THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

By W. H. Wheeler, M. Inst. C.E.

No. XIII.

Bullewijker Polder, Holland.—This machinery was put up in 1881, it is of a similar type to that erected by Messrs. J. and H. Gwynne elsewhere, and is capable of raising 60 tons a minute. The lift is 14ft.—4·67 metres; maximum discharge, 2508 cubic feet per minute—1·184 cm. per second; coals consumed per horse-power per hour in water lifted, 5·22 lb.—2·37 kilogs.; ratio of effective to indicated horse-power, 58 per cent. The trials from which these results were obtained were made by Mr. Elink Sterk, a Dutch engineer, of the Haarlemermeer drainage. This pump has very long suction and delivery pipes, doubtless reducing its efficiency to a small extent.

Bijlmer Meer, Holland. — The first compound centrifugal pumping engine put down in Holland was supplied by Messrs. J. and H. Gwynne for this drainage in 1883. When tested the pumps raised 70 tons per minute 14ft. high; the ratio of indicated to water horse-power was ·613; and the coal used, German, was 4·67 lb.—2·12 m.—per water horse-power per hour. German coal is inferior to good English steam coal; but the consumption need not have been so high as stated had the boilers been more perfectly proportioned to the requirements of the engines. Two are provided. One is rather too small to give steam enough, while both are quite too large.

Lake Haarlem.—This tract of land was originally a large fresh-water lake, which it was supposed had been caused by inundations in 1591 and 1647, previous to which time it had been an inhabited district with three villages. In shape it is an irregular oblong, the length from north to south being 14½ miles, and the greatest width eight miles. The total area contained 56,609 acres of lowlands and meres, and formed the "boezem" or collecting basin for the surrounding lands, being a portion of the great drainage district of Rhynland. The surface of the water in this boezem was maintained at its lowest level by natural drainage, through sluices emptying into the North Sea—one at Katwig and the others into the Y at Spaarndam and Halfweg. Schemes for the drainage of this lake date back two and a-half centuries. In 1643 Jan Adriansz—surnamed Leeghwater—a millwright, published a detail plan for the drainage, which passed through thirteen editions, the latest appearing in 1838. In 1836 very severe storms occurred which drove the water of the lake upon Amsterdam, and up to Leyden, submerging part of the city and inundating 100,000 acres of polders. These disasters finally decided the Dutch States-General in decreeing the reclamation of the lake, and in 1839 a vote, amounting to over three-quarters of a million of money, for the purpose was passed. It was not, however, until nearly ten years afterwards that operations were actually commenced. The first work was to surround the lake with a dyke or bank to shut off the water from the adjoining polder. Parallel with the bank a canal was cut called the Ringvart. The dyke and canal were thirty-seven miles long; the top of the dyke was 7½ft. above A.P.—or 9·63ft. above ordinary high-water in the North Sea—and the bottom of the canal 19½ft. below A.P. The canal was 140ft. wide, having a depth of 10ft. for a width of 95ft., and navigable for vessels. A road was made between the canal and the dyke. The canal had slopes of 2 to 1, and, with the cess, occupied an area of 654½ acres. The dyke was made of peat, and occupied, with its slopes, 1013½ acres. A commission was appointed to determine as to the most suitable machines for raising the water from the lake, and for afterwards keeping it dry. The use of windmills driving scoop wheels or Archimedean screw pumps was strongly advocated, while the advantage of steam was also pressed on the attention of the Commissioners. It was found after fully investigating all the proposals that the estimated cost of draining the lake by wind power would be over £300,000, and that the maintenance of the 114 windmills required would amount to over £6000 a year. The cost of draining by steam power was estimated at £100,000, and the annual expenditure after the lake was dry at £4500. Some of the Commissioners came over to England to inspect the steam pumps in the mining districts of Cornwall and elsewhere, and as the result of their inspection recommended a design submitted to them by Messrs. Gibbs and Deane, which was finally adopted. The dimensions of the steam engines and pumps as set out in this design were larger than any that had previously been constructed, and the whole scheme was so novel, and differed so much from anything that had ever been attempted before by the Dutch, that considerable anxiety was felt by the Commission in incurring so large an outlay. The agreement with Messrs. Gibbs and Deane stipulated that they were to receive a premium of 3000 guilders whether the machinery succeeded or not. If successful, to have 9100 guilders—making about £1000—in addition, and 200 for each million pounds in excess of the stipulated 75,000,000 lb. of water raised 1ft. high with 94 lb. of best Welsh coals. Observations on the rainfall of Holland, extending over a period of ninety-eight years, had shown

Fig. 13.

