THE CHICAGO RAILWAY EXPOSITION.

No. II.

Of late years many light railways, known as "logging roads," have been built in the States for the purpose of bringing timber in the log from the spot where it is felled to market, or to the nearest available saw-mill. These lines are somewhat temporary in their character, as when the district is cleared of all available timber, the logging road is no longer required, and the rails are generally taken up and relaid elsewhere. As the track must be laid to where the timber is, it is impossible to select a

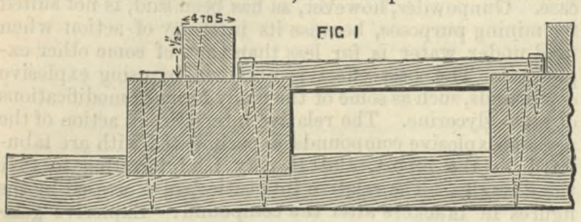


FIG I

route having favourable gradients, and as the road must be cheaply constructed, and follow the surface of the ground, steep inclines and sharp curves are almost invariably found on logging railways. An ordinary Vignoles section rail, weighing from 15 lb. to 35 lb. per yard, is generally preferred, though wooden rails are occasionally used under favourable circumstances; suitable timber being cheap, the gradients easy, rendering the use of a light locomotive possible, and the road required for temporary use only. The wear of a wooden rail is found to be excessive, especially on curves, where, owing to the higher coefficient of friction, the outer leading wheel has a greater tendency to mount the rail, and consequently crush the inner face. A wooden rail also labours under the disadvantage of being very slippery when wet, and is difficult to keep clear of snow and ice in frosty weather, thus greatly diminishing the load an engine can draw. One method of constructing a wooden road is to lay down a longitudinal balk of some cheap timber, and spike on this a maple rail, some 4in. broad by 2½in. thick. The longitudinals rest in notches cut on cross sleepers placed about 10ft. apart, and in some cases light cross ties are spiked to the upper faces of the longitudinals, Fig. 1, to keep the track square and in gauge. Hard pine is used for wooden rails in the southern States, a stick about 5in. square and 16ft. long being laid on cross sleepers of similar section placed about 3ft. apart. The sleepers are notched upon the top face to receive the rails, the notches being about 3in. deep, and 1in. wider than the rails at the top, and 1½in. wider at the bottom, the face of the notch towards the inside of the track being left perpendicular. Wooden keys, Fig. 2, are driven in outside the rails, and hold them firmly in position. When worn out on one face the rail may be reversed, and when worn out on both faces it may be cut into shorter lengths, and used for sleepers. Permanent way of this description can be made for the very small sum of £100 per mile, and will carry a locomotive with 7in. by 12in. cylinders, and weighing about 6 or 7 tons.

Our illustration—Fig. 3—shows a wooden railway in East Tennessee. It will be noticed that the undulations of the country have been pretty closely followed, and that cuttings or embankments are conspicuous by their absence. An American estimate for the lightest possible iron track, suitable for small locomotives, is as under:—

	Dols.		£
Rails, 16 lb. per yard, 25 tons 3 cwt. at 60 dols. ...	1508	say	301
Sleepers, 2ft. centres, 2640 at 10 cents each ...	264	,,	53
Spikes, four per sleeper, 3in. by ⅜in., 1710 lb. at 4 cents ...	68	,,	14
Fish-plates, for 24ft. rails, 440 joints at 25 cents	110	,,	22
Clearing, track laying, timber work for crossing small streams, &c. ...	750	,,	150
Total ...	2700		540

This sum seems surprisingly small, but the surface of the ground is merely "smoothed" for the permanent way, no cuttings or embankments are thought of, and streams are crossed by means of damaged or unsaleable logs, in the form of trestlework, or simply piled upon one another at right angles in the form known to contractors as a "bird-cage." Notwithstanding the rough and simple methods of construction used, the mere fact that a railway can be made for £600 per mile, in spite of rails costing £12 per ton, is sufficient to cause a feeling of envy in many shareholders of lines that have sunk a hundredfold this amount per mile in the vain hope of carrying a remunerative traffic.

Messrs. H. K. Porter, of Pittsburgh, Pa., have made a speciality of the construction of locomotives for narrow gauge lines and for exceptional work, and exhibited an engine suitable for a logging railway laid, however, with iron rails weighing about 30 lb. per yard. We illustrate the engine, which was awarded the gold medal as "the best engine for logging purposes," in Fig. 4. The leading dimensions of the engine are as follow:—Cylinders, diameter and stroke, 10in. by 16in.; driving wheels, diameter, 3ft.; truck wheels, diameter, 1ft. 10in.; rigid wheel base,

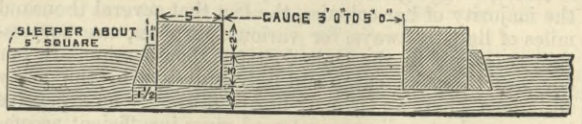


FIG 2

5ft. 3in.; total wheel base, 13ft. 4in.; length over all, 22ft.; weight in working order, 13 tons 8 cwt.; weight on driving wheels, 11 tons 3 cwt.; weight on trailing wheels, 2 tons 5 cwt.; capacity of saddle tanks, 416 gallons; gauge of railway, 3ft. The workmanship of the engines is excellent, and fully equal to that found on main line engines. The tires, slide bars, crank pins, and spring links, are of steel, the valve motion pins are of hardened steel, working in steel thimbles, and the bearing surfaces are somewhat longer than usual. The cylinders contain an admixture of charcoal pig which is still made in certain districts, while in Great Britain even cold blast iron has for many years been understood to be a thing of the past. The principal brasses are made of gun-metal containing six parts of new copper to one of tin, and as usual in America, white metal is not used. The fire-box is of Siemens steel, the tubes being of wrought iron lap welded with copper ferrules brazed on outside at the fire-box end. The edges of plates are planed to a bevel, and are caulked with a blunt-edged tool. The rivets are hand rivetted, and closed by an open-ended snap, see Fig. 5, which makes an exceedingly neat job, and provides for rivets of unequal length, the metal running up towards the open end of the snap instead of forming an irregular collar round the base of the head. The rivets are closed with a light sledge and finished with the set shown in the illustration, no other rivetting being used. The engine is furnished with a pump and an injector, both fitted with seamless copper feed, steam, and delivery pipes. A steam syphon pump is also provided for drawing water out of any pool or stream near the engine, and delivering it into the tank, a very useful provision on a rough line unprovided with water tanks or cranes. It will be noticed that the bar frame between the driving and trailing wheels is stiffened by a species of truss which gives vertical stiffness, and fairly distributes the weight of the engine. As small engines are generally owned by small railways or private individuals who have very imperfect appliances for repair, Messrs. Porter have endeavoured to design their engines so as to be especially capable of being easily repaired, and as they are built to template, interchangeable parts are kept in stock, and can be sent away at short notice. The driving axle-box brasses of Messrs. Porter's engines are generally made in three pieces for convenience of renewal, as it is found that users of small engines can more conveniently fit in the small centre wedge piece than a whole brass. Messrs. Porter put the centre portion into position by means of a suitable screw press, but in effecting repairs at a distance from proper appliances it is usually hammered into place. Messrs. Porter's works at Pittsburgh are specially laid out for this class of work, and are remarkably well arranged and well equipped, especially in grinding tools, a large proportion of work being done by grindstones that is usually finished by machine tools or hand labour. The rocking shafts are turned in the bearing, the holes in the arms bored and faced, and the work done by machine tools is completed, the arms being then ground on a large grindstone, and finished by emery wheels, which are made at the works in a very simple manner. A cast iron spoke wheel is filled up and lined with wood, leather bands are secured round the periphery by means of wood pegs, and the leather is then covered with glue, and rolled in loose emery. When the wheel is worn, the glue is washed off with hot water, and fresh glue, &c., applied. Tender brasses are simply polished on an emery wheel, and not bored out in any way; this practice is usual throughout the States for car brasses, and saves both metal and time, and the surface of the brass is left smoother than if it had been turned or bored. The polishing buffs are made of india-rubber coated with emery, which enables an article of moderately irregular shape to be polished all over. Cocks and other small brass fittings are polished on wheels made of walrus hide cut to the shape of the article, and filled with emery powder, and as this peculiar leather is exceedingly thick and very open grained or porous, it makes an admirable substance for this purpose.

FIG. 9.—MOVING AN AMERICAN RAILWAY STATION.

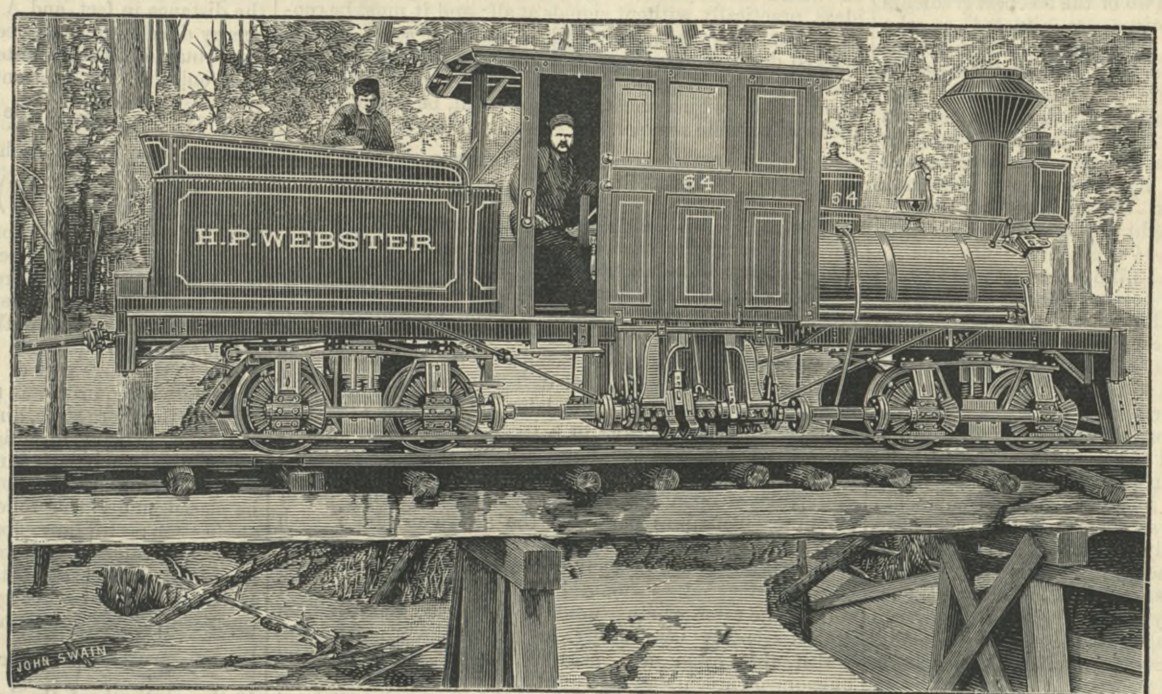


FIG. 6.—GEARED LOGGING LOCOMOTIVE.

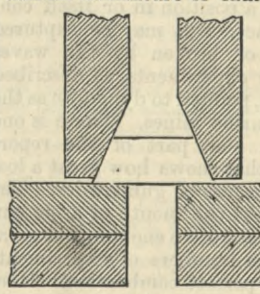


FIG 5

A similar engine to that exhibited is reported by the Cincinnati and Green River Railroad, Kings Mountain, Kentucky, to haul, in every-day work, five cars, each weighing loaded 22,500 lb., or 10 tons 1 cwt., up an incline of 1 in 40, over curves of 3 chains radius. The greatest load ever hauled is reported at 80 tons, while the daily mileage varies from 50 to 98 miles. Another engine of this size and type is reported by the Grand Haven Railroad, Muskegon, Michigan, as having on one occasion hauled five cars, weighing about 125 tons, at 30 miles per hour. Her daily performance is, however, on passenger service, where one car, weighing 18 tons, is hauled over inclines of 1 in 93 and curves of 12 chains radius, the consumption of fuel being one cord of wood—128 cubic feet—for a day's work—112 miles—which is about equal to a consumption of 20 lb. wood per mile. A somewhat larger engine of this type, having 12in. by 18in. cylinders, is employed at the Callie Furnace, Williamsons, Va., and has hauled eleven empty cars, weighing 36 tons, up an incline of 1 in 17½ and round curves of 2½ chains radius. About 15 cwt. of coal is burnt per day on a mileage varying from 40 to 60 miles, the usual load being one eight-wheel bogie car, weighing 9 tons, laden with 12 tons of iron ore.

One of Messrs. Porter's four-wheel tank engines is employed in California in a somewhat peculiar service, being used for hoisting logs from the bottom of a mountain canyon up an incline 1200ft. long, with a rise of 650ft. The engine is run on friction rollers, which are geared to a drum carrying a steel wire rope. The engine has 10in. by 16in. cylinders, with driving wheels 2ft. 9in. diameter, and the usual load hoisted is 11 tons. When used as an ordinary locomotive, it runs round 1½ chain curves on a long gradient of 1 in 38, and hauls a train weighing 86,000 lb., or about 39 tons.

Mr. E. Shay, of Haring, Michigan, exhibited a model of an engine designed for logging railways, and as the mode of construction is bold and somewhat novel, it deserves some notice. The engine, Fig 6, is carried by a long channel iron frame, mounted on two four-wheel trucks or bogies. The cylinders are placed vertically on one side of the fire-box casing, and work on a longitudinal crank shaft placed outside the wheels, and abreast of the ash-pan. This shaft is connected by means of universal and sliding couplings to other shafts which carry cast steel bevel pinions, which engage in bevel wheels fast on the bosses of the wheels, the whole of which are thus made available for traction, and are at the same time free to radiate to any curve on which the engine may be at the time. The employment

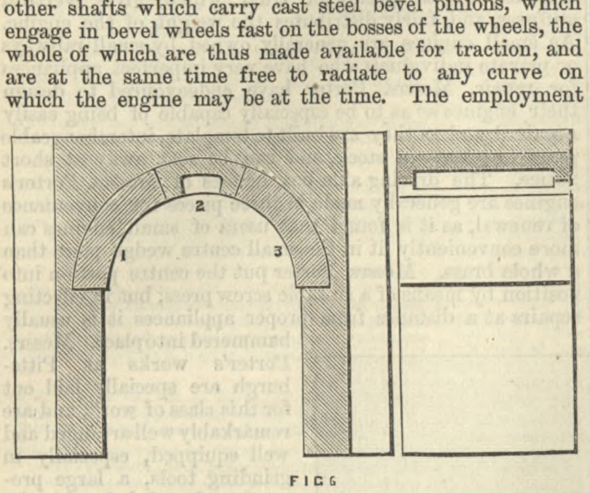


FIG 6

of gearing is of course objectionable, but it permits the use of smaller cylinders, and virtually enables a small locomotive to do the work of a large one, and it is stated that owing to the use of steel pinions, little trouble is experienced from breakage. Our illustration, Fig. 7, shows an engine standing on a trestle or small wooden viaduct, which can be made of spoiled or refuse logs, and is generally used on logging railways in place of embankments. Mr. Shay builds these engines in four different sizes, the leading dimensions of the lightest and heaviest sizes respectively being given below :—

	Heaviest.	Lightest.
Weight in working order	16 tons ...	8 tons 18 cwt.
Driving wheels, diameter	2ft. 4in. ...	1ft. 9in.
Cylinders, stroke and diameter	10in. × 10in.	7in. × 7in.
Contents of tank, gallons	580 ...	417
Speed, miles per hour	12 to 15 ...	6 to 12

Hancock's steam inspirator is used to feed the boiler, and a steam jet low lift injector is used to fill the tanks from any stream or pool near the engine. The larger engine has drawn a train weighing 88 tons up a rise of 98ft. in 3800ft., part of the gradient being inclined 1:17. This is a very remarkable performance when compared with the work done by ordinary locomotives upon steep gradients in Great Britain. Two of the steepest gradients worked by ordinary locomotives are situated on the Cwmfrwdore and Cwmnantdu branches of the Monmouthshire Railway, and when these lines were first opened in 1871, careful experiments showed that an ordinary six-coupled tank engine was just able to push double her own weight up an incline of 1 in 19·3, the coefficient of adhesion being one-sixth, and average pressure in the cylinders 106 lb. per square inch. The figures in the performance of Mr. Shay's engine given above may be roughly summarised as follows :—Weight of train, 88 tons ; weight of engine, 16 tons ; total, 104 tons ; resistance due to gravity on incline of 1 in 17, 13,703 lb. ; resistance due to friction, 4 lb. per ton, 416 lb. ; total, 14,119 lb. The cylinders being geared 3 : 1 to the wheels, the tractive force per lb. average pressure on the pistons is about 107 lb., and it would therefore require an average pressure of 132 lb. per square inch to be maintained in the cylinders throughout the stroke in order to perform this work. As this is a few pounds above the boiler pressure, it is evident that the engine could not have started the train if its whole length had been standing on the incline of 1 in 17, and apparently this incline was barely long enough to accommodate the length of the train, and was surmounted, partly owing to this circumstance and partly to the fact, often lost sight of, that the momentum of the train running at any speed at the foot of an incline is a powerful factor in enabling an engine to ascend with a heavy load. The average power to be exerted by the engine throughout the ascent of the incline in question—98ft. rise in 3800ft. horizontal distance—is only 6016 lb., which tractive force could be exerted by an average pressure of 56·2 lb. per square inch on the pistons ; and this of course should be well within the steaming powers of the engine ; while the adhesive weight being 16 tons, or 36,000 lb., the coefficient of adhesion would be about $\frac{1}{6}$, as in the case of the Monmouthshire engine referred to above. The Cummer Lumber Company, of Cadillac, Michigan, appear to be well pleased with the performances and durability of geared engines, and give the following figures as to the performance of an engine supplied them by Mr. Shay. The engine is constructed for a 3ft. gauge, and has two 8in. by 8in. cylinders geared 2 : 1 to driving wheels 2ft. diameter, giving a tractive force per lb. av. press. in cylinder of 43 lb. The heaviest gradient is 1 in 66, with a reverse curve of 14 chains radius. The average train varies from sixteen to eighteen cars, each car carrying about 125 cubic feet of timber, though as much as 264 cubic feet has been found loaded on one car. No absolute weights of either cars or timber are given, but the fact that an engine weighing in working order but 10 tons 12 cwt. can draw over 2000 cubic feet of wet timber over an incline of 1 in 66, is certainly a remarkable feat. But two men, an engineer and a helper, are employed in working these trains, the helper making up the train at each end of the road.

Our illustration, Fig. 8, shows a logging train *en route*. The car nearest the spectator is the nineteenth, counting from the engine, while the locomotive is almost out of sight in the distance and is further hidden by the stem of a pine tree. Each car is mounted on two four-wheel trucks or bogies, and measures some 30ft. in length, weighs about 9 tons, and carries 15 to 20 tons of wet timber.

Another illustration, Fig. 9, represents the somewhat unusual spectacle of a railway station being moved by train. The main station building—which is somewhat a more elaborate structure that usual in the United States—is loaded on a flat car owned by the Grand Rapids and Indiana Railroad—a line running through the State of Michigan, and controlled by the ubiquitous Pennsylvania Railway. The vehicle labelled "Caboose" is an old passenger car converted into an American goods brake van, which, however, is more a shelter and a sleeping place for the train hands than a source of brake power, this being furnished by the ordinary vehicles of the train.

Though logging roads are impossible in Great Britain or the majority of her colonies, the fact that several thousand miles of light railways, for various purposes, are successfully working in the United States should stimulate our energies to make cheap and light railways in the many situations where an ordinary line of railway is an expensive luxury, and an ordinary cart road gives insufficient accommodation. In order to be remunerative, railways in our agricultural districts must apparently be made on the light and cheap system, the amount of traffic being insufficient to pay interest on the heavy outlay necessarily involved in the construction of an ordinary English railway, while many of the elaborate precautions for safety which are necessary for high-speed traffic can be dispensed with on lines worked at a slow speed, and passing through sparsely populated districts. The working of American railways shows that cheap lines, almost absolutely unprovided with signals, fences, level crossing gates or station platforms, and strewn with facing points and railways crossing on the same level, can be worked with a tolerable amount of safety and with a very great degree of comfort to the passengers ; and while there can be no doubt that the block system, interlocking, and many precautions insisted on by Parliament and the Board of Trade are absolutely essential to the safe conduct of main line traffic, yet they become absurd and unnecessary when applied to small subsidiary lines where a few light trains run at a slow speed and stop at all stations. The Board of Trade officials make laws of the Medes and Persians order, and apply practically the same regulations to a line running 200 or 300 trains a day and to a little branch line worked by one engine ; and the making of railways in remote country districts in England has consequently been much hampered by the expensive signals, &c., insisted on by the Government inspectors, with the not infrequent result that a little out-of-the-way station, perched among the solitary hills of wild Wales, is often provided with elaborate interlocking and signal gear, which are conspicuous by their absence in many overworked main line junctions. Railways in America, being practically unfettered by any Government control, are adopting more elaborate precautions and signals on their crowded main lines than obtain at home, even on such lines as the Metropolitan or Charing-cross, while the majority of lines on which the traffic is light, are, according to English ideas, practically without signals at all ; and it must be confessed that there is a great deal of common sense in this marked distinction between crowded lines which can afford, and absolutely require, a heavy outlay for signals, and branch lines which must, if made at all, be made in the cheapest possible manner.

SUBMARINE MINES.

Monitors and mines have been more studied and developed since the time of the American war than any other engines of destruction. The former have developed into the modern ironclad ; the latter into torpedoes, which are expected to prove more deadly and destructive than any other military apparatus in the next great war between maritime nations. Soon after the introduction of gunpowder, mines were used defensively and offensively in naval warfare. Very much later the Russians protected their ports by such means to a large extent, and this was especially the case in the Baltic during the Russian war ; but it was left for the American war to teach men how powerful a weapon this might be. The protecting power of submarine mines paralysed the action of the French fleet in the Franco-German war. It is of the greatest importance that the protective and the destructive action of submarines mines should be known. The action is, of course, the same whether used to attack or repel, and in both cases the user desires to know the area through which the mine will prove effective. The physical phenomena accompanying submarine explosions have been carefully investigated and reported upon by Colonel Abbott in the United States. As would be expected, the greatest effect is in the line of least resistance, and this is generally vertically upwards from the mine. There is in this phenomenon an analogy to what occurs at the discharge of a cannon. The line of least resistance corresponds to the axis of the bore, while the water around plays the part of the metal of the gun. A vessel is subject to three dangers when in the neighbourhood of an exploding mine—the hull may occupy a position in or itself constitute the line of least resistance, or it may be ruptured by the transmitted pressure, or broken by the waves generated. The results of the experiments, as described in this report of Colonel Abbott, pointed to dynamite as the best explosive to use for submarine mines. There is one very interesting paragraph in that part of the report treating of explosive mixtures that shows how great a loss of power often takes place in the use of gunpowder. The sprinkling of unignited powder at the mouth of a big gun after its discharge has been noticed often enough, and great care has been bestowed on large numbers of experiments that have been made to attain perfect combustion. Here are some facts, then, bearing upon powder ignition. A charge of 50 lb. of mortar powder, in a 1in. 50 lb. box, was fired upon ice. Ten fuses were used, well distributed through the powder. The explosion broke a circular hole through the ice, 5ft. in diameter, surrounded by several concentric cracks, for another 1·5ft., with many radial cracks. The box was broken into small fragments, some of which were thrown to a great height. Unburned grains of powder were distributed uniformly over the ice, the most distant being about 10ft. A belt 1in. wide was marked off, and the powder grains counted, 875 grains being found in 851 running inches. One hundred grains troy, contained by count 1618 grains of powder. The area of distribution of unburned powder was 2,275,000 square inches, with, as will be seen, on the average of a grain of powder to a square inch of surface, and this gives some 20 lb. of powder out of the 50 lb. charge as unburned. Even without experiment it would be inferred that the best result would be obtained with a small charge of powder in a very strong case, rather than with a larger charge in a weaker case. Gunpowder, however, as has been said, is not suited for mining purposes, because its intensity of action when fired under water is far less than that of some other explosives. The best effect is obtained by using explosive compounds, such as some of the many forms or modifications of nitro-glycerine. The relative intensities of action of the various explosive compounds experimented with are tabulated in the report, and it may be interesting to give these results. The relative intensities are expressed by the figures in brackets after the compound :—Explosive gelatine (117), dualin (111), Hercules powder No. 1 (106), dynamite No. 1 (100), rendrock (94), gun-cotton (87), dynamite No. 2 (83), mica powder No. 1 (83), Hercules powder No. 2 (83), Vulcan powder No. 2 (82), nitro-glycerine (81), Brugere powder (81), Vulcan powder No. 1 (78), electric powder No. 1 (69), Designolle powder (69), electric powder No. 2 (62), mica powder No. 2 (62). The experiments made and the results obtained with each of these compounds are fully detailed, but it will suffice us to say that the report recommends the use of dynamite No. 1, at any rate provisionally, though it is not impossible but that explosive gelatine may be a formidable rival. The reasons for this selection may be briefly stated—that dynamite has intense action, retains its normal strength though exposed to freezing, thawing, and occasional wetting, it is with reasonable care safely handled, and of a form that admits of charging easily, while it is manufactured on a fairly large scale and at a reasonable cost. Some of the above-named compounds are made upon a very small scale and at out-of-the-way places, so that if hurriedly required in large quantities for offensive or defensive operations could not be obtained. Dynamite No. 1, recommended, consists of 75 per cent. of nitro-glycerine absorbed by 25 per cent. of Kieselguhr.

A general formula for explosive mixtures was found $W = \frac{K(\theta + E)^t S^y C^x}{(D + A)^q R^2}$, and this formula, when representing the energy developed by explosive compounds in the horizontal plane containing the charge, may be simplified to $W = \frac{K C}{(D + A)^q}$, in which expression K is a constant depending upon the explosive employed, the index q should be 2, except for loss because of the slight compressibility of water, C the weight of the explosive in pounds, D the distance in feet, and A a constant depending upon the energy developed at the centre of the charge. From the data obtained the constants in the latter equation—applicable only to the horizontal plane—were as follows:— $W = \frac{58 C}{(D + 0{\cdot}01)^{2\cdot1}}$. The formula obtained for the mean pressure per square inch developed by the explosion $P = \sqrt[3]{\left(\frac{1832000 C}{(D + 0{\cdot}01)^{2\cdot1}}\right)^2}$.
Comparing these expressions the available energy of the explosive is seen to be directly proportional to the charge and—nearly—inversely proportional to the square of the distance, while the intensity of action varies directly as the two-thirds power of the charge and inversely to the 1·4 power of the distance.

We in the early part of this brief comment stated that the solution required was the area of effective action, and we may therefore state, almost in the words of the report, that the general formula for the extreme destructive range Δ of a submarine mine charged with an explosive compound, and acting upon a first-class ship of war, may be placed under the following form for convenience of application:—In any particular case substitute the numerical values of θ, E and C, and find Δ. If the vessel lies at this or at a less distance she will be destroyed. A submergence of the charge properly suited to its size is supposed, say, not less than 3ft. or 4ft. for 100 lb., and proportionally greater for larger amounts: $\Delta = \sqrt[2\cdot1]{\frac{(\theta + E) C}{8}}$.
If the strength of the hulls of vessels is increased the constant 8 undergoes change ; if some other compound than dynamite is used the constant E changes, and so on. A good deal of attention has been bestowed upon this subject by Englishmen, but little has been published. Perhaps greater attention has been bestowed in obtaining certainty of motion in a required direction than to area of action, but it must be remembered that for defence stationary mines will be largely used. One most important feature in mining work, which needs a much more exhaustive series of experiments than have been given to it, is that of sympathetic explosion. Under what conditions can an enemy's mines be exploded and the path cleared? According to Colonel Abbott's report, no fear need be entertained of the sympathetic explosion of one charge from the explosion of its neighbour, or of a countermine, provided the case be of iron strong enough to resist rupture from the shock.

Naval Engineer Appointments.—The following appointments have been made :—George A. Haggarty, assistant engineer, to the Northampton, vice Bolland ; G. T. Simmons, engineer, to the Pembroke, additional, for service in the Arethusa ; Job. K. Medlen, engineer, to the Asia, for service in the Active ; James C. Oare, engineer, to the Asia, for service in the Bacchante ; J. Stuart, engineer, to the Asia, for service in the Emerald ; Alfred J. Nye, engineer, to the Asia, for service in the Nymph ; Edwin G. P. Mollett, assistant engineer, to the Asia, for service in the Cordelia ; Charles E. Stuart, assistant engineer, to the Asia, for service in the Rupert ; Charles W. Gregory, assistant engineer, to the Euphrates, vice Medlen ; Benjamin J. Lewis, assistant engineer, to the Hector, vice Nye.

RAILWAY MATTERS.

The experiment of a uniform fare for all journeys is to be tried forthwith on the Ceinture Railway round Paris. The *Pall Mall Gazette* says the fare will be thirty centimes (3d.) for any distance. A uniform 3d. fare would not pay on the Inner Circle in London, when completed.

The St. Gothard Railroad, which cost about £8,000,000, in the first eleven months it was open, ending with April last, earned £358,000 gross and £198,600 net. The largest earnings of any months were £40,540, in September. Nearly half of the earnings have been from passengers, but this traffic seems to have fallen off since October.

In the German Empire, exclusive of Hungary, last year 139,452 railroad servants were examined as to their capacity to distinguish colours. Of these, the *Railroad Gazette* says, 998, or 0·72 per cent., were found to be colour-blind. Of 115,154 examined this year, only 46 were wholly and 273 partly colour-blind—0·28 per cent. of the whole number.

In concluding his report on a collision which took place on the 3rd ult. at Ramsgate Station, on the London, Chatham, and Dover Railway, Major Marindin says:—"If the train had been fitted with a continuous brake the driver could have easily stopped the train, even if he had not applied it before he arrived at the west end of the platform, but the necessity for using such a brake ought not to have arisen."

On March 31st there were in New Zealand 1358 miles of railway open for traffic, of which the receipts were £953,347, and the expenditure £592,821; the corresponding figures of last year being, receipts, £892,026; expenditure, £523,099. There were this year 1,564,793 tons of goods and 3,283,378 passengers carried over the lines. The 1358 miles open for traffic, with the amount still to be expended, will cost £11,409,479, the revenue upon which is at the rate of £3 3s. 2d, per cent.

The *Railroad Gazette* record of accidents on American lines during June includes 33 collisions, in which 26 persons were killed and 58 injured; 55 derailments, in which 10 persons were killed and 35 injured, and 3 other accidents, in which 2 persons were killed and 2 hurt. Twenty-five of the killed and 51 of the injured in the collisions were railroad employés, as were all of the killed and 26 of the injured in the derailments, and all of the killed and injured in the other accidents.

A new railway to Princetown, in the heart of Dartmoor, was opened on Saturday. It is worked by the Great Western as a branch from its line from Plymouth to Launceston. The junction is at a place called Yelverton, about ten miles from Plymouth, but passengers are carried on to Horrabridge, the next station beyond, and brought back again. The line is ten miles in length, and is a continuous ascent over the hills to Princetown, rising 800ft. in ten miles, or a mean gradient of 1 in 66.

The train accidents in June in America are classed as to their nature and causes as follows:—Collisions: Rear collisions, 22; butting collisions, 8; crossing collisions, 3. Derailments: Broken rail, 1; broken frog, 1; broken bridge, 2; spreading of rails, 8; broken wheel, 1; broken axle, 4; broken truck, 3; accidental obstruction, 2; cattle on track, 5; land slide, 2; wash-out, 3; wind, 3; misplaced switch, 4; malicious obstruction, 2; unexplained, 14; boiler explosion, 1; broken connecting rod, 2. Total, 91.

In the six months from October 1st, 1880, to April 1st, 1881' 4123 tires broke on sixty-five railroads in Germany, which had 21,247 miles of road—19·4 to every 100 miles of road, against 25 in 1880. The *Railroad Gazette* points out that there was one tire break to every 124,760 miles run by a wheel. Like rails in this country, the breakages increase in cold weather. In successive months the numbers were:—October, 352; December, 435; January, 1562; February, 775; March, 592. Below the freezing point 1553 breakages occurred; above it, 956.

A general classification of the railway accidents in America during June is made as follows by the *Railroad Gazette*:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	12	—	12
Defects of equipment	2	9	3	14
Negligence in operating	31	4	—	35
Unforeseen obstructions	—	14	—	14
Maliciously caused	—	2	—	2
Unexplained	—	14	—	14
Total	33	55	3	91

Earl Granville having placed at the disposal of the Institution of Civil Engineers one of the six sets of invitations forwarded to the Foreign Office by the Northern Pacific Railroad Company, Mr. George Barclay Bruce, vice-president, has been deputed to attend the formal opening of the line as the representative of the Institution. Having been Robert Stephenson's second pupil, and afterwards a trusted assistant of that eminent engineer, this nomination seems to be a very appropriate one. In December, 1859, Mr. Bruce, in accordance with a wish expressed by Robert Stephenson shortly before his death, tested the Great Victoria Bridge over the river St. Lawrence, at Montreal.

A report by Colonel Yolland has been published on an accident that occurred on the 1st ult. to an up passenger train on the Cornwall Railway, between Menhenoit and St. German's stations, when the last vehicle in the train, an empty third-class carriage, and a carriage truck partly loaded with fish, both got off the rails while travelling at about thirty miles an hour, but the train was stopped after running a distance of about 473 yards, without doing much damage except to the permanent way. No persons were hurt, and the train was not separated into two parts. After the accident it was found that the rails had opened out over 2in. Colonel Yolland says:—"It is most fortunate that the train was fitted with a cord communication, as it enabled the under guard at once to sound the engine brake whistle when he found that a carriage was running off the rails, and thus to attract the engine-driver's attention, and caused him to apply the continuous automatic vacuum brake and to pull up the train in a short distance. If this had not been done the results might have been serious. The railway law does not require that trains should be fitted with the means of communication unless they are appointed to run for a distance of twenty miles without stopping, and it is a serious error in the law, which will be corrected, I trust, when any legislation takes place with respect to the working of railways."

Few of our British railways have a series of works in hand so extensive as those that the Lancashire and Yorkshire Railway have. During the past half-year it spent not less than £810,000 on new works charged to capital. Out of that sum £326,000 were expended on lines that are open for traffic—over £270,000 of the latter amount being for enlargements of stations and other works. In adding to the working stock £74,000 were spent, engines being the most costly of the additions. Of the new lines there were several important in progress, as may be judged when it is said that the sum expended was £399,000 in the half-year. There is a widening of the line between Heaton Lodge and Mirfield, a loop line at Liverpool, a widening of the line into Bradford, extension works at the Victoria Station at Manchester, a series of works at Fleetwood Dock, on which half-a-million has been expended, and other costly works. In the half-year that has now been entered upon the expenditure will be heavy—it is estimated at about £950,000—but after that, as the anticipated sum is £1,770,000, it may be expected that there will be a diminished rate of expenditure. The Lancashire and Yorkshire Company has awoke to its position and to the necessity of spending money, though the first result is seen in the fall in its dividend, but as the works grow near accomplishment it gains a capacity of service that with its enormous population should make it much more productive.

NOTES AND MEMORANDA.

Issoudun, the birthplace of Nicolas Leblanc, the inventor of the process for making soda from salt, is about to erect a monument to his memory. His discoveries in chemistry were of the highest importance, that relating to soda being made in 1790.

The annual rate of mortality for the week ending August 4th, in twenty-eight great towns of England and Wales, averaged 20·0 per 1000 of their aggregate population, which is estimated at 8,620,975 in the middle of this year. The six healthiest places were Plymouth, Cardiff, Derby, Birkenhead, Brighton and Bristol.

In London 2505 births and 1465 deaths, or 8·7 per hour, were registered during the week ending 4th August. Allowing for increase of population, the births were sixty-seven, and the deaths so many as 224 below the average numbers in the corresponding weeks of the last ten years. The annual rate of mortality from all causes, which had been equal to 23·5 and 21·2 per 1000 in the two preceding weeks, declined to 19·3.

The death rate in New York during the week ending July 7th, was 41·6 per 1000, the rate in thirty-two United States cities being 30·5. In the North Atlantic cities the rate was 24·7; in the Eastern cities, 35·8; in the lake cities, 21·6; in the river cities, 29·5; and in the southern cities, for the whites, 26·0, and for the coloured, 40·2 per 1000; 58 per cent. of all deaths were of children under five years of age. Accidents caused 2·9 per cent. of all deaths. Consumption caused 8·6 per cent. of all deaths, the proportion being highest in the North Atlantic cities, 35·1 per cent., and lowest among the lake cities 18·9 of the deaths.

Lieutenant Diek, of the Russian army, has discovered a new illuminating substance which is able to impart luminous properties to the objects to which it is applied. It is in the form of a powder and of three colours, green, yellow, and violet, the latter being the most powerful. Water in a glass vessel is by this means converted into an illuminating fluid. In a lecture recently delivered by the inventor at the Nicolai Engineering Academy at St. Petersburg he explained the application of the substance to military and industrial mining operations, as it consumes no oxygen. The illuminating power lasts for eight hours, and the powder must then be renewed. The German Government has lately been making experiments with Lieutenant Diek's invention.

The following method for the preparation of selenium on a large scale has been described by Hugo Bornträger, in "Dingl. Pol. Journ." 64, 247, 12:—The selenium originally contained in the pyrites is afterwards found in every stage of the process—in the burners, flue passages, chamber mud, and the sulphuric acid from which it passes into the hydrochloric acid made with the same. In order to recover it, the chamber acid is allowed to run down a Glover's tower without the addition of any nitrated acid. It is thus brought into contact with the reducing gases from the chambers, viz., SO_2, which precipitate the selenium contained in it as a red amorphous powder. The reddish turbid acid thus got is allowed to settle, decanted, and the deposit of selenium washed and dried at 100 deg.

