Tube Works, Glasgow, has purchased the large works of a similar nature in Broomloan-street, Govan, which he will carry on under the style of the North British Tube Works. Operations at the City Tube Works will not be affected by this purchase.

During July, 82,300 lb. of gunpowder—less than usual—was shipped from the Clyde, of which 44,800 lb. went to Melbourne, and 37,500 lb. to Valparaiso.

The appointment of Sir James Falshaw, Bart., as chairman of the North British Railway, in succession to the late Mr. Stirling, of Kippendavia, has given much satisfaction in railway and commercial circles.

Messrs. Stevenson, M.P., Newall, Leslie, and Co., a deputation of the River Tyne Commissioners, along with Mr. Urwin, the secretary, Mr. Messent, engineer, and Mr. Leishman, harbour-master, have been on a visit to the Clyde, inspecting the harbour works, and particularly the Glasgow underwriters' apparatus for raising sunken vessels.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE is a notice in the *Times* of a considerable extent of bituminous coal-field in the neighbourhood of Swansea for sale. The time is opportune for such investments. Next week the coal-field of Plymouth will be brought to the hammer. The sale in London is taken as suggestive. More prospects, it is maintained, of a sale being effected would be given if carried out on the spot, where purchasers could see what the property was worth for themselves. The statement made of a leading railway being in the field as a purchaser may be dismissed. One of the principals was questioned as to the truth of the statement, and his reply was, "Not at all likely. We can buy rails cheaper than we can make them."

Good progress is being made at Cyfarthfa, and the foundation of the new furnaces is being laid in. Mr. William Evans is now in charge as manager, and will reside at Llnyncelyn, the family residence of the Kirkhouses, who have held it for 100 years, the first of the name being a manager with the first Crawshay. Considerable satisfaction was given in Cardiff this week when it was announced that the Bute Dock Bill had passed the third reading. As I stated last week, it was a foregone conclusion; still, until it had actually passed, public expression was withheld. Now even the opposers are beginning to think that "it is better as it is." It secures the prosperity of Cardiff for a long term of years again. Mr. W. T. Lewis has earned a vast amount of gratitude by his labour, and this success is, so far, the most important. I am glad to hear of his improving health. The efforts of the last twelve months have been sufficient to tell upon the most vigorous condition.

The iron trade is in a brisk state, and every encouragement is given to makers to carry out their alterations and conversions. It is now genererally admitted that iron and Welsh mine are amongst the obsolete, but inquiries for good Welsh mine are still coming to hand, and old scrap iron, broken mouldings, &c., are readily bought. I note an important sale of cast and wrought iron at Nantyglo next week.

An important case was heard at Swansea Assizes last week, in which a claim was made upon a colliery owner for damage caused at Maesteg by working too near the foundation of a house. It was, however, shown that in the lease accepted by plaintiff, it was stipulated that no damages would be allowed in the event of any subsidence of ground, and so a nonsuit was entered. The affair has been freely discussed in the coal district, and the general scrutiny of leases has been the result, the point being of vital importance.

Arching with masonry is resorted to in the deep Navigation pit, Treharris, and is found to answer well. A large output is promised when this has been effected.

There is a good inquiry for coals of all descriptions, house and steam, and prices are remarkably firm for the season. Small coals are in excellent demand, and good prices are secured.

The total exports of coal from the Welsh ports to foreign and coastwise destinations exceeded last week 200,000 tons. Our next total will not be so large, the colliery population having taken a good deal of holiday-making this week, and the Rhondda colliers have been engaged, some as volunteers, others at one of those Welsh Olympian contests known as an Eisteddfod, held at Abergavenny, whereat they figured remarkably well in vocal melody. Notwithstanding these relaxations, a good deal of satisfactory business is being done, and coalowners are not slow in attributing the firmness of the market and its healthy state to the successful passing of the Bute Dock Bill.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—William E. Pilcher, chief engineer, to the Invincible; William J. Cauter, chief engineer, to the Humber; James G. Bain, chief engineer, to the Asia, for service in the Rupert; Andrew Watt, chief engineer, to the Duncan, for service in the Hydra; Richard H. Tregenna, engineer, to the Indus, for service in the Hotspur; William H. Moon, engineer, to the Indus, for service in the Industry; and Henry G. Burr, engineer, to the Asia, for service in the Elk.

TWIN FIRST-CLASS CARRIAGES. — Some new twin first-class carriages just completed at the Wolverton Carriage Works of the London and North-Western Railway Company were on Saturday run from London, attached to the mid-day train. The two carriages are each rather larger than the ordinary first-class carriages. One is devoted to gentlemen, and has a small separate smoking-room for six persons; the other has its central saloon devoted to family parties, with a separate compartment of like dimensions as the smoking-room — about 6ft. square — devoted exclusively to ladies. Each carriage has its lavatory, and the two carriages are coupled together, the interspace being covered by an enclosed platform, forming, with the end compartments of the carriages, an ante-room, in which an attendant travels with the carriages, and is summoned by the traveller by electric bell. There is a gangway completely through the whole length of the twin carriages, being, including the intermediate platform, a total of 72ft. Doors close one carriage from the other, by which sufficient privacy is ensured, whilst there still remains, in case of need, a means of communication.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

1st August, 1882.

3638. Collecting Dust, A. Stevenson, Chester.
3639. Purifying Gas, J. Walker, Leeds.
3640. Distilling Tar, W. Maxwell, Gartsherrie.
3641. Shirts, G. W. von Nawrocki.—(*Messrs. S. Stern and Sohn, Germany.*)
3642. Sculling Boats, T. J. Edwards, London.
3643. Ammonia, A. Feldman, Germany.
3644. Indicating Firedamp, I. Kitsee, Cincinnati.
3645. Anti-friction Bearings, W. P. Thompson.—(*E. Solomon and E. Armant, Montreal.*)
3646. Obtaining Products from Solid Matters, G. F. Redfern.—(*H. Wurtz, New York.*)
3647. Packing, J. Brown, London.
3648. Fastening, G. F. Redfern.—(*E. C. C. Henderson, Picton, and T. A. McDonald, Durham.*)
3649. Screw Propellers, H. Hardy, Edinburgh.
3650. Trousers, R. Redman, Hebden Bridge.
3651. Preventing Incrustation in Boilers, W. E. Gedge.—(*J. Boissié, Paris.*)
3652. Driving Belt, W. H. Chase, London.
3653. Permanent Way, A. Vogt and A. Figge, London.
3654. Saw-filing Apparatus, A. M. Clark.—(*C. M. Elkins, Matteawan, and W. H. Weston, Newburgh.*)
3655. Electric Lamps, O. G. Pritchard, Penge.
3656. Cigarettes, W. R. Lake.—(*The Cowman Cigarette Machine Company for Foreign Countries, New York.*)
3657. Embroidery Apparatus, W. R. Lake.—(*F. H. Chilton, New York.*)
3658. Steam Pumps, W. W. Beaumont, London.

2nd August, 1882.

3659. Impressing the Postmark, &c., on Letters, E. Brydges.—(*D. Grove, Berlin & A. Plümecke, Germany.*)
3660. Musical Instruments, P. Ehrlich, Gohlis.
3661. Telephone Circuits, J. W. Fletcher, Stockport.
3662. Tube Expanding, G. Sonnenthal.—(*P. Revollon, France.*)
3663. Steam Traps, H. Lancaster, Pendleton.
3664. Fastening, T. Marlborough and J. Cunningham, Sunderland.
3665. Plates of Batteries, T. Cuttriss.—(*C. Cuttriss, Duxbury, Massachusetts, U.S.*)
3666. Wires, P. R. de Faucheux d'Humy, London.
3667. Railway Switches, H. J. Haddan.—(*G. Otte, Apeldoorn, Holland.*)
3668. Lubricating, B. A. Dobson, Bolton.
3669. Looms, J. Whittaker, Padiham, and R. Claydon, Richton.
3670. Stoppering Bottles, T. and J. Brooke, Sheffield.
3671. Railway Switches, &c., P. Prince, Derby.
3672. Figured Cloth, J. Kirkman, R. Smith, P. Entwistle, Bolton.
3673. Steel, &c., Rods, E. Deeley, Walsall.
3674. Preventing Accidents, S. Williams, Newport.
3675. Cleaning Wool, W. P. Thompson.—(*A. Frayssé, Anvers, Belgium.*)
3676. Sliding Gates, W. Thompson.—(*I. Sherwin, U.S.*)
3677. Slide Valves, A. M. Clark.—(*J. De Lancey, U.S.*)
3678. Water, L. A. Groth.—(*F. Piehler and C. Sedlácek, Vienna.*)
3679. Permanent Way, L. A. Groth.—(*F. Schanman, Sweden.*)
3680. Rings, R. J. La Grange, St. Leonard's-on-Sea.
3681. Telephonic Communication, J. Cowan, Garston.
3682. Grass Edge Clippers, T. Green, Leeds.
3683. Locking Mechanism, W. R. Lake.—(*H. F. Newbury, Brooklyn, New York.*)
3684. Fire-arm, W. R. Lake.—(*C. Coronini, Austria.*)
3685. Dynamo-electric Machines, W. R. Lake.—(*H. C. Sample and F. Rabl, Camden, U.S.*)
3686. Exhaust Fans, F. M. Eden, Kettering.
3687. Working Machinery, J. Hircock, Birmingham.
3688. Door Knobs, W. Thomson, Shaw.
3689. Electrical Energy, W. Lake.—(*M. Levy, Paris.*)
3690. Horseshoes, J. R. Thompson, Buckden.
3691. Channels, &c., G. M. Edwards, London.
3692. Tension, &c., Winding, Y. Duxbury, jun., Over Darwen. Lancashire.

3rd August, 1882.

3693. Evaporating, &c., Liquids, H. Gardner.—(*F. B. Nichols and C. Thompson, Halifax.*)
3694. Wagon, E. Hollingworth, Dobcross.
3695. Preserving Milk, H. von Roden, Hamburg.
3696. Preventing Noise, W. Ney, London.
3697. Cleaning Intestines, E. de Pass.—(*S. Oppenheimer, New York.*)
3698. Microphonic Apparatus, J. H. Johnson.—(*Dr. A. D'Arsonval, Paris.*)
3699. Bells, J. Harrison, Birmingham.
3700. Secondary Batteries, E. G. Brewer.—(*O. Schulz, Germany.*)
3701. Preventing Down Draught in Chimneys, C. E. Hanewald.—(*F. Haszelmann, Germany.*)
3702. Cement, L. Roth, Wetzlar, Prussia.
3703. Ice, T. Watts, Newport and W. Gorman, London.