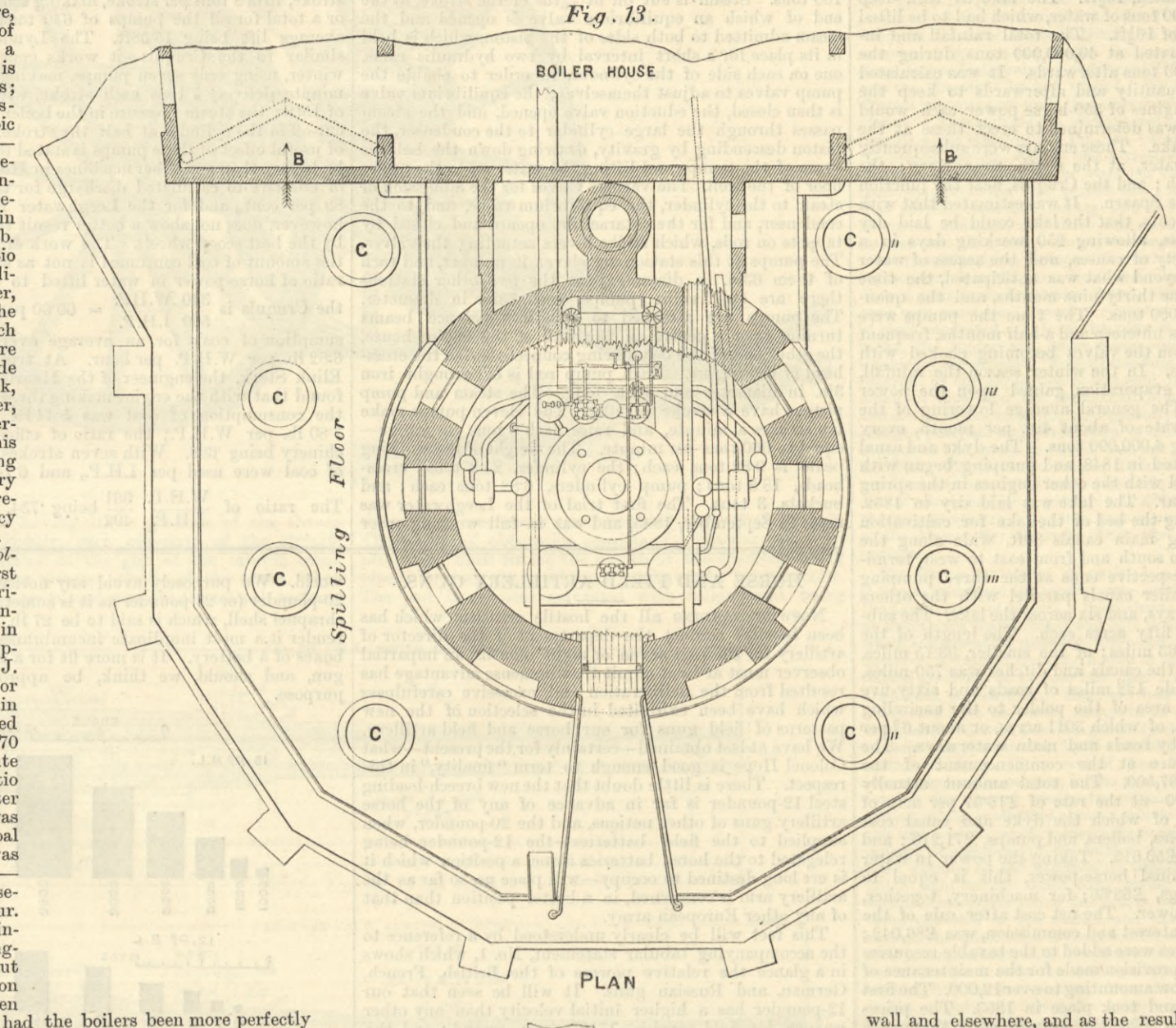


Fig. 13—PUMPS, LAKE HAARLEM.

that the greatest depth of rain in any one month was 6·524in. more than the evaporation for the same period; 1·47in. were allowed for infiltration, giving 8in. to be lifted in one month. The level of the lowest land was 14ft. below A.P., and the water in the drains, after the lake was reclaimed, was settled to be 15½ft. below A.P. The lift into the Ringvart would therefore be, when the pumping was completed, 15½ft. The lake at 13ft. deep contained 780,000,000 tons of water, which had to be lifted an average height of 16½ft. The total rainfall and infiltration was estimated at 40,000,000 tons during the works and 60,000,000 tons afterwards. It was calculated that to lift this quantity and afterwards to keep the polder dry, three engines of 350-horse power each would be required, and it was determined to erect these at the extremities of the lake. These engines were subsequently named the Leeghwater, at the south, near Kaag; the Lynden, at the north; and the Cruquis, near the junction of the canal with the Spaarn. It was estimated that with no delay from accidents, that the lake could be laid dry in fourteen months, allowing 250 working days in a year. From a variety of causes, and the access of water from infiltration beyond what was anticipated, the time actually occupied was thirty-nine months, and the quantity raised 900,000,000 tons. The time the pumps were actually at work was nineteen and a-half months, frequent delays occurring from the valves becoming choked with silt and other causes. In the winter season the rainfall, with the absence of evaporation, gained upon the power of the engines. The general average lowering of the surface was at the rate of about 4in. per month, every inch in depth giving 4,000,000 tons. The dyke and canal were finally completed in 1848, and pumping began with the Leeghwater, and with the other engines in the spring of the following year. The lake was laid dry in 1852. The works for fitting the bed of the lake for cultivation consisted in making main canals 80ft. wide along the centre from north to south and from east to west, terminating at their respective ends at the three pumping stations. Four smaller canals parallel with the others were made lengthways, and six across the lake. The subdivisions contained fifty acres each. The length of the large canals was 18·63 miles; of the smaller, 93·15 miles. The total length of the canals and ditches was 750 miles. There was also made 122 miles of roads and sixty-five bridges. The total area of the polder to the encircling canal is 41,648 acres, of which 3011 acres, or about 6¾ per cent., are occupied by roads and main waterways. The estimated expenditure at the commencement of the operations was £687,500. The total amount actually expended is £781,500—at the rate of £16·57 per acre of available land, out of which the dyke and canal cost £161,527; the engines, boilers, and pumps, £71,216; and buildings for same, £50,615. Taking the power in water lifted at 1037 nominal horse-power, this is equal to £48·23; for buildings, £68·66; for machinery, together, £116·89 per horse-power. The net cost after sale of the lands, exclusive of interest and commission, was £86,042; for which 41,648 acres were added to the taxable resources of the country, and provision made for the maintenance of a large population, now amounting to over 12,000. The first public sale of the land took place in 1853. The prices realised ranged from £25, the average over the whole polder being about £16 an acre.

The average rainfal on the polder for the ten years ending 1872 was 31·267in. The time the pumps were working during the same period was 5584¾ hours, divided as follows:—

	Rainfall inches.	Hours pumps working.
First four months	7·472	... 2254¼
Second ,, ...	10·503	... 398½
Third ,, ...	13·292	... 2932

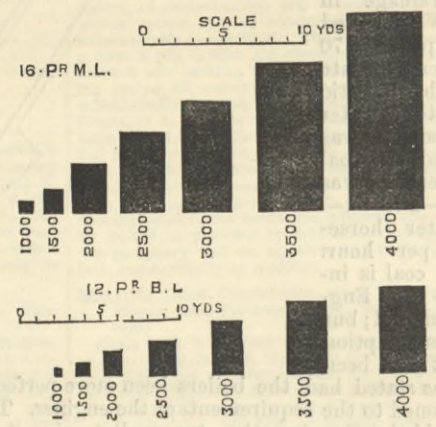
The average annual consumption of coals was, during the same period, 2690 tons. The rainfall for the last ten years —1877-86—has averaged 32in., the maximum being 39·13in. in 1877; and the minimum, 26·69in. in 1884. The average number of hours the pumps were working, during the same period, was 6823 hours; equal to ninety-four days of twenty-four hours for each station, the average quantity of water pumped being 96,091,600 tons. The water is kept at an average level of at least 3ft. below the surface of the arable land, and about 2ft. for the grass land.