Sub-irrigation trials have been lately made in America with good results. Mr. Biggs, a prominent horticulturist in California, has tried the plan in an orchard of 150 acres in Solano county, and he found that the product was so increased in quantity and quality as to pay the cost of the improvement in one year. Trenches about 18in. in depth are dug at intervals of 7ft., and as long as required to cross the piece of land to be irrigated, and in these cement pipe 4in. in diameter and of 2in. open bore is laid by a machine like that illustrated in our last volume, carried along by hand, making a continuous pipe. While the cement is still soft, holes are punctured in the pipe at intervals of 7ft., and in each of these a peforated plug is inserted, through which the water, when let into the pipes, will percolate and irrigate the ground. These pipes connect with a main trunk of 4in. or 6in. in diameter, through which the supply of water runs.

A soft alloy which attaches itself so firmly to the surface of metals, glass, and porcelain that it can be employed to solder articles that will not bear a very high temperature, can, according to *Amateur Mechanics*, be made as follows:—Copper dust obtained by precipitation from a solution of the sulphate by means of zinc is put in a cast iron or porcelain lined mortar and mixed with strong sulphuric acid, specific gravity 1·85. From 20 to 30 or 36 parts of the copper are taken, according to the hardness desired. To the cake formed of acid and copper there is added, under constant stirring, 70 parts of mercury. When well mixed, the amalgam is carefully rinsed with warm water to remove all the acid, and then set aside to cool. In ten or twelve hours it is hard enough to scratch tin. If it is to be used now, it must be heated so hot that when worked over and brayed in an iron mortar it becomes as soft as wax. In this ductile form it can be spread out on any surface, to which it adheres when it gets cold and hard.

Durand has explained the spontaneous ignition of coal as being due to the presence of pyrites, which on oxidation under suitable conditions inflames and then sets fire to the coal in which it is imbedded. According to Fayol's experiments, however, the real cause of this phenomenon is the oxidation of the coal itself and not of the pyrites. The absorption of oxygen by coal—carbon—takes place more or less readily according to the temperature and the coal being more or less finely divided. According to the "Journal" of the Society of Chemical Industry, lignite in the state of fine dust takes fire at 150 deg., gas carbon at 200 deg., coke at 250 deg., and anthracite at 300 deg. or above. On heating a mixture of finely-powdered coal and pyrites to 200 deg. for four days the coal took up 6 per cent. of oxygen, whilst the pyrites absorbed only 3·5 per cent. Hence coal absorbs oxygen much more energetically than pyrites does, which has also been confirmed by the following experiment:—About 900 grams of powdered coal and 3350 grams of powdered pyrites were placed in tin cans and put in a drying chamber. Up to 135 deg. both behaved similarly, but from there the temperature of the pyrites remained almost stationary whilst that of the coal quickly rose, ignition taking place after a few hours. Two other samples of coal and pyrites were put in a chamber at 200 deg. The temperature of the coal quickly increased. After forty minutes it got up to 200 deg., and the coal took fire, whilst the pyrites had at the same time only been raised to 150 deg. The ignition of the coal was not at all hastened by an admixture of pyrites.

Mr. W. Crookes, F.R.S., Dr. W. Odling, and Dr. C. M. Tidy, reporting to the official water examiners for the metropolis as to the results of their analyses during July, state that of the 182 samples of water collected by them from the mains of the seven London companies taking their supply from the Thames and the Lea, the whole, without exception, were clear, bright, and well-filtered. In respect to aëration and to general freedom from colour and excess of organic matter, they had maintained their excellent character, although, indeed, in one exceptional sample the proportion of organic matter present was in excess of what was customary at this season of the year. Referring to Dr. Frankland's report on the water supplied during June, these gentlemen point out that it is stated that the river-derived waters supplied to London in June contained from nearly 2 to 2¾ times as much of organic impurity as a certain well-water standard, peculiar to the reporter. As usual, it is not thought advisable to point out that, measured by the same peculiar standard, the "organic impurity" of the highly-reputed Loch Katrine water supplied to Glasgow is, according to the reporter's own figures, in excess of that present in the Grand Junction, Chelsea, West Middlesex, Lambeth, and East London Companies' waters, and is double that present in the New River Company's water. We would renew our protest against the use of this misleading scale of implied unwholesomeness and the partisan purposes it is skilfully made to subserve—a protest specially called for at the present time, when the possible spread of cholera from Egypt to the United Kingdom has directed unusual attention to questions of water supply, and more particularly to the supply of the metropolis.

MISCELLANEA.

The Queen has intimated her intention of conferring the honour of knighthood upon Mr. Robert Rawlinson, C.E.

The number of visitors to the Fisheries Exhibition on Saturday last was 20,494, a total for last week of 151,467, and a total from the opening of the Exhibition of nearly a million and a-quarter.

Mr. Alex. B. W. Kennedy, M. Inst. C.E., Professor of Engineering and Mechanical Technology, University College, London, has been nominated by the Council of the Institution of Civil Engineers to serve as a juror in Class 42, Section 2, "Engineering and Machinery," at the Amsterdam Exhibition.

A contractor, who had lately undertaken to repair a road in Clinton county, State of New York, employed for the purpose clinkers and refuse from a neighbouring smelting furnace. People soon remarked an abundance of glistening particles on the road surface, which, on examination, proved to be pure silver. The explanation was soon found. The ore sent to the furnace came from an ironstone mine which was traversed by an irregular vein of silver ore. But the ore smelted indiscriminately, and so silver became mixed with the scoriæ that were employed to repair the road. The contractor reconsidered the use of that slag.

Attention is now being again given in Mecklenburg to the Rostock and Berlin Canal scheme, to complete which there have still to be two portions constructed. Herr Hess, of Hanover, has lately modified his project drawn up ten years ago in accordance with the altered requirements of the present time. This plan deals with the section between Bützow and Güstrow, the cost of which is estimated at about £62,000. The original full dimensions will be adhered to, as it has been calculated that the saving to be effected by reducing them would not be considerable. It has been decided to draw up a new project for the final section between Güstrow and the Plauersee.

An accident occurred this week at the Eston Steel Works, Middlesbrough. Something was wrong in a culvert near the converters. A man named Baxter went in to put it right, accompanied by a man named Sharpe. These men not re-appearing in due time, Mr. Bunting and Mr. Watherspoon, foreman, went to the rescue, but both were rendered insensible by the poisonous gases with which it then became evident that the culvert was charged. Means were quickly taken to ventilate the culvert and abundant assistance was procured. All four men were brought to the surface, and after receiving proper treatment three of them recovered. Baxter, however, the man who first went down, was dead.

There will, says a daily contemporary, be on view at Nice during next winter's exhibition a vessel described by M. Torelli, its inventor, as a "submarine observatory." It is made of steel and bronze, and is constructed so as to resist the pressure of the water at a depth of 400ft. It is 26ft. in height and is divided into three portions. The upper one is for the commander, who directs the work and gives explanations as to the wonders of the sea to the passengers, who are in the middle compartment, partly constructed of glass in order to facilitate observations. The balloon is provided with electric light, and a telephone communicating with the steamer which accompanies it. The third part is reserved for the machinery used in ascending and descending.

During the last few years the question of normal sections for iron has occupied in Germany the attention of practical and technical authorities on the subject, with the result of certain normal models having been adopted for rolled iron, as applied to building purposes. While the commission engaged in the necessary investigations was at work the Imperial Admiralty requested the members to consider the question of applying this principle to iron for shipbuilding purposes. The matter was under discussion for about three years, and has in its different stages of progress come before several of the annual congresses dealing with engineering subjects. The recommendations made have now received the official sanction of the German Admiralty.

A meeting was held on the 10th inst. to consider a proposed waterworks at Bungay, under the provisions of the Public Health Act, 1875, for the parishes of Bungay St. Mary and Bungay Holy Trinity. Mr. J. Compton Merryweather, M.I.C.E., and Mr. J. Howard, C.E., of the firm of Messrs. Howard and Baker, London, invited by the committee, were present to discuss the water supply of the district. The discussion resulted in an offer being made by Messrs. Merryweather and Howard to construct the waterworks within four months, under a new and economical system. The offer was accepted by the committee. Street watering is to be done by means of the tricycle reel and hose system, also an improved water tower for fire-extinguishing purposes, which is carried out in conjunction with fire-escapes, is to be used.

According to a correspondent of the *Times* there are now altogether six lighthouses and one light vessel in the Red Sea; four of these are in the Gulf of Suez, and of the remaining three one—that upon the Brother Islets—is not yet lighted. Between the Dædalus Shoal and Perim Island, a distance of more than 800 miles, there is no light at all; and though for 600 miles, after leaving the Dædalus, there are no dangers in the track of steamships, after that the sea is studded with islands and rocks, which render the navigation difficult and dangerous, especially on dark and hazy nights. The places which are more especially dangerous are Jibbel Zukur Island and the Mokha Shoals. On Jibbel Zukur Island there are now the remains of three or four large steamers which have been wrecked there during the last year or two. By placing a lighthouse on Abu Ait Island, three miles to the eastward of the northern point of Jibbel Zukur, and a light vessel on the Mokha Shoals, the navigation of this most dangerous part of the Red Sea would be rendered much more safe and easy. For homeward-bound ships there is also a great necessity for a light on the south-east end of the Shadwan Island, as a guide to the entrance of the Straits of Jubal. With the great increase of the traffic through the Red Sea which has taken place during the last few years, it is now high time that there should be some improvement in the lighting of this great highway to the East. We may point out that the Canal Company is now extensively adopting Pintsch's fixed and floating gaslights for the canal entrance and elsewhere, and no doubt will soon employ them in the Red Sea, where they are very much wanted.

The change that is taking place in the tonnage of the vessels that do the carrying over sea is very well exemplified by a statement of the tonnage that left the port of Sunderland during the first half of the present year. In that period the average tonnage of the vessels frequenting the port had increased by about 14 per cent. In the number of vessels there is a considerable variation. Comparing the half-year with the first half of the past year, it is seen that of vessels frequenting the port of less than 150 tons register there has been a decrease of 224, and of the vessels between 150 and 250 tons the decrease is 53 in number; but all above that show an increase. Between 250 and 350 tons the increase is 36; between 350 tons and 500 tons it is 4; between 500 and 750 tons it is 104; between 750 tons and 1000 tons it is 46; and above 1000 tons the increase is 29. It is thus evident that small vessels are less frequenting the great port of North Durham, and that the work is done by fewer and larger vessels; and this experience will probably be found to be general, for the tendency is marked towards the use of steam-propelled vessels, whilst the small sailing craft that a few years ago were the chief support of the ports are dying out. The result is that there is a tendency towards the use of the ports that can offer the fullest facilities for vessels of large tonnage, and as Sunderland has very considerably increased its facilities of late, it finds the benefit of the change, and some of the smaller ports lose. And probably that change will go on, for it is not likely that the small vessels that now exist will be renewed when they are removed from the register; so that the ports that prepare themselves with the fullest facilities for the loading of large vessels will reap the benefit.

PORTER'S LOGGING LOCOMOTIVE AT THE CHICAGO RAILWAY EXPOSITION

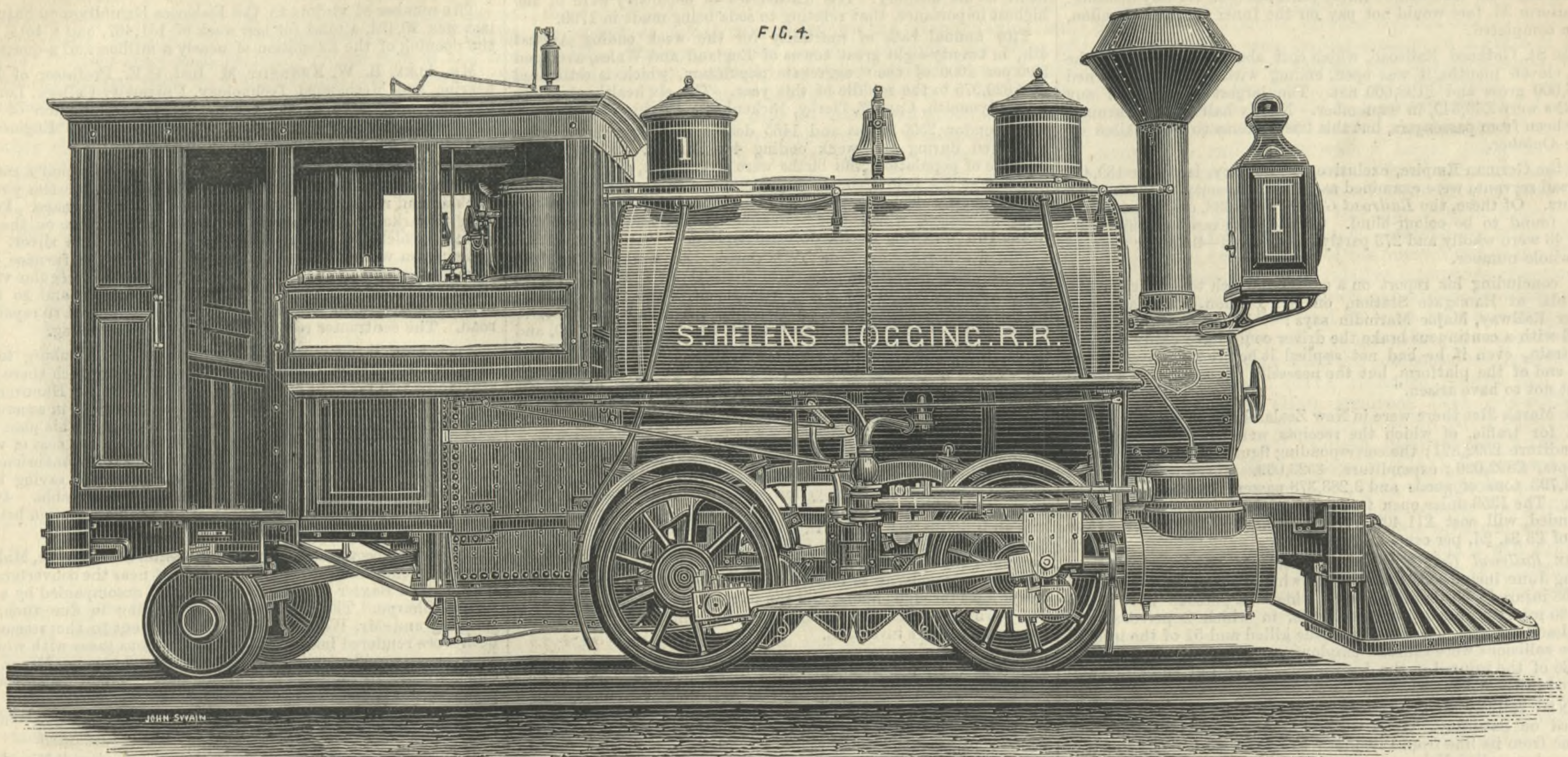


FIG 8.—LOGGING TRAIN.

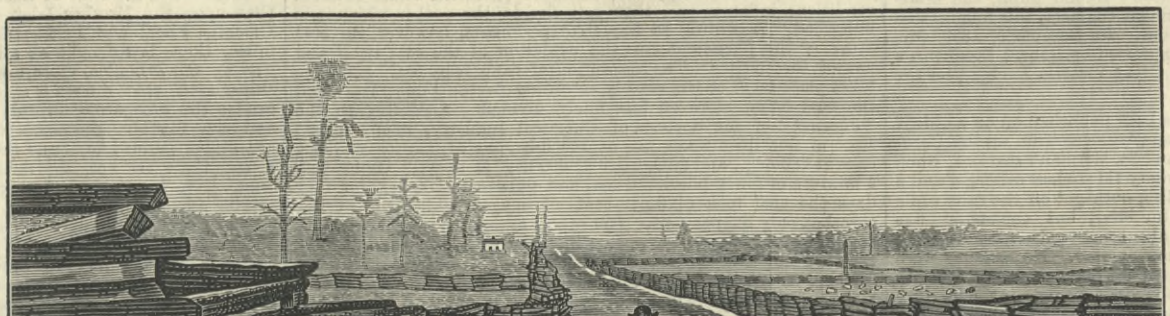


FIG. 3. WOOD RAILWAY IN EAST TENNESSEE.

STEAM TRAMWAYS.

An important meeting of engineers and managers connected with steam tramways in England was held on Monday at the Westminster Palace Hotel, when the following gentlemen, amongst others, were present:—Messrs. J. S. Ayrton, North Staffordshire Tramways; W. Baxter, Leeds Tramways; B. S. Biram, Birmingham Central Tramways; Chas. Blagburn, C.E.; R. S. Dugdale, Huddersfield Tramways; H. Foley, Gateshead Tramways; J. W. Grover, C.E.; G. Herbert, Nottingham Tramways; J. Kincaid, C.E.; W. Mason, Bradford Tramways; J. Y. Mawson, Wigan Tramways; T. F. McNay, C.E.; J. W. Newton, C.E.; C. E. Newill, Manchester, Bury, and Oldham Tramways; C. N. Nicholson, South Staffordshire Tramways; E. Pritchard, C.E.; H. Burdon, Manchester, Bury, and Oldham Tramways; H. Smith, Manchester, Bury, and Oldham Tramways; G. Truswell, Dewsbury and Batley Tramways; and W. Vaux, Bradford Tramways.

The meeting originated in a suggestion from the Board of Trade, that before issuing the regulations that were contemplated with regard to the working of steam tramways, the engineers and managers should express any special views they had on the subjects. The arrangement was made, therefore, that a preliminary meeting should be held at twelve o'clock on Monday, after which Major-General Hutchinson, R.E., from the Board of Trade, would attend the conference later in the day.

At the preliminary meeting, Mr. J. Kincaid, C.E., in the chair, the views of several of the gentlemen present were elicited on various interesting points, and the experience obtained on the tramways in various localities was referred to. The most important points discussed referred to the engines in use, which were of various types, viz., Merryweather and Sons, Manning and Wardle, Kitson and Co., the Falcon Engine Company, Messrs. Wilkinson and Co., and Mr. Perrett's combined engine and car, each having special characteristics. The type of passenger cars was also much discussed, and the causes of the accidents that have occurred at Huddersfield, Birkenhead, Bradford, and Blackburn were also discussed.

At the second meeting at three o'clock, Major-General Hutchinson taking the chair, Mr. Kincaid reported the results of the discussion at the preliminary meeting, which appeared to resolve themselves into the following:—(1) Controlling the speed of the engines by reversing is objected to. (2) The engine should have brakes on four wheels. (3) The automatic brake cylinder should be used by the driver as well as by the automatic action. (4) A separate mechanical brake as well as the steam brake should be in the hands of the driver. (5) The top load is dangerous on cars with a short fixed wheel base, except only where the cars are required to be small and the curves are not severe, and generally the passenger cars with bogies or flexible wheel base are approved in preference to the fixed wheel base. (6) The top load is advantageous where the wheel base is not fixed, and strict rules are enforced against overcrowding and against high speed round curves. (7) In certain hilly parts of the routes, either an additional brakesman should be provided on the car, or the conductor should not be allowed to collect fares at those places, so as to be ready to apply the car brake. (8) An additional chain coupling is advisable in addition to the ordinary draw-bar. (9) It would be advisable that the automatic governor should be applied by a fifth wheel instead of by connection with the engine driving axle. Major-General Hutchinson went through these matters again and received further explanations from the gentlemen present, and thanking them for the assistance which he had received, explained that before issuing the new rules the various companies interested would be consulted before the rules were finally settled.

THE LIEGE STEAM TRAMWAYS.

A secondary railway has lately been opened between Liége and Jemeppe, a village on the Meuse, opposite Seraing, where are situated the works of the Société John Cockerill, and connected with it by a suspension bridge. Arrangements were made with the company by the committee for the reception of the Institution of Mechanical Engineers for the use of the cars by the members during their stay at Liége in July. Previously the tramway stopped near the Guillemins Station, at Liége; but in July it was extended to the middle of the city. It was 7½ kilos. (373 chains) long, and of the normal gauge, 1·435 metres, equal 4ft. 8½in. The line, which is single, with crossing places at intervals, is laid in the middle of the road in the city and suburbs, and on one side of it in the country, so as to interfere as little as possible with the other traffic. The steepest gradient is insignificant; but there are some sharp curves. The line is divided into five sections of unequal lengths, each being run over in seven minutes, that is to say, thirty-five minutes for nearly five miles. The speed in the city is slow, in the suburbs rather faster, and in the country about twenty-five miles an hour. The locomotives, enclosed with awning, curtains, &c., but carrying no passengers, are built by the Société de la Métallurgique, of Brussels and Tubise. They weigh about 14 tons in running order, and work at a pressure of 6 to 10 atmospheres (90 lb. to 150 lb.) per square inch drawing two, and sometimes five, ordinary tram-cars behind them. There are four departures per hour, and on an average 3500 passengers are carried daily. Some goods wagons are ready, but not yet used. Only 3½ kilogs. (7¾ lb.) of small coke are consumed per kilo. (1093½ yards) run over, and this includes the getting up steam. The engines can condense their steam, but rarely do so. On first running the drivers were ordered to go slowly when passing horses, and stop entirely if they showed signs of restiveness; but it was soon found that the only fright the horses had was communicated to them by the drivers. They have now become educated up to passing their new rivals with no more concern than their own congeners. Thanks to the many works on the line of route, the company have no reason to complain of support, and they propose shortly to make a new line on the right bank of the Meuse, between Liége and Seraing.

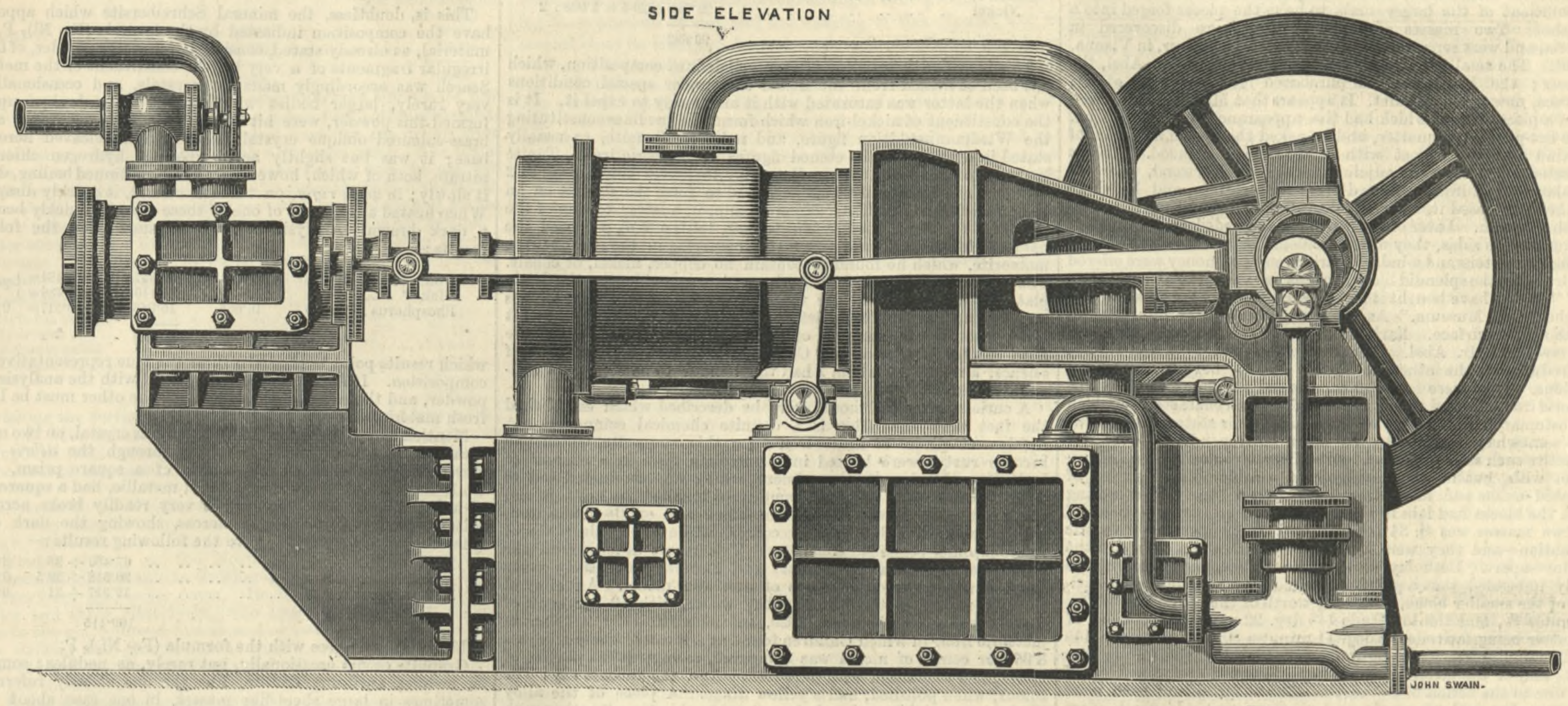
South Kensington Museum.—Visitors during the week ending Aug. 11th, 1883:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 20,903; mercantile marine, Indian section, and other collections, 14,155. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 2085; mercantile marine, Indian section, and other collections, 2289. Total, 39,432.

IMPROVED GIFFARD COLD AIR MACHINES.

THE GENERAL ENGINE AND BOILER COMPANY, LONDON, ENGINEERS.

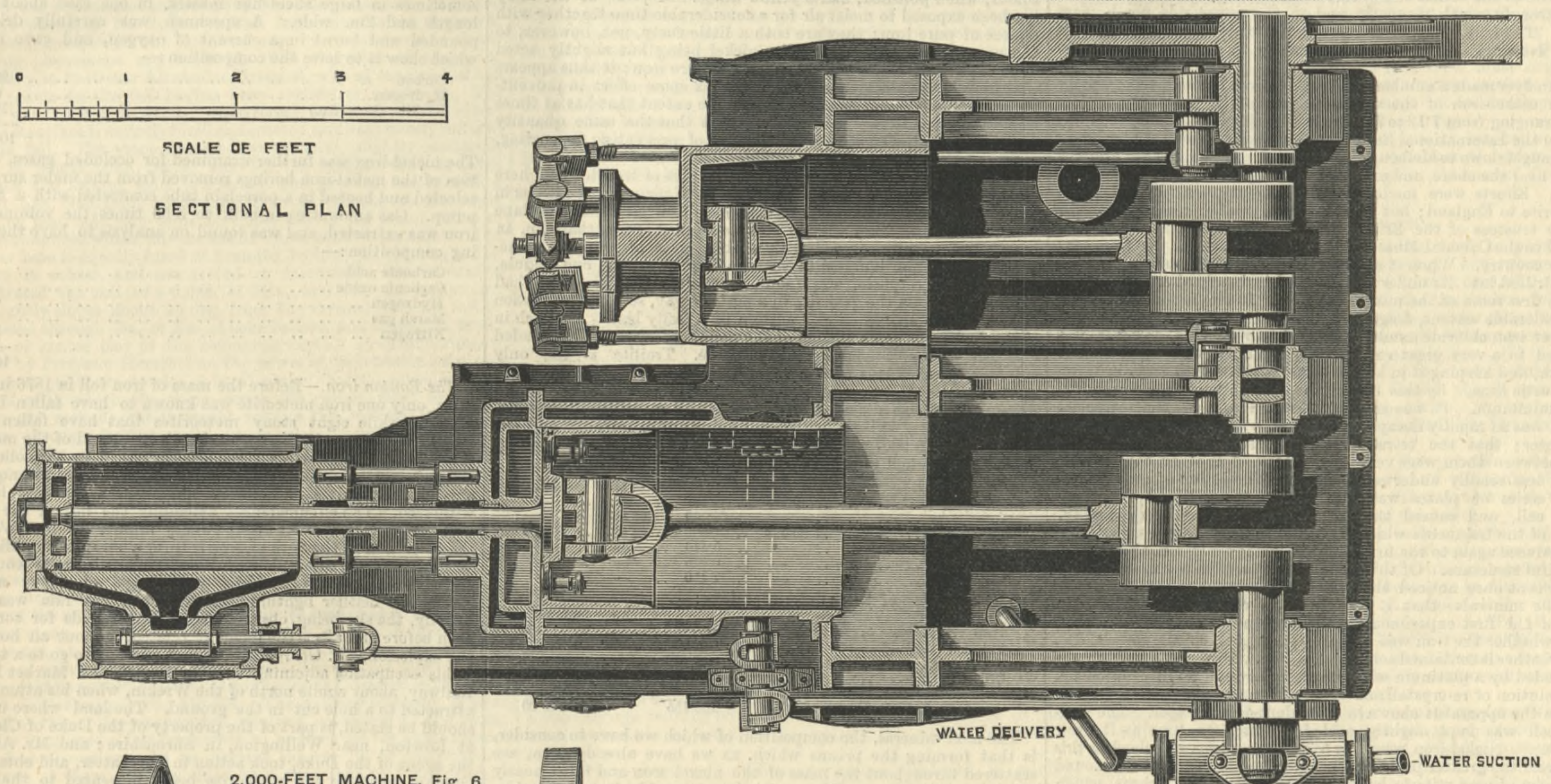
(*For description see page* 135.)

SIDE ELEVATION

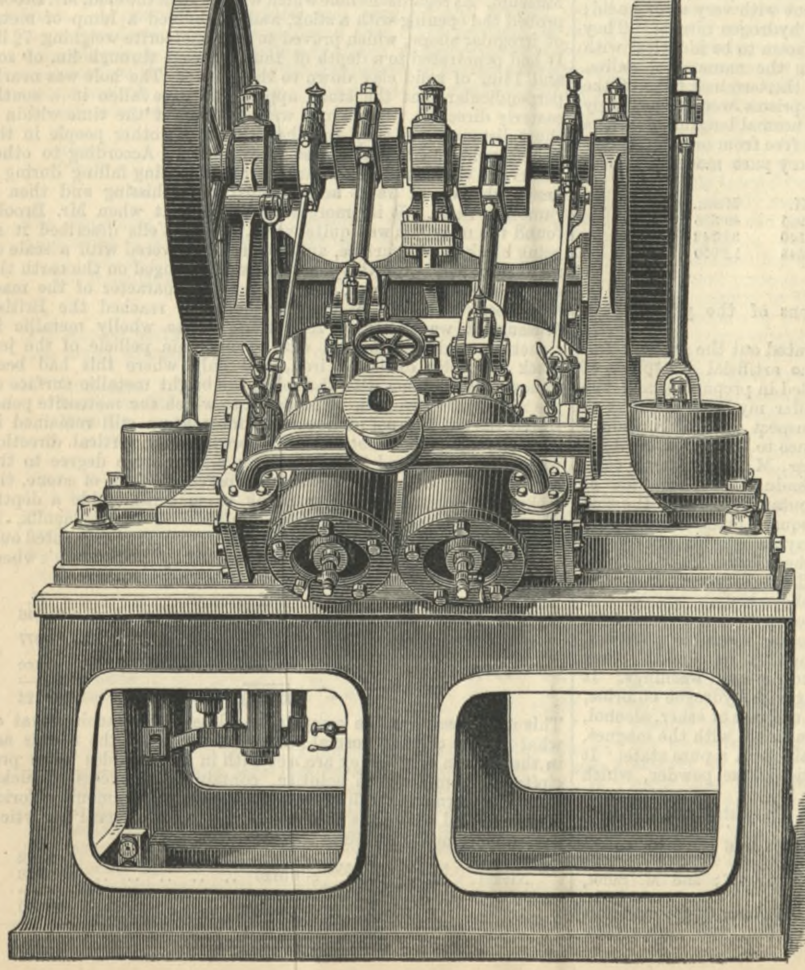


SCALE OF FEET

SECTIONAL PLAN

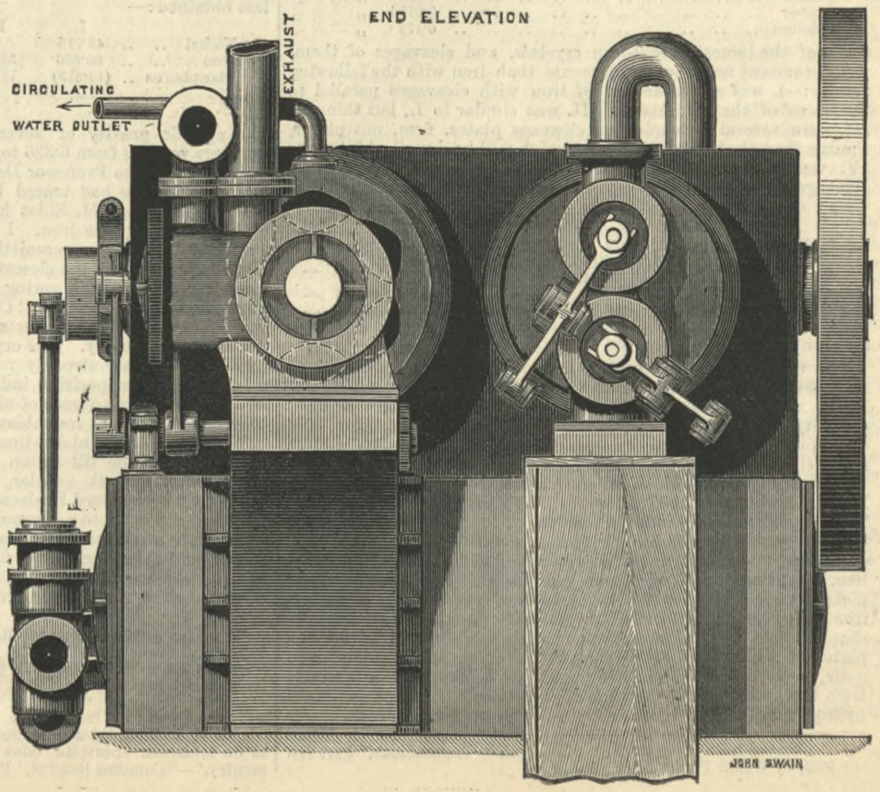


2,000-FEET MACHINE, Fig 6



20,000-FEET MACHINE, Figs. 3, 4, and 5

END ELEVATION



THE METEORITES OF CRANBOURNE, ROWTON, AND MIDDLESBROUGH.*

ALREADY in 1854 it was known that masses of iron lay near Western Port, south-east of Melbourne. Mr. E. Fitzgibbons, the secretary of the Municipality of Melbourne, was the first to direct attention to their meteoric character, and he succeeded in removing sufficient of the larger mass to have the pieces forged into a horseshoe. Two masses of meteoric iron were discovered in Victoria, and were reported on by the late W. Haidinger, in Vienna, in 1861. The smaller block became the property of Mr. Abel, the engineer; the larger one was purchased for a sovereign of Mr. A. Bruce, now of Chislehurst. It appears that Mr. Bruce had been shown a piece of iron, which had the appearance of meteoric iron, in the fire-place of a squatter, and he asked the man if any more of the kind was to be met with in that neighbourhood. He was conducted to a spot in the adjoining parish of Sherwood, where an irregular spur of iron projected from the surface, and he there and then purchased it, with the intention of presenting it to the British Museum. Later on, when they proceeded to dig round it and uncover its sides, they were astonished at its size—it was found to weigh three tons and a-half. Various sums of money were offered Mr. Bruce for the splendid block, but his one answer to all such offers was: "No! I have bought it for a sovereign, and I am going to give it to the British Museum." As has been stated, a part only of the iron was above the surface. Early in 1861 the spot was visited by Dr. Neumayer and Mr. Abel. One mass was found to weigh several hundredweight, the other, as already stated, between three and four tons. They were found to be, beyond all question, native, or meteoric iron, covered with a crust of the usual character, in which the customary hollows were not wanting. This statement is, however, somewhat misleading; no crust corresponding to that of magnetite such as is presented by the Rowton siderite—see *infra*—is met with, but in place a layer of considerable thickness of hydrated oxide and magnetite, indicating a long period during which the blocks had lain in the earth. The relative positions of the two masses was S. 34 deg. W., and N. 34 deg. E.—magnetic declination—and they were 3·6 miles—60 miles to a degree at the equator—apart. Both lay close to the surface, and were only so deeply imbedded that a point protruded from the soil. The latitude of the smaller block, which lay north of the other, was 38 deg. 8 minutes S., and the longitude 145 deg. 22 minutes E., those of the latter being latitude 38 deg. 11 minutes S., and longitude 145 deg. 20 minutes E. The height above sea level of the former was 107ft., and of the latter 127ft. They showed no polarity beyond that due to the action of the earth. The under side of each mass was strongly south magnetic, and on the upper side north magnetic. The longer axis of the Bruce meteorite, the larger mass, is about five English feet, and it lay exactly in the meridian of the place.

Neumayer made a number of determinations of the specific gravity of the nickel-iron of the smaller mass, in the possession of Mr. Abel, ranging from 7·12 to 7·6, the crust being 3·66. This block was sent to the International Exhibition in London in 1862. The larger was brought down to Melbourne, and placed in the University grounds there, near the shore, and unfortunately exposed to the action of sea water. Efforts were made to delay the shipment of the Bruce meteorite to England; but eventually the smaller block was bought by the trustees of the British Museum for £300, and it was presented to the Colonial Museum; the Bruce meteorite was then sent to this country. When it reached the British Museum some holes were drilled into its under surface, and it was fixed on a turntable in the first room of the mineral gallery. It was found to decay to a considerable extent, fragments oxidised and crumbled off, and drops of iron chloride exuded here and there. This, however, was stopped to a very great extent by injecting it with clear shellac varnish, and keeping it in a glass case provided with trays containing caustic lime. By this means the destruction has been reduced to a minimum. It was noticed that the part of the meteorite which was so rapidly decaying presented a very marked crystalline character; that the tetrahedral structure broke up into plates, and between them were very thin plates of another constituent, which less readily underwent change. The action of moisture on these series of plates was like the exciting liquid of a galvanic cell, and caused the oxidation to proceed very rapidly. Many of the fragments which came off at this time were selected and reduced again to the firm, solid, original condition, and present beautiful structure. Of this I shall have more to say later on.