4th August, 1882.

3704. Vacuum Brake, J. Gresham, Salford.
3705. Electric Lamp, J. L. Somoff, London.
3706. Combining Harmoniums with Pianos, L. Küstner, Hamburg.
3707. Steam Engines, C. J. Galloway and J. H. Beckwith, Manshester.
3708. Wool, H. Haddan.—(*F. Fernau & Co., Belgium.*)
3709. Propellers, W. G. Wrench, Glasgow.
3710. Electric Lighting, T. Parker, Coalbrookdale, and P. B. Elwell, Wolverhampton.
3711. Boiler Bridges, C. Hill, Blaydon-on-Tyne.
3712. Electro-magnets, S. C. C. Currie, London.
3713. Electric Arc Lamps, E. G. Brewer.—(*Société Anonyme des Ateliers de Construction Mécanique et d'Appareils Electriques, Paris.*)
3714. Sulphurous Anhydride, S. Pitt.—(*Compagnie Industrielle des Procédés Raoul Pictet, Paris.*)
3715. Dressing Waste Silk, S. Lister, Manningham.
3716. Cube Fire-lighters, T. V. Trew, Plaistow.
3717. Axles, W. R. Lake.—(*D. Anderson, Australia.*)
3718. Treating Ore, W. R. Lake.—(*R. McCully, U.S.*)
3719. Folding Seats, W. H. Avis, Polegate.
3720. Solitaires, &c., A. B. Furlong, London.
3721. Boiling Liquors, A. Barraclough, York.
3722. Button, A. Combault and W. T. Taylor, London.
3723. Ploughing, &c., J. Imray.—(*P. Dietrich, Berlin.*)
3724. Sulpho-acids, F. Wirth.—(*Farbfabrick vormals Brönner, Germany.*)
3725. Vaporising, &c., E. J. C. Fear, Redland.
3726. Fac-simile Copies of Writings, T. H. Taylor, Manchester.

5th August, 1882.

3727. Type-writers, A. Boulton and C. Dickie.—(*A. Hausen, Hamburg.*)
3728. Carriages, U. Scott, London.
3729. Wash-stands, A. J. Boult.—(*N. O. Bond, U.S.*)
3730. Bicycles, J. G. Horsey and T. Bell, London.
3731. Recovering Tin, A. T. Becks, Aston.
3732. Preventing the Removal of Corks from Bottles, H. Shaw, Aston, near Birmingham.
3733. Propellers, G. C. Parini, Lombardy, Italy.
3734. Conveying, &c., Grain, L. E. Mansfield, Paris.
3735. Reducing, Minerals, R. J. Cunnack, Helston.
3736. Heating, Fluids, W. & G. Lawrence, London.
3737. Ceramic Composition, B. Mills.—(*F. Gillet, Paris.*)
3738. Holder for Chalk, C. E. Bryant, London.
3739. Rotary Engines, J. G. Jones, London.
3740. Bleaching, &c., J. C. Mewburn.—(*J. Vercruysse-Degraeve, Belgium.*)
3741. Bricks, &c., A. Bauquié, Paris.
3742. Tricycles, I. T. Townshend, Coventry.
3743. Hay Rakes, G. Perrott, jun., Cork.
3744. Painting, &c., Fabrics, D. Guille, London.
3745. Regulating the Flow of Gases, R. Macintyre, London.
3746. Dyeing, &c., of Hanks, G. Heywood and S. Spencer, Lancaster.
3747. Spring Mattresses, G. H. Slack, Manchester.
3748. Mules, J. E. Eppenstall, Milnsbridge.
3749. Fabric for Wall Hangings, A. M. Clark.—(*A. Hutchinson, Paris.*)
3750. Dental Plates, J. H. Gartrell, Penzance.
3751. Electrical Signalling, W. R. Lake.—(*G. W. and A. D. Blodgett, Boston.*)
3752. Transmitting Electricity, T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
3753. Holder for Electric Lamps, C. Sibley, London.
3754. Furnaces, W. R. Lake.—(*C. P. de Bondini, Constantinople.*)
3755. Electrical Meters, T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
3756. Dynamo, &c., Machines, T. J. Handford.—(*T. A. Edison, Menlo Park, U.S.*)
3757. Light Emitting Conductors, R. Werdermann, London.

7th August, 1882.

3758. Ventilating, A. R. and J. W. Harding, Leeds.
3759. Perforating Cheques, &c., P. Jensen.—(*O. A. Ericsson, Sweden.*)
3760. Turbines, J. McConnell, Ballymena.

Inventions Protected for Six Months on Deposit of Complete Specifications.

3644. Indicating the Presence of Fire-damp, I. Kitsee, Cincinnati.—*1st August*, 1882.
3656. Cigarettes, W. R. Lake, London.—A communication from the Cowman Cigarette Machine Company for Foreign Countries, New York.—*1st August*, 1882.
3676. Sliding Gates, W. P. Thompson, London.—A communication from I. S. Sherwin, Battle Creek.—*2nd August*, 1882.

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

3106. Locks, J. Betjemann, London.—*31st July*, 1879.
3119. Stoppers for Bottles, W. W. Bird, jun., St. Sampson's, Guernsey.—*1st August*, 1879.
3401. Fire-engines, B. Massey, Stafford.—*23rd August*, 1879.
3142. Steam Generators, T. Russell, Aberdeen.—*5th August*, 1879.
3227. Moulding Machines, F. Wirth, Germany.—*11th August*, 1879.
3245. Gas Motor Engines, C. D. Abel, London.—*12th August*, 1879.
3271. Melting and Casting Glass, H. Simon, Manchester.—*13th August*, 1879.
3282. Friction Brake, C. Fairholme, London.—*14th August*, 1879.
3131. Chucking, &c., Pipes, T. Milburn and C. W. Haydon, Staley Bridge.—*2nd August*, 1879.
3172. Valve Gear, J. R. Jefferies, Ipswich.—*7th August*, 1879.
3173. Hames, C. Kesseler, Berlin.—*7th August*, 1879.
3262. Dental Engines, G. Pitt, Sutton.—*13th August*, 1875.
3287. Paper and Ropes, G. Hawksley, London.—*14th August*, 1879.
3153. Enabling Deaf Persons to Distinguish Sounds, W. R. Lake, London.—*5th August*, 1879.
3159. Gauges, J. R. Arnoldi, Ottawa.—*6th August*, 1879.
3174. Treating Vitreous, &c., Surfaces, H. J. Haddan, London.—*7th August*, 1879.

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

3521. Treating Drying Oils, G Hadfield, Manchester.—*19th September*, 1877.
2881. Fixing of Taper and Flanged Tubes for Boilers, C. J. Galloway and J. H. Beckwith, Manchester.—*16th August*, 1875.
2727. Producing Cold, R. P. Pictet, Geneva.—*3rd August*, 1875.
2752. Revolving Shutters, H. Woodburne, Ulverston.—*4th August*, 1875.
2786. Firing, &c., Torpedoes, C. A. McEvoy, London.—*7th August*, 1875.
2788. Coffins, J. Larkman and J. Diprose, London.—*7th August*, 1875.
2866. Mordanting, &c., Yarns, M. Baerlein, Manchester.—*14th August*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 25th August, 1882.

1513. Taps and Valves, F. Robinson, Bradley.—*29th March*, 1882.
1514. Engines, G. Tidcombe, jun., Watford.—*29th March*, 1882.
1533. Extracting Gases from Molten Metals, &c., R. Aitken, London.—*29th March*, 1882.
1556. Generating, &c., Electricity, J. S. Williams, London.—*30th March*, 1882.
1566. Looms, J. Wade, Wortley.—*31st March*, 1882.
1576. Tin, W. A. Barlow, London.—A communication from L. Bourau.—*31st March*, 1882.
1583. Electric Bell, &c., H. Binko, South Hornsey.—Com. from M. I. Siegel.—*1st April*, 1882.
1598. Grinding Spindles, G. Ryder and M. Fielding, Bolton.—*1st April*, 1882.
1603. Pianos, W. Fischer, Dresden.—*3rd April*, 1882.
1651. Fire-escape, &c., W. R. Lake, London.—A communication from L. D. B. Shaw.—*5th April*, 1882.
1670. Electric Lamps, J. Jameson, Akenside Hill.—*6th April*, 1882.
1785. Ventilating Apparatus, T. Rowan, London.—*14th April*, 1882.
1847. Printing Apparatus, J. F. Haskins, London.—*18th April*, 1882.
1928. Treating Mineral Oils, E. de Pass, London.—Com. from P. J. N. Labouret.—*22nd April*, 1882.
2203. Printing Machines, W. R. Lake, London.—Com. from J. T. Hawkins.—*10th May*, 1882.
2204. Printing Machines, W. R. Lake, London.—Com. from J. T. Hawkins.—*10th May*, 1882.
2208. Printing Machines, W. R. Lake, London.—Com. from J. T. Hawkins.—*10th May*, 1882.
2639. Folding Chairs, &c., J. Hayes, Kingsland.—*5th June*, 1882.
3025. Dynamo-electric Machines, E. A. Sperry, Cortland, U.S.—*27th June*, 1882.
3231. Fastening Letters, &c., F. A. R. Russell, London.—*7th July*, 1882.
3281. Electrical Conductors, F. Jacob, London.—*11th July*, 1882.
3419. Dynamo-electric Machines, S. Z. de Ferranti, Shepherd's-bush, and A. Thompson, London.—*18th July*, 1882.

Last day for filing opposition, 29th August, 1882.