The Leeghwater was the first machine erected; the three sets of machinery are almost similar in design and dimensions. The engines are beam engines of the Cornish type, single-acting, condensing, and working expansively, giving motion to a series of pumps, working at a single lift arranged concentrically round the engine. The water is delivered by the buckets of the pumps on to a spilling-floor A, Fig. 13, at either side of which are self-acting doors B, which open out to a short channel leading to the main canal. These doors open as soon as the water on the floor rises above the level of that in the canal, and close as soon as the pumps cease. There are valves which, when opened, leave the spilling-floor dry, so that the buckets and other parts of the pumps can be drawn out and laid on the floor for repair. The general arrangement of these engines will be seen from the drawing, Fig. 13. The foundation for the machinery and buildings consists of 1400 piles driven to a depth of 40ft. into a stratum of hard sand. On these a platform was laid 21ft. below the surface of the lake, and upon this a brick well was built in which the pumps were fixed. The engine was placed in the centre, with the pumps C, eleven in number, ranging round three sides in the segment of a circle, the boilers being placed at the back. The engine is of peculiar construction, having two cylinders D, E, one within the other, united at the bottom and having a clear space of 1½in. between them at the top under the cover, which is common to both. The outer or annular cylinder E is 12ft. in diameter, and the inner D 7ft. The pistons are connected to the rocking-beams by one main piston-rod attached to the smaller piston 12in. in diameter, and four small rods attached to the annular piston, each 4½in. in diameter and having a large crosshead with a circular body 9ft. 6in. in diameter, and formed to receive the ends of the balance-beams of the pumps. When the pistons are at the bottom of the cylinder steam is admitted at a pressure of from 40 lb. to 45 lb. beneath the interior piston, which is then raised, carrying with it the annular piston, cross-head, and a weight of about 30 tons of iron, with which it is loaded, the total dead weight lifted being about 100 tons. Steam is cut off at $\frac{8}{10}$ths of the stroke, at the end of which an equilibrium valve is opened and the steam admitted to both sides of the piston, which is held in its place for a short interval by two hydraulic rams, one on each side of the cylinder, in order to enable the pump valves to adjust themselves; the equilibrium valve is then closed, the eduction valve opened, and the steam passes through the large cylinder to the condenser, the piston descending by gravity, drawing down the balance beam of the pumps and lifting the water on to the upper floor of the well. The various valves for the admission of steam to the cylinder, the equilibrium valve, and to the condenser, and for the cataract are opened and closed by tappets on rods, which strike levers actuating the valves. The pumps at this station are eleven in number, and each of them 63in. in diameter; at the two other stations there are only eight pumps, each 73in. in diameter. The pumps are attached to cast iron balance beams turning upon a centre in the wall of the engine-house, the other end of the beam being connected with the cross-head of the engine. Each pump rod is of wrought iron 3in. in diameter and 16ft. long. The steam and pump pistons have a stroke of 10ft. The eleven pumps make ten strokes a minute, and raise each 6 tons per stroke—equal to 660 tons per minute. The weight of the working beam is 9·82 tons each; the cylinder, 24·2 tons; cross-heads, 18·8 tons; pump cylinders, 6·82 tons each; and buckets, 3 tons. The first trial of the Leeghwater was made in September, 1845, and was in full working order in the following November. The engine was found at the trial to do a duty equal to raising 75 million pounds 1ft. high by the consumption of 94 lb. of good Welsh coal, and exerting a net effective force of 350-horse power with a lift of 13ft. There are five boilers each 30ft. long by 6ft. in diameter, with a single flue 4ft. in diameter. The Cruquis has eight pumps 6ft. in diameter with 10ft. stroke, lifts 8 tons per stroke, making ten strokes a minute, or a total for all the pumps of 640 tons per minute, the average lift being 15·58ft. The Lynden machinery is similar to the Cruquis—it works generally during the winter, using only seven pumps, making seven strokes a minute, delivery 7 tons each stroke, with an average lift of 15ft.; the steam pressure in the boiler being 40 lb., and cut-off in the cylinder at half the stroke. The coefficient of useful effect of these pumps is stated by Sig. Cuppari to be higher than any other machines in Holland. The ratio of effective to calculated discharge for the Cruquis being 89 per cent., and for the Leeghwater rather less; this, however, does not show a better result than that attained by the best scoop wheels. The work of the engines and the amount of coal consumed is not as satisfactory. The ratio of horse-power in water lifted to that indicated of the Cruquis is $\frac{340}{560}\frac{\text{W.HP.}}{\text{I.H.P.}} = 60{\cdot}60$ per cent.. The consumption of coals for an average over a long period is 6·82 lb. per W.H.P. per hour. At trials made by Mr. Elink Sterk, the engineer of the Haarlemmermeer, it was found that with the engine making three strokes a minute the consumption of coal was 5·44 lb. per I.H.P., and 7·80 lb. per W.H.P.; the ratio of efficiency of the machinery being ·698. With seven strokes a minute 4·94 lb. of coal were used per I.H.P., and 6·74 lb. per W.H.P. The ratio of $\frac{\text{W.H.P.}}{\text{I.H.P.}}\frac{361}{492}$ being ·734.

HORSE AND FIELD ARTILLERY GUNS.

Notwithstanding all the hostile criticism which has been levelled against the department of the director of artillery for the past seven or eight months, an impartial observer must at least admit that immense advantage has resulted from the deliberation and excessive carefulness which have been exhibited in the selection of the new patterns of field guns for our horse and field artillery. We have at last obtained—certainly for the present—what Colonel Hope is good enough to term "finality," in this respect. There is little doubt that the new breech-loading steel 12-pounder is far in advance of any of the horse artillery guns of other nations, and the 20-pounder, when supplied to the field batteries—the 12-pounder being relegated to the horse batteries alone, a position which it is ere long destined to occupy—will place us, so far as the artillery arm is concerned, in a better position than that of any other European army.

This fact will be clearly understood by a reference to the accompanying tabular statement, No. 1, which shows in a glance the relative powers of the British, French, German, and Russian guns. It will be seen that our 12-pounder has a higher initial velocity than any other weapon for field service—1710ft. per second; and the 20-pounder takes the second place, with 1650ft. But there is another point in regard to this velocity. With the foreign guns it rapidly decreases upon approaching 3000 yards, which is about the limit of a reasonable range. But with the British guns there is a high remaining velocity even at this distance, superior by 100 foot-seconds to that of any of their competitors. Again, the greatest extreme range of any of the foreign weapons is 7535 yards, with an elevation of 25 deg. We have, in order to meet this, worked out the extreme range of our own 12-pounder, which computes to 7930 yards, thus beating any of its opponents. But this is an absurd figure, as the gun would never be fired with such an elevation as 25 deg., nor would any foreign gun. The extreme effectual limit of range is certainly not more than 6000 yards, and this can be obtained with our own 12-pounder by an elevation of 15 deg. 30 min., though the gun can be laid to 18½ deg. Another matter must not be lost sight of. The performances of our own field guns are not reckoned from guess work, but are notified as the result of actual experiments made in practice at Shoeburyness and other places. But the figures quoted for the foreign guns are, we greatly fear, not in every case based on so sound a foundation. That a 3·425in. Russian gun, with only a charge of 3·16 lb. of powder, should have a range of 7000 yards at any elevation at all is to usa statement which we accept with reservation. We are also inclined to doubt whether the range of the 17-pounder French gun has been correctly given as 7535 yards. The charge appears too small to warrant such a presumption. Under any circumstances there is little question that our military authorities have done wisely in not deciding too hastily upon the new weapons, and that they may be congratulated now upon possessing the two most powerful field-guns employed in the armies of the world. We purposely avoid any notice of the Russian 20-pounder (or 24-pounder as it is sometimes called). The shrapnel shell, which is said to be 27 lb. in weight, would render it a most inordinate incumbrance in the limber-boxes of a battery. It is more fit for a siege than a field gun, and should, we think, be appropriated to that purpose.



The 12-pounder field gun is not only good in regard to velocity, low trajectory, and range, but its lateral deflection is very small indeed. The correctness of firing obtained with it may be seen by a reference to the accompanying figures, which show targets that would cover the area of 25 per cent. of shots fired by both the 12-pounder B.L. and the 16-pounder *muzzle-loading* gun at various ranges. The superiority of the former is remarkably striking, particularly at 4000 yards, where the target of the 16-pounder spreads out into a space 12 or 13 yards high by 5 broad.