It was at once noticed that the meteorite consisted entirely of metallic minerals—that it contained no rocky matter whatever. One of the first experiments which suggested itself was to determine whether the iron was alloyed with nickel, cobalt, copper, &c., and whether it contained combined carbon. A weighted portion was suspended by a platinum wire, carefully covered up in caoutchouc, in a solution of re-crystallised salt, and connected with a Bunsen cell, in the apparatus shown in a woodcut in the paper. The positive cell was kept slightly acid from time to time as it grew alkaline. Nickel-iron weighing 5·9989 grms. was dissolved in this way, and the greater part of the insoluble ingredients was found to consist of very minute bright, apparently square, prisms, which pervade all the nickel-iron, and apparently constitute nearly 1 per cent. of its mass. These prisms are acted upon slowly and with considerable difficulty by hydrogen chloride, but go readily in hydrogen nitrate. But I shall return to the consideration of the characters and composition of the prisms later on. The absence of all combined carbon was fully established. The nickel-iron thus dissolved was found to contain of—

Prisms	0·932 per cent.
Nickel	7·651 „
Cobalt	0·501 „
Copper	0·0156 „
Silicium	0·172 „

Some of the largest nickel-iron crystals, and cleavages of them, were examined for other constituents than iron with the following results:—I. was a tetrahedron of iron with cleavages parallel to the faces of the tetrahedron; II. was similar to I., but thinner; III. were several examples of cleavage plates, firm, not pliant, thicker than the paper-like plates which will be described later on; IV. were thinner plates, but not pliant ones; V. were thick cleavage plates; and VI. some borings. The following ingredients were met with:—

	I.	II.	III.	IV.	V.	VI.
Insoluble part	1·405	0·072	0·103, 0·106, 0·724	none	none	0·137
Nickel	—	7·837, 7·712, 7·529, 7·504	9·764, 6·476	—	—	—
Nickel and cobalt	8·057	—	—	9·801	9·046	—
Cobalt	—	0·601	0·756	—	—	—
Phosphorus	—	0·187	0·018	0·059	—	—
Sulphur	—	0·023	—	—	—	—

The rusted fragments of the meteorite, which were very carefully picked over, yielded many very good crystals of nickel-iron. These were reduced in porcelain tubles in hydrogen; a large quantity of hydrogen chloride was extracted from them, and dozens of perfectly complete tetrahedra of nickel-iron, as well as many cleavage pieces with sharp edges, were safely preserved.

In one of the early notes on the Bruce meteorite, published by M. W. Haidinger in 1862, he wrote: "Vielleicht finden sich in der That innerhalb der Meteoreisenmasser . . . . selbst manche Sättigungspunkte, welche wirklich verschiedene Mineralspecies darstellen." Such an instance presents itself in the thin, paper-like, pliant plates which lie on the faces of the tetrahedra of nickel-iron and between the large plates of the crystals of nickel-iron; they are in the form of equilateral triangles or are lozenge-shaped, have the thickness of stout writing paper, and unlike the plates of nickel iron, are quite pliant. They are strongly magnetic, are of a pure white colour, and have evidently been extruded from the nickel iron at the time of formation. They are soluble in hydrogen chloride and nitrate. As the examination of them was made in the case of some which had been reduced in hydrogen, a further portion picked direct from the fragments which had come off the meteorite was taken; both kinds were found to be equally pliant. The fresh plates taken direct from the meteorite contained 0·688 per cent. of phosphorus. Analysis of the plates showed them to consist of—

Iron	$70·138 \div 28 = 2·504 : 5$
Nickel	$29·744 \div 29·5 = 1·008 : 2$
	99·882

This is evidently an alloy of very well defined composition, which has been extruded from the nickel iron under special conditions when the latter was saturated with it and ready to expel it. It is the constituent of nickel-iron which forms the fine lines constituting the Wiedmannstädtian figure, and not Schreibersite, as usually stated in writings on the etched figures of meteoric iron. Tänite is the name Professor Gustav Rose gave to leaves containing 13·2 per cent. of nickel, and which he stated to form the figures on an etched surface. Dr. K. G. Zimmermann, in a letter to one of the editors of the *Jahrbuch für Mineralogie*, 1861, p. 557, proposed the name "Meteorine" for a new metal occurring in the Cranbourne meteorite, which he found to contain no copper, nickel, or cobalt. The substance referred to in both cases was evidently the little plates above described. As the composition of this mineral has now for the first time been definitely made out, I propose to call it Edmondsonite, in memory of the late George Edmondson, the head master of Queenwood College, Hampshire, a great lover of science, a man with whom I had the honour to be long and intimately connected.

A curious accident should here be described which established the fact that the alloy is a definite chemical compound. A number of pieces of nickel-iron from this meteorite, which had become rusty, were heated in a porcelain tube in a current of hydrogen. During the experiment, which was conducted out of doors, it came on to rain, and some drops touched the hot tube and cracked it. Air slowly entered the crack and oxidised the iron, till it acquired a bright blue colour, while the little plate of Edmondsonite remained colourless. This result accords with the conclusion arrived at by Stodart and Faraday some sixty years ago,* on the oxidation of alloys of iron and nickel. An alloy of iron, or rather of the best Bombay wootz, with 10 per cent. of nickel, made by them in 1820, in imitation of the Siberian meteoric iron, in which Children found as a mean of three analyses 8·96 per cent.† of nickel was compared, as regards its powers of undergoing oxidation, with pure iron. And the authors say: The colour, when polished, had a yellow tinge. A piece of the alloy has been exposed to moist air for a considerable time together with a piece of pure iron; they are both a little rusty, not, however, to the same extent, that with the nickel being but slightly acted upon comparatively to the action on the pure iron; it thus appears that nickel, when combined with iron, has some effect in preventing oxidation, though certainly not to the extent that has at times been attributed to it. It is a curious fact that the same quantity of the nickel alloyed with steel, instead of preventing its rusting, appeared to accelerate it very rapidly."

The Bruce meteorite contains many nodules of troilite lying here and there amongst the plates and crystals of nickel-iron, always in rounded masses, only very occasionally an ill-defined cleavage plane being met with. They vary in size from ½in. to more than 2in. in length, are usually covered with a thin layer of graphite, sometimes with some daubreelite surrounding them, and one nodule, consisting of graphite, was found to enclose troilite which had aggregated inside the graphite in a curious way, so that the section of the nodule suggested the outline of a holly leaf. A sketch in the paper represents a section of the nodule of graphite, the shaded enclosed part representing the sulphide. Troilite is the only sulphide found in this meteorite, and, it need hardly be said, was not in the slightest degree magnetic. A specimen of pounded and dried mineral was digested with a quantity of carbon disulphide, which had been twice distilled, for a day and a-half, and sulphur amounting to 0·0207 per cent. was dissolved. A portion chosen for analysis was found to possess the following composition:—

	I.	II.	III.	IV.
Insoluble part	0·215	2·297	—	—
Iron	—	62·150	63·613	—
Sulphur	36·543	—	36·207	36·250
Nickel	—	0·446	—	—
Copper	—	0·076	—	—
Chlorine	—	1·130	—	—

Or, as the mean of these determinations:—

		Fe S requires
Iron	=63·613	63·64
Sulphur	=36·333	36·36
Copper	= 0·079	—
Chlorine	= 0·130	—
	100·155	100·00

The next mineral, the composition of which we have to consider, is that forming the prisms which, as we have already seen, are scattered throughout the mass of the nickel iron and form nearly 1 per cent. of its mass. They resist the action of hydrogen chloride, and are only dissolved after long treatment with very strong acid; they dissolve, on the other hand, easily in hydrogen nitrate. They exhibit strong magnetic characters; they seem to be identical with the mineral to which Gustav Rose gave the name of rhabdite. They appear to form square prisms, and the terminal faces of the prism could rarely be met with. The prisms were exceedingly brittle, and were rarely, if ever, of their normal length. It was a difficult matter to obtain the prisms quite free from organic matter—dried varnish, &c.—but the following very pure material was at last obtained:—

	I.	II.	III.	Mean.	$(Fe_4 Ni_3) P$.
Nickel	49·715	—	48·955	49·335	48·38
Iron	36·666	39·519	38·540	38·242	38·23
Phosphorus	(13·619)	12·586	12·645	12·950	13·39
					100·00

The specific gravity of several specimens of the prisms gave numbers varying from 6·326 to 6·78.

A few years ago Professor Daubrée‡ pointed out the great resemblance which he had traced between the artificial phosphide of iron, $Fe_8 P$, which M. Sidot had succeeded in preparing, and the rhabdite of meteoric iron. I have to offer my hearty thanks to Professor Daubrée for permitting me to inspect some of M. Sidot's crystals, which bore the closest resemblance to the above crystals. More recently, in the spring of last year, M. E. Mallard§ communicated a note to the "Comptes Rendus" on phosphide of iron found among the products of the spontaneous fires in the coal mines at Commentry. The crystals are square prisms terminated by a pyramid, are strongly magnetic, have a specific gravity of 6·71, and the composition indicated by the formula $Fe_7 P$. They, of course, contain no trace of nickel; in all other respects, however, they bear the closest resemblance to the above body.

When the crude nickel-iron of the meteorite was treated with hydrogen chloride till action ceased, coarse, insoluble particles, mixed with a black powder, and the needles remained. They could both be removed by decantation and repeated washings. It was then subjected to a thorough cleansing with hydrogen chloride, with dilute nitric acid, with water, with a mixture of ether, alcohol, benzol, and chloroform, and, finally, when dried, with the magnet. In this way the coarse powder was obtained in a pure state. It consisted of a very brittle, very magnetic, coarse powder, which dissolved easily in strong hydrogen nitrate. Analysis gave the following results:—

	I.	II.	
Iron	56·245	55·990	$56·117 \div 28 = 2·004$ } 2·993
Nickel	29·176	—	$29·176 \div 29·5 = 0·989$ }
Phosphorus	13·505	—	$13·505 \div 31 = 0·435 \times 7 = 3·045$
			98·798

This is, doubtless, the mineral Schreibersite which appears to have the composition indicated by the formula $(Fe_2 Ni)_7 P$. The material, as already stated, consisted of a coarse powder, of faceless irregular fragments of a very brittle constituent of the meteorite. Search was accordingly made for crystals, and occasionally, but very rarely, larger bodies which might when broken up have formed this powder, were hit upon. One was met with, a large brass-coloured oblique crystal, which readily cleaved across the base; it was but slightly acted upon by hydrogen chloride or nitrate, both of which, however, on long continued boiling, dissolve it slowly; in *aqua regia*, on the other hand, it quickly disappears. When heated a fragment of one of these crystals quickly became of a dark brown. Analysis of these crystals gave the following results:—

	I.	II.		
Iron	69·251	69·843	$69·547 \div 28 = 2·484 =$ }	2·972
Nickel*	—	—	$14·410 \div 29·5 = 0·488 =$ }	
Phosphorus	15·420	16·666	$16·043 \div 31 = 0·517 =$	0·517
			100·000	

which results point to $(Fe_9 Ni_2) P_2$ as the true representative of its composition. It does not accord very well with the analysis of the powder, and the relation of one body to the other must be left till fresh material comes to hand.

Mention should here be made of a curious crystal, on two or three occasions met with while searching through the *débris* of the meteorite. It consisted apparently of a square prism, which, while the sides were quite bright and metallic, had a square centre of a dull, almost black colour; it very readily broke across the prism. Such a prism broken across, showing the dark centre, when subjected to analysis, gave the following results:—

Iron	$67·480 \div 28$	2·410
Nickel	$20·318 \div 29·5$	0·688
Phosphorus	$12·317 \div 31$	0·387
	100·115	

Which numbers agree with the formula $(Fe_7 Ni_2)_8 P$.

Graphite occurs occasionally, but rarely, as nodules; sometimes as nodules enclosing troilite, like the one already referred to; sometimes in large sheet-like masses, in one case about 4in. in length and 2in. wide. A specimen was carefully dried and pounded and burnt in a current of oxygen, and gave numbers which show it to have the composition:—

Carbon	89·661
Hydrogen	0·257
Residue (iron, &c.)	10·412
	100·330

The nickel-iron was further examined for occluded gases. A portion of the nickel-iron borings removed from the under surface was selected and heated in a porcelain tube connected with a Sprengel pump. Gas amounting in bulk to 3·59 times the volume of the iron was extracted, and was found on analysis to have the following composition:—

Carbonic acid	0·12
Carbonic oxide	31·88
Hydrogen	45·79
Marsh gas	4·55
Nitrogen	17·66
	100·00

The Rowton iron.—Before the mass of iron fell in 1876 in Shropshire, only one iron meteorite was known to have fallen in Great Britain, while eight stony meteorites that have fallen in the British Islands are in the national collection, and of the more than three hundred meteorites which are contained in the collection in the Natural History Museum, more than one hundred are unquestionably iron meteorites, and of these the fall of seven only has been witnessed. The circumstances attending the fall of the Rowton iron are as follow:—At about twenty minutes to four o'clock on the afternoon of the 20th of April, 1876, a strange rumbling noise was heard in the atmosphere, followed almost instantaneously by a startling explosion resembling a discharge of heavy artillery. There was neither lightning nor thunder, but rain was falling heavily, the sky being obscured with dark clouds for some time both before and after the incident related. About an hour after the explosion, Mr. George Brooks had occasion to go to a turf field in his occupation adjoining the Wellington and Market Drayton Railway, about a mile north of the Wrekin, when his attention was attracted to a hole cut in the ground. The land where it fell, it should be stated, is part of the property of the Duke of Cleveland, at Rowton, near Wellington, in Shropshire; and Mr. Ashdown, the agent of the Duke, took action in the matter, and obtained his Grace's assent to the meteorite being presented to the British Museum. As regards the hole which was found in the field, Mr. Brooks probed the opening with a stick, and discovered a lump of metal of irregular shape, which proved to be a meteorite weighing 7¾lb. It had penetrated to a depth of 18in., passing through 4in. of soil and 14in. of solid clay down to the gravel. The hole was nearly perpendicular, but the stone appears to have fallen in a south-easterly direction. Some men were at work at the time within a short distance, and they, together with many other people in the neighbourhood, heard the noise of explosion. According to other observers, the sound was heard as of something falling during a heavy shower of rain, accompanied by a hissing and then a rumbling noise. It is, moreover, stated that when Mr. Brooks found the mass "it was quite warm." Mr. Wells described it as being black on the surface, and apparently covered with a scale of metallic oxide, but at the point where it impinged on the earth the oxides had been removed, and the metallic character of the mass had been revealed. When the meteorite reached the British Museum it was at once seen that it was wholly metallic in structure, and was covered with a very thin pellicle of the jet-black magnetic oxide of iron, and only where this had been removed by abrasion with the soil is the bright metallic surface of the nickel iron revealed. The depth to which the meteorite penetrated the soil is proof of how much momentum still remained in it, partly due, no doubt, to the approximately vertical direction with which it entered the atmosphere, and in some degree to the higher density of an iron mass as compared with one of stone, the rocky meteorites rarely penetrating to so considerable a depth. The meteorite closely resembles the siderite of Nedagolla, in India, as Professor Story-Maskelyne, M.P., F.R.S., has pointed out.

Some fragments which had been removed by the lapidary's wheel were submitted to analysis, with the following results:—

	I.	II.
Iron	91·250	91·046
Nickel	8·582 }	9·077
Cobalt	0·371 }	
Copper	trace	trace
	100·203	100·123

This nickel-iron has the composition closely approaching that of what may be called a normal nickel-iron—in short, the metals are in the ratio in which they are met with in their oxides when precipitated from an iron solution, containing an excess of nickel oxide, by ammonia, both when a large excess of ammonia chloride is present and when it is absent. As a result of several analytical determinations it was found to be:—

Iron	= 0·1231	= 91·12
Nickel	= 0·0120	= 8·88
	0·1351	100·00

* Condensed from paper in the "Philosophical Transactions," Part III. of 1882, by Walter Flight, D.Sc., F.R.S.

* Faraday's "Experimental Researches in Chemistry and Physics." Taylor and Francis, 1859, p. 63.

† Berzelius found nickel 10·73 per cent. and Co. 0·46 per cent. in the Krasnojarsk nickel-iron.

‡ G. A. Daubrée, "Comptes Rendus," lxxiv., 1427; and M. Sidot, "Comptes Rendus," lxxiv., 1425.

§ M. E. Mallard, "Sur la production d'un phosphure de fer cristallisé et du feldspath anorthite, dans les incendies des houillères de Commentry."—"Comptes Rendus," 1881, xcii., 933.

* Both determinations were lost.

One of the fragments of nickel-iron devoted to the analytical examination was found to contain a section of a nodule of troilite; this easily dropped out of the iron; where it was in immediate contact with the alloy it was covered with a very thin layer of graphite. No cleavage planes were noticed on the specimen; it was examined with a magnetic needle and found not to be in the slightest degree magnetic. It was shown on analysis to have the composition:—

		The proto-sulphide (theory.)
Sulphur	= 36·073	36·36
Iron	=[63·927]	63·64
	100·000	100·00

Some fragments of the iron were sawn into very thin plates, and were kept quite cool all the time by a current of methylated spirit; they were carefully dried and weighed, and the gas drawn from them when at a bright red-heat with a Sprengel pump. The plates of iron taken measured 1·198 cubic centimetres, and the gas collected after many hours' heating was 6·38 times the bulk of the metal. This is about double the quantity met with by Graham and Mallet in other meteoric irons which had lain a long time in the ground.

After subtracting a little oxygen and the corresponding amount of nitrogen, due probably to the entrance of a little air into the apparatus, the gas was found to have the following percentage composition:—

Carbonic acid	5·155
Hydrogen	77·778
Carbonic oxide	7·345
Nitrogen	9·722
	100·000

By etching the surface with bromine they show larger figures than are usual, with less of the bright, extruded ingredient, doubtless a compound rich in phosphorus. A small, darker-coloured mass at the bottom of the section in the drawing in the paper is a nodule of troilite.

The meteorite of Middlesbrough, Yorkshire.—During the year 1881 a very beautiful specimen of a meteorite fell near Middlesbrough, in Yorkshire. It struck the earth at a spot called Pennyman's Siding, on the North-Eastern Railway Company's line from Middlesbrough to Guisbrough, about one mile and three-quarters from the former town. Its descent was witnessed by W. Ellinor and three platelayers, who heard a whizzing or rushing noise in the air, followed in a second or two by a sudden blow of a body striking the ground not far from them; the spot was found to be 48 yards from where they stood. The fall took place on the 14th March, 1881, at 3.35 p.m. The wind was from the north-east, and it was a clear and bright but rather cold afternoon. At more distant places, as Northallerton and four miles to the eastward, the sound resembled the boom of a gun; no luminous or cloud-forming phenomena are reported. The character of the hole, according to Professor Alexander Herschel, who at once visited the spot, points to the fall having been vertical or nearly so. The stone was "new milk warm" when found, and weighed 3 lb. 8½ oz.; the dark surface is entirely fused and crusted, and has scarcely suffered by the fall. The stone forms a low pyramid, slightly scolloped, 6½in. in length, 5in., wide, and 3in. in height. The rounded summit and sloping sides are scored and grooved deeply with a polish like blacklead, in waving furrows running to the base, showing that this side came foremost during the fusing action of the atmosphere which the meteorite underwent in its flight. The rear or base is equally fused or branded by heat, but is rough, dull brown in colour, and not scored or furrowed. The meteorite penetrated the soil to a depth of 11in., and the penetration line apparently slopes about 10 deg. from the vertical from the S.S.E. It passed through 7in. or 8in. of coke ballast, and thereafter brick-earth or coarse clay to the remaining depth. From experiments made by Professor Herschel on the power of penetration of a cast iron model of the meteorite, it is calculated that the actual velocity of fall with which the stone struck the ground must have been 412ft. per second. As it would acquire this velocity by falling freely through half a mile, it is clear how little of the original planetary speed with which it entered the atmosphere can have remained to affect its fall. The interior of the stone has a greyish-white appearance, and is evidently for the most part composed of silicates; frequent bright metallic granules are to be seen, and they appear to be entirely or almost entirely granules of nickel-iron. The rocky portion varies from grey to pure white, of which there are patches, and while the greater part appears to be homogeneous in structure, there are many enclosed chondra of large size and of a darker grey than the body of the stone. In the well-developed markings of the exterior of the stone, it bears a close resemblance, as Professor Herschel points out, to the meteorite of Karakol—Kirgis Steppe, May 9th, 1840—of which Professor Goebel gives a figure in his paper of 1866, in the "Mélanges Physiques et Chimiques de l'Academie Imperiale de St. Petersbourg," vii., 318-324. The railway company, who at the time this notice was written retained possession of the stone, kindly permitted a few fragments to be removed for examination, and I shall now proceed to describe the results of the chemical analysis of them. It has since been presented to the Yorkshire Philosophical Society, and is now preserved in the museum at York. A quantity was dried and weighed and treated with mercury chloride, and it was found that 9·379 per cent. of constituents were removed. As already stated, of those examined under a microscope the metallic particles appeared to consist entirely, or almost entirely, of nickel-iron. The nickel-iron was found to have the following composition:—

Iron	76·990
Nickel	21·320
Cobalt	1·690
	100·000

The remaining constituents, consisting of purely rocky matter, amounting to 90·621 per cent., are thus composed:—

(A) Soluble silicate	54·315
(B) Insoluble silicate	36·306
	90·621

The soluble portion and the silicic acid belonging to that portion was found to have the following composition:—

		Oxygen.
Silicic acid	41·100	21·92
Iron protoxide	27·960	6·213
Magnesia	30·940	12·380
	100 000	18·593

These numbers indicate the presence of an olivine of the form 2 ($\frac{1}{3}$ Fe, $\frac{2}{3}$ Mg) O, SiO_2, or one resembling that which occurs in the Lancé stone, which fell July 13th, 1872, and was examined by Daubrée. No lime and no alumina were found in the soluble part, though carefully sought for. The constituents of the insoluble part were as follows:—

		Oxygen.
Silicic acid	55·389	29·541
Alumina, and a little chromium oxide	4·770	2·223
Iron protoxide	23·580	5·241
Lime	4·373	1·249
Magnesia	11·043	4·417
Alkalies	not determined	
	99·155	10·907

If the chief silicate in the above portion be regarded as bronzite, it most closely resembles that met with in the meteorites of Iowa Co., Iowa, east of Marengo, which fell 12th February, 1875.* If, on the other hand, as is more probable, it be regarded as a lime-magnesia-iron augite, it is closely allied to the augite of the stones of Stannern and Jnvinas. The aluminous constituent is doubtless labradorite, and is probably present as some of the occasional chondra which are seen is a microscopic section of the meteorite.

* J. L. Smith, "Amer. Jour. Sc. (3)," vol. x., 1875, p. 363.

DIAMOND MINING IN SOUTH AFRICA.

THE obtaining of diamonds at the South African diamond fields at Kimberley has called for a very extensive use of machinery of modern type in the various processes of industry. Thus within the last six years of the development of the four principal diamond mines, *i.e.*, those of Kimberley, De Beers, Dutoitspan, and Bultfontein, in the hauling of the "ground" containing these precious stones, and the washing of this ground, and in several cases its transport from the mines to the depositing floors —where the diamondiferous soil goes through a process of weathering and becomes pulverised—steam power is throughout used. The general system of hauling is by inclined aerial gears, consisting of a double pair of stretched steel wire ropes, on which tub carriages of 16 cubic feet to 32 cubic feet capacity run, and the type of hauling engine used is generally of the semi-portable class of geared winding engines—boiler and engine frequently on separate bed-plates, but generally combined, and the boiler invariably of the locomotive type—the engine is generally of from eight to twenty-five nominal horse-power, and the vast majority of those in use have been made by Messrs. Robey and Co., or Messrs. Davey, Paxman, and Co. The washing engines are mostly by the same makers, and are also of the semi-fixed type, with a locomotive or multitubular boiler fixed on same bed with the engine, and they generally vary between six and twenty nominal horse-power. For the safety and protection of the mining community from accident owing to this extensive adoption of steam machinery at the mines, the Cape Government last year created the post of an inspector of machinery at the diamond fields, in addition to the inspector or surveyor at the mines; and below we publish his recently published rules to be observed by steam users in the working of engines, boilers, &c., a perusal of which will, we think, interest those of our readers who discuss the question so frequently brought up of the desirability or otherwise of Government interference with steam users, especially with regard to the inspection or surveillance of boilers. From recent statistics we gather that the deepest worked claims in the Kimberley mine—which quality with all the other mines could more appropriately be termed the Kimberley Hole—are now a depth of 420ft. below the original surface. The shallowest of the other "holes" is the Bultfontein mine, which has a greatest depth of 200ft. The number of hauling engines in position at the four mines mentioned is close upon 150, and above 100 washing engines treat the ground thus brought to surface; then again there are many engines employed in pumping water for the washing gears, and about a dozen small locomotives are in use. The diamond industry is, however, at present in a depressed condition, and nearly one-third of the gears are lying idle. An idea of the amount of work performed during the short life of these mines—up till now about a dozen years since their proclamation—and also their immense value is shown in the following few paragraphs. About twenty-one million cubic yards of solid ground have been excavated in the four mines of Kimberley, De Beers, Dutoitspan, and Bultfontein. The assessed value of the Kimberley mine for 1882-83, as adopted by the Mining Board, was about £3,400,000. The value of diamondiferous soil taken out of the Kimberley mine during 1882 has been estimated at close upon £2,000,000. The yield of diamonds from good "blue" ground in the Kimberley mine has a value varying between £6 and £14 per solid cubic yard.

Standing General Order for Safety, No. 2 of 1883, taking effect from and after 1st July, 1883, framed under Clause 12 of Section VI. of the Rules and Regulations for the working of Diggings and Mines on Crown Lands or on Private Properties in which the Precious Stones and Minerals belong to the Crown, in the Province of Griqualand West; published under Proclamation No. 8 of 1880.

MACHINERY.

PART I.—ENGINES, GEAR, &C.

Starting machinery.—1. Previous to starting any new engine, steam boiler, or hauling or lifting gear, and previous to resuming work with any machinery or gear after disuse thereof for a period exceeding four weeks, and before filling up any pit in which standing wires are anchored on bank or below, claimholders, accredited agents of companies or firms, must give at least twenty-four hours' notice to the inspector of machinery, in case he may deem it necessary to make preparatory inspection.

Stopping for repairs.—2. When engines or boilers are to be stopped for repairs or for being thoroughly cleaned out—especially with reference to manhole covers, &c., being taken off for inward inspection of boilers—at least twenty-four hours' notice should be given to the inspector of machinery, in order that he may have an opportunity of being present should he so wish.

Accident to machinery.—3. In case of breakage of hauling or standing wires or damage to machinery or gear, or in the event of a tub carriage running off the standing wires, the nature of such accident must be reported within twelve hours to the inspector of machinery.

Reporting danger.—4. When any person employed in mining operations shall apprehend danger to himself or others on account of the unsafe position, state, or condition of machinery, plant, or gear, or of careless conduct of those in charge of such—*e.g.*, careless engine driving—or from any other cause whatsoever, he shall report the same to the manager of his company or firm, or to his employer, who, after having without delay satisfied himself as to the reality of the danger so reported, shall at once cease work in, and remove his labourers from, the position of danger, or stop the machinery, &c., found to be unsafe or carelessly managed or controlled, until the cause of the danger has been removed.

Fencing to machinery.—5. (*a*) All fly-wheels of engines or other exposed quickly moving parts of machinery—when persons for sufficient reason can pass near them—are to be securely fenced in with suitable guards. (*b*) The opening in the wall of the engine-house where the hauling wires pass through, must be so constructed or fenced that persons may not gain entrance to the house that way in close proximity to the wires while the engine is running.

For examining standing wires.—6. All standards or jumpers and tipping boxes supporting standing wires, to be provided on the outside with a suitable ladder or steps convenient to the bearings on which the wires rest, to afford facility for their proper and systematic examination, even while tubs are being hauled.

Systematic inspection of wires.—7. A competent person to be appointed by every firm using hauling gear, who shall at least once in twenty-four hours examine the state of all hauling and standing and signalling wires, and shall keep a true report of every such examination in a record book kept for that purpose, and which shall be at the service of the Inspector of Machinery whenever he may require it.

Riding in tubs or cages.—8. No persons are allowed to ride in or about tub carriages running on aerial gears or in cages in shafts, without the special permission of the manager of the company. 9. No persons are allowed to ride in or about loaded tub carriages in aerial gears, or in the case of working shafts in any cage with a loaded truck therein, or in any cage unprovided with a proper shield or covering overhead, to prevent stones or other material falling into the cage; and all cages must be provided at each end with a suitable bar or chain to prevent persons within from falling out. 10. In all hauling gears the number of persons allowed to travel at one and the same time may not exceed the following limits, except when allowed in special cases by the inspector of machinery:—(*a*) Not more than three persons may ride in or about 16ft. or 20ft. tub carriages, and not more than four persons may ride in or about 24ft. or larger tub carriages running on ordinary aerial gears. (*b*) Not more than six persons may ascend or descend at one and the same time by means of single truck cages, or more than ten persons by double truck cages in all shafts where the usual pit gear is in use.

Signal to drivers of hauling engines.—11. Signals from the men in charge of the tips, or at the bottom of shafts to drivers of hauling engines, shall be made only by means of gongs or knockers, and the following code of signals must be adopted, viz., a signal of ONE RING or knock means *haul-up* if the gear be at rest, and *stop* if the gear be in motion. TWO RINGS or knocks means *reverse.* THREE RINGS or knocks mean *pull steady*, and signifies that there is a man in the tub or cage.

Safe working condition of hauling gear.—12. Before commencing actual work with hauling gears in the morning, or after blasting periods, each empty tub carriage in aerial gears, or in the case of shafts, each empty cage, must be run up and down into the mine at least once before any person is allowed to ride in or about such carriage, with the view of ensuring the aerial standing gears and tub carriages, &c. &c., to be in safe and good working order.

Signals for "man in tub."—13. Whenever a person is about to descend in a tub or cage, he shall give notice of the fact to the engine-driver, and if the engine-driver can see the tub or cage from his place at the engine-house, he shall satisfy himself before starting the engine that the person about to descend has entered the tub or cage. 14. In localities where the engine-driver cannot see the tub or cage, a semaphore, of a pattern to be approved by the Inspector of Mines or the Inspector of Machinery, shall be erected, and by means of this semaphore—which shall be visible by the engine-driver—signal is to be made to the engine-driver that the person about to descend has entered the tub or cage. 15. The engine-driver is in all cases to await a signal from the tips or bottom of the shaft before starting the gear.

Protection of signalling wire.—16. Great care is to be taken by claimholders and managers of companies to prevent access to the gong wire pulls by any persons other than those in charge of them, and to guard against the possibility of their being accidentally moved, every gong wire should be at least 8ft. above the ground between the engine house and the edge of the mine.

Safety chain for tub carriage.—17. A safety chain or wire perfectly independent of and apart from the ordinary tug chains and connections between tub carriages in aerial gears, or cages in shafts, and their hauling wire must be provided and be of sufficient strength to sustain the tub carriage or cage in the event of fracture of the tug chain.

Indicator for hauling gears.—18. When any aerial hauling gear is particularly availed of for hauling men out of the mine, a reliable indicator showing the engine driver the position of the tub carriage, &c., on the wires must be arranged in the engine house.

Brake power for hauling gear.—19. (*a*) In all geared hauling engines the winding drum or drum shaft is to be fitted with a suitable brake with foot lever, &c.—or other approved method of working it. This brake is to be quite independent of the brake that is generally affixed to the engine itself, in order to enable the engine driver to have effectual control of the hauled tub, carriages, or trucks running on an incline, should anything go wrong with the crank shaft, or geared wheels, &c. (*b*) In order that this brake may always be ready for action, the foot lever must not be supported by a wedge or chock of wood or similar method, but when necessary the brake strap must be kept off its bearings by this lever being held up by a suitable balance weight.

Length of hauling rope.—20. In the case of hauling ropes there must not be less than two rounds of rope upon the drum when the tub carriage in aerial gears, or the cage in the case of shafts is at the bottom of the mine.

PART II.—BOILERS.

Mounting on boilers.—21. Every boiler must be provided with the following complete set of mountings, and where existing mountings have to be replaced, or for new boilers, the mountings should be arranged in conformity with the particulars following in paragraphs 22 to 28 inclusive:—(1) Glass water gauge with water level pointer. (2) Set of test cocks. (3) Steam pressure gauge with syphon. (4) One manhole of ample size. (5) Set of mud plugs or hand holes in shell over fire-box, and in tube plate of smoke-box. (6) Blow-off cock. (7) Fusible plug in crown of fire-box. (8) Injector or a feed pump, driven by engine feeding through a check valve attached to the boiler. (9) Detached donkey pump. (10) Two safety valves.

Test cocks and water gauges.—22. Every boiler is to be fitted either with a glass water gauge and a set of test cocks of straight-way construction, or with two glass water gauges each with independent connections to the interior of the boiler.

Steam pressure gauge.—23.—Every boiler is to be fitted with an efficient steam pressure gauge having a distinct mark on the dial plate, indicating the highest stipulated working pressure, otherwise the maximum working pressure allowed, is to be distinctly painted in bold figures—not less than 3in. in height—either immediately above or below the fire-door of the boiler. 24. If it is considered advantageous by the Inspector of Machinery, any boiler is at his direction to be fitted with a suitable extra branch nozzle to which his standard pressure gauge can be easily temporarily attached for purposes of comparison.

Note.—In ordinary new boilers or mountings, proprietors would do well to specify that the steam pressure gauge attachment should be fitted with suitable nozzle—as above—and a cock so that the efficiency of the pressure gauge might be readily tested occasionally by shutting it to the boiler and opening it to the atmosphere.

Water level.—25. The lowest limit of the working water level of every boiler, or the relative height of the crown-plate of the fire-box is to be conspicuously marked either by a brass plate and pointer placed immediately behind the tube of the glass water-gauge or by a distinct white line painted across the plate on the stoking side of the boiler, with words signifying its meaning.

Manholes on boilers.—26. On every boiler one manhole at least of ample size—and convenient to the fire-box where possible—must be provided in order to afford adequate means of examining the interior of the boiler, and it is to be fitted with an easily attached cover tightened up by two bolts.

Feed to boilers.—27. Every boiler is to be provided with at least two independent feed apparatus, preferably a donkey pump and an injector, either of which must in itself be able to supply the necessary quantity of feed water.

Safety valves.—28. Every boiler is to be fitted with at least two efficient safety valves—one of which must be a "lock-up" valve, or one that cannot be tampered with—which must have adequate combined steam way area to realise so much steam as to prevent the pressure in the boiler exceeding the limit allowed, no matter with what intensity the fire is burning.

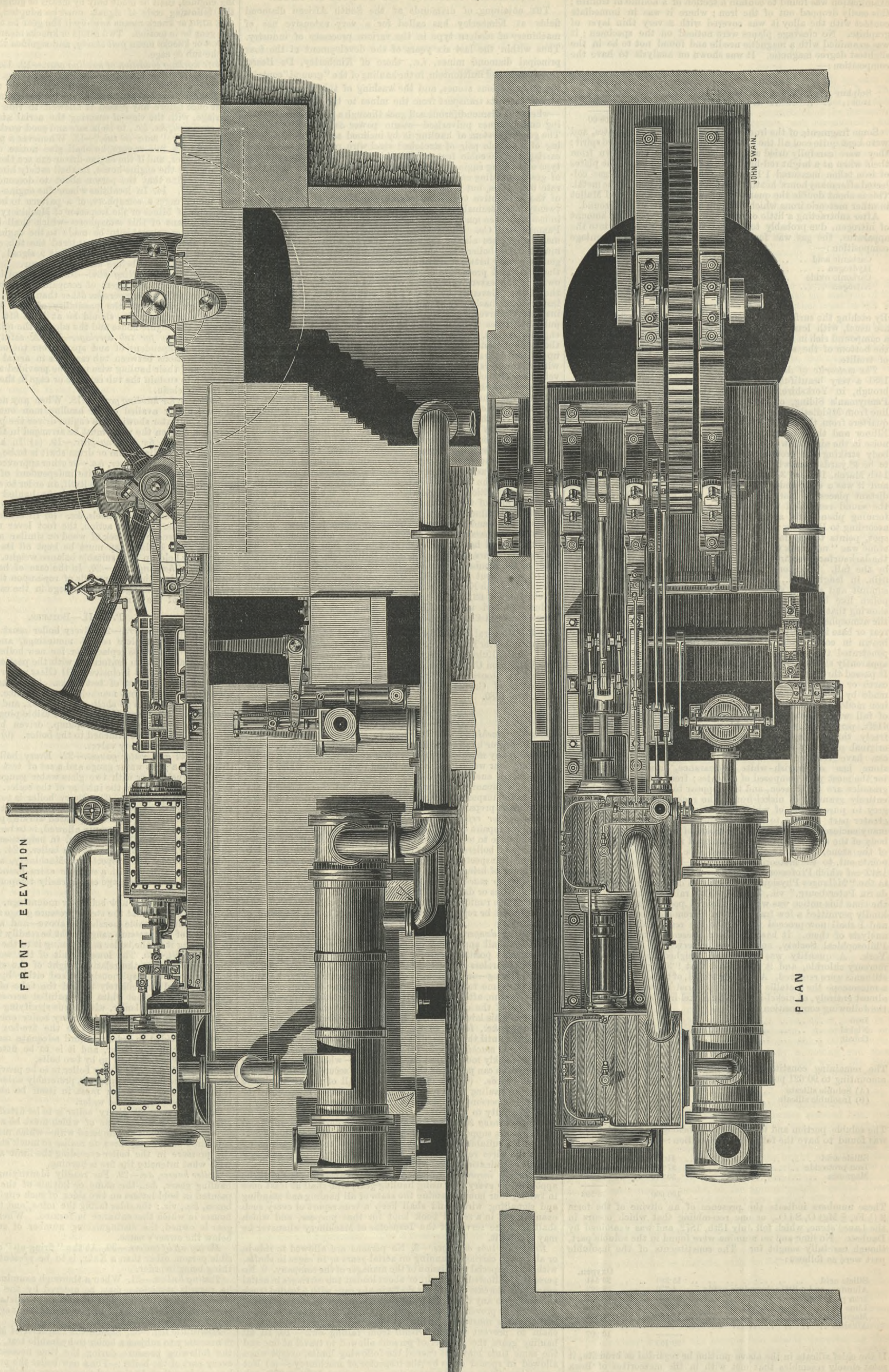
Boiler houses, &c.—29. For readily identifying boilers, engines, hauling gears, &c., the name or initials of the owners are to be painted in bold letters on two sides of such engine houses, tipping boxes, &c., viz.: the sides facing the mine, and the side in engine houses in which the entrance is formed. When more than one gear is owned, the distinguishing number of such to be painted below the owner's name.