1396. Purifying Sewage, &c., G. J. Andrews and F. H. Parker, London.—*22nd March*, 1882.
1610. Feeding Wool, W. Cliffe, Ley Moor—*3rd April*, 1882.
1613. Taps and Cocks, F. G. Fleury, London.—*3rd April*, 1882.
1614. Dynamo-electric Machines, W. R. Lake, London.—Com. from E. Weston.—*3rd April*, 1882.
1616. Electric Currents, W. B. Brain, Cinderford.—*3rd April*, 1882.
1617. Cutting Wood Blocks, F. Wirth, Frankfort-on-the-Maine.—Com. from G. Sebold.—*3rd April*, 1882.
1619. Carbon Conductors, W. R. Lake, London.—Com. from H. S. Maxim.—*3rd April*, 1882.
1623. Bicycles, A. E. Gorse, Birmingham.—*4th April*, 1882.
1632. Hydraulic Cranes, &c., E. Priestman, Sheffield.—*4th April*, 1882.
1639. Electro-depositing Copper, &c., W. H. Walenn, London.—*4th April*, 1882.
1646. Bobbins and Spools, J. Spence, Shipley.—*5th April*, 1882.
1652. Road Curbs, J. J. Wheeler, London.—*5th April*, 1882.
1653. Travelling Bags, &c., T. A. Mitchell, Chislehurst.—*5th April*, 1882.
1655. Water-closets, H. Conolly, London.—*5th April*, 1882.
1569. Utilising Sea Waves, R. J. Scott, London.—*5th April*, 1882.
1662. Wheel or Under Frames, R. Hadfield, Sheffield.—*5th April*, 1882.
1663. Telephone Circuits, F. D'A. Goold, London.—*5th April*, 1882.
1665. Tannin, E. A. Brydges, Upton.—A communication from A. Mitscherlich.—*6th April*, 1882.
1669. Tipping Frame for Wagons, R. Hadfield, London.—*6th April*, 1882.
1674. Safety Apparatus, C. D. Abel, London.—A communication from F. Pelzer.—*6th April*, 1882.
1680. Bicycles, &c., W. Scantlebury, Lower Clapton.—*6th April*, 1882.
1691. Mounting Tobacco Pipes, &c., W. Rest, London.—*6th April*, 1882.
1697. Electric Lamps, Hon. R. Brougham and F. A. Ormiston, London.—*8th April*, 1882.
1700. Galvanising Sheet Iron, T. Johns, London.—*8th April*, 1882.
1703. Projectiles for Ordnance, E. Palliser, London. *8th April*, 1882.
1716. Washing Coal, &c., T. Bell, jun., York, and W. Ramsay, Durham.—*11th April*, 1882.
1731. Bevelling Glass, T. Parsonage, London.—*12th April*, 1882.
1742. Creams or Beverages, F. P. Beck, Brussels.—*12th April*, 1882.
1806. Casing for Ships, &c., A. L. S. Leighs, London.—*15th April*, 1882.
1808. Pickling, &c., Metal Plates, J. R. Turnock, Dafen.—*15th April*, 1882.
1883. Printing Machinery, W. Conquest, London.—Com. from R. Hoe and Co.—*19th April*, 1882.
1945. Telephone Alarms, W. Morgan-Brown, London.—Com. from J. F. Kettell.—*25th April*, 1882.
1947. Coke, J. Jameson, Newcastle-on-Tyne.—*25th April*, 1882.
1965. Head Coverings, C. E. Naish, Birmingham.—A communication from W. Gotaas.—*26th April*, 1882.
2147. Tobacco Pouches, B. L. James, Wanstead Park.—*6th May*, 1882.
2166. Utilising Heat, T. Charlton and J. Wright, London.—*9th May*, 1882.
2715. Treating Regulus or Matte, E. A. Parnell, Swansea.—*9th June*, 1882.
2771. Dynamo-electrical Machines, J. Farquharson, Fulham.—*13th June*, 1882.
2872. Distilling Spirit, J. T. Board, Bristol.—*17th June*, 1882.
2919. Cable Traction Tramways, &c., J. Wright, London.—Com. from C. F. Findlay.—*20th June*, 1882.
2980. Horseshoes, J. C. Mewburn, London.—A communication from L. G. Claude.—*23rd June*, 1882.
3250. Furnaces, J. Burch, Stockport.—*8th July*, 1882.
3348. Treating Skim Milk, H. J. Haddan, London.—A communication from D. H. Burrell.—*14th July*, 1882.
3363. Hood Joints, C. E. Gibson, Birmingham.—*15th July*, 1882.
3383. Ice, H. J. Haddan, London.—A communication from T. S. Rankin.—*17th July*, 1882.
3445. Drying, &c., Apparatus, H. J. Haddan, London.—Com. from F. H. C. Mey.—*20th July*, 1882.
3446. Steam Engine Governors, H. J. Haddan, London.—Com. from F. H. Ball.—*20th July*, 1882.
3644. Fire-damp Indicator, I. Kitsee, Cincinnati, U.S.—*1st August*, 1882.
3676. Sliding Gates, W. P. Thompson, London.—A communication from I. Sherwin.—*2nd August*, 1882.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 4th August*, 1882.)

561. Dust Collectors, P. V. Gelder, Sowerby Bridge.—*6th Febuary*, 1882.
577. Cocks or Valves, T. Morgan, London.—*6th February*, 1882.
578. Electric Lamps, B. J. B. Mills, London.—*7th February*, 1882.
583. Tricycles, B. Roberts, Wolverhampton.—*7th February*, 1882.
600. Tricycles, J. G. Smith, Eccles.—*8th February*, 1882.
606. Fluid Meter, C. D. Abel, London.—*8th February*, 1882.
615. Window-sash and Door Frames, J. H. Miles, Southampton.—*8th February*, 1882.
620. Triple Alloys of Manganese, &c., G. Scott, London.—*8th February*, 1882.
621. Electric Currents, J. B. Rogers, London.—*8th February*, 1882.
622. Leather Soles, E. A. Brydges, Upton.—*8th February*, 1882.
640. Stamping Machines, J. G. A. Haller, Hamburg.—*10th February*, 1882.
654. Linings for Vent Flues, &c., T. Fraser, Aberdeen.—*10th February*, 1882.
697. Horseshoes, G. Collier, Newcastle-upon-Tyne, and W. Armes, Norwich.—*13th February*, 1882.
700. Generating, &c., Electricity, J. S. Williams, London.—*13th February*, 1882.
716. Purifying Coal Gas, T. E. Jones, Tottenham.—*14th February*, 1882.
725. Feeding Mechanism, R. B. Pope, Dumbarton.—*15th February*, 1882.
738. Cases or Receptacles, J. Ferguson, Ashton Keynes.—*15th February*, 1882.
743. Utilising Sewage, G. H. Gerson, Berlin.—*15th February*, 1882.
750. Transmitting Motion, W. Spence, London.—*16th February*, 1882.
753. Travelling Building for a Circus, C. H. Keith, Bradford.—*16th February*, 1882.
758. Telegraph Instrument, F. J. Cheesbrough, Liverpool.—*16th February*, 1882.
810. Ventilating Valve, A. S.-C. Buxton and F. O. Ross, Hammersmith.—*20th February*, 1882.
824. Driving, &c., Metallic Staples, W. R. Lake, London.—*20th February*, 1882.
845. Seats or Saddles, C. Edwards, Birmingham.—*21st February*, 1882.
864. Furnaces, J. H. Johnson, London.—*22nd February*, 1882.
889. Water-closets, J. C. Mewburn, London.—*23rd February*, 1882.
892. Desiccating Sewage, &c., J. H. Johnson, London.—*23rd February*, 1882.
963. Preventing Railway Accidents, C. N. Leroy, Paris.—*28th February*, 1882.
993. Pocket-hanger, A. M. Clark, London.—*1st March*, 1882.
1058. Aluminium, J. Morris, Uddingston.—*4th March*, 1882.
1080. Reels of Reaping Machines, A. M. Clark, London.—*6th March*, 1882.
1255. Repeating Small-arm, F. J. Cheesbrough, Liverpool.—*15th March*, 1882.
1262. Knitted Fabrics, R. Mackie, Stewarton, and W. Start and H. Scattergood, Nottingham.—*15th March*, 1882.
1304. Thrashing Machines, T. and W. Nalder, Wantage.—*17th March*, 1882.
1409. Armour-plates, H. Reusch, Prussia.—*23rd March*, 1882.
1753. Sulphide of Sodium, &c., W. Weldon, Burstow.—*13th April*, 1882.
1912. Springs, W. Buckley, Sheffield.—*21st April*, 1882.
2064. Measuring Instruments, H. H. Lake, London.—*2nd May*, 1882.
2263. Secondary Batteries, A. Tribe, Notting-hill.—*13th May*, 1882.
2391. Secondary Batteries, J. Pitkin, London.—*20th May*, 1882.
2412. Ground Marker, T. Green, Leeds.—*22nd May*, 1882.
2414. Insulating Materials, J. A. Fleming, Hampstead.—*22nd May*, 1882.
2427. Knives, C. H. Wood, Sheffield.—*23rd May*, 1882.
2432. Electric Lamps, G. G. André, Dorking.—*23rd May*, 1882.
2452. Electric Lamps, J. Wetter, New Wandsworth.—*24th May*, 1882.
2471. Blue Colouring Matters, R. Meldola, Hackney Wick.—*24th May*, 1882.
2577. Washing, &c., Bottles, E. Lofts, Cherryhinton.—*31st May*, 1882.
2662. Kilns, J. Davis, Kearsley Moor.—*7th June*, 1882.
2719. Coupling and Buffing Apparatus, W. R. Lake, London.—*9th June*, 1882.

(*List of Letters Patent which passed the Great Seal on the 8th August*, 1882.)