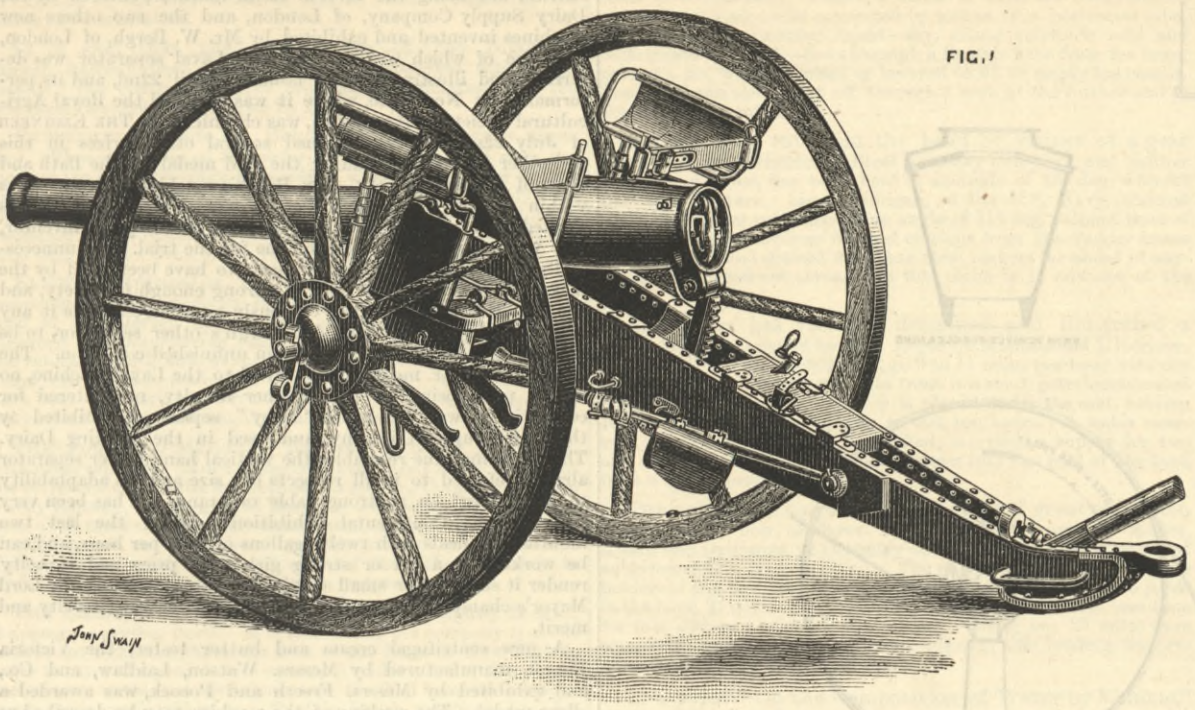
Table No. 1.—*Field Guns of different Armies.*

Nation.	Gun.	Calibre. Inches.	Weight.	Charge.	Muzzle velocity. Foot-seconds.	Utmost range.	Elevation.
			cwt.	lbs.		yards.	
British.	12-pr.	3·0	7	4·00	1710	7930	With 25°
	20-pr.	3·4	12	6·00	1650	6000	With 15 °30′
						(not known)	
French.	12-pr.	3·15	8·45	3·30	1608	7655	With 25°
	17-pr.	3·54	10·41	4·18	1493	7535	With 25°
German.	12-pr.	3·09	7·66	2·75	1525	6196	With 25°
	17-pr.	3·47	8·84	3·3	1457	6551	With 25°
Russian.	12·125-pr.	3·425	7·09	3·16	1350	7000	With 25° 16′
	15·26-pr.	3·425	9·03	3·16	1450	7000	With 22° 5′
	20-pr. Shrapnel, 27 lb.	4·2	12·25	3·61	—	—	—

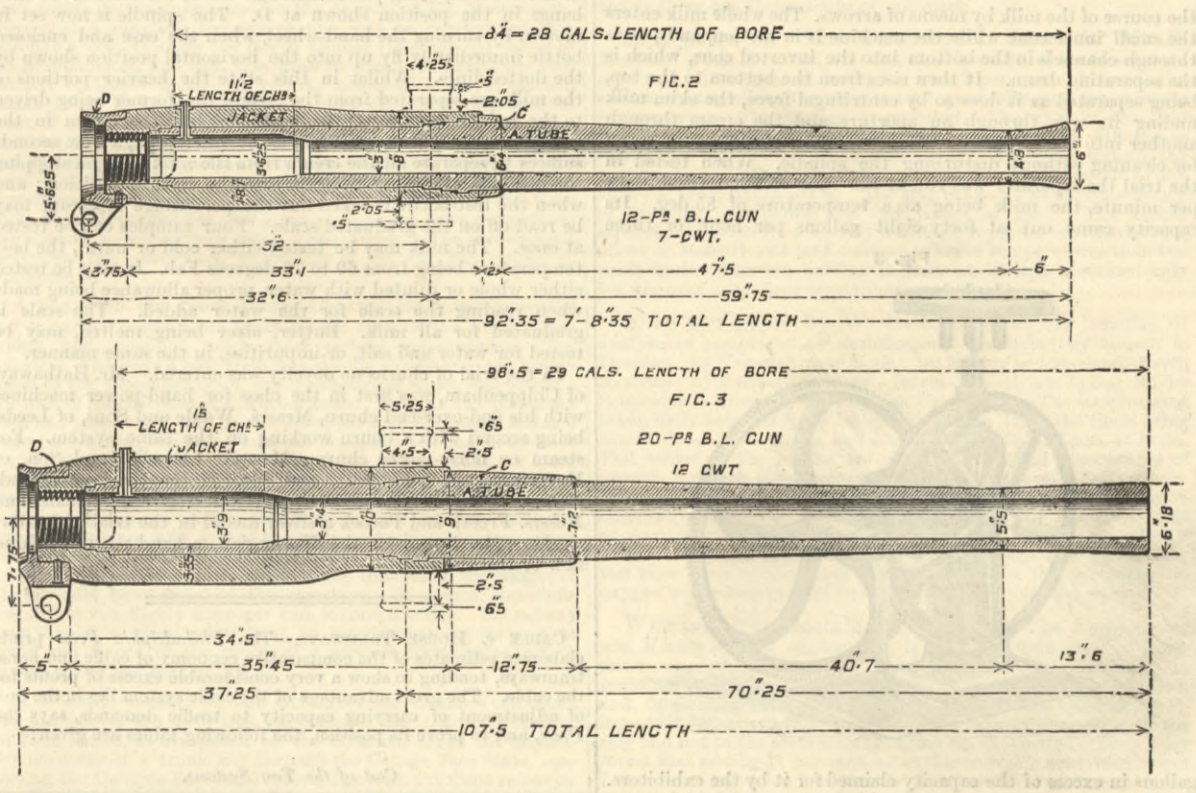
The annexed drawings give the construction of both 12-pounder and 20-pounder, Figs. 2 and 3. They are slightly different, not only in dimensions, but in the arrangement of the several parts. The 12-pounder only consists of an A tube with jacket, on which trunnions are forged, shrunk on, and locked to the tube by "locking shoulders." A small foresight ring, marked C in the drawing, covers the ends of the wedges by which the locking process—called a bayonet-joint—is effected. The "hood" is marked D. On it is formed the elevating eye. The 20-pounder has a regular hoop, which is marked C in the drawing of that gun. It makes a break in the outline of the chase of this weapon, thus altering its appearance, and at the same time strengthening the joint materially.