Firing up of boilers.—30. At the "firing-up" of boilers a responsible person, other than a Kafir, is to be present to see to everything being in order.

Testing boilers.—31. When a thorough examination of any boiler he regards suspicious, may be ordered by the Inspector of Machinery, the proprietor must supply any assistance or appliances required, as also afford the Inspector of Machinery every facility for making such inspection.

Hydraulic test.—32. Should the Inspector of Machinery consider it necessary to subject a boiler to hydraulic test, it must maintain the following pressure during the time necessary for examining every part of the boiler:—For a new boiler the proof pressure must be not less than 1½ times the maximum working pressure, and for a boiler that has been in use not less than 1¼ times the working pressure.

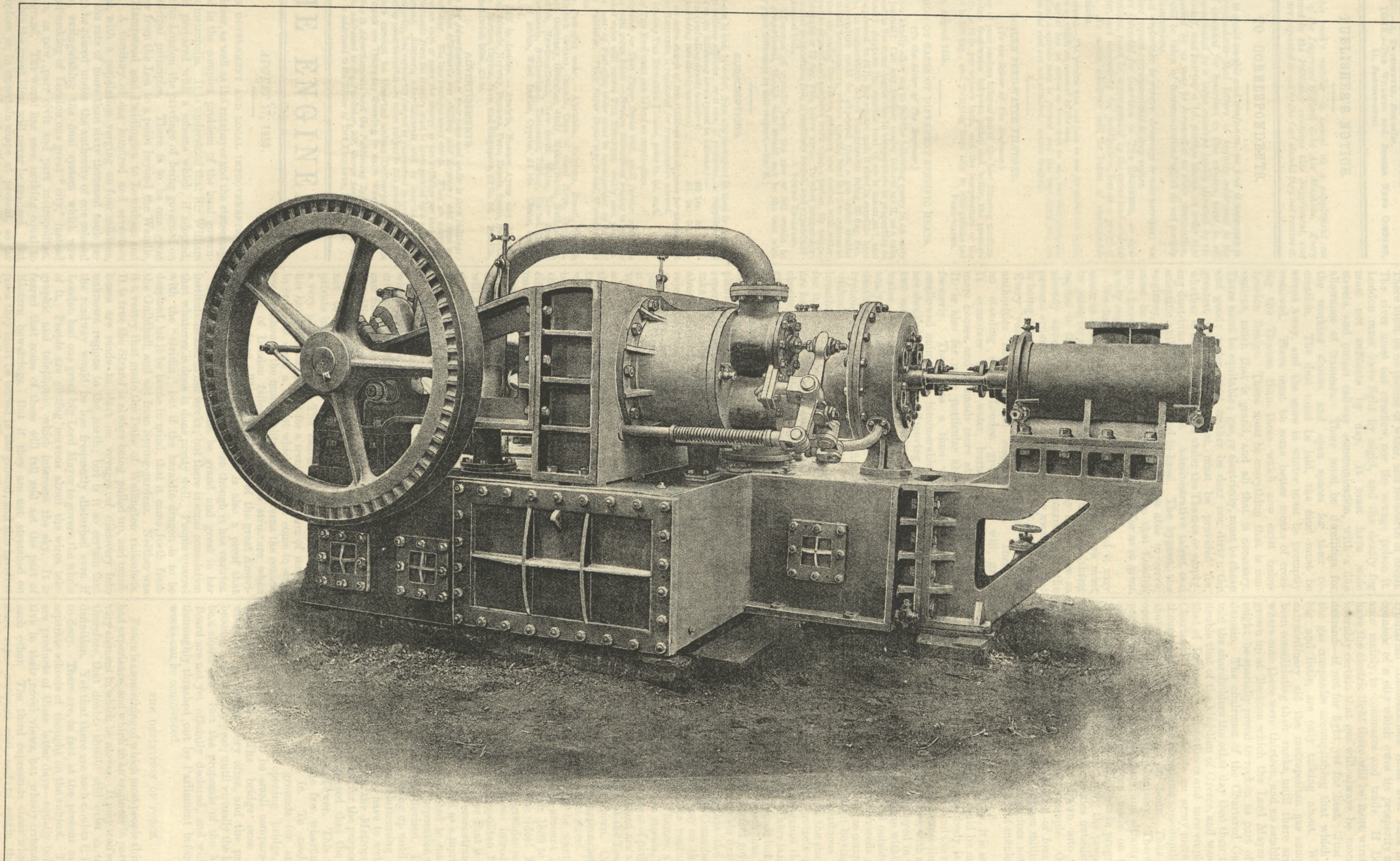
When reports as above required cannot be made personally to the Inspector of Machinery, written reports or notices may be sent to him at the undermentioned office, (Signed) F. SCHUTE,
Chief Inspector of Mines' Office, Inspector of Machinery,
Kimberley, 12th April, 1883.



COMPOUND TANDEM ENGINES, ST. ALBAN'S WATERWORKS.

MR. A. F. PHILLIPS, M.I.C.E., ST. ALBANS, ENGINEER.

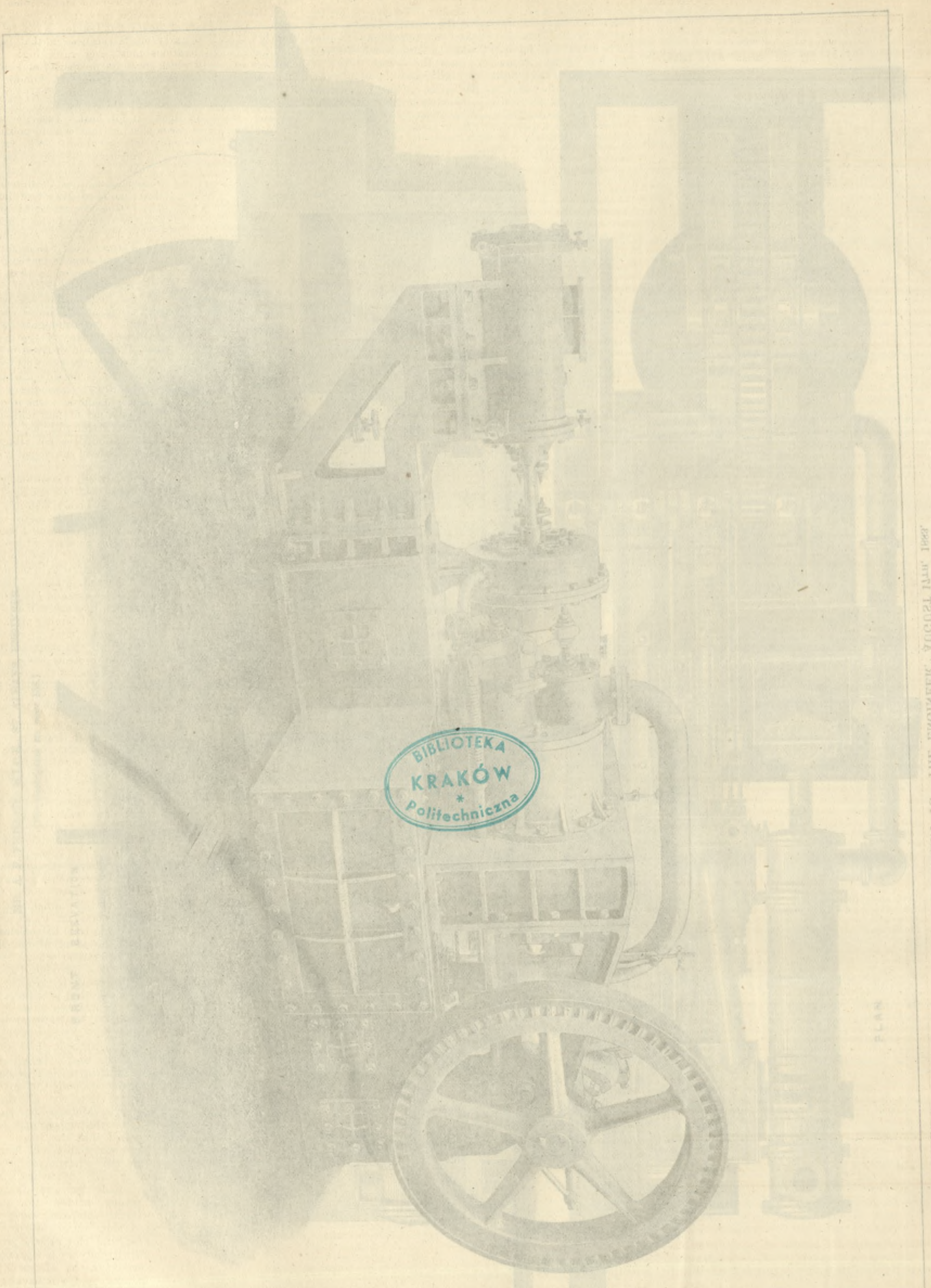
(For description see page 138.)



INK-PHOTO, SPRAGUE & Co. LONDON.

IMPROVED GIFFARD COLD AIR MACHINE.

THE GENERAL ENGINE AND BOILER COMPANY, LONDON, *ENGINEERS.*



PUBLISHER'S NOTICE.

**** With this week's number is issued as a supplement an Engraving of the Improved Giffard Cold Air Machine. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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.*

C. A. M. (Demerara).—*The process has not been in use for about ten years, and was given up chiefly on account of the cost.*

G. R.—*Caustic alkali has no action on iron even in air, but with ammonia in presence of air a nitride may be formed and the iron acted on, but generally, iron and steel are not attacked; neither is silver.*

BOILER FEED-WATER FILTERER.

(*To the Editor of The Engineer.*)

Sir,—Can any of your readers inform me of the best filtering medium for filtering boiler feed-water between pump and boiler, the pressure being from 50 lb. to 70 lb. per square inch, and the temperature of the water from 250 to 300 deg., and pumping from 1000 to 5000 gallons per hour?

Feed-water.

Spennymoor, August 14th.

COMPRESSION OF GASES OF DIFFERENT SPECIFIC HEATS.

(*To the Editor of The Engineer.*)

Sir,—Will you kindly allow me to put the following query in an early issue of your journal? Can any brother reader inform me if, as a rule, gases compressed to the same degree rise in temperature in proportion to their specific heat? Suppose the specific heat of air is taken as 1, and upon being compressed to 65 lb. per square inch it rises in sensible heat to 380 deg. Fah., its temperature before compression being 60 deg. Fah. Then what temperature could be expected from a gas under similar pressure, and initial temperature, whose specific heat is 1·5 as compared with air? If the air under the above pressure was cooled with water, and then allowed to expand and perform work upon a piston, its temperature would fall to 60 or 70 deg. Fah. below zero. To what temperature would the gas under supposition fall, if similarly cooled, and expanded?

Blackburn, August 14th. A Young Engineer.

[With small difference of specific heat the rise or fall would be approximately proportional, though this would not be the case with gases if of very great difference in this respect.—Ed. E.]

THE ENGINEER.

AUGUST 17, 1883.

LONDON GOVERNMENT AND LOCAL IMPROVEMENTS.

The engineer, as well as the ratepayer and the statesman, is interested in the complex problem of the local government of the metropolis. It is understood that Sir William Harcourt is prepared with a scheme which, if adopted, shall confer on London the privilege of being governed on purely municipal principles. There is to be one great ruling power from the Lea to a point beyond the Wandle, and from Hampstead and Paddington to Lewisham and Plumstead. A territory of one hundred and seventeen square miles, with a population verging on four millions, growing at the rate of more than sixty thousand souls per annum, is to be placed under the authority of one colossal Corporation, extinguishing the dual system which now prevails, and making of London one great "city," instead of having it, as now, part civic and part metropolitan. The idea is grand. The world has seen nothing equal to it, and possibly the great ideal will never be realised. But there it is before us, in uncertain shape at present, so far as details are concerned. A broad outline is sketched, but how it is to be "filled in" does not yet appear. London has great wants, and a giant power is to be created for the purpose of meeting the necessity. To govern London is to touch the mainspring of the world. London must neither be desolated by cholera nor burned up by fire. There must be no famine of water, and no dearth of bread. The river must not overflow, nor the sewage poison it. London must have light by night, and the deadly fog must not suffocate by day. It must have wide streets, and proper railway communication, with a due allowance of tramcars. There must be dwellings for the working classes, and open spaces for their recreation. The dust must be laid, the mud must be swept away, and the snow in winter must be promptly removed. There must be some better means of crossing the Thames than those which now exist below London Bridge. There must be everything that is convenient, much that is grand, and all that is necessary. Taxes must be equitable; gas, or electricity, must be cheap and good; water must neither be dear nor dirty; the greatest wants, and the least, must be provided for, whether it be driving tunnels under the Thames or emptying dust-bins in back streets. Administrative talent and scientific skill must go hand-in-hand. The hygeist, the engineer, the mechanic, and all who are able to serve, must be worked up to the highest pitch, so that London may have health and wealth, and be cared for as so great a city ought to be.

We have sketched no small undertaking, and it may occur to some people that a great amount of work must be going on already, or London would not be the healthiest capital in the world, nor possess so many advantages as already appertain to it. Those who quarrel with the present order of things are perhaps scarcely aware of what is being done, and how much mischief is being prevented. Every year seems to bring fresh claims upon the authorities and additional responsibilities. There is no standing still. London grows, and will grow. It consumes more water, burns more gas, builds more houses, and demands more attention, year by year. It is also far more particular about things now than formerly. There was a time when its population swallowed animalculæ innumerable; but now the people are shocked at the idea of "moving organisms" detected in two samples of water in twelve months. Gas is tested, water is tested, the smoke is critically examined, food is analysed, and everything is overhauled. Danger and death are detected on every hand. A whiff of sewer gas is typhoid fever, and diphtheria has been detected times without number in the milk jug. To eat, to drink, to breathe, is all alike perilous. It is dangerous to live, for it involves the risk of sickness and death. These are hard times for local authorities. How can they discharge their multifarious duties? Parliament itself is getting puzzled. It is told that passengers on the District Railway are being stifled and suffocated. There is forthwith an Act of Parliament permitting the erection of ventilating shafts. Then comes an outcry that people and plants above ground are being poisoned. Parliament repents, recants, and makes a general muddle, seeking to take away what it has already given, and getting well abused all round. So with the water question; Parliament rejected certain terms with disdain, and it now appears that a very fair chance was missed. So also Parliament passed a Metropolis Valuation Act, without thinking that it would make any difference to the water charges. Sir William Harcourt says that London has got "into a scrape." If so, it is Parliament that dug the pit. But are there no signs and tokens of vigour in our local administration as at present constituted? Power has been given with a grudging hand, and a Treasury auditor has ever been on the watch to seize the Metropolitan Board by the throat. But London has been growing grander and cleaner, brighter and better for some years past. The mudbanks of the Thames have given place to a magnificent river promenade. The river can be seen now without the necessity of the spectator getting on a bridge, or going on board a steamboat. It is said that nobody will give London so much as sixpence, because there is no one great municipality to glorify the giver. Somebody, nevertheless, has given London the Egyptian obelisk, which is itself an engineering trophy, not only on the part of the ancients but also the moderns; the former for having made such a thing, and the latter for having put it where it now is. But there is nothing sacred to the small critics, who think that criticism is nothing unless it can find fault. Perhaps on this question of personal liberality we might say something about Leicester-square, though it is not a popular subject. Still it ought not to be forgotten that in this instance it was a private individual who transformed a very ugly blot into a very pleasant area. The Baroness Burdett-Coutts put her hand into her pocket for a tremendous sum of money, in order to erect a market which may yet come to some good, although the municipality which governs the central region of London failed to utilise the structure when invited to do so. The munificent gift of the great American philanthropist and millionaire is also a proof that London is not without friends, even though it has vestries.

By all means let London be grand and great in her institutions and in her works; but there is some consolation that whatever is done is done pretty well. People quarrel with the "Griffin;" but if the heraldic dragon is to be despised, let it be borne in mind that it came forth from the Guildhall, and not from Spring-gardens. Neither was it a vestry that made the Duke of Wellington ridiculous. It is true the Strand is always being pulled up, and omnibuses are made to start on voyages of discovery into unknown regions to the north; but is it so certain that the roadway would be less frequently disturbed even if London had one great big Lord Mayor to govern the whole of it. People are getting nervous about the wires, telegraphic and telephonic, which intercept the sky. It is feared that some of these will fall and act the part of Eastern bowstrings. But if they are not stretched on poles they must be buried in the ground, and this involves digging and disturbance. We may change physical conditions, but we cannot alter natural laws. So far as science has yet gone, if we will have telegrams and telephones, we must have wires. A message may indeed be made to travel along a beam of light; but London is not yet sufficiently ethereal to carry on its business in that fashion. Utilitarian considerations must ever rank high in the counsels of a city which owes its prosperity and importance mainly to commerce and trade. If London is to have the electric light there will be more wires; but it is tolerably certain that gas will always be more or less in demand—if not for light, yet for heat. Just now we see the gas companies accomplishing that which politicians, big and little, are only talking about. Without any extraordinary aid the metropolitan gas companies have been consolidating their ranks, until there are but three where once there were thirteen, and an establishment has grown up at Beckton which the Lord Mayor of London might be specially proud to reckon as part of his official domain. The chairman of the Chartered Gas Company told the shareholders the other day that their revenue was double that of the kingdom of Greece, and was larger than that of Denmark. The officers and men employed by the Chartered Company constitute an army more than eight thousand strong, and the maximum consumption of coal at the works is nearly 400 tons per hour. Thus vast are the operations of the Chartered Company. There is also the prospect of further amalgamation, and although no authoritative announcement has been made on the subject, there are certain indications of efforts in progress to make the whole metropolitan gas supply the property of one company. Even suburban companies outside the metropolitan area are likely to be drawn into the vortex, Brentford being possibly an early example. One immense gas company, supplying a population of four millions or more, and possessing a capital of fifteen millions sterling, would afford fair proof that London does not altogether depend for greatness on the existence of municipal institutions.

The metropolitan water supply, which, it is seriously proposed and believed by many people, could be managed by a mere committee of the new municipal body, is itself a very large and complex affair, extending beyond the metropolitan area, and comprehending a population exceeding 4,800,000. There are no less than 142 steam engines, with an aggregate power of more than 16,000 horses, employed in pumping up the supply. There are 3000 miles of main within the metropolitan boundary, and another thousand outside. The total capital raised by the water companies exceeds £13,000,000, and the capital of the metropolitan gas companies is just about the same. Nothing is said about buying up the gas companies, so that it would be superfluous to calculate what these capitalists might require in the shape of $3\frac{1}{2}$ per cent. gas stock. The electric light protects the gas companies from the crusade which rages against the companies who supply water to the metropolis. There is no substitute for water. The source may be changed, but it must be water still. Another great work which has been accomplished before the advent of that perfect government for which reformers sigh, is that of the main drainage. This is complained of as imperfect, seeing that the sewage still enters the Thames. What the Royal Commissioners, with Lord Bramwell at their head, may say on this point we cannot tell, though we might perhaps venture to guess. Now at last, having embanked the Thames, absorbed the Fire Brigade, constructed sundry new streets, bought a lot of bridges, and taken charge of 1769 acres of parks, commons, and open spaces, the Metropolitan Board are about to produce a scheme for a low-level bridge at the Tower, and two tunnels under the Thames lower down. Coupled with these are projects for improving the approaches to the new Law Courts, and widening Parliament-street. Some eight or nine millions sterling will thus be wanted, and the Board hope to gain a moiety of this amount by an extension of the coal and wine dues from 1889 to the close of the present century. Not even the ideal Municipality could be expected to propound a grander scheme. But those who wish to see the new *régime* introduced are by no means pleased to find the Metropolitan Board anticipating the achievements of the power that is to be. It is demanded in tones of indignant remonstrance that the Metropolitan Board shall be treated as a moribund body, and shall henceforth be strictly limited to matters of routine, until superseded by the grand Corporation which Sir W. Harcourt and Mr. James Beal have devised. If every great and important measure is to be hung up until Parliament has sanctioned a scheme for revolutionising the government of London, we may possibly have to wait a little too long. Whether the plans which the Metropolitan Board are about to adopt are the best for the purpose may be a matter of dispute. It is expected that the Board will propose a closed bridge at the Tower. This will involve enormous compensation to the few wharfingers whose premises will be thus shut in. To moderate their demands, or to remove all grounds for any demand, we would recommend an opening bridge, the extra expense for which would be small compared with the wharfingers' claims. The bridge once constructed would not be opened very often, and the process would become rarer year by year, until virtually the bridge would be a closed one. But the proposals of the Metropolitan Board are not yet officially declared, and will have to be thoroughly thrashed out by Parliament before any of the works can be commenced.

THE DEFINITION OF FORCE.

Force is a something of which most people think they have had experience, and which to an engineer in particular is the very element in which he moves. It may well seem strange, therefore, that doubts should still exist as to its proper definition. Yet that there are such doubts it is impossible to deny. There are, in fact, at the present moment three separate schools of thought on the subject. Two of them are products of these latter days—equally bold and positive in their novel views, but wholly irreconcilable with each other. The third represents those who are content *stare super antiquas vias*, and to retain the definition which satisfied their fathers, but who, nevertheless, are quite aware that their friends of the new light—or lights rather, possibly somewhat interfering with each other—regard them as sunk in worse than Egyptian darkness.

The first of these new schools shelters itself under the ægis of Mr. Herbert Spencer. That gentleman, ever since he published his "First Principles," has claimed a high place amongst the authorities on mechanical science; and this claim seems to be most readily admitted in all those circles where mechanical science is least understood. Now it is not too much to say that, in the eyes of Mr. Herbert Spencer, force is everything, and everything is force. The Persistence of Force is the one great, unquestionable, all-embracing principle, which explains all other principles, including evolution itself, and is the foundation and essence of the physical universe. True, Mr. Spencer does not anywhere define the persistence of force. But so far as we can gather, the persistence of force means that the forces of nature are continuous, not discontinuous; that they are always in action, not sometimes acting and sometimes quiescent. If we go further, and ask for a definition of force, we fear that neither will this be forthcoming; but at any rate we may gather that force is a reality, if not the only reality. For this definition, if we could get it, would be a most comprehensive one; it would embrace what we mean when we speak of the force of a sledge hammer, and also what we mean when we speak of the force of an argument. So at least we may gather from Mr. Spencer's disciples, if not from himself. The latest of these disciples appears under the name of Mr. Norman Pearson. This gentleman deliberately, and without a smile on his countenance, adopts the view just stated; and actually founds an argument for the immortality of the soul on the ground that the soul is a force, and that all forces "persist." It is true, he admits frankly, first, that he knows nothing at all about the force of the soul; and secondly, that, so far as he does know, it is a chemical force, resulting from special combinations of phosphorus with carbon, &c. Now, nothing can well be more certain than that these processes of combination cease when the man dies and his brain turns to dust; but as the soul must of necessity persist, that only proves that the soul is a force of some other character. By parity of reasoning, the same will of course hold of other descriptions of force—say, the force of a conclusion, the force of a repartee, the force of a joke; nay, we are thereby emboldened to put all the force we can into this present article, in the assurance of thereby rendering it as immortal as ourselves.

The second party we have alluded to proceed in a wholly different fashion. Far from regarding force as everything, they regard it as nothing. The leader of the party in this country is Professor Tait, whose knowledge of mechanics, unlike that of the gentleman named above, will be most fully recognised where mechanics are best understood. Now, Professor Tait has said repeatedly that we have no right to regard force as having any objective existence whatever. All we know is that bodies, under certain circumstances, alter their velocities at a certain rate, and this rate of change of velocity—or taking into account the mass of the bodies, their rate of change of momentum—is that to which Professor Tait gives the name of force. When we speak of force, all we mean, or ought to mean, is this rate of change of momentum. This, and only this, is what we have to investigate. On this view the persistence of force, which to Herbert Spencer is the first of all truths, becomes not only meaningless, but false; for if there is one thing clear, it is that all bodies are not continuously changing their relative velocities. Moreover, since force is only a rate of change of momentum, it ought to be possible to write a book on elementary mechanics without introducing the conception of force at all. Professor Tait recognises this, and some little time ago he presented to the Royal Society of Edinburgh a sketch of the way in which such a book might be drawn up. How the Society felt after it we have not heard. We do not, of course, question for a moment that Professor Tait understood his own meaning. We will go further, and admit that if he could have got one of his hearers quietly by himself for an afternoon or so, he might have made him understand it also—say that he understood it, at any rate; but further than this we are not able to go. Nevertheless, Professor Tait has followers no less confident and enthusiastic than those of Mr. Spencer; and only a few weeks ago, in these columns, the assertion was made that in physical science no other meaning can possibly be given to force than the rate at which momentum is transferred from one body to another.

Who shall decide, when doctors thus disagree? The humble student of mechanics, anxious to learn what the "men of light and leading" in his generation have to tell him about the ultimate principles of his science, stands by perplexed, embarrassed, perhaps at last a little indignant. We will not presume to offer him advice, but, as one brother recounts his spiritual experiences for the good of another, so we, as humble students also, may perhaps whisper to him how we have succeeded in taking comfort to ourselves. In the first place, we would suggest that he need not trouble himself much with the views of Mr. Herbert Spencer or his followers. They may be left with perfect confidence to time and to themselves. In the second place, as regards the school of Prof. Tait, we would ask him to look at an utterance coming, not from an enemy, but from a supporter, or at least a candid friend of the school in question. In the *Philosophical Magazine* for April, 1883, he will find a short note by Mr. Maxwell Close, in which he points out very clearly the manifold confusions, the almost inextricable jumble, in which the ordinary terms and conceptions of mechanics are involved, by the adherence to this wrong definition of force as the rate of change of momentum. Having read this article, our student will probably do one of two things—he will either give up mechanics in disgust, or he will take heart and resolve to see whether after all there is not some third definition which has been given for force, and which has been upheld by men with whom a student need not be altogether ashamed to agree. And he will be surprised to find that this is so. For instance, he may come across the following words:—"Force is an action exercised on a body, tending to change its state either of rest or of uniform motion in one direction." This is a literal translation from a book called the "Principia," written—some time ago it must be confessed—by one Isaac Newton. Now, Newton is generally supposed to have known something of mechanics—in fact, a good many people are disposed to put him very near the head of mechanical philosophers. True, freshmen of Trinity College, Dublin, are said to prefer Salmon; the students of Edinburgh may thunder "Tait," and the Burschen of Germany may shout for Kant or Helmholtz. But all these, we are inclined to think, would put Newton next to their favourite hero; and therefore—as in the celebrated Greek election, where each man voted for himself first and Themistocles second—we may fairly forecast what would be the result of an unbiassed decision. But Newton's view of force, as we have seen, was quite different from either Spencer's or Tait's; and our student will be still more surprised to learn that this was not an antiquated superstition of his—that it has been largely held since, and by men not in themselves inconsiderable. Thus we read: "Force is that which tends to cause or to destroy motion, or which actually causes or destroys it?" This is the first sentence in "The Mechanical Principles of Engineering and Architecture," by Henry Moseley. Again, "Force is said to be whatever produces, destroys, or changes motion:" this is the definition of Whewell. Whewell and Moseley were not unknown in their day as students of mechanics; their fame even yet lingers among us. Coming down to more recent times, we find the definition of Newton restated as follows:—"Force is an action between two bodies, either causing or tending to cause change in their relative rest or motion." These are the words of William Macquorn Rankine, to whom even Edinburgh students will not refuse a measure of respect. In like terms Harvey Goodwin—who is undoubtedly a mathematican, and when he wrote these words could not even be branded as a bishop—"Force is any cause which changes or tends to change a body's state of rest or motion." If he looks abroad he finds that Navier, Morin, and Redtenbacher measure force in kilogrammes; and whatever we take a kilogramme to be, it certainly is not a rate of change of momentum. Lastly, if he turns to the "Elements of Natural Philosophy" itself, he will be astonished to find that its distinguished authors, *nolentes volentes*, have delivered themselves in the following terms:—"Force is any cause which tends to alter a body's natural state of rest, or of uniform motion in a straight line."

Fresh from this search our student will be able to appreciate at its full worth the confidence which asserts that it is quite impossible in physical science to look at force in any other light than as the rate of change of momentum. He will assert humbly, but fearlessly, that it is quite possible; that, in fact, it has often been done; that better men than himself or his interlocutor have been content so to do; nay, perhaps his bad passions may get the better of him, and he may be led to declare that it is not he who lives in darkness, but rather in the light of truth, with Newton, and Whewell, and Rankine, and Thomson, and Tait.

The fact is, the whole question is simple enough to those who will approach it from the right direction. Force is known to us in two ways—first, as exercised by ourselves upon other things; secondly, as exercised by other things upon us or each other. It is the second class of forces which is studied in mechanics. These forces, like everything else outside us, can only be known ultimately by their effects. The most special and obvious effect of force is motion, and it is the leading principle of mechanics that forces are proportional to the motions which they cause, these motions being measured by the momentum given to the bodies on which they act. So far, there is no room for difference of opinion. But it is easy to make a step further, and to say that forces are not only *proportional* to the changes of momentum they cause, but that they *are* those changes of momentum, and nothing else. It is this step which has been made by Professor Tait, or rather it would seem by his followers. Let us see how it is justified by an appeal to similar cases. We will take first an illustration furnished us by Mr. Maxwell Close in the article already referred to. Disease causes death, and the strength of different diseases, or of the same disease at different times and places, might be measured by the increased rate of mortality which they have induced; therefore, on these principles, we must define disease as being a rate of increase of mortality, and must demand that our medical literature should be re-written in order that it may square with this definition. Again, the burning of fuel under a boiler causes the evaporation of steam, and, other things being kept the same, the rate of evaporation in cubic feet per hour will be proportional to the quantity of fuel burned; therefore, we must say that fuel is the rate of evaporation of water per hour in a given boiler, that and nothing else; and our treatises on steam boilers must proceed on that supposition.

We may go on for ever quoting instances to show the absurdity of the step thus confidently taken, but it is needless. Our opponents can really find only one thing to say. They may point out that we do not call disease an increase in death-rate, or fuel a rate of evaporation, because we know a good deal about disease and fuel over and above the particular effects which they thus produce. We will not stop to inquire what would be the force of this objection, if it were true—as is here tacitly assumed—that we know nothing of force except from the motions it causes. It is sufficient to observe that this assumption is obviously and absurdly false. As it has been well put to us, it would seem that these gentlemen can never have got wedged in a crowd. We know that force produces at least one thing besides motion, namely, pressure. In fact, in our persons we know it much oftener as the cause of the latter than of the former. To put this latter effect aside altogether, and insist on dealing with the former as the absolute and exclusive effect of force, is as unwarrantable in theory as it is absurd in practice. A definition of force which involves the statement that there is no force acting between oneself and the earth, no force between the jib of a crane and the weights hanging motionless from it, no force between a locomotive engine and the train which it is trying in vain to start—such a definition is actually worse than that absence of all definition which we find among the followers of Mr. Spencer. Like them, it may safely be left to itself; meanwhile, we shall be contented with that view of force which contented the men whose names are quoted above, and on which they and their compeers have reared the magnificent fabric which goes by the name of mechanical science.

ENGINEERING PROGRESS IN SWITZERLAND.

In the Swiss National Exhibition—now open at Zurich—there are several groups referring particularly to engineering and kindred matters. The subject of engineering is divided into four branches, respectively dealing with road-making, railway construction, water engineering, and the improvement of towns. In the official report upon the progress made under these various heads, it is remarked that the Alpine roads were, up to the commencement of the present century, in an imperfect state, but since then the existing improved communications have been established, partly by Napoleon I. for military purposes, and partly by international efforts made by the districts most interested. The system of roads in Switzerland itself has been much extended and improved, although the spread of railway communication has diminished the importance of many principal highways. These roads are said to contain numerous well-built stone and iron bridges, in addition to the picturesque wooden bridges, of which specimens are exhibited. The introduction of railway communication in Switzerland was at first restricted on account of the objections then entertained by technical authorities in all countries against the employment of sharp curves and steep gradients. Thus, the line from Zurich to St. Gall was at first regarded as impracticable. When, however, the first Swiss railway was opened in 1849, a rapid extension of that form of communication resulted, and the present full development of the system was gradually attained. At first foreign talent was principally employed, but the Federal Polytechnic Academy—opened in 1855—led to the formation of a body of Swiss engineers, whose representative association did much to raise their technical standing. Competition between the private lines has done much of late years to reduce the profits of many Swiss railways. Local interests and political manœuvres had, in some cases, led to the construction of lines almost parallel to each other, and many railways of third-rate importance were built in a manner only suited to an important main line. A better state of things now exists, it is stated. Special reference is made to the Gothard Railway as being a lasting monument of engineering skill. Several Swiss lines are of a special character with very steep gradients, and intended to meet the requirements of tourists in various mountainous districts, such as the Rigi, &c. There is a separate display of plans and models in connection with these lines. In addition to similar exhibits from some other railway companies, there is a collection of interesting exhibits referring to tunnelling, in which the most important systems of boring machines are represented. The two other branches referred to are appropriately represented by plans and models representing works of importance already constructed or in contemplation. Machine construction is treated in a separate group, and is represented by 160 exhibitors. The pioneer of the industry in Switzerland was John Gaspar Escher, born in 1775, who established the firm of Escher, Wyss, and Co., Zurich. Other firms shortly followed, and the industry soon acquired relative importance. The construction of boilers and steam engines was begun about the year 1840. Amongst the most notable improvements effected in this branch, reference is made to the model of steam engine introduced by Sulzer, and shown by him with marked success at the Paris Exhibition of 1867. The water motor invented by Schmid, of Zurich, was the result of a competition established by that city for plans, by which the pressure of the water afforded by the newly-arranged municipal water supply could be utilised as a motive power for small industries. This motor is said to have met with great success, being now employed not only for the purposes indicated, but also in connection with large factories. With reference to the development of engineering and mechanical science in Switzerland, it must be remembered that the country produces comparatively little fuel, the annual import of coal being 660,000 tons.

MILL FURNACE BOTTOMS.

Experiments of interest to the iron trade have this week been completed at the Greatbridge Iron and Steel Works, Tipton, of the Greatbridge Iron and Steel Company, as to oxide bottoms for mill furnaces. An arrangement that has been adopted at several works in South Staffordshire and also in Scotland, for doing away with sand bottoms and using oxides, is a hot-air chamber, patented by Mr. Job Tibbs. In constructing a furnace according to his invention, our Birmingham correspondent says, the iron plate bottom of the furnace is inclined from front to back, and also from the fire bridge to the flue bridge. At the back, and near the flue end of the furnace, is a hole or channel which opens out into a small supplementary chamber containing wagons, and during a heat the fused cinder formed runs off into the wagon, leaving the bed dry. An oxide bottom used under this arrangement, with a fettling of from 3½in. to 7in. thick, as compared with the sand bottom, will, the maker claims, produce a far superior quality of iron, and at a cost of at least 10s. per ton less, so effectual is the prevention of the accumulation of the melted cinder on the bed and its running in among the piles. The patentee claims also that whereas some cinder bottoms are used in plate and rail mills for the first heating, re-heating being accomplished on a sand bottom, by his chamber the second heating can be accomplished on the same bottom as the first. Recognising its advantages, Mr. Scovil, of Scovil, who leases Coldbrook Rolling Mills, St. John's County, N.B., Canada, is about to introduce this form of the oxide bottom system into the States, and for this purpose adapt the chamber to gas furnaces in Pittsburg, where sand bottoms are now almost exclusively used. A native ore that would make as good a cinder bottom in the States as the pottery mine in Staffordshire was expected in the Port Henry ore, a high-class hematite material found in large quantities at Port Henry, on Lake Champlain, in the north-eastern part of New York State. Five tons of this ore were sent over to Staffordshire, and it was to test its action that the Greatbridge experiments were conducted. There were present a number of South Staffordshire ironmasters during certain of the days during which the trial was proceeding. The 5 tons kept one mill furnace bottom good whilst 74¼ tons of finished iron was made from it and rolled into angles and other sections. Throughout the trial the heat was purposely kept extreme in view of the prospective use of the gas furnace, and the opinion was that the greater the heat the better. On several occasions when our correspondent examined the bottoms, during the heats and after them, they were perfectly uniform in surface and in colour, and notwithstanding the extra heat there were no cracks or gutters; whilst the clearness of the piles as they were taken to the rolls showed that there had been no approach to sucking. The appearance also of the sections after passing through the rolls was all that could be desired. Altogether the Port Henry cinder was not only as good but surpassed the pottery mine, and led makers to remark that if the ore could be got from the States at ballast rate it would be worth while to import it rather than continue to use the pottery mine. Touching the action of the cinder in the puddling furnace, I may add that the cinder from the 5 tons was taken to two puddling furnaces, and lasted eleven turns. The yield in this case also surpassed that obtained where the Staffordshire materials are used, being larger by 1½ cwt. per hour for the two furnaces. The cinder from the mill furnace turned out 28 tons 3 qrs. 26 lb. of puddled bars, and the weight of pig iron taken to the puddling furnace was 29 tons 9 cwt. 2 qrs. 16 lb., or 130 heats of 4 cwt. 29 qrs. 4 lb. each.