631. Corsets, &c., A. Wardrop, London.—*9th February*, 1882.
635. Steam Boilers, W. Arnold, Barnsley.—*9th February*, 1882.
645. Puddling, &c., Iron, R. Thompson, Wigan.—*10th February*, 1882.
658. Slabs or Panels, A. M'Lean, Surrey.—*10th February*, 1882.
677. Interlocking Apparatus, W. E. Langdon, Derby.—*11th February*, 1882.
678. Gas Engines, W. Watson, Leeds.—*11th February*, 1882.
690. Fastening Rails to Sleepers, G. Schwartzkopff, Berlin.—*13th February*, 1882.
718. Hat Naps, E. K. Dutton, Manchester.—*14th February*, 1882.
723. Speed Governor, G. B. Goodfellow and R. Matthews, Hyde.—*15th February*, 1882.
766. Generating, &c., Electricity, J. S. Williams, London.—*16th February*, 1882.
775. Photography, R. T. Wall, Longfleet.—*17th February*, 1882.
783. Fountain Ink-holders, F. F. Benvenuti, Swansea.—*17th February*, 1882.
815. Rivetting, &c., Apparatus, F. J. Rowan, Glasgow.—*20th February*, 1882.
831. Electric Lamps, J. Rapieff, London.—*21st February*, 1882.
841. Knitting Machines, J. W. Watts, Countesthorpe.—*21st February*, 1882.
846. Weldless Tubes, R. Elliott, Newcastle-on-Tyne.—*21st February*, 1882.
850. Raising, &c., Blinds, J. Everard, Birmingham.—*21st February*, 1882.
888. Water-closets, H. Sutcliffe, Halifax.—*23rd February*, 1882.
994. Gas-motor Engines, J. Fielding, Gloucester.—*1st March*, 1882.
1037. Pumps, R. Skene, London.—*3rd March*, 1882.
1092. Knitting Machines, T. Priestley, Bradford.—*7th March*, 1882.
1269. Fixing Tuning Pins, &c., G. Wilde, Selston.—*16th March*, 1882.
1590. Gas-motor Engines, R. Skene, London.—*1st April*, 1882.
1821. Silicious Copper, &c., J. C. Mewburn, London.—*17th April*, 1882.
1949. Bessemer Converters, S. G. Thomas, London.—*25th April*, 1882.
1952. Nut-lock, H. J. Haddan, London.—*25th April*, 1882.
1971. Racks, C. J. Appleton and S. H. Ogden, Manchester.—*26th April*, 1882.
1982. Cartridge Magazines, G. E. Vaughan, London.—*27th April*, 1882.
2134. Gas, &c., Meters, W. C. Parkinson, London.—*6th May*, 1882.
2144. Electric Lamps, J. H. Johnson, London.—*6th May*, 1882.
2328. Doubling Cotton, &c., F. J. Smith, Heywood.—*18th May*, 1882.
2352. Perambulators, J. Preston, Stratford-le-Bow.—*18th May*, 1882.
2426. Bottling Apparatus, F. Foster, London.—*23rd May*, 1882.
2458. Stoppers for Bottles, &c., N. Thompson, London.—*24th May*, 1882.
2540. Furnaces or Fire-grates, G. F. Janes, London.—*27th May*, 1882.
2568. Barrels and Keys of Locks, &c., G. Bolton, Wolverhampton.—*31st May*, 1882.
2612. Stoves, C. Lister and T. Wardle, Middlesbrough.—*2nd June*, 1882.
2613. Electric Lamps, W. E. Ayrton and J. Perry, London.—*3rd June*, 1882.
2630. Dynamo-electric Machines, A. J. Jarman, London.—*5th June*, 1882.
2885. Dynamo-electric, &c., Machines, J. A. Berly, London.—*19th June*, 1882.

List of Specifications published during the week ending August 5th, 1882.

4880, 6d.; 5524, 8d.; 5552, 4d.; 5620, 6d.; 5629, 6d.; 5649, 6d.; 5654, 6d.; 5662, 6d.; 5664, 10d.; 5668, 1s. 10d.; 5674, 10d.; 5676, 6d.; 5682, 8d.; 5691, 6d.; 5692, 6d.; 5699, 6d.; 5702, 6d.; 5714, 6d.; 5716, 6d.; 5717, 6d.; 5718, 6d.; 5720, 6d.; 5723, 6d.; 5725, 8d.; 5728, 8d.; 5732, 6d.; 5734, 6d.; 5736, 4d.; 5741, 8d.; 5743, 6d.; 5745, 6d.; 5746, 6d.; 5747, 8d.; 5748, 6d.; 4, 6d.; 6, 6d.; 7, 6d.; 8, 6d.; 10, 4d.; 14, 6d.; 15, 6d.; 21, 10d.; 22, 2d; 23, 2d.; 26, 6d.; 29, 2d.; 30, 2d.; 31, 8d.; 32, 2d.; 33, 4d.; 34, 8d.; 37, 6d.; 40, 4d.; 41, 4d.; 42, 6d.; 43, 2d.; 45, 8d.; 47, 4d.; 48, 6d.; 49, 6d.; 51, 4d.; 52, 2d.; 54, 2d.; 56, 2d.; 57, 2d.; 58, 2d.; 59, 2d.; 60, 6d.; 61, 6d.; 62, 4d.; 63, 2d.; 64, 6d.; 65, 6d.; 66, 2d.; 67, 2d.; 68, 2d., 69, 4d.; 70, 6d.; 71, 10d.; 72, 2d.; 75, 2d.; 76, 6d.; 78, 10d.; 80, 6d.; 81, 4d.; 89, 4d.; 90, 2d.; 93, 4d.; 94, 2d.; 96, 2d.; 97, 2d.; 98, 2d.; 99, 6d.; 101, 4d.; 102, 6d.; 103, 6d.; 105, 4d.; 106, 6d.; 112, 2d.; 113, 2d.; 114, 4d.; 115, 6d.; 116, 6d.; 117, 6d.; 118, 4d.; 120, 8d.; 121, 6d.; 123, 4d.; 124, 2d.; 128, 6d.; 129, 6d.; 160, 4d.; 180, 6d.; 192, 2d.; 204, 1s. 10d.: 207, 8d.: 209, 10d.; 1221, 6d.

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

ABSTRACTS OF SPECIFICATIONS.

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

4880. Portable Forges, *G. H. Pym, Nottingham.—8th November*, 1881. *6d.*

The inventor claims the construction and employment of a self-acting clutch for operating the fan of a portable forge.

5524. Improvements in Electric Lamps, *R. Kennedy, Glasgow.—17th December*, 1881. *8d.*

This relates both to incandescent and arc lamps. With regard to incandescent lamps, the invention consists of improvements in a mercury pump for exhausting the glass globe. The inventor constructs his carbons of the fibres of the aloe plant, and the joint of the platinum wires with the carbon is made durable by the deposition of carbon on it. In the inventor's arc lamp the upper carbon is attached to the core of a solenoid in the lamp current. The lower carbon is held by a cross-bar held up by cords passing over pulleys to counterweights proportioned to give the lower carbon an upward feed. On the pulleys are fixed ratchet wheels, and in connection with these wheels are catches which are movable by the holder of the upper carbon. When the current through the solenoid is too weak, the upper carbon descends, and at the same time releases the pulleys, so that the lower carbon rises.

5552. Heel for Boots and Shoes, *A. M. Clark, London.—19th December*, 1881.—(*A communication from P. Lemarchand, Paris.*) 4d.

This relates to the construction of heels of boots and shoes made of horn, moulded or otherwise shaped, of hollow form, either in a single piece or in sections united together, with or without a suitable filling.

5620. Lifting the Safety Valve of Boilers by the Action of a Float Actuated by the Water in the Boiler, *T. Rogers, Smethwick.—23rd December*, 1881. 6d.

The drawing shows a longitudinal section of a Cornish boiler. At a convenient distance from the ordinary safety valve is secured a cast or wrought iron stem or pillar A having a slot or aperture at the top, in which the weighted lever B works by means of a centre

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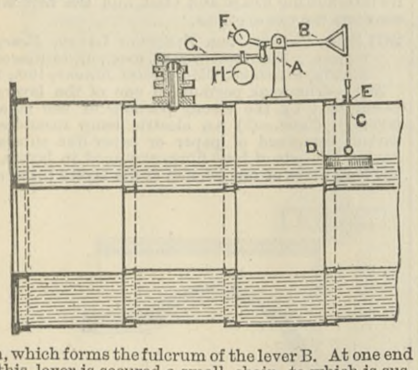

pin, which forms the fulcrum of the lever B. At one end of this lever is secured a small chain, to which is suspended a rod C. To the end of the rod C is attached a float D. The rod C works through a stuffing-box E. The lever B is balanced and capable of being nicely adjusted by the weight of the float D in connection with the weighted ball F at its other end. The safety valve lever G is weighted and adjusted in the ordinary way, viz., by means of the weighted ball H.

5629. Apparatus for Shifting Grain and other Substances in the Holds of Vessels, &c., *E. J. Power, London.—23rd December*, 1881.—(*A communication from W. H. Power, New York.*) 6d.

This consists principally in giving a to-and-fro transverse motion to scoops or shovels used for shifting grain and other substances by means of ropes led over and under guide pulleys.

5649. Gas Burners, *W. T. Sugg, Westminster.—24th December*, 1881. 6d.

The object is to so construct the burner as to prevent the "roaring" of the burners when the supply is at full pressure.

5654. Machines for Rifling Gun and Pistol Barrels, *P. Mauser, Germany.—24th December*, 1881. 6d.

The invention relates to peculiar arrangements and devices on those parts of machines for rifling gun and pistol barrels which produce the shape and direction of the rifle cuts, and its object is by means of these arrangements and devices to produce tapered cut grooves, and to make the machine adjustable to such an extent that any desired twist may be given to the cuts.

5662. Shafts and Poles for Vehicles, *A. M. Clark, London.—24th December*, 1881.—(*A communication from A. V. Sillière, Paris.*) 6d.

This relates to the construction of the shafts and poles for vehicles of discs (of cardboard, paper, leather, or equivalent material) juxtaposed upon a metal rod or core, and glued and compressed together to form a solid continuous body.

5663. Extinguishing Fire in Theatres, &c., *W. R. Lake, London.—24th December*, 1881.—(*A communication from H. S. Maxim, Brooklyn, U.S.—(Not proceeded with.)* 6d.

This relates to a system of water supply pipes for extinguishing the fire.

5664. Mechanism for Producing Traverse for Cutting Feeds in Machinery for Cutting Metals, *W. W. Hulse, Manchester.—24th December*, 1881. 10d.

The chief objects are to give greater steadiness to the cutting operation, and thus enable a greater amount of work to be done in a given time; to increase the extent and range of the width of the cut, which may be applied to enable unusually long lengths of work to be operated upon; and to diminish the wear and tear to which the mechanism of the cutting feed apparatus is generally subjected.

5669. Destroying Insects which Infest Vines and other Plants, &c., *H. H. Lake, London.—26th December*, 1881.—(*A communication from La Société La Reconstitution Viticole, Paris.*) 6d.