The breech-closing action may be seen from the accompanying drawing of the breech of the 12-pounder. It is very simple. The gun consists of a toughened steel tube, over which are shrunk five hoops, including that for the trunnions. A hood is attached by screws to the breech end for the purpose of protecting the breech fittings. The chamber is cylindrical, slightly coned at the entrance, and terminating in front with a curved slope. The breech is

12-POUNDER BREECH-LOADING FIELD GUN.



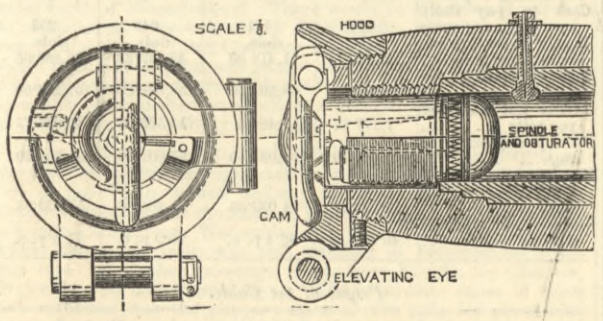
closed by a screw having three portions of the thread removed longitudinally, each one-sixth of the circumference. The interior of the gun at the breech, being prepared in a similar manner, admits of the screw, when the raised portions are placed opposite the smooth surfaces through the breech screw, but vertically through the breech. The system of obturation consists of a circular pad, with protecting discs fitting the mouth of the chamber, being placed between the mushroom head and the breech screw. The pad is asbestos saturated with tallow, and being



12-POUNDER AND 20-POUNDER FIELD GUNS.

in the gun, being pushed home and locked by the sixth of a turn.

The screw has hinged to it a cam lever, by which it is locked and unlocked; the cam portion of this lever when the breech-screw is locked falls into a recess in the carrier-ring—described further on—and so prevents any move-



BREECH OF 12-POUNDER GUN.

ment of the breech-screw during firing. In depressing the cam lever after the breech-screw is unlocked, the cam, acting upon the surface of the carrier-ring, partially withdraws the breech-screw together with the obstructor—in fact, starts it.

Encircling the rear end of the breech-screw, and hinged to the hood, is the carrier-ring, which supports the screw when withdrawn from the breech of the gun. The carrier-ring is held to the gun during the withdrawal of the breech-screw by a clip pivotted within the left side of the ring, engaging with a recess in the hood.

Passing through the breech screw is a solid spindle, having at its inner end a mushroom head, behind which are placed the obturating pad and discs, and at the outer end a removable clip that secures it to the breech screw. This gun is not axially vented, as in the larger natures, slightly elastic, expands radially when compressed by the action of the powder gas, thus sealing the escape. Thin discs of steel are used to adjust the required thickness of the obturating pad.

A drawing, Fig. 1, of the 12-pounder with its carriage complete is also given. It shows the position of the elevating screw and the breech arrangement very clearly. The shell for this gun is of steel, and with comparatively thin walls. The shrapnel is of an entirely novel character, the base and not the head being removable, and the bursting charge is contained in the former. Thus, upon the action of the fuze, the 177 bullets which the shell contains are blown out backwards, and the "cone of dispersion" is thus rendered far more extensive than in the old form of shrapnel, whose head was lightly attached and blew forwards when the bursting charge took effect. The 20-pounder will have a shrapnel weighing fully 22 lb., and will contain about 300 bullets.

It is satisfactory to know that when our batteries of horse and field artillery are fully equipped with these two guns, that we shall be better armed than our neighbours; but we would vehemently urge upon the authorities the necessity for carrying this into effect at once. Guns cannot, of course, be constructed in a moment, but now that we have actually decided upon so effective a weapon, every effort should be made that is possible to hasten the supply, and questions of finance should be set aside until the whole of our artillery is armed with it. We commend this opinion to the consideration of the War-office.

THE SEWERAGE OF HENLEY-ON-THAMES.

These works were formally opened on the 13th inst. by the mayor, in the presence of a large company of eminent engineers. Henley-on-Thames is the first instance of a town in which the Shone system has been adopted in its entirety, and not grafted on any existent system of gravitation sewerage, as was the case at Eastbourne, for instance. The result is therefore interesting in a very high degree, as we shall here be enabled to see tested for the first time the efficacy of the Shone system pure and unadulterated, and to see how far the promises of Mr. Shone will be realised, or to what extent the gloomy forebodings of his opponents are justified. Most of our readers are probably familiar with the Shone system, which has been fully described in previous numbers of The Engineer. At Henley the sewage of a population of 5000 has to be dealt with, and there is further the difficulty that none of this is permitted to be discharged into the Thames. Indeed, Mr. C. Simmons, a former Mayor of Henley, in making a speech on the occasion of the opening, stated that to the query put him by some economically-minded individual, "Why don't you drain into the Thames?" he had replied, "We have drained into the Thames as long as we could, but they won't allow as to do so any longer." Although this is, perhaps, not strictly accurate, it is roughly a fair statement of the case. Until the introduction of the present system, Henley was a cesspool town, and naturally enough the contents of the cesspools found their way to the river by gravitation and percolation. Another difficulty was that several residents, fearing lest the outfall works should become a nuisance and drive visitors away in the summer, insisted that the sewage should be carried a considerable distance from the town, and some land was found at a considerably higher level than the town itself, and about a mile and a-half distant from it, in Lambridge Wood. Here four acres of land have been purchased, cleared of timber, and a layer of about 3ft. of chalk excavated. It is on this piece of land that the settling tanks, the engine and boiler house, and the air-compressing machinery are situated. Notwithstanding the additional expense incurred by the acquisition of this land, the laying of a mile and a-half of pipe, and the erection of intermediate ejectors, the cost of the works, including the legal and preliminary professional charges, purchase and preparation of land, and all the various charges on the town sewerage, does not amount to more than £18,000. This is more noteworthy as a rival scheme on the gravitation principle had been submitted previously, the estimated cost of which had been put down as £30,000. The adoption of the present system is due in a large measure to the perseverance of the Mayor, Mr. Frederick Bull, who is himself a sanitary engineer