NEW VOLUMETRIC METHOD OF DETERMINING MANGANESE IN STEEL, CAST IRON, FERRO-MANGANESE, &c.

THE method referred to, devised by E. Raymond, is recommended as being expeditious and accurate. It consists in precipitating all the manganese as peroxide, dissolving it in a ferrous solution so as to bring back the manganese to the state of manganous oxide, and determining volumetrically, by means of potassium permanganate, the quantity of ferrous salt which has been converted into ferric salt. The method of rapidly precipitating manganese peroxide is peculiar. If we act upon cast iron or steel with nitric acid and potassium chlorate in certain proportions, and boil the mixture, the manganese is completely precipitated in the state of peroxide insoluble in nitric acid, but retaining a small quantity of ferric oxide. Suppose that we have a sample of steel or manganiferous cast iron containing less than 7 per cent. of manganese. Three grammes are tested in a small flask, with 40 cc. of nitric acid, of specific gravity 1·20, added little by little. The liquid is stirred, and ultimately heated to complete solution. It is withdrawn from the gas flame, and fifteen grammes of potassium chlorate are added, and then 20 cc. of nitric acid, of specific gravity 1·40, are now added. It is boiled for about fifteen minutes until the escape of chlorine ceases; all the manganese is found thrown down as peroxide, but water is added, the mixture is filtered, and the precipitate is washed with boiling water. To dissolve manganese peroxide thus obtained he measured exactly 50 cc. of an acid solution of ferrous sulphite made up with 40 grammes of ferrous sulphate to 750 cc. of water and 250 cc. of sulphuric acid, of full strength. The 50 cc. are poured into the flask in which the sample has been dissolved, and to which a little peroxide adheres, and it is then poured upon the precipitate and the filter in a porcelain evaporating dish. The manganese peroxide dissolves very readily, transforming its equivalent of ferrous sulphate into ferric sulphate. The liquid is then diluted with from 100 to 150 cc. for the next operation. We can take a solution of permanganate formed by the same proportions as are used in determining iron by the process of Marguerite—5·65 grammes of the crystalline salt per litre of water—and determine its standard exactly. By means of this liquid we determine volumetrically the quantity of ferrous sulphate remaining in the solution of manganese. We then take 50 cc. of the original solution of ferrous sulphate diluted as above and determine the total ferrous salt. The difference between the two determinations corresponds to the ferrous salt which has been peroxidised by the manganese peroxide. The quantity of iron then peroxidised, multiplied by 8·491, gives the quantity of manganese contained in the portion operated upon. In the case of a steel or cast iron containing but little of the manganese it is convenient to dissolve the peroxide in 25 cc. only of the ferrous solution. Small Gay-Lussac burettes may then be used in the titration of only 0·010 metre internal diameter and graduated into $\frac{1}{20}$ cc., which allows of great exactitude in the determination. For a spiegeleisen, not more than 1 gramme of the sample should be taken, and for a ferromanganese 0·3 gramme is sufficient.

A MODIFICATION OF NOACK'S METHOD OF PREPARING CARBONIC OXIDE.

NOACK'S method was described in THE ENGINEER, June 29th. He showed that carbonic oxide can be obtained by passing carbon dioxide over zinc dust. It has occurred to Leonard P. Kinnicutt that the same gas might be obtained by heating carbonates directly with zinc dust and more conveniently. This led him to try a number of experiments with magnesite. He found that when powdered magnesite mixed with twice its weight of zinc dust is placed in a copper retort and heated so that the bottom of the retort is nearly surrounded by the flame, a gas is immediately given off which, after the first five minutes, is nearly pure carbonic oxide. For the first five minutes the gas is a mixture of carbonic oxide, carbon dioxide, and, in case the substances were not perfectly dry, a little hydrogen. In place of a retort, hard combustion tubing can be used. An analysis of the gas when given off at the rate of four bubbles a second, collected directly from the retort and measured over mercury, gave the following results:—Volume of gas = 152·5 P = 583·4 t = 4 deg. Cor. V = 115·4. After absorption of CO_2 by KOH: Volume of gas = 150·0 P = 588·8 t = 5 deg. Cor. V = 114·7; per cent. of CO_2 = 00·61. He has undertaken the study of the decomposition of other carbonates; but as a method for preparing carbonic oxide the above is in every way satisfactory, the manner in which the gas is given off resembling that of oxygen when made from potassium chlorate, with the advantage that the evolution is more easily controlled.

LITERATURE.

Practical Electric Lighting. By A. BROMLEY HOLMES, Assoc. M.I.C.E. London: E. and F. N. Spon. 1883. 154 pp.

IT is a difficult thing to write a small book on electrical matters which, while being stripped of the innumerable details which afflict the mind of an electrician, and seem to him to have a necessary place in a book however elementary, to prevent inaccuracies, shall contain that information which is required by those who wish to gather an intelligent conception of the why and wherefore of the very modern practical applications of electricity and magnetism. There is so much that has for years been looked upon as essential to a knowledge of electricity, that those who are thoroughly acquainted with that old school jargon which has been now largely displaced by what may be called practical electricity, cannot, though accomplished electricians, divest their minds, and so cannot write a book suitable for the engineer who wants to get an introduction to the subject which shall not disgust him at the outset with its minutiæ of wholly inapplicable erudition. It is, therefore, necessary that some one who has approached electricity and magnetism with a view to its modern applications, and unfettered by the traditions of the old school, whose largest currents were used for telegraphy or electroplating, should write this sort of introductory volumes. Mr. Holmes has not done it.

The promise of the title is somewhat modified by the preface, which states it is only intended to explain briefly and clearly to those who have no electrical knowledge "the principles involved in the production of the light," and to give them some information about the apparatus employed. It does not profess to be a complete guide through all the practical details, nor is it, on the other hand, a mere compilation of lecture experiment notes, more calculated to astonish and amuse than to instruct. But really the use in its title of the word practical is not warranted. The book is only practical in the sense that it is written in a way which appeals to the practical mind which is impatient with the study of the half-dozen books which must be gone through with the selective judgment as to what is really required, and which an amateur cannot possess.

After an introduction in Chapter I., we have in Chapter II. a terse yet sufficient description of various elementary facts and of the chief units of measurement. Then follows a chapter on batteries. Chapter IV., on magneto-electricity, and currents, and magnets, is commendable for its simplicity and directness. Chapter V., on dynamos, gives a general idea of most of the usual kinds; and Chapter VI. a very clear description of the different results in working, characterising various modes of winding the electro-magnets, followed by a description of some of the ordinary electrical measuring instruments. As with dynamos, so also with lamps—described in Chapters VII. and VIII. A close examination of the actual things would be necessary to enable the reader to fix in the memory the author's descriptions, but these are sufficient to outline in the mind the general types. Chapters IX. and X. on conductors, circuits, and testing, form a very good introduction to the subjects dealt with, and Chapters XI. and XII., on storage of electricity, and selection and cost of light, will serve to clear up the notions of the general reader and help him to understand the leading features of these subjects. Finally, a short chapter is added on motive power.

Into the explanation of the way in which currents are generated in coils of wire by magnetic induction, the author might and should have entered more fully before proceeding to describe magneto and dynamo-electric generators, especially as this is necessary to enable the reader to understand the reason for the forms of armature, coils, and cores explained further on. Chapter VI. should be carefully digested by the reader before reading the latter three-fourths of Chapter V. On arc lamps more information with more engravings should have been given, and in this matter the author might have adopted the same care as he has bestowed on the dynamo machine windings with advantage. The author has apparently forgotten those questions which most puzzle beginners on electric lighting subjects. He does not remember how often the questions "how much?" "how many?" and "what size?" must have occurred to him in days gone by. As he has used the word practical in his title he should have had clear detailed engravings of at least one well-known form of dynamo electric machine, and one good arc lamp. These he should have explained in principle and detail, and then of other machines and lamps explained their peculiarities, but shown that all depend on the same principles. The value of Chapter XIII. on motive power may be questioned, as may also the formula for the indicated power of a steam engine. In this the author has taken the trouble to eliminate the 33,000, he measures stroke in inches instead of feet, and uses square of diameter of cylinder instead of area. He thus gets inch-pounds instead of foot-pounds, and a divisor of 252,000 instead of 33,000. The direct relation between the Watt unit of horse-power on one side of the equation and the pressure × feet moved through on the other is thus lost without any advantage.

There is, however, little fault to find with the book, if we forget part of the title, and remember the disclaimer in the preface. A paragraph on page 69 relating to compound shunt dynamos may be modified. The proportion of the main current that passes through the fine wire magnet shunt will vary when the external resistance of the main circuit varies, but if the machine self-regulates perfectly, *i.e.*, if the difference of potential between the terminals of the dynamo remains constant, the actual amount of current passing through the fine wire magnet shunt will be practically constant also. The book is nicely got up, and the original engravings in it are clear and well selected. It will be found useful as giving beginners a good idea of the selection they may make of subjects for special study in complete works.

INTERNATIONAL ELECTRICAL EXHIBITION IN VIENNA, 1883.

No. II.

WRITING on Tuesday, our special correspondent at the Vienna Exhibition says that in spite of many evil prophecies, it could then be said definitely that the opening of the Exhibition on Thursday—yesterday—would be what may be called a fairly complete success. Everything would not be ready, but at what exhibition was there ever everything ready at the opening? Most of the cases he says had arrived, a great deal had been unpacked and put in order, and the rest were being rapidly got out and placed on the shelves.

In entering the Exhibition one meets with great piled-up stands of electrical wire, cable, copper and brass plate, and lead-covered wire and cable. Telephones and galvanic batteries of innumerable variety are already in place. Some very good exhibits are made simply of vulcanite formed to the various shapes required for batteries, insulating stands, &c. Telegraph instruments are numerous, and Italy seems to come out stronger in this line than one would have expected. The London Gutta-percha Company has one large stand completed, and from the unpacking going on on their portion of the floor their exhibit promises to be extensive and interesting. The Eastern Telegraph Company, London, exhibits among other things Sir William Thomson's syphon recorder with tray battery, which is sure to attract much attention. A very large stand containing an immense variety of electroliers and lamps of graceful design is stocked by Hesse and Woolf, of Vienna. This firm also has a large lustre in the centre of the small theatre that has been fitted up in one of the annexes. This theatre is sure to form a great attraction, and is, indeed, very nicely fitted up, so far as the stage is concerned. The accommodation for the audience is such as cannot be expected to be sufficient for the probable number of visitors. The rest of the lighting of this theatre is by Ganz and Co., of Pesth; not only the auditorium but also the stage being, we understand, undertaken by this company. There is another small model theatre outside a northern annexe, which is designed with the intention of making it absolutely invulnerable, or rather absolutely safe when attacked by fire. We are told that practical experiments will be made with this theatre. We hope they may be carried out without risk to the main building. An interesting department is that in which the effects of electric lighting upon furniture and drapery are to be shown. This seems almost ready. In the Rotunda itself a great deal of electrical railway apparatus is already put in place. Signal-posts are there without number. The Northern Railway of France exhibits a miniature electrical railway, and the Southern Railway of Austria have carriages shown fitted up with electrical brakes, with the electrical currents also utilised for lighting the carriages. This latter is a most interesting exhibit, to which we hope to refer at length on a future occasion. We are sorry to observe that Professor Fleeming Jenkin's new system of telpherage is not to be illustrated here. We believe there were difficulties in the way of finding the space necessary for it. The Municipality of Vienna has had a quarrel with the tramway company, so that the latter has determined not to run its cars down to the Exhibition from the town. They were willing to lay down the necessary lines if they had been allowed to make an extra charge for the journey, but this was refused. The consequence has been that the Siemens Company has constructed a line for itself from the Prater Stern to the north gate of the Rotunda, and thus a most interesting practical demonstration of their electric railway system will be made.

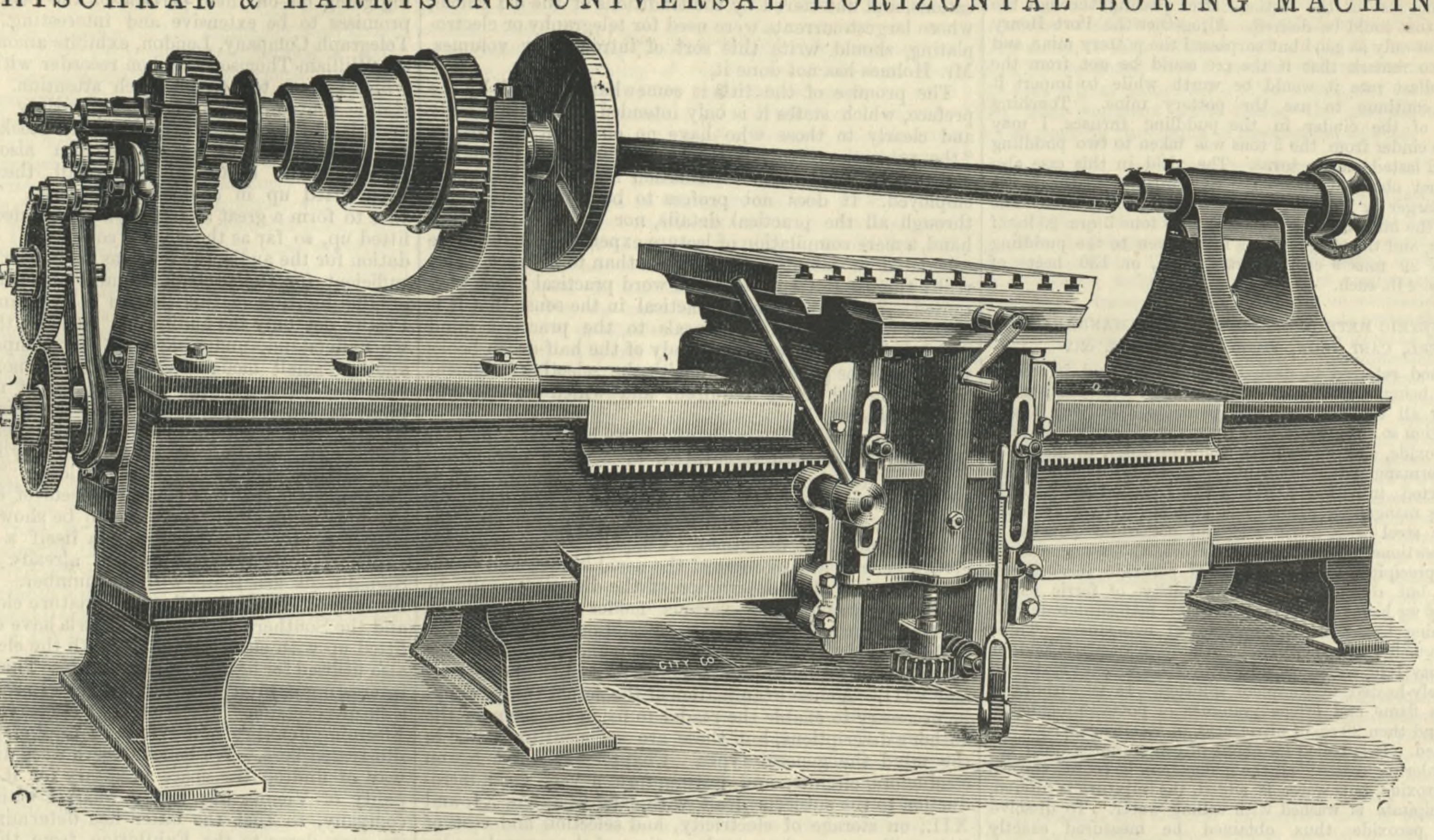
The dynamos already on the floor are numerous. Ganz and Co. have failed as yet to get their enormous dynamo machine, the outside diameter of which is 52ft., erected. The heavy casing containing the field magnets has fallen twice, we are told, in the attempts to get it in place. The Edison Company, the Burgin-Crompton Company, and the Anglo-Austrian Company are making extensive preparations. The former are quite ready, but the two latter, we regret to say, are very much behindhand. Great credit is due to Schwerdt, of Carlsruhe, who has four dynamo machines laid down, which are at present doing a great deal of the lighting work of the buildings during the preparations.

IMPROVED GIFFARD COLD AIR MACHINES.

IN our impression for 6th July last we gave illustrations and description of two forms of cold air machines made under the patents of M. Giffard, but modified by the General Engine and Boiler Company. We now illustrate by a supplemental ink photograph and by engravings, at page 129, one of the large size machines made by the above company, and a small machine. Figs. 3, 4, and 5 show the 20,000ft. machines and the larger sizes and all of the same general construction. In the 20,000ft. machine the air cylinders are 20in. diameter and 25in. and 20in. stroke for the compressing and expanding cylinders respectively. The steam cylinder is 12in. diameter by 25in. stroke, and the full speed of the machine is 100 revolutions per minute. The action of all these machines is precisely the same, air is compressed in a carefully jacketted compression cylinder, and as, however well jacketted the cylinder may be, the compressed air is certain to rise in temperature, after leaving the compression cylinder it is passed through a large number of solid drawn brass tubes, on the outside of which water is circulated by a circulating pump which will be see in all the illustrations. The air is cooled in this way to within a few degrees of the circulating water, which in case of machines used on board ship is taken from the sea. The compressed air is then admitted to an expanding cylinder, where it performs work against a piston coupled to the crank shaft, and aiding the compression of the original air. The air when expanded down to about atmospheric pressure is discharged into the freezing chamber, and used for any purpose requiring extreme cold. Minus 40 deg. Fah., that is to say 72 deg. below freezing point, is the temperature guaranteed in the case of all machines of 5000ft. and upwards; but these machines have frequently delivered air at 100 deg. Fah. or more below freezing point, and the General Engine and Boiler Company say there will be no difficulty in obtaining much lower temperatures if such were required. Fig. 6 represents the 2000ft. and 1000ft. size of the Giffard machine; these were copied as closely as possible from M. Giffard's own designs. These small machines have given good results, and have indicated as low as minus 65 deg. Fah. Our engravings explain themselves.

THE FORTH BRIDGE RAILWAY.—Major-General Hutchinson and Major Marindin have reported to the Board of Trade upon an inspection which they made of the works in progress for the construction of the bridge over the river Forth at Queensferry. After giving details of the progress made with the excavation of the foundations of the viaduct piers, which are on Whinstone rock, the inspectors say:—"The engineers have furnished us with diagrams of the strains upon the piers and other parts of the bridge, showing that, according to the result of their calculations, under no possible combination of a 56 lb. wind blowing in any direction, and a rolling load of 3400 tons on the span (*i.e.* two tons to the foot), will the stress either in tension or compression exceed one-fourth of the ultimate resistance of the steel to be used in the construction of the bridge, viz., 30 tons per square inch in tension, and 34 tons in compression. We can report that the preparations which have been made, and the machinery and plant which we are informed have been ordered, indicate that it is the intention of the engineers and contractors to carry out the works in a manner suitable to the magnitude of the undertaking, and that, so far, these works have been completed in accordance with the authorised plans, and in a satisfactory manner."

SCHISCHKAR & HARRISON'S UNIVERSAL HORIZONTAL BORING MACHINE.



EXAMPLES OF THE GRAPHIC TREATMENT OF STRESSES IN FRAMEWORK.

By Robert Hudson Graham, C.E.

No. II.

1. *Didcot roof.*—The roof over Didcot Provender Store, represented in outline on page 137, is 46ft. 6in. in span, and 10ft. 6in. in total rise; so that the ratio of rise to span, expressed in fractional form, is $\frac{1}{4 \cdot 43}$. The principals are 20ft. apart. The incumbent weight upon the roof is found by assuming 45 lb. to be superposed upon each square foot of covering between bays. This includes dead weight of materials, as well as all accidental weights arising from wind pressures, and the lodgment of rain and snow. The given reciprocal figure of the roof shows that the maxima stresses take place in the extreme divisions 12 and 44 of the side rafter, and are each equal to about 22·8 tons. Supposing the working limit of stress for iron to be 5 tons per square inch, the corresponding area of cross section would be 4·56 square inches. The thrust in the rafter decreases uniformly from the end next the principal to that next the ridge, where the stresses in divisions 27 and 29 are only 12·2 tons. Consequently, the area of cross section, if calculated for uniform strength, can be reduced from 4·56 square inches at the lower to 2·44 square inches at the upper end of the rafter. The stresses induced in the various members of the roof-bracing are least in bars near the principals, and greatest in bars situate at the centre of span, between which limits they increase in almost uniform ratio. The maximum tension in the members of the bracing is brought to bear upon the vertical rod 28, in which the stress amounts to as much as 9 tons; and the corresponding area of cross section will therefore be 1·8 square inches. The minimum compression takes place in the struts 14 and 42, in each of which the stress amounts only to 1·7 tons. Hence, theoretically speaking, the area of cross section might be here reduced to 0·34 square inches. It will be remarked that the members of this roof-bracing are alternately in tension and compression, the former being represented by light and the latter by dark lines.

2. *Goods shed at Weymouth.*—This roof is 71ft. 6in. in span and 16ft. in total rise, so that the ratio of rise to span is $\frac{1}{4 \cdot 47}$. The principals are 10ft. apart. The incumbent weight is found on the supposition that 40 lb. is superposed upon each square foot of surface between bays, including dead weight, as well as all accessory pressures due to wind pressures and lodgment of rain and snow. This weight is distributed over the roof by apportioning 1·6 tons to each joint of the side rafters. The reciprocal diagram shows that the greatest strains are brought to bear upon the extreme division of the side rafters next the principals, where the thrusts in the parts 10 and 34 are each equal to 13·7 tons. Assuming as before, in the case of the Didcot roof, that the working limit of stress of iron is 5 tons per square inch, we find the corresponding area of cross section to be 2·74 square inches. Here, again, the stresses in the rafters decrease in uniform ratio towards the ridge, where the thrusts in division 21 and 23 are each 7·8 tons, and the theoretical area of cross-section 1·56 square inches. The stresses in the bracing are alternately compressive and tensional, increasing uniformly in amount from the ends towards the centre of span. The greatest tension induced in any member of the bracing is brought to bear on the vertical rod 22, in which the stress amounts to as much as 5·5 tons, and the corresponding area of cross section to 1·1 square inches. The least compression in any member arises in the struts 12 and 32, in each of which the induced stress is as low as 1·9 tons. Hence, theoretically speaking, the area of cross section might be reduced to 0·4 square inches. It will be observed that the stresses in the great tie rods go on increasing uniformly from the centre to the ends of the span, attaining their maxima of 12·2 tons in the divisions 11 and 33, and their minima of about 8·7 tons in the divisions 19 and 25. If, therefore, it were decided to design these tie rods round in section and uniform in strength, they would each assume the form of a long truncated cone.

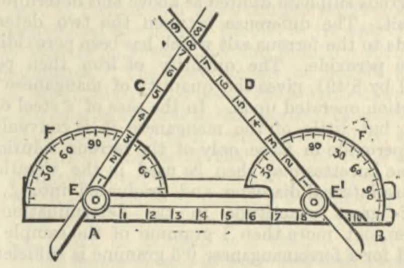
UNIVERSAL HORIZONTAL BORING MACHINE.

The machine here illustrated has been specially designed by Messrs. Schischkar and Harrison, of Halifax, to meet what they have found to be a requirement in engineers', machine makers', and general millwrights' establishments, where it specially recommends itself as a strong boring machine, which is readily applicable for the many different uses to which machines of its class are put. The engraving represents a No. 4 machine, for boring cylinders up to 20in. diameter, and the compound tables of which are self-acting in the horizontal and transverse slides. The tables rise and fall by screws and gearing, and can be worked either by hand or power. The table is propelled in the horizontal motion by a steel screw 2½in. diameter, which runs along the inside of the bed, and is fitted with double disengaging nuts, the handle of which is underneath the table and easy of access to the operator. It is also fitted with quick return traverse motion. The carriage, which fits on all four sides of the bed, is fitted with adjustable dies to take up all wear, and to insure a perfect fit. The table will fall from the centre of bar 15in., and has a transverse traverse of 2ft., and is 3ft. 6in. long by 3ft. wide, with T slots the full length of the table to secure the work. The table is arranged so as to turn completely round, thus enabling the operator to bore at any angle. Supposing a cylinder to have been set on the table, it can be bored out, faced up at each end, the flanges turned by block and cutter fixed on the bar. The boring bar then being taken out, a drill can be placed in the spindle, the back gear thrown out, and a high rate of speed thus gained, the stud holes can all be drilled out, the table turned quarter round, the valve chest stud holes drilled, turned half round; the stud holes can then be drilled in the opposite end of the cylinder. Thus it may be seen that the cylinder can be practically finished with the exception of planing out the steam chest face.

Supposing this machine is used in an establishment where a horizontal boring machine cannot be kept constantly going, by placing a tool-holder on top of the table, it is at once converted into a sliding, surfacing, and screw-cutting lathe. As the machine is fitted with a full set of change wheels and reversing gear for cutting right and left-hand screws, and will take in anything over the top of the table up to 2ft. 6in. diam. and 4ft. diam. over top of bed, and in length 7ft. The machine is also adapted for cutting key beds, as a drill can be fixed in the spindle end, the shaft secured by V block on the table, which gives a traverse of 2ft. The fast head is fitted with a steel spindle with long phosphor bronze bearings. It carries a 3ft. 6in. face-plate by which any class of work can be bored and turned. The boring bar which is supplied with it is 6in. diameter, and is fitted with steel-hardened centres and sliding block for facing purposes. The makers have made this machine a speciality, and everything is put together in the simplest manner so as to secure economy in cost. Its aggregate weight is 5½ tons.

KELWAY'S TELEMETER.

The accompanying engraving represents an instrument which enables a navigator to ascertain the distance of his ship from a light, headland, or other object, without consulting a chart. It consists of a base line A B and two arms C D, each of which is graduated to inches and tenths of inches. The two arms C and D are respectively pivotted at E and E¹, and can be freely moved over the protractors F and F¹, and clamped at any desired angle. The protractors are graduated in both directions from 0 deg. to 90 deg., cut to 30¹, and also to ¼ points of the compass. The right-hand arm and protractor D is capable of being moved to and clamped at any point on the base line A B. In using the instrument the operations are as follows:—(1) Take a bearing of the light, or other fixed object, noting the exact time. (2) Place the left-hand arm to the bearing found by observation and clamp it. (3) Let the vessel run for a given time on the same course, when take a second bearing. (4) In a printed table supplied with the instrument, and by using the above observations and the speed of the ship, and the time occupied between the two bearings, the figures found will show the distance run in knots, tenths of knots, and yards. (5) On the base line A B, set the protractor F¹ to the distance thus found; place the arm D to the second bearing, and the graduation at which the arm D is cut will be the distance from the object at the time of the second bearing. This instrument is not only useful for navigational purposes, but it is applicable to naval gunnery and torpedo operations, in such a manner that the range of an object from a point in advance of the vessel can be easily found before the point is reached, thus allowing the necessary adjustments to gun and torpedo to be made in anticipation. For instance, assume the distance of the object has been found by the instrument, and it is required to know how far the ship will be when it reaches a point in advance of the ship's then position, the arm C would be put to the ascertained bearing on F and the graduation on C, representing the distance remembered. The centre of protractor E¹ would be placed on A B to the distance it was proposed to run, and the arm D made to intersect C at the point



to be remembered, when the graduation at which D is cut will give the range for which preparation should be made. The tables referred to which have to be supplied with the instrument, shows how far a ship will travel in given times at given speeds, the lines of figures being printed alternately in black and red to facilitate reference. The scale on the arms is in inches and parts of inches, but they may be read as knots, cables, 1000 yards, 100 yards, or in any scale, and the instrument can be used at any bearing. The scale is larger than that of ordinary charts, and can be varied at will. It will, of course, be noted that continuous bearings can be taken and the mean adopted, so as to eliminate errors in speed observations.

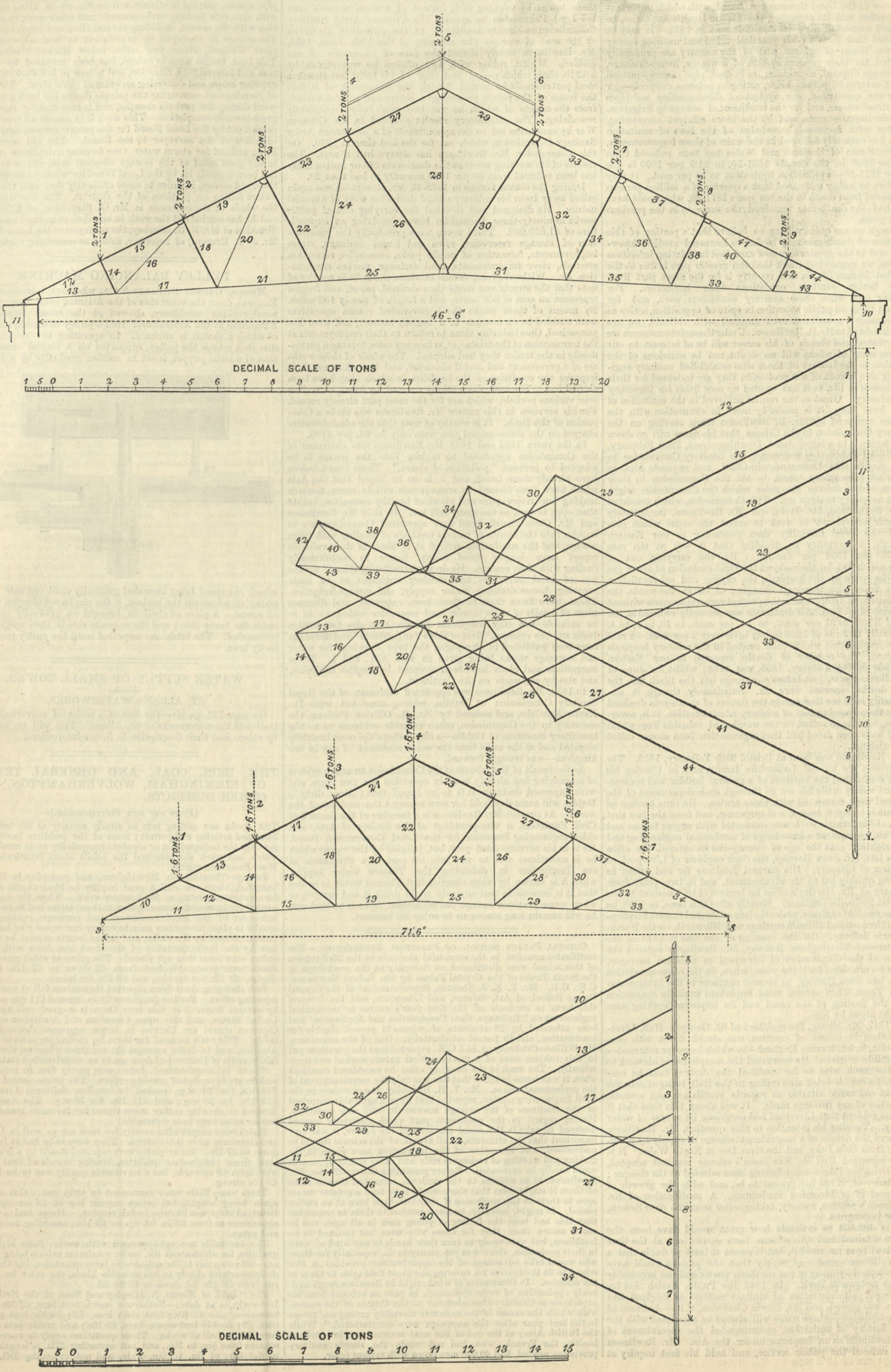
THE NORDENFELT GUN TRIALS AT DARTFORD.

On July 26th Mr. Nordenfelt carried out a programme of experiments, showing the powers of several of his machine guns, at Dartford. The arrangements were well ordered, and such as enabled the visitors to see all that they wished. A twelve-barrel rifle calibre gun, weighing 2½ cwt. on naval carriage, was fired for half a minute for rapidity, discharging in that time 600 rounds. A single-barrel rifle calibre gun, weighing 13 lb., on tripod stand, in half a minute fired 54 rounds. A three-barrel rifle calibre gun, weighing 56 lb., on combined field and tripod carriage, in half a minute fired 186 rounds. A five-barrel rifle calibre gun, weighing 128 lb., on combined field and tripod carriage, fired 300 rounds in half a minute. A ten-barrel rifle calibre gun, weighing 260 lb. on field carriage, fired in one minute 900 rounds. These pieces were fired with Martini-Henry ammunition with solid drawn cartridge cases, that is to say, not of the service pattern, but such as can be fired from the service rifle on an emergency.

A two-barrel gun, 1in. bore, weighing 185 lb. on mounting for torpedo boats or mastheads, was fired against a ⅜in. steel plate in front of a 1in. iron plate; range, 50 yards. There was a slight hitch, but the piece was got off fairly well, firing twenty rounds in six seconds, the bullets, which were solid steel, passing through the plates. A four-barrel 1in. gun, weighing 3¾ cwt. on naval carriage, fired 100 rounds—twenty-five volleys—in twenty-four seconds. There were also the following pieces tried:—A five-barrel rifle calibre gun on two-wheeled infantry limber carriage, a 1½in. 2-pounder shell gun, weighing 3 cwt., mounted on naval carriage; a five-barrel rifle calibre gun, mounted on Lord Charles Beresford's "galloping carriage," and a 2in. 5-pounder shell gun, weighing 6 cwt.. mounted on naval recoil carriage. A volunteer squad, taking the name of the London Rangers Machine Gun Club, exercised with the five-barrel rifle gun, handling the gun well. The galloping carriage was, we believe, founded on the idea of a fire-engine. Its front wheels were very small, and locked under so as to enable the sharp turn to be made; and Lord Charles Beresford appeared to be confident as to its powers to move well at a gallop, urging the drivers to keep up a good speed.

EXAMPLES OF THE GRAPHIC TREATMENT OF STRESSES IN FRAMEWORK.

(*For description see page 136.*)



SIR ROBERT RAWLINSON, C.B.

We observe with pleasure that her Majesty has been pleased to state that she will confer the honour of knighthood on Mr. Robert Rawlinson, C.B., member of the Council of Civil Engineers, who for many years has been chief engineering inspector to the Local Government Board, with which important public office and its precursor, the Public Health Act Office, he has been connected since its establishment in 1848. It may be admitted that it is to his practical mind and untiring energy that the towns of a large part of the country are principally indebted for their modern system of sewerage, house-drainage, and sewage disposal, comprising, as it does, pipe sewers—instead of vast caverns of porous brick, acting as noisome cesspools—for our sewer ventilation, our system of disconnecting soil-pipes from street sewers, and for the treatment of sewage by irrigation. By these improvements, and by the more efficient scavenging, together with increased knowledge of the laws of sanitation which has naturally followed in the wake of these improvements, the death-rate of England and Wales has been reduced from 22·5 per 1000 in the decade 1861-70, to 21·5 per 1000 in the decade 1871-80—a reduction equivalent to 4½ per cent. It may therefore be safely estimated that a quarter of a million persons were saved from death in the ten years 1871-80, who would have died had the death-rate remained the same as in the previous thirty years.

Though we are quite willing to believe that a portion of this reduction of death-rate may be due to increased medical knowledge, and to the greater care now exercised in isolating infectious diseases, we cannot but think that the greater part is due to the fact that human life in this country is for the most part lived under better sanitary conditions than heretofore. For pointing out what these sanitary conditions were, and for pressing them on public attention in spite of opposition, active as well as passive, sometimes even mingled with ridicule, we are much indebted to Mr. R. Rawlinson. Under these circumstances we think that a brief sketch of his career will be of interest to our readers, many of whom will no doubt not be oblivious of the fact that to the labours of those who established sanitary engineering as a branch of the profession they are indebted for their own success in life, as it has opened up new fields for ingenuity and industry. Great as the results achieved in the sanitation of cities have been, it is probably more in connection with the services rendered by Mr. R. Rawlinson when serving on the Sanitary Commission in the Crimea that his name will go down to posterity. In a letter dated Downing-street, 22nd February, 1855, Lord Palmerston commends the Sanitary Commission to Lord Raglan, the Commander-in-Chief, and requests him, in somewhat peremptory terms, to aid the Commission in their labours, and to enforce the rules which the Commission might find it necessary to draw up. This Commission, which consisted of Dr. Sutherland, Dr. Gavin, and Mr. Rawlinson, immediately on their arrival set to work to arrest the cause which produced the awful mortality then prevailing in our Eastern hospitals, a mortality so dreadful that it was at the rate of 420 per 1000 per annum. By the carrying out of works which had for their object the rigid exclusion of sewer gas from the wards of the hospitals, the drying and subventilation of the floors, the thorough changing of air in the wards, the equalisation of temperature, the prompt removal to spots without the camp of all filth, this death-rate was promptly reduced at the end of March to 31 per cent., to 14 per cent., to 10, to 5, to 4, and finally in June of 1856 to but little over 2 per cent.—a rate approximating that which then existed in the military hospitals at home. The number of deaths reported in our Eastern hospitals during January, 1855, was 3168; whilst for June of the following year, just before our troops left the Black Sea, the total deaths reported were six. Satisfactory though it undoubtedly is to see how surely the figures of death-rate declined before the advancing foot of sanitary administration, it is, nevertheless, terrible to reflect on the number of valuable lives which would have been saved had that organisation been sooner called into existence.