This relates to the method of destroying phylloxera and other subterranean insects which are injurious to agriculture, which method comprises the injection into the ground of sulphide of carbon finely divided or vaporised by a current of air or steam, or by other suitable means, by causing the liquid to escape through a small pipe, and by the employment of apparatus which distributes the sulphide of carbon in a furrow formed by the said apparatus.

5674. Improvements in Transmitting and Receiving Apparatus for Type-printing Telegraphs, *S. Pitt, Sutton, Surrey.—27th December*, 1881.—(*A communication from van Hoevenbergh, Elizabeth, New Jersey, U.S.A.*) 10d.

This relates to printing telegraphs, the type wheels of which are impelled by a weight and wheel work, and the progressive movements of which are controlled by a series of electrical pulsations, alternately of opposite polarity. In the inventor's improved apparatus the printing is effected by increasing the strength of the current during some one of the pulsations, without reference to its polarity, at the instant the required division of the type wheel is opposite the platen. The printing instrument is provided with a double type wheel and an oscillating printing platen, so that either one of the wheels can be printed from. For this apparatus two independent circuits are required, one to control the movement of the type wheels, and the second to control the angular position of the oscillating platen. Other improvements are also described.

5676. Machinery for Blacking, Colouring, or Dressing Leather, Hides, &c., *W. Morgan-Brown, London.—27th December*, 1881.—(*A communication from F. B. Batchelder, East Boston, U.S.*) 6d.

The invention consists chiefly in a small rotating supporting surface for the leather, a receptacle for blacking or dressing, receptacle roller therein, and a blacking or dressing applying brush or roller located between the receptacle roller and the said supporting surface, and a spatter brush or roller back of the blacking applying brush or roller combined with a wiper or cleaner.

5682. Velocipedes, *J. White and J. Asbury, Coventry.—27th December*, 1881. 8d.

The invention relates to improvements in the driving gear of velocipedes in which one travelling wheel is driven, and also in which both travelling wheels are driven. It has likewise reference to an improved arrangement of brake for acting on both wheels simultaneously.

5691. Trueing the Surfaces of the Cylinders of Calendering and Finishing Machines, *C. A. Barlow, Manchester.—28th December*, 1881.—(*A communication from J. Tolra, Barcelona.*) 6d.

The inventor claims the method of trueing the surfaces of the paper or cotton cylinders of calendering and finishing machines, by a grinding wheel or roller, with or without removing the cylinders from the calendering or finishing machine.

5692. Machinery Employed in the Application of Designs and other Delineations to Various Surfaces, &c., *T. Jones, Clerkenwell.—28th December*, 1881. 6d.

This relates to improvements in the general construction of machinery or apparatus employed in the application of designs and other delineations in paint or other colouring material, in gold or other leaf, or in bronze or other powders to various surfaces and materials.

5699. Feeding Apparatus for Grain Mills and Dressing Machines, &c., *J. Hurt and A. M. Strathern, Glasgow.—28th December*, 1881. 6d.

The essential nature and novelty of the invention consists in the use of a single simple feeding hopper over the feeding roller or other equivalent of the mill, into which the grain or granular substance is supplied in an approximately regular stream from the supply bin, hopper, or elevators above.

5702. Improvements in Sockets or Holders for Electric Lamps, *J. W. Swan, Newcastle-on-Tyne.—28th December*, 1881.

This relates to holders for incandescent lamps, whereby a lamp without any external fittings can be readily attached to the conducting wires. The holder is provided with two hooks insulated from each other, and terminating in binding screens on opposite sides of the holder. Connection between the lamp and holder is made by engaging the two hooks of the holder with the two eyes which constitute the terminal conductors of the lamp, contact between the two being effected by a spring, which must be compressed to join the lamp to the holder, and which thereafter exerts an outward pressure on the lamp, keeping the hooks and eyes in good contact.

5714. Portable Ovens for Baking Bread, &c., *J. H. Johnson, London.—29th December*, 1881.—(*A communication from Messieurs Geneste, Herscher, and Company, Paris.*) 6d.

This consists in constructing the ovens in sections, whereby they are rendered capable of being transported to localities inaccessible to wheeled vehicles, and the operations of erecting them and taking them to pieces are also greatly expedited and facilitated.

5716. Roasting Coffee, &c., *M. Robinson, Manchester.—30th December*, 1881. 6d.

This relates to the general construction of the machines, so as to render them as light as possible.

5717. Brushes, *W. Willeringhaus, London.—30th December*, 1881. 6d.

This relates to connecting the handles of brushes to their frames by means of a hinged joint and a bolt or fastening.

5718. Mechanically Played Wind Musical Instruments, *W. P. Thompson, Liverpool.—30th December*, 1881.—(*A communication from M. Harris, New York.*) 6d.

This relates to improvements in wind instruments mechanically played or controlled by perforated strips of paper.

5720. Fire-lighters, *F. Holmes, New-cross.—30th December*, 1881. 6d.

This relates to the construction of "wheel fire-lighters."

5723. Feeding Hurdles for Sheep, &c., *A. J. Scott, Rotherfield Alton, Hants.—30th December*, 1881. 6d.

This relates to making feeding hurdles, so that they may be folded up and rendered portable.

5725. Manufacture of Linoleum, &c., *M. B. Nairn, Kirkcaldy.—30th December*, 1881. 8d.

This relates to machinery for manufacturing linoleum, and consists of a cylindrical mixer mounted horizontally, and traversed by a revolving shaft carrying arms, which pass between other arms fixed within the cylinder. Over the mixer at one end is a bin containing ground cork, which is passed to the mixer by means of a revolving measure, and when a sufficient quantity has been supplied a slab of cement made from oil is thrown in and the whole well mixed. The mass as it is delivered from the outer end of the cylinder is cut into slices, which are acted upon by crushing rollers. The material adheres to one of the rollers, and is taken off in small fragments by a spiked drum enclosed in a case, which serves as a hopper to deliver the material to spreading rolls, between which the cloth to form the back of the fabric passes.

5728. Signalling by Sound at Sea, *J. M. Gray, Edinburgh.—30th December*, 1881.—(*Not proceeded with.*) 2d.

The object is to enable vessels in a fog to communicate to other vessels the direction in which they are moving without having to commit the signals employed to memory, and consists in producing long and short sounds on the signalling apparatus.

5732. Towing of Lighters and Similar Vessels, *W. R. Lake, London.—30th December*, 1881.—(*A communication from H. Ressel, Vienna.*) 6d.

This relates to the towing of lighters on rivers and canals, and consists, First, in giving the bottom of the tug steamer and the lighters the shape of a flat tray, having its face downwards, and in maintaining a layer of air in these trays by means of air pumps; Secondly, in giving the stern of the tug and of each lighter a concave shape, and to the bow of each lighter a corresponding convex shape, so that the tug and lighters can be closely jointed together and form a continuous articulated body for the purpose of confining the shock of water to the bow of the tug boat; and Thirdly, in a special construction of steam steering gear connecting the tug with the lighter immediately behind it, for the purpose of causing the latter to act as a rudder.

5734. Binding Sheets of Paper with Metal Fasteners, &c., *W. F. Lotz, London.—31st December*, 1881.—(*A communication from G. W. McGill, New York.*) 6d.

This relates partly to improvements on apparatus described in patents No. 756, A.D. 1879, and No. 369, A.D. 1881, and one improvement consists in providing special mechanism to automatically feed forward to the plunger the staples which are held in a suitable receptacle. A coiled spring is fixed to the upper front end of the press behind the plunger, and acts on the staple pusher, which consists of a metal bar lying on the staple track and travelling in a groove in the upper part of the press.

5736. Shirts and Shirt Fronts, *J. Ridley, London.—31st December*, 1881. 4d.

This relates to constructing shirts and fronts so as to prevent them creasing when the wearer stoops, and it consists in forming the bottom part of the front tongued or tapered on each side of the centre line, and making it of such a depth as not to reach the lowest rib of the body.

5743. Improvements in Electrical Resistances, *G. Pfannkuche and R. E. Dunston, Fitzroy-square, London.—31st December*, 1881. 6d.

This relates to a device for rendering resistance coils more handy and inexpensive, by embedding the wires in plaster of Paris or glass, so that the heat engendered in them may be readily diffused. By this means it is claimed that smaller wires than at present in use can be employed.

5741. Steam Boilers, &c., *G. H. Lloyd, Birmingham.—31st December*, 1881. 8d.

The inventor claims, First, the construction of steam multitubular boilers with a front and back wall of tubes connected together so that the steam has liberty to ascend and the water to circulate through the various members with the utmost freedom;

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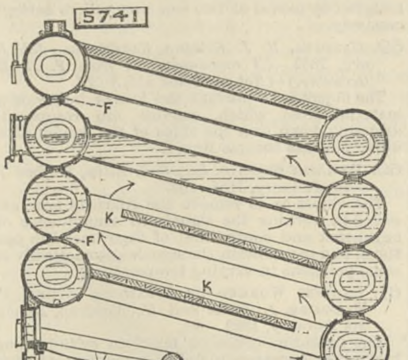


Secondly, the particular plan of setting with the blocks K; Thirdly, the use of the slotted packing piece or diaphragm plate F in combination with and for connecting together the boiler tubes.

5745. Softening, Purifying, and Filtering Water, *F. H. and W. G. Atkins, London.—31st December*, 1881. 6d.

This relates to apparatus for filtering water treated with lime or other softening or purifying substance, and it consists, First, in an improved valve for regulating the flow of water and lime to the mixing vessel; Secondly, to a mixer for intimately mixing or combining the lime and water, and consisting of a trough having a series of openings and baffle plates; Thirdly, to the filter which consists of a tank in two parts bolted together, and between which is fixed a plate with a series of parallel slots to receive the filter bags.

5746. Numbering Machines for Printing, *W. R. Lake, London.—31st December*, 1881.—(*A communication from P. L. Hanscom, Chicago.*) 6d.

The object is to produce a numbering machine which with two type wheels will print consecutively from 1 up to and including 100, and repeat indefinitely, and consists in providing an ordinary unit wheel and a tens wheel provided with types to print 10, and to which at the proper time a double motion is imparted, so as to bring the blank space on such wheel in line with the one of the units wheels and print 1 again.