The Shone system in its purity is a separate system, and it was as such that its merits were particularly recognised by the Corporation of Henley. Such drains as existed previously at Henley are disconnected, and only used for the stream water, which is allowed to discharge into the Thames. The sewage, however, is drained from the houses in pipes 7in. in diameter, having gradients in no case less than 1 in 200. The junctions are all 5in. in diameter. There are four town ejector stations, which deal with the town sewage in as many sections, and are each furnished with two 150 gallon ejectors, the second ejector in each being insisted on by the sanitary authorities to provide against accidents. From each of these four ejector stations an iron sewage main, varying in size from 5in. to 8in. in diameter, conveys the ejected sewage to a fifth or intermediate ejector station, which is situated about a mile from the outfall. From this fifth station, which contains three ejectors, an 8in. iron main conveys the sewage to the outfall tanks. The rise from the town ejectors to the intermediate station is 78ft., and from the latter point to the tanks 52ft., giving a total lift of 130ft, which, however, including friction, is equal to 180ft. The elevated situation of the outfall, and also of the intermediate station, will enable the Corporation to supply sewage to a large area of arable land, and of course whatever sewage is delivered on to the land from the intermediate station will reduce the working lift for that portion. Two settling tanks are provided at the outfall, into which the sewage is delivered alternately. The effluent from there is conveyed for purification and irrigation by carriers on to the adjacent prepared grounds. These settling tanks are each 100ft. long by 10ft. wide and 8ft. deep; they are divided into three compartments. When the sewage rises to a given level, it passes over a ridge and under another ridge into the next, and so on. In each compartment the solid matters settle, and are periodically removed, the strained effluent passing finally away over a third ridge in an even, almost imperceptible flow to the carriers. These tanks are of course of a very simple and elementary type, the arrangements for filtration, &c., being very primitive; but the object is not so much a perfect filtration as economy in construction. It is estimated that the effluent, after percolating through the prepared land, will have become thoroughly purified, and be then in a fit state for discharging into the river.

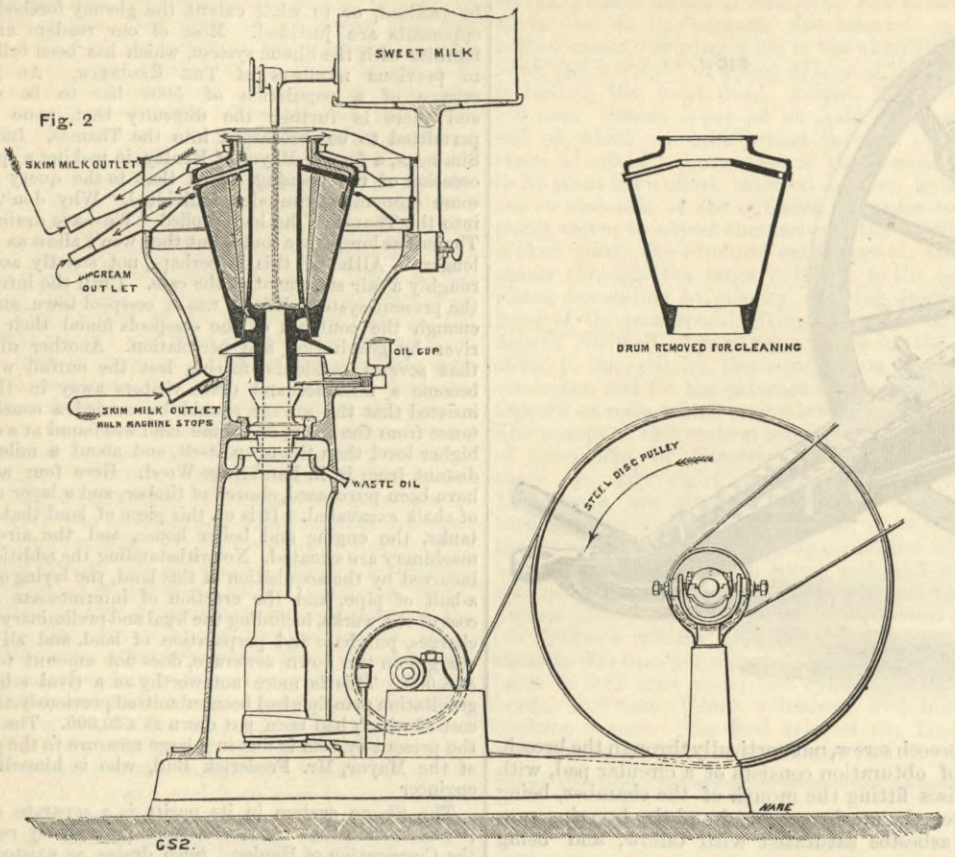
The compressing station is established on the site of the outfall works, and contains two air compressors for alternate working, built from a design of Messrs. Shone and Ault: each engine is 35 indicated horse-power, and has two single-acting cylinders 14in. diameter and 21in. stroke, fixed vertically; one high-pressure steam cylinder 11in. diameter, and a low-pressure cylinder 19in. diameter, both of 18in. stroke, fixed horizontally. All the cylinders are connected to the same crank-shaft, the exhaust steam is condensed, the air pump being worked with a chain from the crank-shaft. Steam is supplied from two Lancashire boilers at 60 lb. pressure, the cut-off in high and low pressure cylinders varying from 0·3 to 0·6 of the stroke. The air is compressed to 35 lb., and is led through a 4in. pipe to the four town stations. These compressors did not strike us as particularly efficient or economical. A good deal of air seemed to run to waste, and there appeared to be much too much unnecessary friction and noise. We were informed by the makers of these engines that they have profited by their experience, and that in all future applications of the Shone system a more modern type of engine will be adopted. As it is, the supply of compressed air from these engines is sufficient to raise 180 gallons per minute the whole lift of 180ft.. The consumption of coal is said to be 2·8 lb. per horse-power per hour, but the grate area under the boiler is much too large for the small quantity of fuel required, the stoking indifferent.

The plant and machinery have at present to deal with 150,000 gallons of sewage per day, and to do this the ejectors are only worked for twelve hours per day. The contractors for the various portions are Mr. Kidley, Mr. Hughes, and Mr. Pratchett. Already the sewage is finding favour as a manure with the farmers. During the construction of the walls the intermediate station was flooded and a large volume of sewage overflowed into an adjacent oat-field, with the result that, whereas the oats in the immediate vicinity gave a very poor crop, those that were flooded by the sewage were remarkably fine and most satisfactory, so much so that the circumstance has attracted the attention of the farmers in the district, with the expected result that the sewage will find numerous customers.

So far as we were able to judge from a brief survey of the system, it is highly satisfactory, simple, and economical; whether it will realise its present promise time alone will show. In the meantime the Henley drainage system must be regarded as a most interesting and memorable experiment.

THE VICTORIA CREAM SEPARATOR.

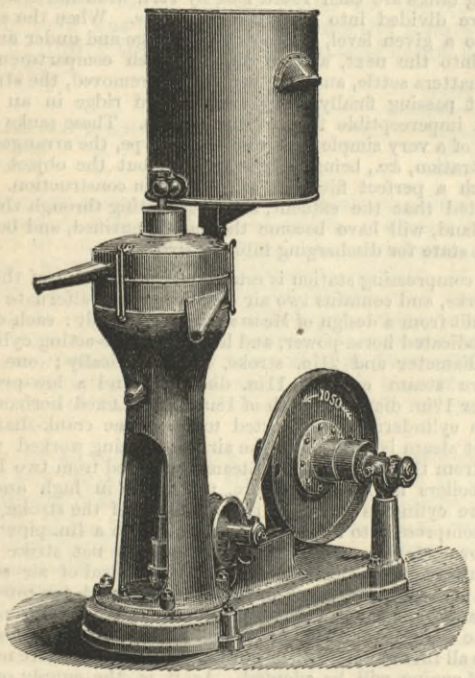
Fig. 2



NOVELTIES AND TRIALS AT THE DAIRY SHOW.