Mr. Rawlinson was born at Bristol 28th February, 1810. The Rawlinsons are an old Lancashire family, and in Chorley his father established the business of a general builder and contractor, and wisely made his son go through each department of the practical work connected with those trades. He thus became an efficient bricklayer, mason, and carpenter, and from the fact that much of his father's work was connected with engine houses and factories, he acquired a knowledge of mechanical engineering and millwrighting. At the age of twenty-one he entered the office of the late Mr. Jesse Hartley, the dock engineer of Liverpool, as measurer of masonry. His natural fondness for and talent in drawing quickly led to his advancement, and in two years from his entry of Mr. Hartley's office he became chief assistant to the eminent hydraulic engineer. Shortly after this time, in 1836, he became resident engineer, under the late celebrated Robert Stephenson, in the deep and difficult cuttings near Blisworth, on the North-Western Railway. On the opening of the line in 1840 as the London and Birmingham Railway, Mr. Rawlinson entered the service of the Corporation of Liverpool as assistant surveyor, where he remained for three years, when, on the recommendation of the late Jesse Hartley, he became engineer to the Bridgewater Canal Trust, when several most important works in connection with the feeding of the canal and its improved working were brought about by him.

In 1847, Mr. Elmeg, the architect of St. George's Hall, Liverpool—then in course of erection, was struck down with consumption, before leaving England—to which he never returned—for a milder climate. He entrusted the completion of his work to Mr. Rawlinson, who so far modified the designs that he constructed a hollow brick arch ceiling to the Hall, being at once the lightest and most suitable as regards ventilation and acoustic properties of any hitherto made. It was about this time that it became evident that Liverpool had outgrown its source of water supply. Turning his attention to this question, Mr. Rawlinson prepared the details of a magnificent scheme of supply by gravitation from Bala Lake, and the river Dee in North Wales. It is to be regretted that Mr. Rawlinson's scheme was not adopted, the Rivington Pike scheme having been selected as the cheaper; this, however, it has not proved to be, and with the growth of Liverpool it is becoming inadequate. A modification of Mr. Rawlinson's scheme, namely, taking water from the river Severn, is now in progress.

It is difficult to estimate how great would have been the results attained had this scheme been carried out at the time Mr. Rawlinson proposed it, but it seems at least probable that a vastly different source of supply than the present would have been adopted by many of our northern towns, and not impossibly for the metropolis itself. In 1848, the Public Health Act for the proper administration of sanitary matters in England and Wales, was passed, and Mr. Edwin Chadwick, C.B.—chairman of the commission—whose name will always be associated with the early history of sanitation, recommended the appointment of Mr. Rawlinson as an inspector under the Act. Mr. Rawlinson thus entered the public service, and held his first inquiry at Dover, which resulted in a complete reorganisation of the sewerage, surface drainage, road making, scavenging, water and gas supply of that city. This inquiry was quickly followed by others, so that there is scarcely a large town in this country which has not availed itself of Mr. Rawlinson's advice on subjects affecting sanitation. The reduction of death rate attained in these towns by working with, instead of against, nature's laws led Lord Palmerston to appoint the Crimean Army Sanitary Commission as already described. In the pursuit of his duties at the seat of war on the morning of the 10th June, 1855, Mr. Rawlinson nearly shared the fate of thousands of our soldiers. Whilst riding with two officers he was struck by a 42 lb. shot, which passed just clear of his body, but struck a steel portmonnaie he carried, forcing the framework of it into the bones of the pelvis, producing a severe and painful wound, from the effects of which he was two years before completely recovering. The satisfactory results obtained in the Crimean War by sanitation led to the appointment of a permanent Army Sanitary Commission, which sat for the first time in 1860. On this Commission Mr. Rawlinson has always had a seat. The results of its working are that the death-rate of our Indian army has been reduced from 60 per 1000 annually to less than 20.

During the cotton famine in 1865-66, Mr. Rawlinson was again called away from his ordinary official duties for work of a special nature. He designed and directed the carrying out of public works in ninety-three Lancashire towns, involving an expenditure of £1,650,000. These works were principally the construction of storage reservoirs, town and house drainage, street improvements, formation of public parks, cemeteries, recreation grounds, river improvements, land drainage, market construction, &c. Without giving details of these works, it is worthy of note that the streets and roads thus drained, paved, and flagged represent an area of 800 acres, and a length of nearly 400 miles. By means of these works the impoverished cotton operatives were enabled to earn wages in a healthy manner, and were not pauperised, thus inducing them to return to their employments at the termination of the famine, or, as in many cases, to remain permanently in the trades they had adopted. The whole of these works are of a permanent and useful character, and have done much to improve the condition of the localities in which they have been carried out. The cost was entirely covered by loans, extending over various periods, which are for the most part already repaid. For his services in this matter Mr. Rawlinson was made a Companion of the Bath. It is worthy of note that the administrative charges on the above-named sum were only 3s. 6d. per £100.

In the years 1865 and 1868 Mr. Rawlinson was chairman of the Commission appointed to inquire into the means to be adopted to prevent "pollution of rivers." These Commissions have already done much, and it is to be hoped that the Acts which have been framed in consequence will do more towards making our rivers pure and places of healthy recreation, rather than open sewers, as too many still are. In 1876 Mr. Rawlinson and Mr. Clare Sewell Read were appointed Commissioners to inquire into the merits of various methods of dealing with town sewage, and the conclusions arrived at by them in their valuable report have largely aided many towns in satisfactorily dealing with their sewage. He drew up the "suggestions" for the use of local surveyors and sanitary engineers as to main sewering, house draining, water supply, and sewage irrigation. These have from time to time been extended, and diagram plans of details of main sewers and reservoirs added, so as to be suitable not only for Great Britain, but also for British India and the colonies. Most of these "suggestions" and drawings have been published in our pages, the type drawings for water and sewerage works being given in vols. xlix. and l. These suggestions and plans have been accepted by English engineers, and also by engineers on the Continent.

In 1879, Mr. Rawlinson was appointed chairman of the Royal Sanitary Commission of Dublin, where, associated with Dr. Xavier MacCabe, and assisted by Mr. R. O'Brien Furlong, the secretary to the Commission, much valuable evidence as to the insanitary condition of Dublin—a city perhaps the most healthily situated and at the same time the worst sanitated of any in the kingdom—was brought forward.

As the result of the labours of the Commission an active system of scavenging has already been in operation for two years, and with improved drainage it is to be hoped that ("dear dirty") Dublin will some day hold her own amongst the capitals of the world. At present Mr. Rawlinson is a member of the Council of Civil Engineers, a vice-president of the Society of Arts, and chief engineering inspector for the Local Government Board. He is in his seventy-third year, but, judging by the vigour which he is sometimes able to put into his part in a discussion at the Institution in defending the Thames water supply, when it is shown by some chemist that Thames water is so bad that it is impossible that anybody could drink it and survive, or when some previous sewage contamination farce is trotted out, he will remain long among us to enjoy his honours.

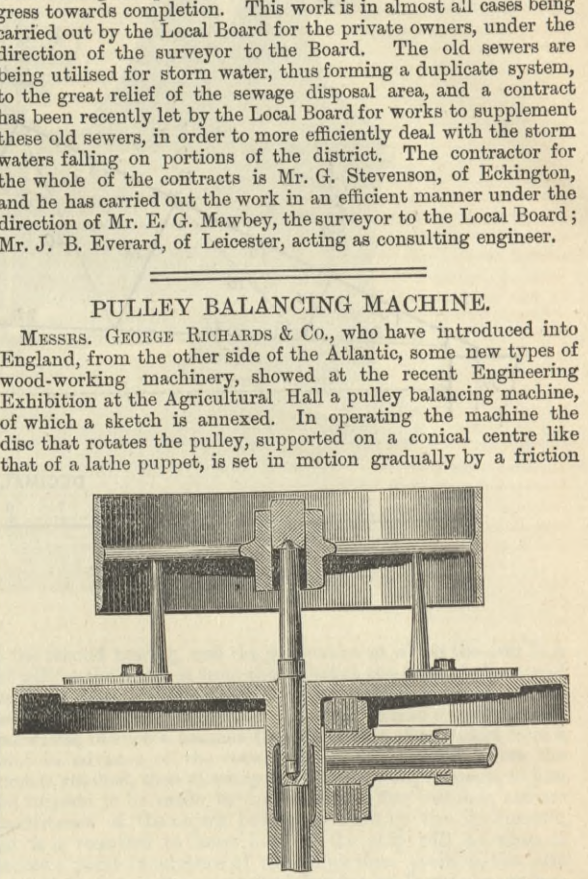
Crystal Palace School of Practical Engineering.—The certificates awarded to the successful students in the 23rd session of this school were distributed on Saturday at the workshops in the South Tower of the Crystal Palace by Mr. Robert Rawlinson, C.E., C.B. Mr. F. K. J. Shenton, Superintendent of the Crystal Palace School of Art, Science, and Literature, said the lectures this term to students of the first year's course in mechanical engineering on "Railways, their Construction and Appliances," had been attended by 28 students, of whom 21 proved eligible for examination, and 19 passed satisfactorily. One of the examiners, Mr. William Crickmay, A.M.I.C.E., reported that the questions put in this subject were of a most practical nature worked out theoretically. The work in the drawing office he considered excellent when it was borne in mind that this was only the commencement of the professional course. Mr. T. H. Blakesley, the examiner in the Civil Engineering section, reported that he was agreeably surprised at the readiness of the average answers to *vivâ voce* questions. Having regard to the prominent part which electricity seemed destined to take in the social economy of the future, it was very important that the elements, at all events, of the science should be understood, and the value of the instruction here given in the making and working of resistance coils and other simple apparatus could hardly be over-rated. Before presenting the certificates, Mr. Rawlinson, in an address to the students, remarked that to some of them it might seem that there would have been a greater career open to them in this profession if they had been born at an earlier period. It might, however, be some comfort to them to remember that this had been the feeling of young men in all ages, and he could assure them that for those who were not inclined to be fastidious, but were ready to turn their hands to any kind of work in their profession, there was yet plenty to do, especially for those who would take advantage of the opportunities provided in this school to fit themselves for entering the great field open to them in the colonies. In illustration of what might be done in a rough-and-ready application of rude appliances, he gave an account from his experience as Sanitary Commissioner in the Crimea of the success with which the causes of the excessive mortality among our troops in the first year after the campaign were counteracted. While the British Army at the end of the next summer was in excellent health, the French, who had not made the simple sanitary provisions needed, had 40,000 men down with typhus fever.

MARKET HARBOROUGH DRAINAGE.

The main sewerage scheme for the united districts of Market Harborough and Great Bowden, in Leicestershire, and Little Bowden, in Northamptonshire, is now completed at a cost of upwards of £16,000. The work consists of over nine miles of pipe sewers, varying in diameter from 9in. up to 24in., together with elaborate flushing arrangements and other work in connection with the sewers, including several river and brook crossings. The sewage is conveyed by gravitation to land adjoining the river Welland, about two miles below Market Harborough. This land, twelve acres in extent, has been prepared for irrigation and intermittent filtration, and is now in full working order, growing crops, and delivering an effluent quite clear. The work of forming and connecting the private drains has been going forward during the past six months, and is now making rapid progress towards completion. This work is in almost all cases being carried out by the Local Board for the private owners, under the direction of the surveyor to the Board. The old sewers are being utilised for storm water, thus forming a duplicate system, to the great relief of the sewage disposal area, and a contract has been recently let by the Local Board for works to supplement these old sewers, in order to more efficiently deal with the storm waters falling on portions of the district. The contractor for the whole of the contracts is Mr. G. Stevenson, of Eckington, and he has carried out the work in an efficient manner under the direction of Mr. E. G. Mawbey, the surveyor to the Local Board; Mr. J. B. Everard, of Leicester, acting as consulting engineer.

PULLEY BALANCING MACHINE.

Messrs. George Richards & Co., who have introduced into England, from the other side of the Atlantic, some new types of wood-working machinery, showed at the recent Engineering Exhibition at the Agricultural Hall a pulley balancing machine, of which a sketch is annexed. In operating the machine the disc that rotates the pulley, supported on a conical centre like that of a lathe puppet, is set in motion gradually by a friction



wheel, the speed being increased gradually until one side of the pulley dips towards the horizon, if the rim be not of equal weight all round. A piece of chalk is brought up gradually so as to mark the heavy side; and the opposite side is then weighted to correspond. The trials are repeated until the pulley runs perfectly true.

WATER SUPPLY OF SMALL TOWNS.

ST. ALBANS WATERWORKS.

On page 132 we give the first of a series of engravings illustrative of the waterworks of St. Albans. This will be followed by others and their description in future impressions.

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

(*From our own Correspondent.*)

The works are getting into as steady activity as the orders in hand and arriving will permit; most of the puddlers having now got over the indisposition or absolute incapability to do much work which last week characterised the hands about Smethwick and West Bromwich mainly.

To-day—Thursday—in Birmingham, and yesterday in Wolverhampton, there was still a good inquiry for black sheets, as well for corrugated roofing as for braziery work. When the iron was needed for immediate consumption, makers' terms had to be given; but most of the chief consumers had contracts running, and sought to place new orders only to satisfy customers who had been inconvenienced by the strike, and whose wants cannot be wholly met by the instrumentality of the sheet iron firms with whom orders were some time ago placed. The prices at which galvanising sheets were procurable were from £8 down to £7 17s. 6d. for singles, £8 10s. for doubles, and £9 10s. for latens.

Best stamping sheet firms reported themselves full of work, and rejecting offers. For the gauge mostly in demand £11 was required by several firms. For this iron there is a good call upon the United States, and also upon Canadian and Australian account. Common sheets are likewise in larger aggregate demand than lately. There is a demand for them for roofing purposes in South America, and in India amongst the countries where an absence of rain permits of their out-of-door use in an ungalvanised state.

Sheets in a galvanised form were pretty firm in price, and makers are in receipt of growing orders. The prices quoted are:—£13 10s. for 24 w.g., packed in bundles, delivered Liverpool; £15 10s. for 26 w.g.; and £17 10s. for 30 w.g. The Australian demand is showing rather more vigour for favourite brands than has for some time been noticeable.

Plates were sought after mostly for tank use as well in London and elsewhere as in this district. They were to be had at from £8 down to £7 15s. Boiler plates were reported steady by a few high-class firms. High-class qualities, bearing brands of that order, were from £9 upwards, but a serviceable quality was to be had at £8 10s. strong.

There was a little more movement in strip iron. Gas strip is again being bought, but prices remain low at £6 5s. upwards. Bedstead strip was likewise in fair request. Hoops had a steady appearance at from £6 7s. 6d. up to £6 15s., according to quality and gauge.

The bar mills are not oppressed with work. Some high-class qualities, for which about 10s. under maximum rates is being taken, are still going out to the colonies in large quantities, but the local demand relates chiefly to less valuable kinds, the rates for which run from £6 12s. 6d. down to £6 2s. 6d.

The "list" of Messrs. N. Hingley and Sons, of the Netherton Ironworks, is at date:—Netherton crown best bars, £7 10s.; best horseshoe, also £7 10s.; best rivet iron, £8; double best plating bars, £9; double best crown bars, £8 10s.; and treble best crown bars, £9 10s., all at works. These quotations apply to rounds and squares from ½in. to 3in., and not exceeding 27ft. in length; and to flat bars of 1in. to 6in. wide, and not exceeding 25ft. For angles up to eight united inches, 10s. per ton extra was demanded, and for tees, 20s. per ton extra.

The Pelsall Coal and Iron Company, Limited, quote their list as: Bars, ½in. rounds and squares and upwards, £6 5s.; hoops and strips, £6 10s.; superior bars, suitable for horseshoe and other purposes, £6 15s.; B.B. crown hoops and strips, £7; gas strip to 6¾in. wide, £6 5s.; 7in. to 8½in., £6 15s.; and 8¾in. to 12½in., £7 5s.; nail strip from 12in. to 24in., and from 14 w.g. to 12 w.g., £6 10s.; angles, £6 10s. to £7; and tees, £7 10s. to £8. Sheets—singles—of the same firm, not thinner than 20 w.g., were £7 10s., and tank plates to 13 w.g. also £7 10s. B.B. "Eureka" sheets, to 20 w.g. were quoted £9 10s., and charcoal sheets, £14 10s.

The intended manufacture of steel in this district by the basic process has just acquired additional interest by the success of the exhibit of that class of steel at Amsterdam. To-day it was mentioned on Birmingham 'Change that the jury at the Holland International had awarded Messrs. Thomas and Gilchrist a diploma of honour—the highest award—for their exhibit of basic steel and ingot iron made from phosphoric pig. The exhibit, it will be recollected, had been collected from all the European countries where the method has been adopted.

Pigs were not in active sale, but accumulated stocks are being steadily reduced through the greater freedom with which proprietors of mills and forges are prepared to accept deliveries. Cinder qualities were procurable at from 42s. 6d. down to 38s. 9d.; some Northampton qualities were to be had at 46s.; and Derbyshire sorts went up occasionally to 48s. as a practicable figure. Best hematites were a trifle firmer upon the week, though sales for two or three brands would still have been booked at from 61s. 6d. down to 60s. Staffordshire and Shropshire all-mine pigs were named at 65s., but in actual sales 62s. 6d. was the general price. South Yorkshire, Thorncliffe brand, was quoted 57s. 6d., which is 2s. 6d. less than a fortnight ago.

Coal is moving. The gas and steam coal collieries are doing more, and the unsettled weather is helping the firms who have put up the price of the best household descriptions.

There was a satisfactory meeting on Monday in Birmingham between the representative masters and men who were delegated to make arrangements for a coal trade wages' board upon the model of that which obtains in the finished iron trade. Mr. J. B. Cochrane was appointed chairman of the Wages Board, and Mr. H. Rust, the men's representative from Oldbury, vice-president. It was decided to ask Mr. Haden Corser, barrister, Wolverhampton, to become president of the board, and, failing him, Mr. S. Wilkinson, Town Clerk of Walsall. A Rules Committee was appointed, and is now engaged in drawing up a code of rules.

The directors of the Midland Railway Carriage and Wagon Company, Limited, have decided to recommend the payment of a dividend at the rate of 5 per cent. per annum on the ordinary, and 6 per cent. per annum on the preference shares for the past year, carrying £2000 to the reserve fund for the renewal of wagons, and £587 17s. 5d. to depreciation of plant and machinery.

The directors of the Sandwell Park Colliery Company in their annual report which will be presented on the 21st inst. state the profit made during the year at £5185, which with £4365 brought from last account makes £9551 available. From this £2000 has been deducted for depreciation, £3402 for an interim dividend paid in March. The report recommends a dividend at the rate of 5 per cent. per annum and the carrying forward of £636. It states that the new shaft is nearly completed, and the machinery advancing so as to be in readiness for the winter trade. The engineers report that the depressed state of the trade has prevented the raising of as much coal as usual. There are 11½ miles of gate-roading in the mine. The whole of the work, this report said, had been maintained in a state of efficiency, and no lives had been lost.

The mills and forges in North Staffordshire are generally steadily on. Girders and angles are selling pretty freely. Export orders are the most numerous for hoops and some other merchant sections, but the prices attached by middlemen are unsatisfactory. Indeed, throughout the entire trade there is more complaining on the score of prices than on the question of demand. Bar makers are experiencing a good average demand as times go. Messrs. Robert Heath and Sons quote:—R.H. crown or R.D. crown bars, £7; best ditto, £7 10s.; R.H. angles and tees, £7 10s.; R.H. best angles, £8; R.H. best tees, £8; R.H. plates, £8 10s.; R.H. best plates, £9; R.H. best best plates, £10; R.H. best best best plates, £12; Ravensdale hoops, £7 15s.; and Ravensdale sheets, £8 5s.

Messrs. Kinnersley and Co., of the Clough Hall Works, quote: "Crown" bars, £6 7s. 6d.; best ditto, £6 17s. 6d.; angles, £6 17s. 6d.; best ditto, £7 7s. 6d.; tees, £7 7s. 6d.; best ditto, £7 17s. 6d.; "Crown" plates also £7 17s. 6d.; and best boiler ditto, £8 5s. per ton. These quotations include delivery to Liverpool, or equal.

The North Staffordshire pig iron trade is rather better at the moment. But the present outturn is fully equal to the demand, and hence there is no chance of getting prices up.

NOTES FROM LANCASHIRE.

(*From our own Correspondents.*)

Manchester.—The condition of the iron trade here continues with very little variation, either as regards prices or demand, from what I have had to report for several weeks past. The amount of buying going on is extremely small, but as producers of pig iron are still making large deliveries against old contracts, they are not very much in want of new orders at present, and prefer to hold on to their full rates, even if they are not able to do much business, rather than force sales by reducing prices. Finished ironmakers are also generally well supplied with work, but this is due in considerable measure to the extra pressure brought about by the recent strike, and a considerable proportion of the orders in hand are for prompt delivery. For the present manufacturers are not in want of orders, but there is no heavy weight of business apparent in the market, and buyers show a hesitation about purchasing forward to any large extent, which is not an indication of any great confidence in the stability of the market.

There was a moderately good attendance at the Manchester market on Tuesday, but the demand both for pig and manufactured iron was very dull. Where there are inquiries for pig iron in the market it is chiefly for forge qualities, for which makers are now asking very nearly the same price as for foundry. Lancashire makers have been able recently to dispose of a fair weight of iron among the forges in the neighbourhood of their works, and further local business to a moderate extent is still pending. In district brands occasional sales of forge Lincolnshire continue to be made at makers' prices, and a few small sales of Middlesbrough iron are reported. Delivered equal to Manchester local and district brands are from 45s. to 45s. 6d. for forge and foundry Lancashire, 45s. 4d. for forge, and 45s. 10d. for foundry Lincolnshire, less 2½; but in north country iron there are second-hand lots, offering at about 1s. per ton under the prices asked by makers.

The business doing in hematites continues only very small. Where there are buyers in the market it is chiefly for long forward delivery, the low prices now ruling being a temptation to purchase on speculation, but makers apparently do not care to commit themselves heavily very far ahead on the basis of present values, and for prompt delivery, which they are willing to entertain, there is very little inquiry.

In finished iron business is steady generally. Here and there low sellers of bar iron are to be found, but as a rule prices are well maintained. Delivered into the Manchester district bar iron averages £6 2s. 6d. to £6 5s.; hoops, £6 12s. 6d. to £6 15s.; and sheets, £8 to £8 7s. 6d. per ton.

The reduction in the wages of the finished ironworkers in this district which was put into force generally last week has met with some little opposition, but the actual stoppages of work have been only temporary and unimportant.

If anything there appears to be rather a falling off in the demand for labour in the engineering trades. It is, however, only in one or two branches of industry that there is any very appreciable actual decrease of activity, but the general tone of the reports issued by the Trades' Union societies connected with the engineering trades is less cheerful. The secretary of the Steam Engine Makers' Society reports that whilst there is no marked improvement in the branch returns for the past month, in a few cases a decline of trade is recorded, which does not speak well for the future, unless a revival were to set in from causes which are not known at present. In the number of unemployed, although there is an apparent decrease, owing to there being less on the books in connection with the Sunderland strike, there has practically been an increase. The greater part of this increase is in the London district. Throughout Lancashire the state of trade continues satisfactory, the number of unemployed in the above district not being more than ½ per cent. of the society's membership. The returns sent in by the various branches of the Amalgamated Society of Engineers show an increase in the number of unemployed members on the books. The Sunderland strike is still causing a drain upon the society, and in the machine trade of Lancashire there is a decreasing amount of activity, makers throughout the district, with the exception of one or two leading firms, being only badly off for work. Almost entirely from this cause there has been an increase of 1 per cent. in the number of unemployed members in the Manchester and Salford district. In other branches of trade, such as locomotive building, where the pressure of orders still necessitates the working of a good deal of overtime, tool making and boiler making, in which a steady business continues to be done, and in heavy engineering work activity is generally being well maintained, and for pattern makers and smiths there is still a good demand, extremely few of this class of workmen being on the books for want of employment.

Some of the leading boiler makers in this district have been successful exhibitors at the Amsterdam Exhibition. Messrs. W. and J. Galloway and Sons, of Manchester, have received a gold medal, which is the highest award in the class, for their exhibit of fittings and general accessories for boilers, and a gold medal has also been awarded to Messrs. Joseph Adamson and Co., of Hyde, for their exhibit of a boiler specially constructed for the Java trade.

During the past week further experiments have been made with the 20-ton gun manufactured by Sir Joseph Whitworth and Co. for the Brazilian Government, and to which I have previously made brief reference in my "Notes." The experiments took place on the Birkdale sands, near Southport, where a target had been specially erected to test the penetrating capacity of the gun. The target consisted of a solid wrought iron plate 18in. in thickness of very good quality, manufactured by Messrs. John Brown and Co., of Sheffield. In the rear of the plate was a backing composed of a steel hoop 37in. long with a 23in. hole, and rammed hard with wet sand; then a second backing composed of T-iron rivetted on to a steel plate 1⅛in. thick and built in solidly with oak; this was further supported by a cast iron bed-plate 20ft. long by 5ft. wide and 14½in. deep, and finally securely strutted by a series of timbers driven firmly into the sand, the whole being covered over with wet sand to a height of six or seven feet. Prior to firing at the target an experiment was made for range, and the gun having been loaded with a projectile weighing 300 lb. and a charge of 181 lb. of powder, was fired at an elevation of 10 deg., when a velocity of 1990ft. per second, and a range of 7876 yards, was obtained. This was considered satisfactory, as a full charge of powder—200 lb.—would, it is estimated, carry the shot at the same elevation upwards of five miles. For penetrating the plate, the gun was loaded with a Whitworth steel shell weighing 403 lb. and a charge of 200 lb. of powder, and was fired at about 90ft. distance from the target. The shot, which was 9in. diameter, went clean through the plate about an inch from the centre, next through the hoop, bursting it open; then, after passing through the second plate, the shot struck the iron bed-plate, breaking it into fragments, and finally lodged in the sand underneath. The shell, with the exception that it had been slightly shortened, was found in practically perfect condition at a distance of 17ft. 6in. from the point of first contact with the target. The gun is manufactured entirely of steel, on the Whitworth breech-loading principle, with all the recent improvements, and the experiments were watched by Admiral Azevedo, of the Brazilian Navy, and Capt. Carvalho, naval constructor for that Government.

In the coal trade, although the home demand is only quiet for present requirements, there is plenty of inquiry for forward delivery, with a large quantity of coal going away for shipment, and the market shows a strong tendency towards an early advance in prices. The pits generally are kept running nearly five days a week, and of the present output there is comparatively very little going into stock, both house fire and steam coals moving off fairly well. Engine fuel is still only in moderate demand, and slack continues plentiful. Quoted prices at the pit mouth remain at 9s. for best coal; 7s. for seconds; 5s. 6d. to 6s. for common; 4s. 6d. to 5s. for burgy; 3s. 9d. to 4s. 3d. for best slack, with common sorts to be bought from as low as 2s. 6d. per ton upwards. As regards round coal, however, the above prices are only quoted for present sales, and for delivery over next month an advance of 1s. per ton is asked.

The activity in shipping is also tending to strengthen prices, but as yet there has been no very material advance. Delivered at the high level, Liverpool or the Garston Docks, steam coal averages 7s. 6d. to 7s. 9d., and seconds house coal 8s. 6d. to 8s. 9d. per ton.

For coke there is a fair demand on the basis of late rates.

Barrow.—It is satisfactory to note that the improvement in the demand for Bessemer pig iron, which I noted last week, is fully maintained, and there is some probability that it will show itself to be something more than a flash in the pan. The demand is coming from continental, home, and American buyers, and there seems to be a disposition to close contracts before quotations advance. Prices are still the same; but makers are stiffer to deal with, and should the firmer tone of the market be maintained for a short time prices will rise. No. 1 Bessemer is quoted at 51s. per ton; No. 2, 50s.; and No. 3 forge, 49s. The inclination of a few weeks back to take orders of any bulk at prices slightly below these has gone, and buyers are not now so slow to make contracts at quotations as they were a short time since. Stocks of iron have been reduced somewhat owing to the heavy tonnage that is being shipped. Steelmakers are also better supplied with work, especially in the rail department. Iron ore in better demand at unchanged prices. The importation of Spanish ores has fallen off considerably owing to the low price of native ores. Shipping fairly employed.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

When the strike among the ironworkers took place in Staffordshire, the men employed in the Sheffield district came to the sensible conclusion not to cease work, but to abide by the result. Messrs. John Brown and Co., and Messrs. Charles Cammell and Co., agreed to give whatever wages were paid in Staffordshire. A meeting of Sheffield ironworkers was held on Monday, when a letter was read from Mr. James Capper, in which he said:—"I beg to inform you that the strike is practically over, and the majority of the workmen have been working at the reduction since Monday, the 23rd July." Under the agreement entered into here, the masters could claim the reduction for five weeks. Mr. W. Ellis, the representative of South Yorkshire on the Board of Arbitration, said he believed the men were bound by the agreement which they had entered into with the masters. Afterwards a deputation waited upon Mr. J. D. Ellis, the chairman of John Brown and Co., Limited, who informed them that in his opinion the men employed by the company had acted honourably throughout, and he thought they were worthy of some concession. It was stated at the interview that the wages of Messrs. C. Cammell and Co.'s workmen had not yet been reduced, nor had the wages of those employed at the Tinsley establishment.

The Derbyshire miners, at a meeting held at Eckington on Tuesday night, resolved to make a levy of 3d. per week per man for the North Staffordshire miners until the strike is over. This resolution affects the colliers employed at the Renishaw Park, Hornsthorpe, Holbrook, Plumbley, Renishaw, and neighbouring collieries. The coal trade, both in South Yorkshire and North and East Derbyshire, continues fairly active, and the recent advance in house coal is easily maintained.

Wagon companies have been doing pretty well during the past six months. The British Wagon Company have declared a dividend at the rate of £6 per cent. per annum, and it was reported that a much larger business had been done during the past half year than for several half years previously. The North Central Wagon Company, Rotherham, also declare a 6 per cent. dividend, while they are able to put £900 to the credit of the reserve fund.

Messrs. Unwin and Rodgers, Limited, of the Globe Works, have confirmed the resolutions to wind up the affairs of the company in liquidation.

The unfortunate feature of the trade returns for July are that the decline in exports, though not heavy, is almost wholly in iron, steel, hardware, and cutlery—the articles in which Sheffield is chiefly interested. A great deal of the falling off is due to the depression in the United States, to which market we are sending very little in raw material, steel rails, or finished goods. Taking steel alone, we sent to the United States last July only 1131 tons, as compared with 11,359 tons in July, 1882, and 13,750 in July, 1881. The total weight of steel exported in July last was only 4360 tons, as compared with 15,273 tons in the corresponding month of 1882. The value was £112,235, being £64,000 less than a year ago. The decline in the exports of steel to the United States is chiefly in Bessemer billets and blooms; these, of course, are of little value compared with crucible steel. In hardware and cutlery, Canada, the West Indies, and Spain are the only markets which show an improvement. The value is some £36,000 less than last year. In steam engines and general machinery the foreign demand is maintained, the only falling markets being Russia, Spain, Italy, and India.

A slight improvement is reported in the plated ware trade. One large concern, I hear, have made a profit equal to 9 per cent., though it is only intended to pay 5. The exports of plate and plated ware last month were also larger. Generally, the local trades are but indifferently employed, and there is an increase in the number of men in the cutlery departments who are only partially employed. The heavy trades, with the exception of steel rails, are busy, especially in armour-plates, large castings for marine purposes, and similar goods.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland district is practically paralysed this week, owing to the Stockton races. It is true that the blast furnaces continue in operation, but the whole of the rolling mills, foundries, engineering works, and so forth are standing. Formerly the races did not begin until the Wednesday in race week, and then it was frequently attempted to work up to Wednesday night, laying off only the rest of the week. But recently the Race Committee made the race days Tuesday to Thursday inclusive. Under these circumstances it became obviously useless to start works where furnaces had to be heated up for the fragment of the week before or for that after the races. The manufacturers avail themselves of the opportunity to give a holiday to their staff, and they devote the week to making those necessary repairs and alterations to their machinery and other appliances which would take too much time to do at ordinary week-ends. Meanwhile, consumption of pig iron being practically stopped, and shipments impeded, the produce of the blast furnaces is necessarily put into stock, and there accumulates at a prodigious rate.

For the reasons given above, the attendance at the Cleveland iron market held in Middlesbrough on Tuesday last was meagre in the extreme. But little business was done. No. 3 g.m.b. was sold at from 38s. 6d. for forward to 39s. for prompt delivery; but transactions were few and far between. These prices were settled by merchants, as makers, to a great extent, held aloof, and did not encourage business at all.

Shipments still continue poor. During August they have scarcely averaged above 2300 tons per day, as against 4000 tons per day, to which figure the average for June reached. It seems certain that there will be a heavy accumulation of stocks at the end of the month, and lower prices may possibly result. The price of warrants is nominally 38s. 9d. for Connal's No. 3 grade, delivered f.o.b. Middlesbrough; but this figure is merely nominal, as no transactions are recorded. The stock of Cleveland iron in Connal's Middlesbrough store has diminished 647 tons during the week, leaving the quantity 73,020 tons.

In the finished iron trade there is nothing new to report. Most of the manufacturers are from home, and were, therefore, not in attendance at the market. No buying or selling was done. Prices continue the same as last week, and are as follows:—Plates, £6 to £6 5s., according to specification and to delivery required; angles, £5 10s.; bars, £5 17s. 6d.; all for payment in cash monthly, less 2½ per cent. discount, and with delivery at makers' works. There is considerable pressure for quick delivery, and this will certainly be intensified by the non-productiveness of the present week. It seems clear that the consumption is still quite equal, if not slightly in excess of the production. Under these circumstances prices would rise, but for the prevailing feeling of despondency taken by the shipbuilders as to the future. Acting upon this, they in almost every case refrain from buying ahead. As there has been no considerable amount of buying since March last, it is clear that contracts must be fast running out everywhere. A time is therefore approaching when either the shipbuilders must largely contract their operations, or they must come into the market to buy shipbuilding materials. As the latter is the more probable of the two alternatives, an increased firmness in manufactured iron may shortly be expected.

Great preparations continue to be made for the reception of the members of the Iron and Steel Institute in September. The principal hotels in the district have been requisitioned, and other arrangements are in a forward state. At the different works a great deal of cleaning up, tarring, painting, &c., and so forth, is proceeding, and there is every prospect that the district will be made to assume a suitably festive appearance. It is reported that the Council of the Institution of Mechanical Engineers have invited Mr. Isaac Lowthian Bell to be their next president. Mr. Westmacott's term of office ends in January next. Mr. Bell has long been a vice-president of the Institution, and should he accept the invitation of the Council, there is no doubt that he will worthily and ably fill the presidential chair.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Glasgow pig iron market has been very quiet during the greater part of the week, and warrants have been selling at lower prices. In a number of cases operators, who found the holding of pig iron unprofitable, have been disposing of it, and this is the chief cause of the drooping condition of the market. There is, however, a good, steady demand for makers' iron. From America the reports are quiet, but the shipments of the past week are again fully above the average, amounting to 14,054 tons, as compared with 13,722 in the preceding week, and 13,258 in the corresponding week of 1882. A furnace has been put out at the Portland Ironworks, leaving 114 in blast, as against 110 at the same date last year.

Business was done in the warrant market on Friday forenoon at 46s. 11½d. to 46s. 10½d. cash, and 47s. 1½d. to 47s. 1d. one month, the quotations in the afternoon being 46s. 11½d. to 47s. ½d. cash, and 47s. 2d. to 47s. 3d. one month. The market was quiet on

Monday, with a moderate business in the morning at 46s. 11½d. to 46s. 11d. and 46s. 11½d. cash, and 47s. 1½d. to 47s. 1d. and 47s. 1½d. one month. At Tuesday's market business was also quiet, with no appreciable change in prices. Yesterday's market steady; business from 47s. 0½d. to 47s. 2d. cash and 47s. 3d. and 47s. 4d. one month. To-day—Thursday—market idle, with business at 47s. 1d. and 47s. 1½d. cash and 47s. 3½d. one month.

Ordinary mixed numbers of pig iron are at the moment rather slow of sale, but the special qualities are in active demand at quotations fully equal to those prevailing a week ago. Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, is quoted at 57s.; No. 3, 53s.; Coltness, 61s. and 53s.; Langloan, 60s. and 53s.; Summerlee, 57s. and 51s.; Chapelhall, 57s. 6d. and 54s.; Calder, 57s. 6d. and 50s.; Carnbroe, 55s. and 49s.; Clyde, 50s. 6d. and 48s. 6d.; Monkland, 48s. 3d. and 46s. 3d.; Quarter, 47s. 9d. and 45s. 9d.; Govan, at Broomielaw, 48s. 3d. and 46s. 3d.; Shotts, at Leith, 59s. and 54s. 6d.; Carron, at Grangemouth, 49s. (specially selected, 55s.) and 47s.; Kinneil, at Bo'ness, 49s. and 47s. 6d.; Glengarnock, at Ardrossan, 55s. and 48s.; Eglinton, 48s. 9d. and 45s. 9d.; Dalmellington, 49s. 6d. and 48s. 6d.

In the malleable department there is great animation, and the prospects are improved owing to the placing of important fresh orders in the shipbuilding trade.

The coal trade is in a satisfactory condition, and the advance intimated a fortnight ago seems to be well maintained. As the value of pig iron is not, however, much, if any, affected by the increase, it is doubtful whether it will be possible for the coalmasters to obtain the full advance they desire. At Glasgow the week's shipments exceed by fully 5000 tons those of corresponding week of last year. In Fifeshire the tone of business is a shade quieter, although prices are maintained f.o.b. at from 7s. 6d. to 8s. 3d. per ton according to quality. There is a rather better demand for house coal, and gas coal is likewise in request. The coal shipped at Leith during the week amounted to 5000 tons, while 7500 tons were despatched from Grangemouth, and 7584 at Ayr.