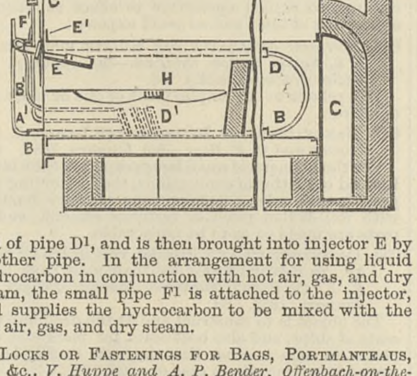
5747. Roofs and Roof Coverings for Protection of Buildings in course of Construction, &c., *A. M. Clarke, London.—31st December*, 1881.—(*A communication from Le Compte A. C. de Barbaran, Paris.*) 8d.

The invention relates to a system of roofing for the protection of buildings in course of construction from rain, and also to apparatus for raising the roofing as the construction of the building progresses.

5748. Consuming Smoke and Economising Fuel in Furnaces, *J. MacDonald and A. J. M. Bolanachi, Dulwich.—31st December*, 1881. 6d.

In the drawing the air is taken in at A^1 by the lower pipe B, and the gas is introduced into the air by the small pipe B^1. The mixture is then taken along the lower pipe B, placed in flues C, and back to front of boiler by the return pipe D. It is then introduced into the injector E, where the steam jet forces it through a delivering pipe and deflector into furnace H. The steam pipe C^1 passes through a superheating

5748



coil of pipe D^1, and is then brought into injector E by another pipe. In the arrangement for using liquid hydrocarbon in conjunction with hot air, gas, and dry steam, the small pipe F^1 is attached to the injector, and supplies the hydrocarbon to be mixed with the hot air, gas, and dry steam.

4. Locks or Fastenings for Bags, Portmanteaus, &c., *V. Huppe and A. P. Bender, Offenbach-on-the-Main.—2nd January*, 1882. 6d.

This relates to the construction of the lock, and to the means of fastening.

6. Nickel Plating, &c., *J. E. Chaster, Manchester.—2nd January*, 1882. 6d.

The invention consists, First, in using the double citrate of nickel and ammonia, instead of the double sulphate; Secondly, in the arrangement and construction of battery for electro-plating with nickel.

7. Double-acting Hot-air Engines, *T. Morgan, London.—2nd January*, 1882.—(*A communication from S. Sudheim, Cassel.*) 6d.

This relates to the general construction of the machine.

8. Dead-weight Safety Valves for Steam Engines, *J. T. Stubbs, Manchester.—2nd January*, 1882. 6d.

A is a central hollow pillar attached to the shell of the boiler or steam generator and having free openings into the steam space thereof. At the upper end is a large valve C C with corresponding seatings B B perforated to afford communication with a transverse chamber, at each end of which is a small valve seating

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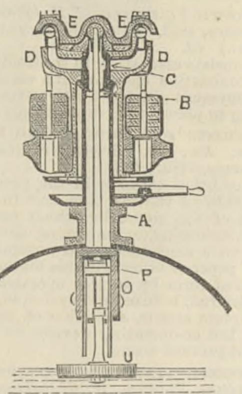

D; covering the apparatus is a saddle, which is connected with the valves E corresponding to the seatings D. A crutched fork is attached to each of these valves, having pendulous weights proportioned to the determined pressure of blow off, and prevented from rising too far by the fork being checked by the under exterior surface of the transverse chamber. On the upper inner surface of the boiler is suspended a bracket O which carries two excentric sheaves or cams, which have attached thereto a lever or levers connected with the float U in such manner that when the water sinks below the determined point, the float or floats following it turn the excentric sheaves or cams, thereby raising the lifter P.

10. Tuyeres of Blast Furnaces, *E. G. Brewer, London.—2nd January*, 1882.—(*A communication from T. Martin, Victoria.*) 4d.

This relates to the construction of blast furnaces with a poker or rod for each air channel through which the blast passes, such poker or rod being sufficiently long to pass quite through and push away any obstructions that may have gathered in or in front of such passages.

14. Improvements in Apparatus used for Electric Lighting, *A. Mackie, Pimlico, London.—2nd January*, 1882. 6d.

This relates to an apparatus for preventing any one of a series of incandescent lamps in a circuit from being overheated and destroyed by an excess of current. All the positive terminals of the lamps, when in multiple arc as in the illustration, are connected to studs fixed in insulating material as shown. A sliding contact piece is attached to a spindle connected with the armature of an electro-magnet. The

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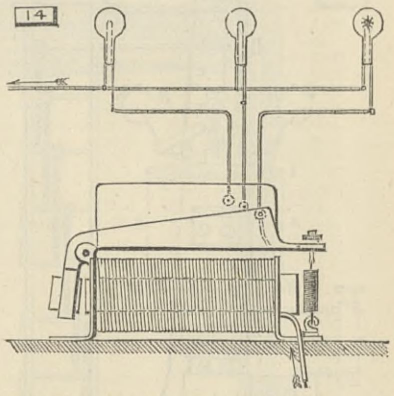


current passes through this magnet, and according to its strength as compared with that of the opposing spring, so the armature is attracted and one or more studs covered by the contact piece, and consequently one or more lamps supplied with current.

15. Transmitting Heat to Fluids, &c., *T. W. Duffy, Liverpool.—2nd January*, 1882. 6d.

This relates to the use in the apparatus of corrugated concentric tubes or casings united at their ends in pairs by ring flanges.

21. Machines for Preparing Wire for Securing Corks or Stoppers in Bottles, &c., *W. R. Lake, London.—3rd January*, 1882.—(*A communication from O. R. Chaplin, Boston.*) 10d.

This relates to the construction of machinery for cutting, looping, and twisting pieces of wire which are to be used in securing the corks or stoppers in bottles and other like vessels.

22. Imitation Lace Printing, *A. G. Tottem and J. B. Gloag, London.—3rd January*, 1882.—(*Not proceeded with.*) 2d.

This relates to the treatment of the material for the purpose of printing from a lithographic stone or plate of zinc.

23. Machinery for Producing and Applying Motive Power, *J. Jeffs, Islington.—3rd January*, 1882.—(*Not proceeded with.*) 2d.

This relates to the employment of clockwork or other suitable gearing for the purpose of setting in motion one or more fans or bellows, which in their turn blow or project air against the vanes or pallets of one or more windmills or paddle wheels causing the same to rotate. The motion is then transmitted to the machinery or other object to which it is intended to impart motion.

26. Fittings for Ships' Anchors, &c., *S. Baxter, Hornsey Lane.—3rd January*, 1882. 6d.

The inventor claims fitting hawse pipes with their external entrance a distance within the outer skin of the ship sufficient to permit of the arms and flukes of the anchor being seated in a recess specially formed for the same, and entirely within the outer skin of the ship.

29. Secondary Batteries, *D. G. FitzGerald, C. H. W. Biggs, and W. W. Beaumont.—3rd January*, 1882.—(*Not proceeded with.*) 2d.

Electrodes are obtained by utilising local action.

30. Fire-grates, *Sir W. W. Hughes, Bayswater.—3rd January*, 1882.—(*Not proceeded with.*) 2d.

The object is more especially to construct an open fire-grate, suitable for burning anthracite coal.

31. Vessels for Aerial Navigation, *W. R. Lake, London.—3rd January*, 1882.—(*A communication from C. W. Petersen, San Francisco.*) 8d.

This relates to an air ship formed of a guiding and reefable lifting vessel or vessels, whereby the ship may beat or tack regularly in the air in vertical inclinations.

32. Glove Fasteners, &c., *F. Wirth, Frankfort.—3rd January*, 1882.—(*A communication from F. Koch, Frankfort.*)—(*Not proceeded with.*) 2d.

This relates to a button or stud fastening for gloves, &c.

33. Street Cleansing and Sweeping Apparatus, *S. L. Hunt, Holborn.—3rd January*, 1882. 4d.

This relates to the application of a horizontal cylinder to street-sweeping apparatus.

34. Flying Engine, *J. K. Smythies, London.—3rd January*, 1882. 6d.

The flying engine is driven through the air without a balloon, gas, or hot air to give it buoyancy, solely by reciprocating action of wings flapped by a steam engine, gas engine, or other prime mover.

37. Compound Packing for Stuffing-boxes, *P. Blair, Birkenhead.—4th January*, 1882. 6d.

This relates to the combination of metal and fibrous or like packing.

40. Manufacture of Grape Sugar, *W. R. Lake, London.—4th January*, 1882.—(*A communication from Dr. A. Behr, New Jersey, U.S.*) 4d.

One of the objects is to produce crystallised anhydrous grape sugar, or, in other words, crystallised anhydride of grape sugar from a watery solution.

41. Manufacture of Rings, &c., *C. Touaillon, Paris.—4th January*, 1882.—(*A communication from J. G. Bertry, Paris.*)—(*Not proceeded with.*) 2d.

This relates to the manufacture of metal rings without soldering.

42. Stoves and Furnaces, *E. G. Lakeman, Modbury.—4th January*, 1882. 6d.

This relates to the method of effecting the combustion in stoves and furnaces of the smoke and unconsumed gases which usually escape by the chimney, by causing the same, with a supply of air, to be conveyed from over the fuel by a flue or flues into a perforated combustion flue in the fire.

43. Barges, &c., *E. Moxon, Tunbridge Wells.—4th January*, 1882.—(*Not proceeded with.*) 2d.

The object is to obtain increased buoyancy combined with greater strength.

45. Roller Mills, *A. V. Newton, London.—4th January*, 1882.—(*A communication from A. Mechwart, Buda Pesth.*) 8d.

This relates to improvements in roller mills, and consists mainly in so arranging the adjustable rollers that when thrown out of action the feed rollers of the hoppers shall cease to act.

47. PORTABLE CANDLE CASES, &c., *A. M. Clark, London.—4th January, 1882.—(A communication from J. B. B. Choisy, Lyons.)—(Not proceeded with.)* 4d.

This relates to an improved candle case or holder for the pocket, or for attachment to a walking or umbrella stick or otherwise, for the use of railway travellers and others.