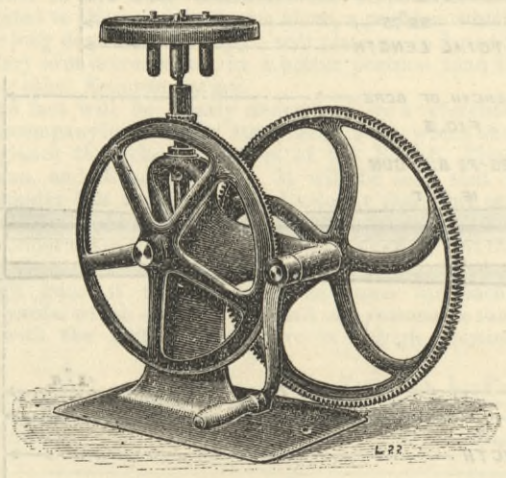
The display of implements and machines at the Dairy Show, which closed last week, included a few novelties. The most important of these were the new cream separators, two of which competed for the medals offered by the British Dairy Farmers' Association. The Victoria separator, which we illustrate—Figs. 1 and 2—is manufactured by Messrs. Watson, Laidlaw, and Co., of Glasgow, and was exhibited by Messrs. Freeth and Pocock, of London. The manufacturers have been charged with imitation of the older separators, such as the Laval and the Danish; but they point to the fact that long before cream separators were introduced, they made centrifugal machines of a like character for use in sugar, chemical, textile, and other industries. Their machine is for steam or horse-power, and is worked by intermediate motion, as the original Laval machine was and is; but they announce that they are about to introduce also machines on the turbine and hand-power principles, as has been done by the Laval Company. The Victoria separator is made in four sizes, to deal with 45, 70, 100, and 150 gallons of milk per hour respectively. It was the smallest size which was exhibited at the Dairy Show, and it is

Fig. 1



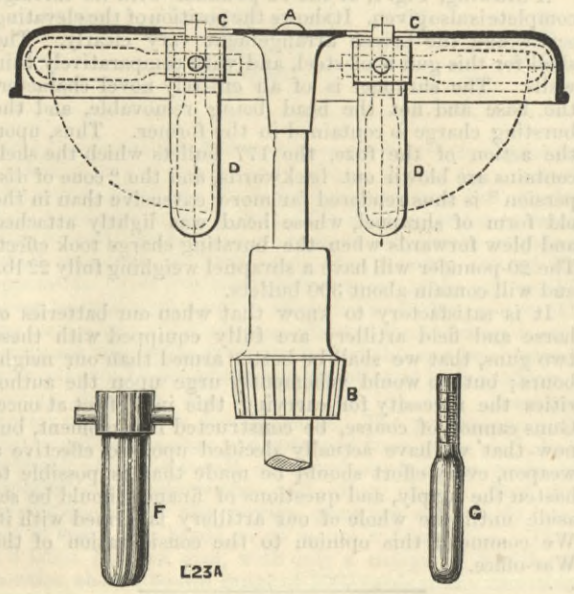
quite large enough for all but exceptionally large dairies or factories. It differs in a few points from the older machines of its kind. The separating drum is conical, instead of being cylindrical, and is bottomless, and therefore self-emptying when the machine stops. Whether there is any advantage beyond increase in strength in the conical shape of the drum or not remains to be proved; but the self-emptying arrangement is a decided improvement, as some of the older machines require to be emptied by a syphon, a very tedious arrangement, and one involving a considerable loss of time, it being desirable that the drum should start empty. The separator is self-skimming, in the sense that it does not depend upon either pipes or valves, and it is supplied with an automatic feed regulator, not shown in the illustration, by means of which the density of the cream may be varied while the machine is in motion. The drum is made of forged steel, to give it strength to sustain the strain of over 6000 revolutions per minute, and it is believed to be strong enough for much greater speed, though that is not necessary. One great advantage of the machine is its compactness. Another is the self-oiling arrangement fitted to the bearings of the countershaft. At the bottom of every bearing on the machine there is a chamber holding oil, and in the middle of it a plug of felt enclosed in iron, through which the oil is gradually drawn by capillary attraction. The sectional drawing—Fig. 2—shows the course of the milk by means of arrows. The whole milk enters the small inner cone while the machine is in motion, and passes through channels in the bottom into the inverted cone, which is the separating drum. It then rises from the bottom to the top, being separated as it does so by centrifugal force, the skim milk finding its way through an aperture and the cream through another into the collecting vessels. The drum can be taken off for cleaning without disturbing the spindle. When tested in the trial the separator was run at the rate of 6300 revolutions per minute, the milk being at a temperature of 85 deg. Its capacity came out at forty-eight gallons per hour, or three

Fig. 3



gallons in excess of the capacity claimed for it by the exhibitors. The judges awarded it a third-prize bronze medal, giving two equal first-prize silver medals to the Laval turbine separator, described and illustrated in The Engineer of April 22nd, and to an improved machine with intermediate motion. The awards are presumably based chiefly upon the relative completeness

Fig. 4



with which the fat was taken out of the milk. In the trial the turbine machine separated at the rate of 72·7 gallons of milk per hour, as compared with its nominal capacity of ninety gallons, working with a 3-horse power boiler at a pressure of 55 lb. The other Laval machine separated at the rate of eighty gallons per hour, its nominal capacity being 120 gallons. It was worked with an 8-horse power engine, at a pressure of 60 lb. The speed of both Laval machines was 6500 revolutions per minute. These three were the only power machines which went through the trial, the old Lefeldt separator, and an unknown one named the Nakskov, not being tested.

For the trial of hand-power separators there were three entries, one being the vertical Laval machine, entered by the Dairy Supply Company, of London, and the two others new machines invented and exhibited by Mr. W. Bergh, of London, only one of which was tested. The Laval separator was described and illustrated in our issue of April 22nd, and its performance at Newcastle, where it was awarded the Royal Agricultural Society's prize of £25, was chronicled in The Engineer of July 22nd. It has obtained several other prizes in this and other countries, including the gold medal of the Bath and West of England Society. Mr. Bergh's machine scarcely comes within the definition of a hand-power separator, as it was worked by a treadle. It is the first one made by the inventor, and was only just finished in time for the trial. An unnecessarily large quantity of metal appears to have been used by the maker in his anxiety to have it strong enough for safety, and the labour of working it was obviously too severe to give it any chance in the competition. Mr. Bergh's other separator, to be worked by a crank, was shown in an unfinished condition. The first prize silver medal was awarded to the Laval machine, no second prize being given. Another novelty, not entered for competition, was the Laval "Baby" separator, exhibited by the Dairy Supply Company, and used in the Working Dairy. This little machine resembles the vertical hand-power separator already referred to in all respects but size and its adaptability to being fixed on a strong table or stand. It has been very successful at Continental exhibitions during the last two months. It deals with twelve gallons of milk per hour, and can be worked by a lad or strong girl. Its price and capacity render it suitable for small dairies. It was awarded the Lord Mayor's champion cup as the best exhibit showing novelty and merit.