The Monkland Iron and Coal Company, Limited, which preceded the company now in possession of the works, is now pretty well liquidated. A report presented to the shareholders shows that the money obtainable is for the most part realised, but further progress in the liquidation is barred by the refusal of Lord Elphinstone's agents to accept the new company as responsible for certain claims for surface damages. It is expected that this dispute will be arranged without much further delay.

After writing off £17,000 for depreciation, adding £5000 to reserve fund, and carrying forward £3300 to next year, the directors of the Steel Company of Scotland have declared a dividend of 11 per cent. for the year ended 12th July last.

Taking advantage, as they might have been expected to do, of the advance in the price of coal, the miners of Lanarkshire are agitating for an increase of wages. The demand they present is 6d. extra per day; but it is as yet by no means clear whether they are likely to be successful in the prosecution of it. The men have no organisation, and they also lack competent leaders. This latter want may, of course, be supplied, as has frequently been the case, in the height of a crisis; but so far the prospects of the movement are not very encouraging from the workmen's point of view.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

My task this week is a slight one, owing to the National Esteddfod, which caused four days' idleness at the great majority of the collieries. The two days worked, however, were unusually heavy ones, as will be seen by the exports; Cardiff sending off, during last week, 113,000 tons, Newport 24,000, and Swansea 15,000.

The principal falling off, it will be seen, was at Cardiff, the districts immediately affected by the Esteddfod being the Rhondda, Merthyr, and Dowlais.

I had the pleasure of seeing and hearing the colliers in another capacity than as hewers of coal, and must admit that as vocalists they acquitted themselves to perfection.

The Barry Dock scheme still continues to engage attention, and already I hear expressions of utmost determination to carry it out.

The Newport, Pontypridd, and Caerphilly Railway is now really approaching completion, and prospects appear certain that October will see it opened.

Iron ore is still slow. Only 12,000 tons came into Cardiff last week, but Newport received nearly 20,000 tons. Pitwood is firmer, and so also are tin-plates. Swansea is exporting freely.

The iron and coal markets are firm; prices well sustained. In finished steel there has been a slight drooping tendency, but makers are not disposed to give way.

In the Swansea coal district trade is good, and the Ynyscedwin collieries are in capital form. I am pleased also to be able to report well of the whole of the anthracite district down into Pembrokeshire. The railways are showing good signs of this, and the samples of coal I have seen are excellent.

Revised Index of Patents.—In the House of Commons, on Monday, Sir E. Wilmot asked the President of the Board of Trade whether the revised Index of Patents, promised some time ago to the Associated Chambers of Commerce, had been completed; and, if so, when it would be published. Mr. Chamberlain, in reply, said the Index from 1617 to 1852, comprising the old law, was nearly completed, and in the ordinary course the remaining portion down to the present time would be proceeded with almost immediately; but, in view of the probable passing of the new Patents Bill, he had asked for a report as to measures which might be taken as soon as that Bill became law in order to expedite its publication. This work has, we believe, been in hand for some years, and in common with most people we hope that steps will be taken to expedite the work. It is certainly one of the most important that has occupied the attention of any department of the Patent Office for years, and its completion will afford the greatest convenience to all patentees and inventors.

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.

7th August, 1883.

3831. Beer, &c., W. Clark.—(*A. E. and W. E. Feroe and J. S. Bancroft, U.S.*)
3832. Die Stocks, H. J. Allison.—(*C. Hart, U.S.*)
3833. Bicycles, &c., A. C. Henderson.—(*G. Rothgiesser, Bielfeld.*)
3834. Cores for Casting Steel, &c., H. A. Gadsden.—(*J. A. Herrick, New York, U.S.*)
3835. Counteracting the Thrust of Screw Propeller Shafts, G. A. Teulon, London.
3836. Stopping, &c., Cables, F. Guilleaume, Cologne.
3837. Adjustable Chairs, W. R. Lake.—(*W. S. Liscomb, Providence, U.S.*)
3838. Boats, A. J. Boult.—(*M. F. Davis, U.S.*)
3839. Electric Wire Insulators, W. P. Thompson.—(*J. F. Martin, Chicago.*)
3840. Taps and Cocks, S. Defries. London.
3841. Watch Keys, J. S. Birch, New York.
3842. Circuit Closers, &c., H. W. Ferris, Merton.
3843. Trays for Bakers' Ovens, R. Morton, Wishaw.
3844. Chemical Fire Engines, J. Gibbs and D. Fotheringham, Glasgow.
3845. Breech-loading Small-arms, T. Woodward, Aston.
3846. Floating Electric Light Depot, A. L. Fyfe and L. Goldberg, London.
3847. Signalling, &c., Apparatus, W. R. Lake.—(*S. Ziembinski, Cracow, M. Eswambaum and H. Stypulkowski, Warsaw.*)
3848. Fireplaces, &c., W. Clark.—(*J. Burnam, U.S.*)

8th August, 1883.

3849. Differential Pulley Blocks, W. T. Eades, Birmingham.
3850. Sifting, &c., Flour, J. H. Johnson.—(*H. Cabanes, Bordeaux.*)
3851. Gas Lanterns, J. H. Johnson.—(*R. Kraussé, Germany.*)
3852. Venetian Blinds, G. Dreghorn, Inverness.
3853. Safety Car Signals, W. H. Rushforth, U.S.
3854. Looms for Weaving, R. H. Brandon.—(*G. Crompton, Worcester, U.S.*)
3855. Distilling Peat, F. C. Glaser, Berlin.
3856. Soda Crystals, C. D. Abel.—(*La Société Anonyme des Produits Chimiques du Sud-Ouest, Paris.*)
3857. Silo and Press, S. H. Stocks, Cleckheaton.
3858. Glove, &c., Fasteners, E. K. Dutton.—(*C. A. Pfenning, Barmen.*)
3859. Breech-loading Small-arms, W. M. Scott, Birmingham, and C. Proctor, Handsworth.
3860. Trimming Cards, H. H. Lake.—(*F. G. Beaumont, France.*)
3861. Washing, &c., Textile Materials, W. E. Gedge.—(*J. Chavanne, E. Bruyas, and J. P. Balme, France.*)
3862. Ships, C. P. Schaeffer.—(*O. Holtermann, France.*)
3863. Cranes, &c., F. Service, Ebbw Vale.

9th August, 1883.

3864. Tunnels, &c., G. Edwards, Hanwood.
3865. Speaking Tubes, T. W. Redfern and R. Wilkinson, Derby.
3866. Providing Compressed Gun Cotton, &c., with a Coating, F. C. Glaser.—(*W. F. Wolff, Walsrode, and M. von Förster, Berlin.*)
3867. Barring Engines, W. Hargreaves and W. Inglis, Bolton.
3868. Screw-propellers, L. Barstow, York.
3869. Bogie Trucks, T. English, Hawley.
3870. Paving Blocks, C. J. Dobbs, Middlesbrough.
3871. Noble's Combing Machines, H. Priestman, F. K. Adcock, J. Brown, and J. Copley, Bradford.
3872. Tricycles, J. McCoig, London.
3873. Separating Metals from Ores, H. Cassel, U.S.
3874. Breech-loading Small-arms, T. Horsley, York, and C. Pryse, Birmingham.
3875. Sewing Needles, R. Brandon.—(*H. Ward, U.S.*)
3876. Gunpowder, O. Bowen, London.
3877. Alcoholic Liquors, W. E. Gedge.—(*A. C. Tichenor, Alameda, U.S.*)
3878. Crank-shafts, J. Russell, Cardiff.
3879. Material for Trunks, &c., H. A. Silver, London.

10th August, 1883.

3880. Steam Winches, R. Roger, Stockton-on-Tees.
3881. Spinning, &c., Cotton, J. Macqueen, Bury.
3882. Looms for Weaving, T. Kidd and J. Maugham, Burnley.
3883. Incandescent Lamps, T. T. Smith, London.
3884. Phosphate of Lime, W. Weldon.—(*E. Lombard, Marseilles.*)
3885. Velocipede Bearings, J. Bradbury, Braintree.
3886. Storage for Secondary Batteries, A. J. Jarman, London.
3887. Door Knobs, J. Finney, Bocking.
3888. Screw-cutting Tools, A. Selim.—(*P. C. J. Lemaire, Paris.*)
3889. Facilitating the Recovery of Lost Umbrellas, &c., A. Watson, Willesden.

11th August, 1883.

3890. Evaporating, &c., Sugar Juice, E. Furness, Belvedere,
3891. Producing Combustible Gases, W. S. Sutherland, Birmingham.
3892. Filters, C. D. Abel.—(*A. Perret, France.*)
3893. Dumping Boats, H. E. Newton.—(*The Barney Dumping Boat Company (Incorporated), U.S.*)
3894. Steam Pistons, A. MacLaine, Belfast.
3895. Letter-press Printing Machines, A. Godfrey, New Reddish.
3896. Dyeing Cotton Fabrics, F. Gatty, Accrington.
3897. Regulating the Speed of Motive Power Engines, N. Macbeth, Bolton-le-Moors.
3898. Heating, &c., Steel Wire, N. Whitley, H. Hoyle, and F. W. Thomson, Halifax.
3899. Looms for Weaving, J. and W. Youngjohns, Kidderminster.
3900. Scoring Lawn Tennis, E. R. Kesterton, London.
3901. Electric Switch, J. Lea, London.
3902. Magazine Fire-arms, G. V. Fosbery, Albury.
3903. Lawn Cutting Machines, T. Green, Leeds, and J. Hargrave, Burley.
3904. Controlling the Movements of Feeding Bells, T. Wrightson, Stockton-on-Tees.
3905. Purifying Water, J. H. Johnson.—(*E. Couillant, Paris.*)
3906. Reproduction of Writings, &c., J. H. Johnson.—(*I. M. de Camarasa, Madrid.*)
3907. Timepieces, O. Fleischhauer, Berlin.

13th August, 1883.

3908. Explosive Cartridges for Blasting Rock, &c., S. Trivick and J. Macnab, London.
3909. Thrashing Machines, E. A. Brydges.—(*Messrs. Vogel and Co., Neusellershausen.*)
3910. Incandescent Electric Lamps, A. Swan, Gateshead.
3911. Actions for Pianofortes, E. A. Brydges.—(*A. Lexow, Berlin.*)
3912. Feeding Apparatus, S. Leetham, York.
3913. Tube Expanders, G. Lohf, Berlin.
3914. Purifying Water, &c., A. Goldthorpe, Wakefield.
3915. Incandescent Electric Lamps, G. F. Redfern.—(*A. Bernstein, Boston, U.S.*)
3916. Kilns, W. Kemp, Miller's Dale.
3917. Galvanic Batteries, H. Allison.—(*A. Haid, U.S.*)
3918. Locks for Bags, &c., J. H. Ross, Dublin.
3919. Reservoir Penholders, J. D. Carter, London.
3920. Controlling Stretching Machines, H. H. Lake.—(*La Société Anonyme des Teintures et Apprêts de Tarare, France.*)
3921. Sighting Devices for Fire-arms, A. J. Boult.—(*L. de Lunden, Brussels.*)
3922. Hydrochloric Acid, L. Mond, Northwich.
3923. Ammonia, &c., L. Mond, Northwich.
3924. Harrows, &c., W. Ogle, Ripley.
3925. Rudders, A. J. Boult.—(*O. D. Levis, U.S.*)
3926. Portable Folding Punts, &c., A. E. Samels, Red Hill.
3927. Disintegrating Machines, T. Bowick, Bedford.
3928. Hops, W. Linden, Streatham Common.

Inventions Protected for Six Months on Deposit of Complete Specifications.

3837. Adjustable Chairs, W. R. Lake, London.—A communication from W. S. Liscomb, Providence, U.S.—*7th August*, 1883.
3858. Fasteners for Gloves, &c., E. K. Dutton, Manchester.—A communication from C. A. Pfenning, Barmen.—*8th August*, 1883.
3877. Purifying Alcoholic Liquors, W. E. Gedge, London.—A communication from A. C. Tichenor, Alameda, U.S.—*9th August*, 1883.

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

3226. Clipping Seal Skins, L. A. Groth, London.—*6th August*, 1880.
3058. Permanent Way, J. Cleminson, London.—*24th July*, 1880.
3245. Circular Knitting Machines, J. Bradley, Lowell, U.S.—*9th August*, 1880.
3243. Spinning, &c., Cotton, E. Hird, Bolton-le-Moors.—*9th August*, 1880.
3250. Torpedo Boats, D. H. Brandon, Paris.—*9th August*, 1880.
3310. Insulating Telegraph Conductors, E. T. Truman, London.—*14th August*, 1880.
4044. Steam Engines, G. F. Corliss, Paris.—*5th October*, 1880.
3264. Refining Sugar, H. Springmann, Berlin.—*10th August*, 1880.
3122. Combing Fibrous Materials, J. H. Johnson, London.—*24th August*, 1880.
3281. Sewing Machines, F. Cutlan, Cardiff.—*11th August*, 1880.
3294. Sewing Machines, M. H. Pearson, Leeds.—*12th August*, 1880.
3483. Feed, &c., Pumps, F. C. Simpson and J. B. Denison, Dartmouth.—*27th August*, 1880.

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

3029. Articulating, &c., the Axles of Railway Carriages, J. Cleminson, London.—*27th July*, 1876.
3217. Printing Machines, E. G. Brewer, London.—*15th August*, 1876.
3150. Getting Coal, &c., J. Macnab, London.—*9th August*, 1876.
3177. Dressing Tampico, &c., H. J. Haddan, London—*11th August*, 1876.
3401. Movable Fire-bars, E. P. Alexander, London.—*29th August*, 1876.
3237. Portable Bedsteads, &c., R. Cane, London.—*17th August*, 1876.
3639. Measuring, &c., Oil Seeds, F. Virtue, Hull.—*16th September*, 1876.

Notices of Intention to Proceed with Applications.

(*Last day for filing opposition*, 31*st August*, 1883.)

1383. Controlling, &c., Clocks, H. J. Haddan, London.—Com. from A. Lasmoles.—*15th March*, 1883.
1685. Dividing, Edge Trimming, &c., Apparatus, E. H. C. Colley, London.—*4th April*, 1883.
1698. Pyrometers, W. L. Wise, London.—A communication from A. and E. Boulier.—*4th April*, 1883.
1700. Boxes, E. Wright, Southend-on-Sea.—*4th April*, 1883.
1701. Actuating Electric Bells, &c., H. J. Eck and D. J. and C. B. Callow, London.—*4th April*, 1883.
1705. Hot-water Apparatus, T. C. Olney, Manchester.—*5th April*, 1883.
1709. Racquets, G. A. Adkins, London.—*5th April*, 1883.
1720. Packing and Preserving Butter, &c., G. Partridge, London.—*5th April*, 1883.
1726. Jewellery, &c., W. R. Lake, London.—Com. from G. L. Maës and H. A. V. Wirth.—*5th April*, 1883.
1727. Ice, W. R. Lake, London.—A communication from S. B. Hunt.—*5th April*, 1883.
1744. Rendering Wood, &c., Uninflammable, F. K. de Stasicki, London.—A communication from B. Hoff.—*6th April*, 1883.
1745. Electric Lamps, F. H. Varley, London.—*6th April*, 1883.
1761. Evaporating and Compressing Fluids, J. Weibel and P. Piccard, Switzerland.—*7th April*, 1883.
1762. Flues, Chimneys, &c., R. H. and S. Reeves, London.—*7th April*, 1883.
1765. Binding Sheaves, B. G. Hall, Malvern Wells.—*7th April*, 1883.
1769. Cut Pile Fabrics, J. H. Johnson, London.—Com. from L. T. Lepage.—*7th April*, 1883.
1774. Electric Arc Lamps, L. B. Miller, London.—*9th April*, 1883.
1775. Distributing Tobacco in Cigarette Machines, A. C. Henderson, London.—A communication from E. F. Leblond.—*9th April*, 1883.
1783. Covering Wire or Strand with Gutta-percha, &c., A. C. Moffatt and W. H. Wardale, London.—*9th April*, 1883.
1791. Secondary Batteries, R. Tatham, Rochdale, and A. Hollings, Salford.—*10th April*, 1883.
1811. Adjusting the Shafts of Wheel Carriages, &c., C. Healey, Gloucester.—*10th April*, 1883.
1825. Rail for Railways, &c., W. P. Alexander, London.—A communication from G. Cowdery and E. R. Thomas.—*11th April*, 1883.
1830. Regulating the Drawing and Delivery of Paper in Cigarette Machines, A. C. Henderson, London.—Com. from E. Leblond.—*11th April*, 1883.
1835. Gas Motor Engines, J. J. Butcher, Newcastle-upon-Tyne.—*11th April*, 1883.
1866. Treating Flax, &c., W. R. Lake, London.—A communication from G. M. Foret.—*12th April*, 1883.
1889. Electric Cables, W. R. Lake, London.—Com. from W. J. Philips & G. L. Kitson.—*13th April*, 1883.
1890. Sewing Apparatus, W. R. Lake, London.—Com. from J. H. Cutten and L. E. Moore.—*13th April*, 1883.
1965. Oil Lamps, H. E. Phillipson, Dublin.—*18th April*, 1883.
1974. Decorticating Machines, W. R. Lake, London.—Com. from T. Burrows.—*18th April*, 1883.
2000. Colouring Kerosene, &c., A. M. Clark, London.—Com. from H. R. Burk.—*19th April*, 1883.
2044. Dynamo-electric Machines, A. M. Clark, London.—A communication from La Société Solignac et Cie.—*21st April*, 1883.
2047. Separating Sugar from Molasses, &c., C. Pieper, Berlin.—Com. from C. Scheibler.—*23rd April*, 1883.
2060. Oil Lamps, &c., A. C. Wells and R. Wallwork, Manchester.—*24th April*, 1883.
2079. Disinfecting Apparatus, H. H. Lake, London.—A communication from C. F. Pike and E. Z. Collings.—*24th April*, 1883.
2188. Removing Hair or Wool from Skins, &c., J. Palmer, London.—*1st May*, 1883.
2243. Nickel, &c., A. M. Clark, London.—A communication from C. Combier.—*2nd May*, 1883.
2277. Facilitating Measurement for Tailoring, &c., W. R. Lake, London.—A communication from J Monjou.—*4th May*, 1883.
2673. Galvanic Batteries, A. M. Clark, London.—Com. from G. G. L. Velloni.—*29th May*, 1883.
2977. Raising, &c., the Chimneys of Portable and other Engines, J. P. Coultas, Grantham.—*15th June*, 1883.
3058. Preserving Milk, &c., W. H. Thew, Waterloo.—*20th June*, 1883.
3154. Cooking Ranges, J. M'I. Shaw, Glasgow.—*26th June*, 1883.
3225. Water Waste Preventers, E. Raitt, Brixton.—*29th June*, 1883.
3275. Electrical Railways, &c., W. A. Traill, Portrush.—*2nd July*, 1883.
3277. Electrical Railways, &c., W. A. Traill, Portrush.—*2nd July*, 1883.
3455. Tin and other Metal Cans, J. Maconochie, Lowestoft.—*13th July*, 1883.

(*Last day for filing opposition*, 4*th September*, 1883.)

1771. Studs, J. Buchanan, jun., and J. Brown, Liverpool.—*9th April*, 1883.
1776. Incandescent Electric Lamps, E. Müller, London.—*9th April*, 1883.
1782. Window-blind Rollers, H. A. Walker, London.—*9th April*, 1883.
1785. Secondary Batteries, E. G. Brewer, London.—Com. from G. Arnould & R. Tamine.—*9th April*, 1883.
1799. Extracting Internal Stoppers from Bottles, J. Hamer, Stalybridge.—*10th April*, 1883.
1800. Tipping Vans, &c., C. Hill, London.—*10th April*, 1883.
1801. Conductors of Electricity, J. G. Parker, Plymouth.—*10th April*, 1883.
1804. Cutting or Shearing Sheet Metal, A. N. Hopkins, Birmingham.—*10th April*, 1883.
1808. Gas Regulators, S. Slack, Sheffield.—*10th April*, 1883.
1823. Steam Pump, J. G. Joicey, Newcastle-upon-Tyne.—*10th April*, 1883.
1827. Thrashing Machines, J. Coulson, Stamford.—*11th April*, 1883.
1832. Incandescent Electric Lamps, J. W. Swan, Laureston.—*11th April*, 1883.
1836. Cleaning Lead and other Metallic Ores, T. Archer, jun., Dunston.—*11th April*, 1883.
1854. Breech-loading Fire-arms, W. Gardner, London.—*12th April*, 1883.
1858. Wick Trimmers, A. J. Boult, London.—A communication from W. C. Seaton.—*12th April*, 1883.
1864. Life and Safety Buoy, G. J. Kirchenpauer and L. H. Philippi, Hamburg.—*12th April*, 1883.
1888. Reversing, &c., the Motion of Planing and other Machines, P. R. Allen, London.—*13th April*, 1883.
1893. Stud and Eyelet Fastener, A. Combault, London.—*14th April*, 1883.
1907. Protecting Firemen in the Discharge of their Duties, W. R. Lake, London.—A communication from S. Richards.—*14th April*, 1883.
1932. Galvanic Batteries, C. L. Clarke, Manchester.—*17th April*, 1883.
1934. Tramways, A. E. Adlard, London.—*17th April*, 1883.
1952. Transmitting Electrical Signals, C. D. Abel, London.—A communication from B. Abdank-Abakanowicz.—*17th April*, 1883.
1953. Bread, J. H. Johnson, London.—A communication from G. Herscher and Co.—*17th April*, 1883.
1963. Paring the Brims of Hats, L. F. Marsh, Bristol, and J. Cree, Denton.—*18th April*, 1883.
1972. Cartridges, &c., H. Simon, Manchester.—A communication from the Schweizerische Industrie Gesellschaft.—*18th April*, 1883.
1982. Conveying Oil to the Surface of the Sea, &c., J. Bowman, Huntly.—*19th April*, 1883.
1985. Rotary Engines, J. C. Mewburn, London.—A communication from E. Genty and J. Deschamps and Sons.—*19th April*, 1883.
2009. Ulmin-brown, H. J. Haddan, London.—A communication from La Banque Industrielle de Belgique.—*20th April*, 1883.
2016. Grooving Metal, &c., Rolls, A. B. Wilson, Holywood.—*20th April*, 1883.
2038. Washing Apparatus, J. H. Johnson, London.—Com. from G. Bozérian.—*21st April*, 1883.
2040. Regulating, Measuring, &c., Fluids, J. H. Johnson, London.—A communication from H. L. J. Parenty.—*21st April*, 1883.
2114. Drawing Geometrical Figures, F. H. Wood, Chiswick.—*26th April*, 1883.
2153. Electric Cut-outs, F. V. Andersen, London.—*28th April*, 1883.
2181. Treating Textile Materials, H. J. Haddan, London.—Com. from O. Obermaier.—*30th April*, 1883.
2402. Wheels, J. C. Merryweather, Greenwich.—*11th May*, 1883.
2542. Pencil-cases, H. J. Haddan, London.—A communication from J. H. Knapp.—*22nd May*, 1883.
2618. Producing Warmth by Absorbing Water Vapour, F. Wirth, Frankfort-on-the-Maine.—A communication from M. Honigmann.—*25th May*, 1883.
2678. Plate or Leaf Springs, G. W. Willford, Sheffield.—*30th May*, 1883.
2958. Bleaching Kiers, C. L. Jackson and J. Westley, Bolton.—*14th June*, 1883.
3126. Making and Breaking Contact between Electromotors, &c., Sir D. Salomons, Broomhill.—*23rd June*, 1883.
3128. Gas, &c., Gauges, Sir D. Salomons, Broomhill.—*23rd June*, 1883.
3376. Conductors for Electrical Railways, H. E. M. D. C. Upton, London.—*7th July*, 1883.
3390. Receiving and Counting Newspapers, J. E. Taylor, P. Allen, and C. P. Scott, Manchester.—*9th July*, 1883.
3445. Implements for Planting Potatoes, W. Dewar, Strathmartin.—*13th July*, 1883.
3489. Shears, J. Seligman, London.—A communication from G. Josephs.—*16th July*, 1883.
3577. Embroidery, C. F. Bally, Schoenenwerd.—*20th July*, 1883.
3581. Steam Packing, J. V. Taylor, Warrington.—*21st July*, 1883.
3624. Extracting Sulphur Compounds from Alkali Waste, J. Simpson, Liverpool.—*24th July*, 1883.
3632. Insulated Wires, H. E. Newton, London.—A communication from A. A. Cowles.—*24th July*, 1883.
3713. Radiating Axles, L. S. Zachariasen, Christiania.—*30th July*, 1883.
3747. Nut-lock, W. R. Lake, London.—A communication from W. J. M'Tighe.—*31st July*, 1883.

Patents Sealed.

List of Letters Patent which passed the Great Seal on the 10th August, 1883.)

762. Flushing Apparatus, A. Codd, Battersea.—*12th February*, 1883.
781. Gas Motor Engines, H. Townsend and E. and E. C. Davies, Bradford.—*13th February*, 1883.
791. Secondary Batteries, T. Rowan, London, and S. Williams, Newport.—*13th February*, 1883.
792. Dynamo-electric Machines, T. Rowan, London, and S. Williams, Newport.—*13th February*, 1883.
807. Plastic Compound, O. Schreiber, London.—*14th February*, 1883.
812. Stoves and Grates, H. Thompson, London.—*14th February*, 1883.
813. Fastenings for Boots, &c., F. J. Brougham, London.—*14th February*, 1883.
814. Locks and Latches, J. Kaye, London.—*14th February*, 1883.
815. Screws, T. Matthews, London, and W. Bayliss, Wolverhampton.—*14th February*, 1883.
816. Single-acting High-speed Steam and other Motive Power Engines, P. B. Elwell and T. Parker, Wolverhampton.—*14th February*, 1883.
823. Fire-arms, F. Beesley, London.—*14th February*, 1883.
828. Compressed Air Motors, R. Bolton, London.—*15th February*, 1883.

830. Treating Waste Liquor, L. Howell, Taibach.—15th February, 1883.
842. Working Grabs, &c., J. H. Wild, Leeds.—15th February, 1883.
850. Electrical Self-registering Money Tills, B. W. Webb, London.—16th February, 1883.
852. Stoppering Bottles, J. C. Schultz, London.—16th February, 1883.
864. White Lead, &c., J. C. Martin, Richmond.—16th February, 1883.
870. Pianofortes, C. Camin, Berlin.—16th February, 1883.
871. Incandescent Lamps, O. E. Woodhouse, F. L. Rawson, and W. H. Coffin, London.—16th February, 1883.
884. Preserving Smoked Fish, H. J. Haddan, London.—17th February, 1883.
897. Phosphoric Acid, &c., T. Twynam, Hampstead.—19th February, 1883.
937. Railway and other Wheels, W. Eyre, Sheffield.—20th February, 1883.
941. Uninflammable Products for Writing and Printing Purposes, &c., A. M. Clark, London.—20th February, 1883.
947. Life-saving and other Mattresses, W. R. Lake, London.—20th February, 1883.
992. Furnaces, P. W. Willans, Thames Ditton.—23rd February, 1883.
994. Floating Docks, G. B. Rennie, London.—23rd February, 1883.
1000. Crank and other Shafts, A. Jack and H. MacColl, Liverpool.—24th February, 1883.
1002. Fixing the Blades of Screw Propellers, E. P. Timmins and J. Rose, Cardiff.—24th February, 1883.
1018. Damping Fabrics, J. B. Jackson and G. Bentley, Bury.—24th February, 1883.
1030. Self-acting Grabs, W. D. and S. Priestman, Kingston-upon-Hull.—26th February, 1883.
1063. Watering Roadways, &c. W. Smethurst, Brynn, and T. T. Crook, Bolton.—27th February, 1883.
1076. Coupling, &c., Apparatus, J. Richardson and C. Greenwood, Harrogate.—27th February, 1883.
1087. Distilling Coal, &c., J. Barron, Clayton.—28th February, 1883.
1118. Rotary Engines, &c., T. A. Hearson, Blackheath.—1st March, 1883.
1181. Buttons, H. E. Newton, London.—5th March, 1883.
1194. Cop Retaining Spindles for Loom Shuttles, A. J. Boult, London.—6th March, 1883.
1206. Pumps, T. Woollerton, Leicester.—6th March, 1883.
1212. Rings for Spinning Frames, A. M. Clark, London.—6th March, 1883.
1229. Permanent Coloured Photographic Card Pictures, A. H. Dawes, Windermere.—7th March, 1883.
1282. Ventilating House Drains, &c., G. E. Mineard and T. Crapper, London.—10th March, 1883.
1294. Railway Fog-signal Apparatus, J. Coleman and I. Henson, Derby.—10th March, 1883.
1319. Heating and Purifying Water, J. H. Johnson, London.—13th March, 1883.
1333. Burning Hydrocarbon Oils with Steam or Water, A. J. Boult, London.—13th March, 1883.
1554. Liquid Compound for Extinguishing Fires, C. D. Abel, London.—27th March, 1883.
1838. Pianos, E. G. Brewer, London.—11th April, 1883.
2476. Wheels and Tires, R. C. Mansell, Highgate.—17th May, 1883.
2554. Spinning Machinery, G. A. Helliwell and J. H. Waller, Todmorden.—22nd May, 1883.
2590. Rolling or Cogging Ingots, D. Evans, Blaenavon.—24th May, 1883.
2680. Extracting Gelatin, Fat, &c., from Bones, &c., C. D. Ekman, London.—30th May, 1883.
2724. Converting Reciprocating Motion into Rotary Motion, W. R. Lake, London.—31st May, 1883.
2726. Cutting Corns, H. W. Sharpin, Bedford.—1st June, 1883.
2883. Stoppering Bottles, R. J. Sankey, South Hill.—9th June, 1883.
2904. Wood Screws, H. H. Lake, London.—11th June, 1883.
2916. Car Axle-boxes, H. J. Haddan, London.—12th June, 1883.
3001. Dynamo-electric Machines, S. Pitt, Sutton.—16th June, 1883.
3007. Insulators for Electric Wires, L. B. Gray, Boston, U.S.—16th June, 1883.

(List of Letters Patent which passed the Great Seal on the 14th August, 1883.)

820. Dressing Textile Fabrics, W. R. Lake, London.—14th February, 1883.
834. Matches and Boxes, G. W. von Nawrocki, Berlin.—15th February, 1883.
859. Indelible Ink, H. A. Dufrené, Paris.—16th February, 1883.
860. Piano Stools, &c., W. Hemingway, Halifax, and W. Bottomley, Brighouse.—16th February, 1883.
863. Mortice Locks, A. W. Pocock, Wandsworth.—16th February, 1883.
873. Apparatus for Holding Ropes or Lines, A. E. Maudslay, Littlebourne.—17th February, 1883.
877. Billiard Tables, J. Reap, London.—17th February, 1883.
879. Beds or Berths for Ships, J. Hamilton, jun., and R. M'Intyre, Glasgow.—17th February, 1883.
895. Starching Collars, &c., S. Barrett, Keighley.—19th February, 1883.
896. Printing Plates, J. R. Meihe, London.—19th February, 1883.
904. Waste-preventing Cisterns, B. C. Cross, Leeds.—19th February, 1883.
906. Looms, J. Williams and H. Barnes, Burnley.—19th February, 1883.
911. Air, &c., Motors, G. M. Capell, Passenham.—19th February, 1883.
921. Water Gauges, J. Holden, Swindon.—20th February, 1883.
950. Knitting Machines, F. J. Drewry, Burton-on-Trent.—21st February, 1883.
959. Harness, &c., J. G. Tongue, London.—21st February, 1883.
983. Knitting Machinery, F. Johnson, Nottingham.—23rd February, 1883.
1006. Warping, &c., Machines, W. M'Gee and T. Watson, Paisley.—24th February, 1883.
1008. Saddles, J. A. Lamplugh, Birmingham.—24th February, 1883.
1136. Steam Engines, &c., L. Perkins, London.—2nd March, 1883.
1218. Electro-magnetic Signal Apparatus, F. J. Drewry, Burton-on-Trent.—7th March, 1883.
1226. Anchors, C. Mace, Sunderland.—7th March, 1883.
1257. Shuttle-box for Looms, J. Brownlee, Glasgow.—8th March, 1883.
1267. Mechanical Telegraphs, W. Chadburn, Liverpool.—9th March, 1883.
1339. Producing Coal Gas, H. E. Newton, London.—13th March, 1883.
1502. Ventilating, W. P. Buchan, Glasgow.—22nd March, 1883.
1686. Ventilators, A. Mechan, Glasgow.—4th April, 1883.
1756. Meters, S. Pitt, Sutton.—7th April, 1883.
1851. Cutting, Printing, &c., Tickets, J. Lewthwaite, Halifax.—12th April, 1883.
1964. Producing a Yellow Dye, G. A. Bang, Leeds.—18th April, 1883.
2210. Dynamo-electric, &c., Machines, W. Siemens, London.—1st May, 1883.
2381. Buoyant Contrivances for Life-saving, &c., F. W. Brewster, London.—10th May, 1883.
2580. Cartridge-holders, S. Pitt, Sutton.—23rd May, 1883.
2588. Steam Engines, A. Hoyois, Clabecq.—24th May, 1883.
2720. Water-meters, H. Frost, Manchester.—31st May, 1883.
2734. Purifying Alkaline Solutions, T. Glover, Runcorn.—1st June, 1883.
2774. Testing Strength and Weighing Machinery, A. H. Emery, New York, U.S.—5th June, 1883.
2776. Pressure and Vacuum Gauges, &c., A. H. Emery, New York, U.S.—5th June, 1883.
2778. Testing the Strength of Materials, &c., A. H. Emery, New York, U.S.—5th June, 1883.
2912. Barbed Fencing, W. H. Johnson, Manchester.—12th June, 1883.
3000. Electric Arc Lamps, S. Pitt, Sutton.—16th June, 1883.

List of Specifications published during the week ending August 11th, 1883.

5812, 6d.; 5843, 2d.; 5851, 2d.; 5852, 2d.; 5890, 2d.; 5892, 2d.; 5895, 2d.; 5906, 2d.; 5907, 6d.; 5919, 2d.; 5930, 2d.; 5936, 8d.; 5947, 2d.; 5952, 2d.; 5954, 2d.; 5955, 4d.; 5956, 4d.; 5960, 2d.; 5962, 2d.; 5966, 2d.; 5967, 4d.; 5979, 2d.; 5981, 4d.; 5983, 2d.; 5984, 2d.; 5987, 4d.; 5988, 4d.; 5990, 2d.; 5992, 6d.; 5993, 2d.; 5994, 2d.; 5995, 2d.; 5996, 2d.; 5999, 2d.; 6000, 6d.; 6001, 2d.; 6002, 8d.; 6003, 2d.; 6004, 2d.; 6009, 2d.; 6013, 2d.; 6014, 2d.; 6015, 2d.; 6016, 6d.; 6018, 6d.; 6020, 6d.; 6022, 4d.; 6023, 6d.; 6029, 6d.; 6031, 6d.; 6033, 6d.; 6037, 6d.; 6038, 6d.; 6039, 10d.; 6049, 6d.; 6050, 8d.; 6051, 6d.; 6052, 6d.; 6057, 6d.; 6058, 6d.; 6061, 4d.; 6069, 6d.; 6076, 6d.; 6082, 6d.; 6083, 6d.; 6084, 6d.; 6086, 6d.; 6088, 1s. 2d.; 6091, 6d.; 6092, 6d.; 6095, 6d.; 6096, 4d.; 6104, 8d.; 6113, 6d.; 6116, 6d.; 6131, 4d.

***** 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.*

5812. Filters, *H. Rawlings, Clapham-road.—6th December, 1882.* 6d.
This consists in means for aërating porous material used in filters, for flushing such material with filtered water, and generally improving filtering apparatus. To aërate and flushing filters they are made in pairs and connected by pipes with valves, so that either can be put out of use while the other is at work, and air or water made to pass through the porous material of the one out of action. A domed plate is placed in front of the inlet to distribute the flow of water into the filter.

5843. Fusible Plugs for Preventing Explosions in Steam Boilers, *J. Burton and R. Byrne, Staleybridge.—7th December, 1882.—(Not proceeded with.)* 2d.
This relates to a fusible plug, which when burnt out can be replaced without entering the boiler, and when blown out presents a larger outlet for the escape of steam than hitherto. A thimble of brass is inserted in the body of the plug and forced up by a screwed ferrule to make a tight joint against an annular feather edge on the body. The point of the thimble projects through the body into the boiler and is separate from the other part, but is held in position by the fusible metal.

5851. Ventilating Shaft or Chimney, *F. A. Binney, Cheshire.—8th December, 1882.—(Not proceeded with.)* 2d.
The shaft has three or more sides, and openings are formed at the angles about 1ft. from the top. Outer curved shields guide the current of air into the shaft, and an internal collar directs it upwards.

5852. Converting Wheeled Vehicles into Sledges, *F. A. Binney, Manchester.—8th December, 1882.—(Not proceeded with.)* 2d.
This consists in the use of bars to form runners, and adapted to receive the wheels of vehicles, which are secured thereto by bolts or screws.

5890. Doors to Exclude Draughts, Dust, and Weather, *A. Skelmerdine, Manchester.—9th December, 1882.—(Not proceeded with.)* 2d.
A groove is formed in the bottom of the door, and a strip of wood inserted therein and forced upwards by springs. An incline on the door frame forces the strip downwards as the door is closed, and brings it in contact with the ground.