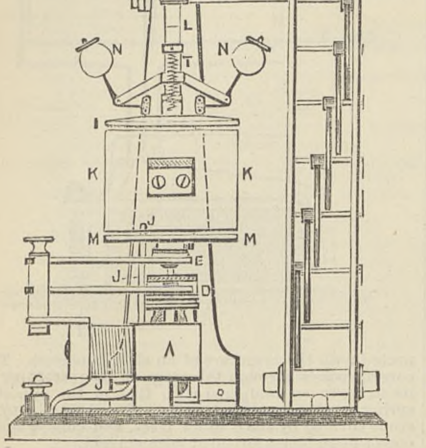
48. MACHINES FOR FOLDING AND HOT PRESSING OR IRONING NECKTIES, *M. Steinbock, New York.—4th January, 1882.* 6d.

The object is to receive the strip of material from which the necktie is to be made, and fold over its edges inwardly, then to fold the strip lengthwise either in its longitudinal axis or at one side of the same as desired, then to hot press or iron it when thus folded, and then to deliver it finished.

49. IMPROVEMENTS IN MEASURING AND RECORDING QUANTITY OF ELECTRICITY, &c., *J. Hopkinson, F.R.S., Westminster.—4th January, 1882.* 6d.

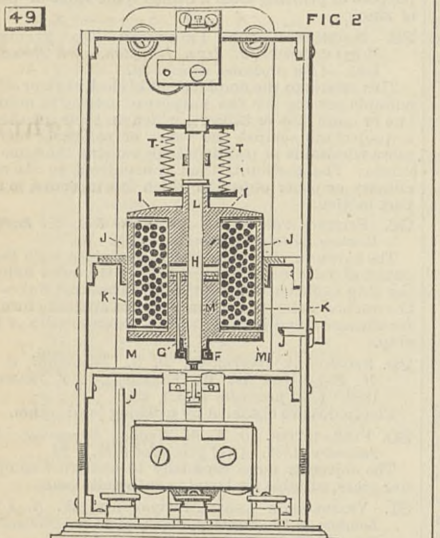
This relates to apparatus for measuring the whole quantity of electricity passing through a conductor. In Fig. 1, A A are the magnets of a small dynamo used as a motor. This dynamo is arranged with fine

49 FIG. 1



wire as a shunt to the current to be measured; this derived current passes through magnets A, by one brush to the armature, thence by brushes D and E to the insulated ring F—see Fig. 2—through wire G to an insulated ring H. Here the circuit can be made or broken, according as core I be lowered or raised; J is a coil of wire through which the current to be measured passes; it is surrounded by iron tube K, supported by the framework; L is a shaft driven by the electromotor, carrying an iron case M fixed to the shaft; N N are governor balls which by levers and links raise I, which revolves with shaft L, and can slide upon it. The revolutions of L are counted by worm and worm-wheel, connected with pinions, wheels, and dials as shown. Springs T take the weight of I, and are so adjusted that when no current passes through J, contact is broken with insulated

49 FIG 2



ring H, but that a small current through this coil will make contact and cause the electromotor to begin to revolve. When a current passes through J, it causes attraction between K and the flanges of the moving cores M and I; also between the cores M and I the magnetic force upon I is vertically downwards, and is proportional within limits to the square of the current in the coil. When the governor is revolving, the centrifugal force on the balls is proportional to the square of the speed of revolution, and tends to lift I in opposition to the magnetic force. These forces balance one another, the result being that the system will revolve with a velocity proportional to the current through the coil.

51. MANUFACTURE OF ARTIFICIAL PARCHMENT, &c., *C. Weygang, South Hornsey.—5th January, 1882.* 4d.

This relates to the treatment of various fibrous fabrics (which are prepared for the purpose) with animal glue, so as to cause the fibres to adhere closely to each other, and then reducing the glue insoluble by treatment with some of the chromic compounds, such as chromate or bichromate of potash, in combination with alum or other salts or acids which liberate the chromic acid, or by treatment with chrome or iron alum.

52. APPARATUS FOR PLAYING THE GAME OF LAWN TENNIS, *A. W. Franklin, London.—5th January, 1882.—(Not proceeded with.)* 2d.

This relates to a combination of means whereby the extent of play given to the balls may be controlled or regulated, and the net is maintained at the proper height.

54. CHIMNEY POT, *J. Wetton, Abergavenny.—5th January, 1882.—(Not proceeded with.)* 2d.

The objects are to increase the draught, and entirely or partially prevent smoking.

55. APPARATUS USED IN THE DISTRIBUTION OF ELECTRICAL ENERGY, *J. Perry.—5th January, 1882.* 4d.

Magneto-electric machines are used in series with dynamo machines.

56. APPARATUS FOR OPENING OYSTERS, *H. J. Haddan, Kensington.—5th January, 1882.—(A communication from A. Lesquillons, Pontoise, France.)—(Not proceeded with.)* 2d.

The instruments consist, First, of a grooved holder provided with a handle, and serving to clip the oyster in the desired position; and Secondly, in a specially shaped knife.

57. TOOLS FOR SETTING SAWS, *H. J. Haddan, Kensington.—5th January, 1882.—(A communication from A. A. Rigaud, Clermont-Ferrand, France.)—(Not proceeded with.)* 2d.

The object is to set the teeth of saw blades correctly and rapidly, by means of a simple tool.

58. COMBING MACHINES, *H. J. Haddan, Kensington.—5th January, 1882.—(A communication from A. N. Sprecher, France.)—(Not proceeded with.)* 2d.

The object is to comb the whole length of the material by means of two combing rollers acting successively.

59. CANDLES, *H. J. Haddan, Kensington.—5th January, 1882.—(A communication from F. E. Berta, Germany.)—(Not proceeded with.)* 2d.

The object is to prevent the loss of tallow or other material from which candles are composed, by dropping down over the sides of the candle after its upper end has become liquid.

60. RAILWAY SIGNALS, &c., *S. S. Allin, Bedford Park.—5th January, 1882.* 6d.

The object is to remove the difficulty now experienced in working the signals, in consequence of the expansion and contraction of their metallic connections, and to maintain the signals automatically in the same positions in varying temperatures.

61. ENGINES WORKED BY STEAM OR OTHER FLUID PRESSURE, *J. James and W. Wardrop, Lambeth.—5th January, 1882.* 6d.

The inventors claim in multiple cylinder engines having their pistons linked to a single central shaft, working from the piston or connecting rod of each cylinder, the slide of the next cylinder in order.

62. TREATING TIMBER WITH ANTISEPTIC OR PRESERVATIVE FLUIDS, &c., *S. B. Boulton, London.—5th January, 1882.* 4d.

This consists partly in the use, for preserving timber, of compounds consisting of the tar acids and other constituents having antiseptic or preservative properties extracted from the heavy oils of tar, and mixed with diluent liquids.

63. RENDERING FABRICS, &c., UNINFLAMMABLE, *J. Jansen, London.—5th January, 1882.—(A communication from A. S. Suillot and H. David, Paris.)* 2d.

The fabrics are impregnated with a solution of salts having incombustible properties.

64. IMPROVEMENTS IN MAGNETO AND DYNAMO-ELECTRIC MACHINES, *L. A. Groth, Finsbury Pavement, London.—5th January, 1882.—(A communication from R. J. Gülcher, Biala, Austria.)* 6d.

This relates to improvements in magneto and dynamo machines, whereby heating effects are reduced. The inductor rotating between the magnetic poles consists of a ring formed of separate insulated plates of soft iron to facilitate the change of the magnetic poles during the rotation of the ring. This allows the wires wound round the inductor to be exposed to the inducing action of the magnetic poles from all sides, thereby obviating the production of heat by the passage of the current through those parts of the wires not exposed to this action. Arrangements are also made for the flow of air through the ring. The poles of the inducing magnets are also of a U or channel form.

65. BRIDGES, *H. H. Lake, London.—5th January, 1882.—(A communication from G. Eiffel, Paris.)* 6d.

The object is the construction of bridges by means of separate parts, all of which are similar to one another, and by the employment of which, in a suitable number, any distance compatible with the resistance of the materials whereof they are composed may be spanned over.

66. GLASS SURFACE TESTING PLATES, &c., *G. Richards, Manchester.—6th January, 1882.—(Not proceeded with.)* 2d.

The invention consists in the application or use of suitable sized pieces of hard plate glass provided with true surfaces or edges, as may be required, to be used as surface plates and straight edges.

67. HAND STAMPS WITH CALENDAR, *A. C. Henderson, London.—6th January, 1882.—(A communication from E. Blum, Paris.)—(Not proceeded with.)* 2d.

This consists in the novel application to hand printing stamps, with or without a calendar, of a composing frame, admitting of the partial or entire change of the type, or a modification thereof, without recourse to skilled operatives to effect the requisite alterations of text, and so avoid expense.

68. OPTICAL APPARATUS FOR MULTIPLYING DESIGNS, *J. B. Fenby, Sutton Coldfield.—6th January, 1882.—(Not proceeded with.)* 2d.

This relates to the employment of one or more pairs of mirrors.

69. MANUFACTURE OF INCANDESCENT LAMPS, *E. H. T. Liveing and C. V. Boys.—6th January, 1882.* 4d.

For the filament of small lamps capillary coke is used. Instead of platinum connections, the conducting wires pass through a long narrow tube and are connected with well-boiled pitch or resinous cement, and the parts are made so as to be replaceable.

70. CONSTRUCTING AND FITTING THE SEATS OF SHIPS, &c., TO RENDER THEM AVAILABLE AS LIFE RAFTS, *E. S. Copeman, Downham Market, Norfolk.—6th January, 1882.* 6d.

The object is to construct and fit the deck and other seats of ships, and also boat seats for piers and other places, in such manner that they can readily be converted into life rafts in case of need.

71. AN IMPROVED SYSTEM OF AUTOMATIC ELECTRIC PRINTING REGISTERS AND RETURN SIGNALS, &c., *A. J. Boult, of Thompson and Boult, High Holborn, London.—6th January, 1882.—(A communication from B. F. Valentine, New York.)* 10d.

This invention relates to a system of telegraphing signals for different purposes, such as to call the police, give alarm of fire, &c., and has for its object improvements on present systems, whereby a legible and lasting record of the signal shall be printed by the receiving apparatus, and whereby the nature of the call and the source from which it came shall be indicated at a single impression of the printing mechanism.

72. SECONDARY OR REVERSIBLE ELECTRIC BATTERIES, *R. Kennedy.—6th January, 1882.* 2d.

The electrodes are lead, upon which spongy lead is deposited.

75. SYPHONS FOR RESERVOIR PENS, &c., *J. D. Carter and J. A. Baker, London.—6th January, 1882.—(Not proceeded with.)* 2d.

This relates to the special construction of syphons for filling or cleansing reservoir pens.

76. DOMESTIC FIREPLACES, *J. H. Johnson, London.—6th January, 1882.—(A communication from M. Perret, Paris.)* 6d.

This consists essentially in contracting the capacity of the combustion chamber in a vertical direction by the employment of a loose slab or cover arranged and operating to prevent the rapid escape of heat.

78. MACHINES FOR PRINTING AND MAKING LABELS, TAGS, &c., *A. Briggs, Providence, U.S.—6th January, 1882.* 10d.

The invention consists in the peculiar and novel construction of the machine, and in the novel combination of the parts, by which one, two, or more printing, stamping, or embossing devices are made to operate on a continuous and automatically supplied sheet of paper or other suitable material, cut up into the desired form by devices operated automatically, and, if desired, bronzed and eyeletted, so as to deliver the complete article, and allow of the ready adjustment of the co-operating devices to ensure accurate work and prevent waste.

80. CONVERTING IRON INTO STEEL BY MEANS OF THE BESSEMER PROCESS, *W. F. Jackson, Bradford.—6th January, 1882.* 6d.

The object is to give the tipping gear used in the Bessemer process greater safety than hitherto.

81. PREPARATION OF MATERIALS FOR FACILITATING THE PREPARATION OF WHITEWASH AND DISTEMPER, *J. I. Fordham, Shoreditch.—6th January, 1882.* 4d.

The inventor claims a preparation consisting essentially of size, glue, gelatine, or other gelatinous matter and whiting in powder, the said materials being mixed together in such proportions that whitewash or distemper may be produced by the addition of water to the said powder. A modification is claimed.

89. LOCK-WASHER FOR SECURING NUTS ON BOLTS, &c., *T. H. Drew, Walsall.—7th January, 1882.* 4d.

In the drawing, A is the seating to which the bolt is secured; B is the bolt; C the nut; D the lock washer having one of its teeth or projections E turned up

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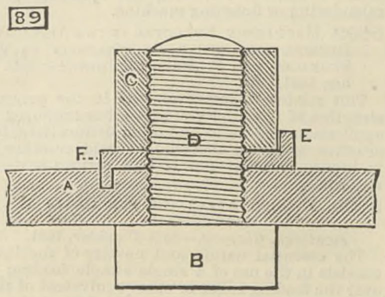


against the side of the nut, and another of such teeth or projections F turned down into a hole formed in the seating, thus effectually securing the bolt in position.

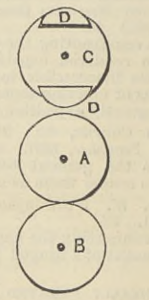
90. BACK-SIGHTS FOR FIRE-ARMS, &c., *P. Taylor, Manchester.—7th January, 1882.—(Not proceeded with.)* 2d.

The inventor dispenses with the adjustable parts, and forms the sight in one piece having the different ranges marked upon its face, with corresponding permanently fixed sighting points, thus avoiding the necessity of shifting the sight with each change of distance.

93. ROLLING METAL, *F. Wirth, Frankfort.—7th January, 1882.—(A communication from L. Rohr, Germany.)* 4d.

The drawing illustrates the combination of a pair of working rollers A and B with an adjusting roller C, in whose circumference are fixed two projecting pieces D D. With this arrangement the roller A approaches

93



twice towards the roller B during each revolution of the roller C, and recedes from the same twice in the same time, thereby causing the material passed through the pair of rollers to become thinner in two places than on the rest of its length.

94. MANUFACTURE OF SUGAR, *J. W. Culmer, Moscow.—7th January, 1882.—(A communication from E. Wernickenck, Moscow.)—(Not proceeded with.)* 2d.

This relates to improvements in the manufacture of "loaf" or "lump" sugar, and more especially that class known as "cube" sugar, and in apparatus therefor.

96. LOCK AND LATCH SPINDLES, &c., *S. Collett, Willenhall.—7th January, 1882.—(Not proceeded with.)* 2d.

This relates to means for facilitating the use of spindles of square section to different thicknesses of doors, and different arrangements of locks or latches.

97. BOLTS OR FASTENINGS FOR CARPENTERS' BENCHES, &c., *C. J. Coxhead, Kilburn.—7th January, 1882.—(Not proceeded with.)* 2d.

This relates to the adaptation and application to the work-benches of an improved bolt or fastener.

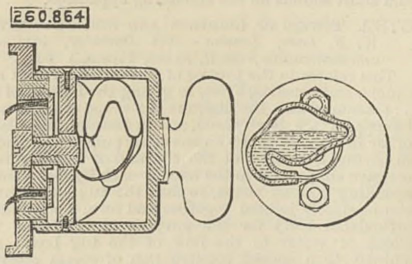
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette

260,864. CIRCUIT-CLOSING KEY FOR ELECTRIC LAMPS, *John H. Guest, Brooklyn, N.Y.—Filed April 24th, 1882.*

Claim.—(1) The combination, with a glass vessel containing mercury, of two electric conductors B C passing into such vessel, a turn button supporting such vessel and conductors, stationary contact surfaces, and contact surfaces upon the turn button, substantially as set forth. (2) The combination, in a

260.864



circuit-closing key, of an insulating vessel containing mercury, and into which vessel the metallic circuit wires pass, and separate cells in the vessel, containing mercury around the ends of such wires, and means for moving the vessel and bringing the mercury therein into contact with the mercury in the cells for closing the circuit, substantially as set forth.

260,921. PUMP, *Nestor R. Alpuche, Merida, Yucatan, Mexico.—Filed May 17th, 1881.*

Claim.—The combination, with a tube having an unobstructed bore, and pivotted at its lower end in a water reservoir, of mechanism, substantially as described, whereby a rapid vibratory motion is imparted to the tube, and the water raised therein by centrifugal action, substantially as set forth.

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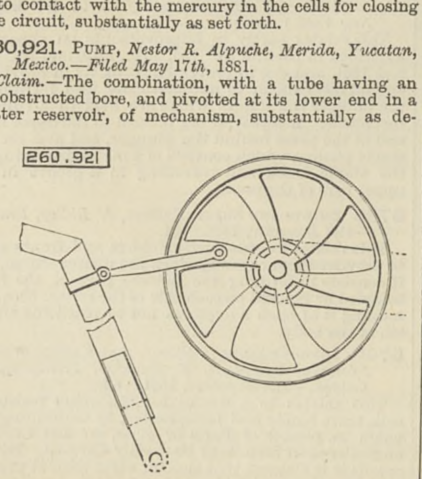

260,940. CONNECTING-ROD HEAD, *Charles Clapp, Trumansburg, N.Y., assignor to Gregg and Co., same place.—Filed June 14th, 1882.*

Claim.—(1) The base or lower section of the head, consisting of a tubular shank for the attachment of the connecting rod, the socket, the transverse groove between the socket and shank, and the locking yoke

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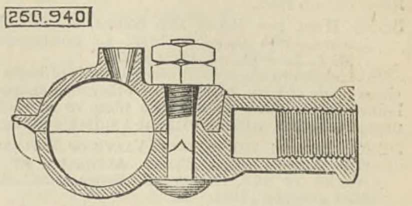

or stirrup on the opposite side of the socket. (2) The head cap constructed, as set forth, with a socket, a transverse flange on one side thereof, and a lug on the opposite side, for the purposes specified. (3) The sectional interlocking head hereinbefore described, consisting of the combination of the lower section, its transverse groove, and yoke with the upper section, its interlocking flange and stud, and the bolt which connects the two sections.

261,264. CARBON FOR ELECTRIC LAMPS, *Henry A. Seymour, Washington, D.C., assignor to George W. Stockly, Cleveland, Ohio.—Filed January 10th, 1882.*

Brief.—The weak portions of one of the layers are re-enforced by the strong portions of the adjacent layers. *Claim.*—(1) An electric lamp incandescent carbon composed of paper or paper-like substance, having two sets of long fibres arranged in layers, and the long fibres of one portion of the layers being at an

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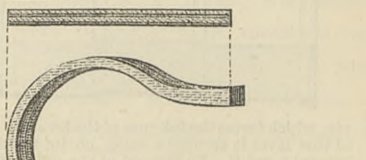

angle to those of the other layers. (2) The method of manufacturing incandescent carbons for electric lamps, substantially as described, the same consisting in cutting layers or elementary filaments in different positions from paper having its long fibres parallel with each other, and combining a number of these layers having the fibres in different positions to form a complete blank or filament, and then carbonising the whole.

261,432. GOVERNOR FOR SHIFTING EXCENTRICS, *Williard A. Clark, Stillwater, Minn., assignor to the North Western and Manufacturing Car Company, same place.—Filed May 9th, 1882.*

Claim.—(1) In a steam engine governor, the combination of the following elements, namely: the shaft, the wheel carried by the shaft, the sleeve and excentric mounted loosely on the shaft, the weight arms pivotally connected to the excentric, the pivots of the weight arms passing through the spokes, the cams J J, carried by the pivots on the side of the wheel oppo-

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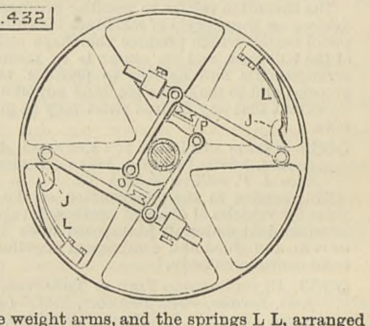

site to the weight arms, and the springs L L, arranged to bear against the cams, substantially as set forth. (2) In an engine governor of the class described, the combination of the shaft, the wheel attached thereto, the excentric and sleeve mounted loosely on the shaft, the weight arms pivotted to the wheel, the centripetally-acting springs to return the weight arms, the sockets P, carried by the wheel and projecting laterally therefrom, and the cushions O in the sockets, all arranged and operating substantially as set forth.

CONTENTS.

THE ENGINEER, August 11th, 1882.