5892. Chimneys and Ventilating Cowls, &c., *J. White, Edinburgh.—9th December, 1882.—(Not proceeded with.)* 2d.
This relates to stationary cowls usually fitted with baffle plates opposite the outlet openings, and it consists in making such cowls with two but narrow channel outlet openings narrowest at the outer lip, and widening inwards, and also in making the surfaces of the outer case between the openings of V or U shape.

5895. Railway Signal Lamps, &c., *H. J. Marshall, Buckingham.—9th December, 1882.—(Not proceeded with.)* 2d.
This relates to the combination of colours to produce a known coloured light in railway signal lamps.

5906. Measuring Chains, *H. J. Haddan, Kensington.—11th December, 1882.—(A communication from G. Fêton, France.)—(Not proceeded with.)* 2d.
The chain consists of a series of oblong rings, preferably 2 decimetres long and 1 centimetre wide, every fifth link being 205 millimetres long and the following only 195 millimetres, the fifth link having a small ring at one end of 1 centimetre internal diameter, and formed by approaching together the two rods of the link, such ring serving to indicate the metre.

5907. Type Dressing Machines, *H. J. Haddan, Kensington, and E. Berger, Leipzig.—11th December, 1882.* 6d.
Endless bands are provided with grooves to receive types and conduct them between adjustable stones or grinders, hooks being placed above the bands to deposit the types in the grooves, and a hook connected with a movable bottom and a treadle lever provided for collecting the types when dressed.

5919. Separating Yarn from Paper Tubes or Cops, *H. J. Haddan, Kensington.—12th December, 1882.—(A communication from E. Scheidecker and E. Kohl, Germany.)—(Not proceeded with.)* 2d.
The object is to separate thread from cop tubes (waste cops) upon which it has been wound, and it consists of two concentric discs with teeth on their contiguous sides, and clearance being left between them, and one disc being fixed and provided with an inlet and central outlet, while the other rotates, and its teeth unwind the threads, which are drawn out through the central opening by an endless band, also having teeth, and travelling perpendicularly or at an angle to the faces of the discs.

5930. Wicks, *J. Telfer, Glasgow.—12th December, 1882.—(Not proceeded with.)* 2d.
This consists in forming wicks used for drawing oil from a reservoir to the place where it is to be ignited, of a bundle or series of capillary tubes made of glass, steel, or other metal, or of a combination of the same.

5936. Machines for "Putting out" Scouring and other Operations in the Manufacture of Leather, *W. R. Lake, London.—12th December, 1882.—(A communication from J. W. Vaughan, Massachusetts.)* 8d.
The machine consists essentially in a pair of yielding rollers with flanges or threads for scraping or stretching the hides, and adapted to revolve in opposite directions in such a manner as to oppose the passage of the skin between them, and a holder or carrier for the hide, which holder passes between the roller, a shipping device being provided for reversing the movement of the carrier, and a treadle device for increasing the pressure of the rollers.

5947. Submarine Tunnels, *C. G. Clarke and R. St. G. Moore, Kingston-upon-Hull.—13th December, 1882.—(Not proceeded with.)* 2d.
The tunnel is constructed in convenient lengths, each provided with false floors, manholes, air-locks, shafts, temporary bulkheads, valves, flexible tubing, and compression rings for jointing, and each length is floated out and sunk into the required position, when the floor is removed, air pumped in, the ground removed, and the length lowered to permanent position, the floor replaced, and the length connected to the preceding length by removal of portion of bulkhead.

5952. Pressing Asbestos into Wood Papier Mache, &c., *J. A. Timmins, Westminster.—13th December, 1882.—(Not proceeded with.)* 2d.
Wood is placed in a cylinder with an asbestos solution, and by means of pressure the solution is forced into the wood, so as to render it non-inflammable and less liable to be damaged by heat.

5954. Steam Boiler and other Furnaces, *T. Cocker and J. Ellis, Yorkshire.—13th December, 1882.—(Not proceeded with.)* 2d.
This relates to means for preventing formation of clinkers between the grate bars of furnaces, and consists in the placing a cistern of water beneath the grate, into which the hot ashes drop and generate steam, which is carried up by the draught through the grate bars.

5955. Controlling and Measuring the Supply of Heating and Illuminating Gas, *A. G. Henderson, Wood Green, and J. A. Kelman, High Holborn.—13th December, 1882.—(Not proceeded with.)* 4d.
This relates, First, to a governor for regulating supply of gas from gasworks, and maintaining an established pressure in the mains; Secondly, to the regulation of pressure of gas supplied to street lamps by day and night, a small igniting light being constantly kept burning, so as to render it unnecessary to light the lamps; Thirdly, to a special tap for street lamps, so as to prevent them being turned on mischievously; and Fourthly, to improvements in the details of the wet gas meter described in patent No. 4084, A.D. 1879.

5956. Illuminating and other Gases, &c., *A. G. Henderson, Wood Green, and J. A. Kelman, High Holborn.—13th December, 1882.—(Not proceeded with.)* 4d.
This relates, First, to the recovery from liquid deposited in the hydraulic main, of certain illuminating properties, of which the gas has been deprived, and restoring them to the gas before passing to the condensers, and also to the partial purification of the gas so treated, and it consists in passing the liquid over steam pipes, whereby hydrocarbous vapours are given off and are mixed with the gas on its way to the condensers; Secondly, to the condensation of gas preparatory to its passage to the scrubber in a vertical multitubular vessel with a closed water-chamber at bottom and an open water chamber at top, such vessel being divided by horizontal perforated discs; and Thirdly, to an improved construction of water-scrubber.

5960. Combined Ventilating and Fire-extinguishing Apparatus, *C. Brothers, Manchester-square.—13th December, 1882.—(Not proceeded with.)* 2d.
A series of distributing pipes are fitted in a building, and in case of fire, can be used to direct water on the flames without entering such building, while when not required for extinguishing fire they may be emptied and used for ventilating purposes.

5962. Photographic Albums, *A. Aron, Newgate-street.—13th December, 1882.—(Not proceeded with.)* 2d.
The object is to enable photographs to be inserted and withdrawn from albums without tearing or injuring the leaf, and it consists in forming each leaf with a removable portion or slide, which is withdrawn when required to insert or withdraw a photograph, and is then replaced in the leaf.

5966. Effecting the Condensation of the Less Condensible Matters Contained in Gas, *J. Jameson, Newcastle-upon-Tyne.—14th December, 1882.—(Not proceeded with.)* 2d.
The gas is cooled and then compressed, after which it is exposed to natural cooling and then to cold produced by the expansion of a portion of the gas previously compressed and cooled.

5967. Permanent Way and Rolling Stock for Mountain Railways, *F. C. Glaser, Berlin.—14th December, 1882.—(A communication from R. Abt, Paris.—(Not proceeded with.)* 4d.
This relates to an improved rack-toothed rod or rail and improved toothed-wheel locomotive and tender to be used on steep inclines. The rail is in several parts, suitably connected, and the teeth are set out and narrowed or tapered crosswise. The axle of the driving wheel of the locomotive is driven by two cylinders to which steam is admitted through the main coupling between the tender and engine frame.

5976. Keys or Wedges, *J. H. Johnson, London.—14th December, 1882.—(A communication from E. C. E. Gallois, Paris.)* 6d.
This consists in providing keys or wedges with means for expanding them, for fixing them firmly in place, and for contracting them for their release.

5978. Apparatus for Actuating Railway Points, &c., *H. Johnson, Eccles.—14th December, 1882.* 8d.
This consists in cases where facing point locking apparatus is employed in forcing the tongues of the facing points away from the stock or fixed rails upon breakage of or injury to the parts by which such points are actuated, and thereby preventing the lowering of the signal.

5979. Fastening for Gloves, Boots, Stays, &c., *F. R. Baker, Birmingham.—14th December, 1882.—(Not proceeded with.)* 2d.
Upon a slide a runner works, and a catch on it engages with notches in the front, back, or sides of the slide. On top of the runner is a knob, over which the button-hole works, and which when pressed forward in the action of fastening the glove depresses the catch and causes it to hold on to the slide. Another improvement consists in forming the slide and back plate of one piece folded over to clip the welt of the glove and carrying the back plate beyond the end of the slide, so as to obtain a good purchase for the thumb while pressing the knob in fastening the glove.

5980. Apparatus for the Manufacture of Bottles, &c., *H. E. Newton, London.—14th December, 1882.—(A communication from Messieurs de Poilly, de Fitz-James, and de Brigode, Paris.)* 6d.
This relates to the mechanical blowing of bottles and other articles of glass; and consists in a novel arrangement of valve apparatus for admitting compressed air from a suitable reservoir to the blowing iron.

5981. Treatment of Town Sewage, &c., *R. Nicholls, Hendon.—14th December, 1882.—(Not proceeded with.)* 4d.
The sewage flows into tanks containing burnt earth or burnt clay and crushed coke, and is allowed to settle, after which it is treated with hydrate of lime. Sulphate of alumina in solution is then added, and carries the solid matters with which it combines to the bottom. The liquid is drawn off to other tanks and heated, vapour steam, and ammoniacal vapours being given off, the former escaping and the latter being retained by a suitable absorbent material. The solid portions are submitted to the action of heat in closed vessels, and the gases given off passed through an absorbent material.

5982. Brackets for Curtain Rods, &c., *T. Smith, Brockley, and J. Drewitt, Peckham.—14th December, 1882.* 6d.
This relates to the method of making brackets having hooks or clips.

5983. Bicycles, Tricycles, &c., *R. W. Brownhill, Walsall.—14th December, 1882.—(Not proceeded with.)* 2d.
The object is to utilise the motive power generated by velocipedes and tram-cars or other vehicles in descending inclines, to compress air which may be afterwards utilised for assisting in propelling the vehicle when ascending inclines.

5984. Fire-grates and Doors for Furnaces, *J. Shepherd, Manchester.—14th December, 1882.—(Not proceeded with.)* 2d.
The objects are to obtain a large area opening for admitting air to the fuel, to obviate the liability of the parts regulating the admission of air to become choked or sticking, and to provide efficient rocking bar apparatus for the grate.

5985. Apparatus for Polishing Jewels, Rings, &c., *W. L. Wise, London.—14th December, 1882.—(A communication from J. Tagell-y-Urell and J. Tagell-y-Nogues, Barcelona.)* 8d.
The object is the polishing by machinery of jewels, rings, brooches and similar objects of comparatively small dimensions usually polished by hand.

5986. Explosives for Blasting, &c., *R. Hannan, Glasgow.—15th December, 1882.* 4d.
This consists in a compound made by combining prussiate of potash, nitrate of potash, chlorate of potash, paraffine, charcoal, or other similar carbon and ferric oxide or other higher oxide.

5987. Hydraulic Steering Gear, *C. Stout, Carnarvon, and C. H. Hillcoat, Liverpool.—15th December, 1882.* 4d.
This consists of an ordinary steam engine cylinder with piston, the rod of which extends through each end cover, and is fitted with hooks to receive the rudder chain. A plate cut off valve has an ordinary slide valve working on its back, and motion is given to it by a quadrant so arranged that when the piston moves the quadrant sets the cut-off valve in motion in the same direction as the piston. The slide valve is moved by the steering wheel, and when opening one of the ports the piston is set in motion, which in turn sets the cut-off valve in motion, and so shuts off the communication when the rudder has attained the desired position. The slide valve is provided with a spring, so that when the steering wheel is left at rest the valve is forced into the centre of the ports and covers all the ports in the cut-off valve.

5988. Checking the Receipt of Money in Public Vehicles, &c., *T. Wrigley and J. Maynes, London.—15th December, 1882.—(Not proceeded with.)* 4d.
This relates to apparatus for effecting the following operations:—First, delivering tickets from a continuous roll; Secondly, punching each ticket as it issues with the amount to be paid; Thirdly, for enabling the punches to be changed for the varying amounts; Fourthly, actuating a hammer so as to strike a bell the number of times, indicating the fare as each ticket issues; and Fifthly, to register the number of fares paid in each class, and the gross total received.

5990. Heating Water, *A. W. L. Reddie, London.—15th December, 1882.—(A communication from E. Theisen, Germany.—(Not proceeded with.)* 2d.
This relates to apparatus in which a stream of water is caused to flow over vertical bars formed with projections in such a manner as to present a large surface to the action of an ascending current of air heated by a coil of gas pipe.

5992. Stove Grates, *H. Hoyles, Sheffield.—15th December, 1882.* 6d.
The objects are, First, to utilise the heat of the fire to the greatest possible extent; and Secondly, to enable the grate to be easily removed and replaced. It consists in the arrangement of reflecting and radiating surfaces, and in the construction of the smoke flue at its junction with the entrance to the chimney.

5993. Wire Cloth, *N. and L. Greening, Warrington, Lancashire.—15th December, 1882.—(Not proceeded with.)* 2d.
This consists in constructing wire cloth so that the interstices instead of being opposite to each other, are arranged at an angle, so that a smoother surface is obtained.

5994. Propelling and Steering Ships, &c., *H. J. Haddan, Kensington.—15th December, 1882.—(A communication from J. L. F. Barbier, France.)—(Not proceeded with.)* 2d.
The object is to combine a screw propeller and rudder in one apparatus. A vertical shaft with a fly-wheel at top carries a bevel wheel at the bottom gearing with a similar wheel on the propeller shaft placed below the rudder with which it turns. The rudder is pivotted on the vertical shaft and the propeller shaft is supported in a forked bearing.

5995. Process and Machinery for Washing and Scouring Wool, *H. J. Haddan, Kensington.—15th December, 1882.—(A communication from E. Tremsal, Belgium.)—(Not proceeded with.)* 2d.
The wool to be washed is caused to circulate through various washing and scouring baths without agitation, by means of two endless bands, whereby the fibres are prevented from interlacing.

5996. Flushing Apparatus for Water-closets, *C. W. Gauntlet, Southsea.—15th December, 1882.—(Not proceeded with.)* 2d.
At one end of a cistern is a syphon with its inlet in the shorter limb near the bottom of cistern, and the overflow or bend above the top of the cistern or normal water level. The longer limb passes down through the bottom of cistern, and forms a flush conduit, and its upper part is enlarged. At the inlet to the shorter limb is a tube fitted with a piston, with a hole through it, provided with a valve. The piston is connected to a lever actuated by a pull rod. The cistern is fitted with a ball valve.

5997. Ironing and Pressing Machine, *H. A. Oldershaw, Leicester.—15th December, 1882.* 6d.
This consists in the general construction of the machine, in which the pressure is regulated by a system of springs or their equivalent.

5998. Machinery for Breaking, Grinding, or Pulverising Stones, Ores, &c., *L. L. Loizeau, Paris.—10th December, 1882.* 4d.
The machine is constructed with levers carrying movable rollers.

5999. Material for the Decoration of Apartments, Furniture, &c., *E. Truchot, Paris.—15th December, 1882.—(Not proceeded with.)* 2d.
A layer of liquid gum arabic is spread on a sheet of paper, and when dry is covered with a white varnish, to which pearl, metal, glass, or other material is applied to form their incrustation. The material is covered with varnish, and cloth applied, by which it is secured to the article to be ornamented, and the paper removed by damping same.

6000. Lighting or Distributing Light and Apparatus therefor, *C. L. A. Baatsch, Upper Clapton.—15th December, 1882.* 6d.
This relates to the use of a combination of tubes, mirrors, lenses, or prisms for conveying and distributing light from any suitable source.

6001. Manufacture of Wire and Lubricating Compositions to be Employed therein, *O. Schölzig, London.—15th December, 1882.—(A communication from G. Reinhard, Germany.)—(Not proceeded with.)* 2d.
The object is to obviate the necessity of continually lubricating the wire by hand as it passes through the draw-plate, and it consists in the use of any lubricating composition which is soluble in water, and placing the wire in a solution of the same for about fifteen minutes before drawing it.

6002. Generating and Distributing Electric Currents for Lighting Interiors, *A. M. Clark, London.—15th December, 1882.—(A communication from G. Trouvé, Paris.)* 8d.
This relates, First, to a system of installation for lighting a suite of apartments by electricity, and consists in effecting the immediate illumination of one or several or all the apartments by the aid of a single commutator or switch board with two or more keys, and provided with two or more series of contact studs. One wire passes by all the lamps of the different

apartments, and is connected by the return wire of each lamp with one series of contact studs, the other wire being connected to the keys. By turning the keys the number of apartments lighted is regulated. The invention further relates to a trough battery in which the zinc electrodes are of triangular form and connected to a winch, so that they can be raised or lowered, and thus regulate the surface exposed to the action of the liquid according to the strength of the latter, for the purpose of producing a constant current. A special mode of preparing the electrolytic solution for the battery is also described.

6003. Electrical Conductors, Couplings, Switches, and Terminal Connections, *S. H. Emmens, Soho-square.*—15*th December*, 1882.—(*Not proceeded with.*) 2*d.*

The objects are to ensure better contacts and insulation, greater safety against fire, and quicker and better laying of the wires of an electric circuit. For fixed contacts, such as for the poles of batteries and dynamos, commutators, &c., screws with conical ends work into bosses with oval holes, so that the wires are wedged up against the bosses to any required degree For contacts that have frequently to be made and unmade, couplings consisting of two hooks are used. To guard against fire from excess of current a cut-out or safety regulator is used consisting of a fusible metal enclosed in a tube, and which, when melted, breaks the circuit. An alarm apparatus is also described.

6004. Attaching Electric Lamps to Fittings or Supports, *S. H. Emmens, Soho-square, and R. J. Barnes, Holborn.*—15*th December*, 1882.—(*Not proceeded with.*) 2*d.*

The main object is to utilise the globes of gas fittings as supports for electric lamps, and it consists in the use of a holder to which the feed wires are connected, and which has projecting arms to engage with the edge of the globe.

6006. Miners' Safety Lamps, *D. Ballardie, Glasgow.*—16*th December*, 1882. 6*d.*

This relates to the general construction of the lamp, and to the means for locking it.

6009. Locks and Latches, *J. M. Hart, Cheapside.*—16*th December*, 1882.—(*Not proceeded with.*) 2*d.*

This consists, First, in means for facilitating the withdrawal of the latch bolt of locks, not only by turning the handle, but also by exerting pressure on them in any of several directions; Secondly, in connecting handles of locks to the door by plates, each of which passes on to a neck on the stem of the knob, and is held there so as to admit of its free rotation, and made fast in position by a screw; and Thirdly, to means for facilitating the adjustment of handles to the thickness of the door.

6012. Excavating Machinery, *J. Imray, London.*—16*th December*, 1882.—(*A communication from P. Jacquelin and V. Chevre, Paris.*) 8*d.*

This relates to the general arrangement of the parts.

6013. Amalgamating and Settling Apparatus, *J. Patterson, London.*—16*th December*, 1882.—(*A communication from F. Morris, San Francisco.*)—(*Not proceeded with.*) 2*d.*

This consists in apparatus by which pulp or even tailings may be advantageously treated for the recovery of precious metals contained therein. Upon supports are placed the bottom planks of a circular wooden tank, within which is a series of flat fan-shaped dies of wood cut with the grain vertical, the dies being arranged so as to leave a series of radial channels round the tank. A central pillar carries overflow pipes passing through the bottom, and also a footstep in which a shaft revolves, and is fitted with arms, through the outer end of which bolts pass and are fitted at bottom with weighted wooden shoes.

6014. Collars, *R. B. Hayward, London.*—16*th December*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to means for keeping neckties in position by passing them through slits formed in the band of the collar.

6015. Explosive Compound or Blasting Powder, *J. Polkinghorne, Cornwall.*—16*th December*, 1882. 2*d.*

The compound consists of chlorate of potash, hydrate of carbon, flour and ferro-cyanide of potassium, mixed together and thoroughly incorporated.

6016. Machines for Automatically Inserting Pressing Boards or Sheets between Folds of Cloth or Fabric, *J. C. Mewburn, London.*—16*th December*, 1882.—(*A communication from C. H. Weisbach, Germany.*) 6*d.*

A table is supported by springs so that it descends according to the weight upon it, and above the table two rollers travel, working in guides above the table and near the sides. Between the rollers the cloth enters and is spread over the table into regularly arranged folds by the rollers. Two sets of pincers travel with the rollers, and are opened and closed at the proper times so as to seize a board and carry it and deposit it upon the cloth.

6018. Audible Signalling Apparatus, *J. Stevens and T. Burt, Glasgow.*—16*th December*, 1882. 6*d.*

This relates to sirens, and consists in substituting for the discs or cylinders carried by central spindles usually employed annular rings or cylinders with slots or orifices, and causing them to rotate upon similarly slotted stationary rings or cylinders, while steam or compressed air flows through the orifices, the rotating rings or cylinders being directly actuated by the steam or compressed air without the intervention of carrying spindles and driving gear.

6020. Telephonic Apparatus, *G. L. Anders and J. B. Henck, jun., London.*—16*th December*, 1882. 6*d.*

This relates principally to instruments for use in connection with static receiving telephones, such as described in patent No. 1395, A.D. 1881, but it is equally applicable to other forms of static receivers, and partly also to other electric telephones. It consists partly in transmitting instruments, especially adapted for use with static receivers, but also applicable to other forms of electric telephones, and according to one modification a metallic diaphragm is fixed horizontally and carries at its centre a button of hard carbon or other suitable non-conducting material. Upon the button rests another one, mounted as in the "Reis" transmitter, so as to be free to follow the vibrations of the diaphragm. There are also a number of thin strips of metal, set so as to project over the diaphragm without touching, and a quantity of granulated coke or other conducting material is placed upon the diaphragm, so as to come in contact with the metal strips which are in connection with the upper button. The mouthpiece is arranged so as to direct the sound waves upwards against the diaphragm. Other modifications are described. So as to avoid the necessity of pressing a key when talking, the plates of the receiver are connected permanently to the ends of the secondary wire of the induction coil used for the transmitter, thus keeping the latter always in circuit for talking, while the receivers are also always in circuit for listening. Before using the instrument an intermittent battery current is passed through the primary wire of the induction coil for the purpose of giving to the receiver an initial charge which is found to increase their sensitiveness, and therefore the loudness of the sound emitted. A compound key enables this charging to be accomplished by the same movement, which serves also to pass a signalling current to the distant station.

6022. Producing Monalcoholised Hydric Bases, *W. A. Barlow, London.*—16*th December*, 1882.—(*A communication from A. Böhringer, Germany.*) 4*d.*

This consists in the process for producing monalcoholised hydric bases by hydrating tertiary bases which have been previously transformed into the salts of the ammonia bases by alcoholisation.

6023. Telephonic Apparatus, *W. R. Lake, London.*—16*th December*, 1882.—(*A communication from G. M. Torrence, Philadelphia.*) 6*d.*

This comprises a transmitter and a receiver, both of special construction. The transmitter consists mainly in supporting one of the electrodes of a microphone in contact with the other electrode by the attraction or repulsion existing between permanent magnets. A bar or magnet is suspended by one end, so that an electrode attached to it will, when in proper position, make contact with the electrode attached to the diaphragm. The magnet is held in working position by the attraction or repulsion exerted on its free end by permanent magnets or magnetic materials placed radially about its free end. The receiver is provided with an annular magnet, which is divided, and one end turned inwardly and then outwardly at the centre, forming a second pole upon which a spool is fitted, the split or divided magnet forming the poles on the upper and outer ends. The sound from the receiver will be sharp, distinct, or well-defined, without the ringing and singing so often accompanying telephonic receivers.

6029. Effecting the Coupling of Vehicles, *H. P. Hoghton, Manchester.*—18*th December*, 1882. 6*d.*

This relates to means for enabling wagons and vehicles to be coupled and uncoupled without necessitating the operator getting between the vehicles, and it consists in the use of a link carrier actuated by suitable side levers, and serving to raise the coupling link over the coupling hook off the next vehicle.

6031. Pianofortes, *W. Thomas, Kentish Town.*—18*th December*, 1882. 6*d.*

The objects are to simplify the action and to arrange the parts so as to facilitate repair, alteration, or adjustment. A jack-guide is used, made of metal pins secured in a hammer rail with a bevelled face, so that the rail increases in thickness from the bottom upwards. The jack works between the pins. The set-off screw or pin passes through the jack at an angle corresponding with that of the hammer rail, and the stroke of the hammer can be regulated by turning this screw pin. The damper wire is connected to the top of the jack, so that it can be removed without disturbing other parts.

6033. Tool for Coupling and Uncoupling Railway Vehicles, *J. Graham, Abergavenny, and T. J. Graham, Birmingham.*—18*th December*, 1882. 6*d.*

The object is to enable railway and other vehicles to be coupled and uncoupled without getting between them, and it consists of a tube about 6ft. long with a handle at one end and a jaw at the other end. Within the tube is a sliding rod actuated by a handle at one end, and the other end also being fitted with a jaw, so that when placed in the proper position over the coupling link and the sliding rod actuated, the link will be grasped, and can be lifted over the hook of the next vehicle. A spring opens the jaws when the handle is released.

6037. Machine for Finishing Textile Fabrics, *L. E. Luzeau-Coudrais, Pimlico.*—18*th December*, 1882.—(*A communication from A. Vincent, France.*) 6*d.*

The fabric is wound on a rotating cylinder, and is drawn by a cloth forming a carrier over a perforated casing and between an iron and copper cylinder. Steam issuing from the casing moistens the fabric, and the cylinders being heated, dry the fabric and smoothe it as it passes between them.

6038. Winches and other Lifting Appliances, *W. Pitt, Bath.*—18*th December*, 1882. 6*d.*

The object is to construct a hand winch which will afford greater safety and facility of working than the ordinary crab. The axis which receives the winch handle or hand rope wheel is connected with the winding drum through a train of gear wheels, and a portion of such train is mounted upon a support, which may either be allowed to move around the axis or be held fast by a brake. When the support is held fast by the brake it serves as a fulcrum, through which the power is transmitted from the handle to the drum; but when the fulcrum is permitted to yield, the drum is free either to remain at rest or to turn independently of the handle under the influence of a load suspended from it, backward motion of the handle being prevented by a ratchet.

6039. Mosaic Floorcloths and other like Mosaic Fabrics, &c., *F. Walton, Twickenham.*—18*th December*, 1882. 10*d.*

Linoleum and like oxidised oil compositions, in various colours, are rolled out into sheets, and by special mechanism cut into pieces, which are combined upon a sheet, preferably of the same material, spread upon a backing of woven fabric and paper, and the whole consolidated by heat and pressure.

6049. Water-closets, *R. H. Leask, Dublin.*—19*th December*, 1882. 6*d.*

This consists principally in a tilting or rocking basin combined with the handle and water supply and discharge mechanism, and is emptied by being tilted when the handle is pulled.

6050. Regenerative Hot Blast Stoves, *E. A. and C. E. Cowper, Westminster.*—19*th December*, 1882. 8*d.*

This relates to the kind of hot blast stoves known as "Cowper's stoves," in which the waste gases of blast furnaces are used for imparting heat to the air blast; and it consists in shaping the bricks used for forming the flues of these stoves, so that when placed together within the stove they divide the space into a great number of equal symmetrical passages, separated from each other by a single thickness of brick. So as to better distribute the current through all the passages of the stove at the cool inlet and outlet, a crescent-shaped baffle plate is provided, and prevents the current from setting directly out of or into the pipe, and divides it over the area of the stove, so that it flows equally throughout all the passages.

6051. Screwing Machines, *S. Dixon, Salford.*—19*th December*, 1882. 6*d.*

This relates to machines in which a sliding collar is moved to and fro to advance or retract the cutting dies; and consists in actuating such collar by means of a movable abutment, which acts upon curved or inclined faces on the collar, the abutment in small machines being shifted or turned over automatically by causing the sliding carriage of the machine to release a rack bar acted upon by a spring or weight, and so actuate a wheel on a shaft carrying the abutment.

6052. Paper Bags, *E. K. Dutton, Manchester.*—19*th December*, 1882.—(*A communication from F. W. Leinbach and C. A. Wolle, Pennsylvania, U.S.*) 6*d.*

This relates to apparatus for completely forming flat-bottomed paper bags. A web of paper has its sides folded over a forming plate, and the pasted edges are caused to overlap by the action of inclined rollers. The tube of paper passes to pressing rollers, one of which is provided with a cutter and the other with a cutter bed, so that a thumb hole may be cut. The tube then passes to severing rollers, the cutting blade of which is curved, so that the cut edges overlap when folded. The blank passes between a presser bar and a bed when the bar descends, and by flattening the tube a distance from the mouth, causes the latter to open for the insertion of a distending rod, which pushes the upper web back over the bar, the ends of the mouth coming inwards. The primary folds are then pressed by connected flattening plates. Other rollers, in combination with a creasing blade, an elastic bed, and travelling tapes, effect the completion of the folding.

6058. Treatment at High Temperature of Alkaline Salts and Metals, *C. A. Faure, Paris.*—19*th December*, 1882. 6*d.*

The object of the invention is the manufacture of metallic sodium of the cyanides by fixing atmospheric nitrogen, and in general the treatment at high temperature of alkaline salts or metals. The matters to be treated are placed in a tube heated externally by suitable fuel. The material then falls on to a block of very refractory brick, in which electrodes or pencils of carbon are inserted, and is subjected to the heat of electric arcs, currents, or discharges.

6057. Drying Salt, &c., *S. Pitt, Sutton.*—19*th December*, 1882.—(*A communication from R. G. Starkie, Montreal.*) 6*d.*

The apparatus consists of a cylinder formed by stretching canvass over a number of longitudinal bars, carried by arms radiating from a central spindle, to which rotary motion is imparted. The cylinder is set in an inclined position, and to the inner edges of the bars, bars are secured, so as to form a series of compartments round the inside of the periphery of the cylinder. The material to be dried is fed to the compartments at the upper end of the cylinder, and hot air is forced in near the centre at the lower end of the cylinder.

6061. Treatment of Fibrous Materials Suitable for the Manufacture of Paper Stock and Paper, *T. Routledge, Sunderland.*—19*th December*, 1882. 4*d.*

This relates to improvements on patents No. 2470, A.D. 1870, and No. 2431, A.D. 1872, in which a series of vessels were employed, and the legs and washing waters caused to circulate continuously through such vessels under hydrostatic pressure, and it consists in making the change of liquor in one vessel only at a time, and by pumping. When treating certain materials, such as season shoots of bamboo and other plants, so as to open out and separate their fibres, and also to eliminate their sappy constituents, they are cut transversely into short lengths and then passed through a willow or devil before being submitted to the boiling process.

6069. Safety Valve for Kitchen Boilers, *J. Williams, London.*—20*th December*, 1882. 6*d.*

This consists in a valve enclosed in a casing, and having an upwardly projecting stem, upon which a weight is placed depending on the strength of the boiler. When the pressure of steam raises the valve from its seat the steam escapes through holes in the casing.

6071. Carriage and Wagon Axles and Bushes, &c., *J. Dakers, Aberdeen.*—20*th December*, 1882. 6*d.*

This relates to improvements in the axles and bushes, and in fittings for the same.

6072. Artificial Horizons for Quadrants, &c., *W. E. Gedge, London.*—20*th December*, 1882.—(*A communication from S. Pattee, San Francisco.*) 6*d.*

This relates to a means of determining the true horizon in sextants, octants, and like instruments when taking observations under conditions when the natural horizon or any fixed distant object is not available.

6075. Incandescent Electric Lamps, *L. A. Groth, London.*—20*th December*, 1882.—(*A communication from A. Bernstein, Boston, U.S.*) 6*d.*

The object is to render incandescent electric lamps more durable and more economical, and it consists in forming the light-giving part of the lamp of a hollow cylindrical carbon, with solid supporting carbon socket pieces, to which the conducting wires are attached. One of the conducting wires is made rigid, while the other is flexible, so as to enable the carbon to expand and contract without liability of breaking.

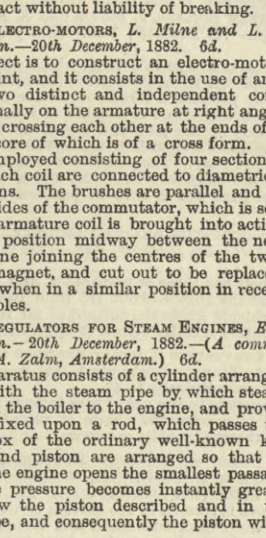
6083. Electro-motors, *L. Milne and L. B. Miller, London.*—20*th December*, 1882. 6*d.*

The object is to construct an electro-motor without a dead point, and it consists in the use of an armature having two distinct and independent coils wound longitudinally on the armature at right angles to each other and crossing each other at the ends of the armature, the core of which is of a cross form. A commutator is employed consisting of four sections, and the ends of each coil are connected to diametrically opposite sections. The brushes are parallel and bear upon opposite sides of the commutator, which is so arranged that each armature coil is brought into action in turn when in a position midway between the neutral line and the line joining the centres of the two poles of the field magnet, and cut out to be replaced by the other coil when in a similar position in receding from the said poles.

6084. Regulators for Steam Engines, *E. Edwards, London.*—20*th December*, 1882.—(*A communication from A. Zalm, Amsterdam.*) 6*d.*

The apparatus consists of a cylinder arranged in connection with the steam pipe by which steam is supplied from the boiler to the engine, and provided with a piston fixed upon a rod, which passes through a stuffing-box of the ordinary well-known kind. The cylinder and piston are arranged so that when the slide of the engine opens the smallest passage for the steam the pressure becomes instantly greater above than below the piston described and in the steam supply pipe, and consequently the piston will descend

6084



nearly to the bottom of the cylinder in which it works, and with a speed dependent upon the quickness with which the steam is admitted, for the greater such quickness the less will be the resistance below the piston. Shocks or concussions of the piston in its descent are prevented by a helical spring arranged around the piston-rod outside the stuffing-box, and supported at its lower end by stops upon guide rods fixed to the cylinder cover and above by a movable plate, which can be adjusted by nuts upon the guide rods, so as to regulate the tension. When the slide of the engine is shut the pressure will become the same above and below the piston, and the spring will therefore instantly raise the latter to its orignal position.

6104. Cocks or Valves, *G. Teideman, London.*—21*st December*, 1882. 8*d.*

The plug of the cock or valve may be formed or constructed in the ordinary way with a lining or liners or false plug between the body and the said plug. The

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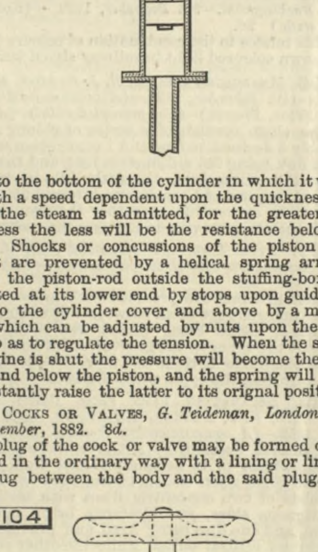

liner or false plug is formed with suitable openings corresponding with the plug, and also openings at the lower part at right or other angles with that in the plug, corresponding with those in the body.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

280,834. Lift Pump, *Henry C. Langrehr, San Francisco, Cal.*—*Filed September 2nd*, 1882.

Claim.—(1) In a lift pump, the casing A, cast in one piece, and provided with an internal cylinder bearing D, and upper channelled rim G, which forms a continuous bearing for the operating lever I, and pro-

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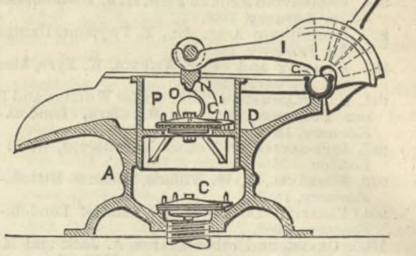

vided at its base with a suction valve C, substantially as and for the purpose set forth. (2) In a lift pump, the combination of the casing A, suction valve C, reciprocating cylinder P, having lugs F, lift valve C[1], connecting link N, and lever I, all when constructed, arranged and operating substantially in the manner and for the purpose herein shown and set forth.

280,882. Process of Treating Alcoholic Liquors with Electricity, *Anson C. Tichenor, Alameda, Cal.*—*Filed April 20th*, 1883.

Claim.—The method of removing fusel oils or other impurities from alcoholic liquors, which consists, first, in passing through them an electric current by

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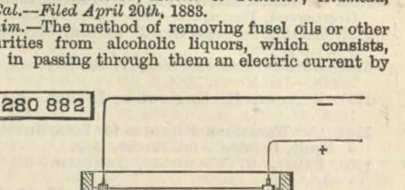

means of wires and electrodes, one of which is provided with a movable envelope or casing; and, secondly, in removing said envelope from the liquor and renewing it by putting on another or cleansing and restoring the old envelope at intervals when it has received a deposit of impurities, substantially as herein set forth.

281,050. Ejector, *Louis B. Fulton, Pittsburg, Pa.*—*Filed July 30th*, 1881.

Claim.—(1) In a water ejector having the threaded eduction branch D, the combination therewith of tube H, having cylindrical mouth, threaded enlargement *i*, and contracted throat *g*, with the main combining

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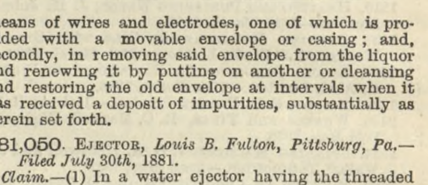

tube G or G G[1], having ribs *f*, fitting in and supported by the tube H, both said tubes having independent communication with the supply chamber, substantially as described. (2) In an ejector, the combination of head A, having branches B, C, and D, nozzle E, cylinder F, having openings *b*, tube G, having flange *c* and ribs *f*, and tube H, having enlargement *i*, and contracted throat *g*, substantially as described.

CONTENTS.

The Engineer, August 17th, 1883. PAGE

The *Liverpool Journal of Commerce* says:—"A meeting is to be held in London in a few days to promote a scheme for the construction of a new canal across the Isthmus of Suez that will be wholly under British control."