A new centrifugal cream and butter tester, the Victoria Fig. 3, manufactured by Messrs. Watson, Laidlaw, and Co., and exhibited by Messrs. Freeth and Pocock, was awarded a silver medal. The working of the machine may be described as follows, by the aid of the accompanying drawing Fig. 4, of the revolving spindle, test tubes, and cases:—A sample of milk is put into the glass test-bottle G up to the zero mark of the graduated scale shown on the neck of the bottle. The bottle is then placed inside the brass case F. This case has a pair of trunnions at the top, by which it is hung on to hooks in the cover A, being passed through one of the holes C. It then hangs in the position shown at D. The spindle is now set in motion by turning the hand-wheel, when the case and enclosed bottle immediately fly up into the horizontal position shown by the dotted lines. Whilst in this state the heavier portions of the milk are separated from the cream, the former being driven to the end or bottom of the bottle, leaving the cream in the narrow neck. Turning the handle at full speed, a few seconds suffices to separate all the cream from the milk. Upon stopping the machine, the case falls again into the vertical position; and when the test-bottle is taken out the percentage of cream may be read off on the graduated scale. Four samples can be tested at once. The milk may be tested either cold or warm, the best temperature being from 60 to 70 degrees Fah. It may be tested either whole or diluted with water, proper allowance being made when reading the scale for the water added. The scale is graduated for all milk. Butter, after being melted, may be tested for water and salt, or impurities, in the same manner.

In the trial of churns no novelty was entered. Mr. Hathaway, of Chippenham, was first in the class for hand-power machines with his end-over-end churn, Messrs. Waide and Sons, of Leeds, being second with a churn working on the same system. For steam or horse-power churns, Messrs. Llewellin and Son, of Haverfordwest, were first, and Mr. Hathaway was second. Messrs. Llewellin also secured silver and bronze medals, and Messrs. Freeth and Pocock a silver medal in the trial of butter-workers, the latter for the Norwegian, a hand-power machine new to this country.

Cable *v.* Horse Tramways.—The *Philadelphia Press* prints elaborate estimates of the comparative economy of cable and horse tramways, tending to show a very considerable excess of profits for the cable. The great advantage of the cable system lies in the ease of adjustment of carrying capacity to traffic demands, says the *Press*, and to prove its position, the following tables are given:—

Cost of the Two Systems.

	Comparison of cost and earnings of a horse and a cable road 3 miles long.		Comparison of cost of doubling the carrying capacity of same road.	
	Horse.	Cable.	Horse.	Cable.
Passengers required to pay daily operating expenses	7144	3754	14,241	5550
Time to pay daily operating expenses	13½h.	7h. 7m.	12¾h.	5¼h.
Cars to pay daily operating expenses	325	171	648	253
Yearly operating expenses per mile	dols. 21,730·70	dols. 11,418 00	dols. 43,149·33	dols. 16,880·66
Total operating expenses	130,384·00	68,508·00	258,896·00	101,284·00
Yearly net earnings per mile	7,177·12	17,48·95	14,500 23	40,937·75
Total yearly net earnings	43,062·70	104,987·50	87,001·40	245,608·50
Total cost, equipment and road bed per mile	15,333·33	54,033·33	25,466·66	57,233·33
Ratio of net earnings to total cost	46·8 p. c.	32·4 p. c.	55·9 p. c.	71·5 p. c.

Profits of the Cable.

	No. 1.		No. 2.	
	Horse.	Cable.	Horse.	Cable.
Speed per hour	4½	6	4½	6
Working hours	18	18	18	18
Number of cars	32	12	64	64
Single cars daily	432	216	864	432
Passengers per trip	22	44	22	44
Passengers carried daily	9504	9504	19,008	19,008
	dols.	dols.	dols.	dols.
Gross earnings daily	475·20	475·20	950·40	950·40
Op. expenses daily	357·22	187·70	712·40	277·50
Net earnings daily	117·98	287·50	238·36	672 90
Op. expenses to gross earnings	75·2 p. c.	39·5 p. c.	·75 p. c.	29·2 p. c.

The above tables speak for themselves, and are said to be submitted by an expert in the subject and as gathered from personal experience and official sources. The "traction bosses" of Philadelphia, however, seem to think differently, judging from their vigorous efforts to maintain present traffic rates in that city, whereby, as one of the city papers puts in, the passenger may continue to pay 6 cents for a 5 cent ride on a 4 cent car

RAILWAY MATTERS.

A CONFERENCE of the railway authorities will assemble in Calcutta in the cold season to discuss matters regarding the railway administration.

IT is said that the continuation of the Bilaspur-Etawah Railway from Umaria is to be proceeded with immediately. The contractors have received an intimation that the line must be carried to Bilaspur by 1889.

EXPERIMENTS made on Belgian State Railways show that, although the use of the water jet instead of sand does not increase the adhesion quite as much as sand, it has many advantages. On thirty-five locomotives the cost per year was only one-eighth of that of sand, it does not interpose, as sand does, a resistance to movement of the train, and thus it is in effect as good as sand, and does not increase the wear of tires and rails.

ELECTRIC apparatus for increasing the adhesion of locomotive driving wheels on rails was tried on the Central Railroad of New Jersey nearly thirty years ago. The American *Railroad and Engineering Journal* says a battery was carried on the running board, and, as far as is known, the wheels were provided with coils and made into electro-magnets. It is believed to have been the work of a French inventor named Quetil, but was not successful, or not thought worth the cost.

THE Tounghoo-Mandalay Railway is being pushed on with great rapidity. Much disappointment is felt at the news that the Government of India has declined to approve the proposed Moo Valley Railway, on the ground that the scheme would be premature until means of internal communication had been provided. Upper Burmah can never be thoroughly pacified unless the Moo Valley line be constructed, and some of the richest districts in Upper Burmah must without it remain undeveloped.

THE Eads Tehuantepec Ship Railway Company is still, it appears, asserting itself. It is stated that the company is about to take out a charter under the laws of the State of New York in order to carry the project into operation under a law of that State, and as soon as this has been done, and the final financial arrangements made, work will begin. Captain Eads's maximum time for completing the work was four years, but he stated frequently that it could be done in three years. All the plans, the profiles, and the designs for the machinery were completed in the lifetime of Captain Eads.

SPEAKING of the Bengal-Assam Railway, the Indian *Engineer* says the detailed plans and sections confirm the preliminary investigations of Mr. Buyers, the engineer-in-chief, in the most satisfactory manner, and, in the opinion of Mr. Molesworth, prove that a practical locomotive line may be constructed at a reasonable cost through the North Cachar Hills into the valley of the Brahmaputra, and that it is quite feasible to develope the rich districts of Upper Assam by railway communication, which will enable goods to be shipped at the port of Chittagong without break of continuity. The North Cachar Hills were formerly supposed to offer an impenetrable barrier to the construction of a railway, and earlier proposals for opening up the valley of the Brahmaputra were founded upon an extension of the Dacca Railway from Mymensingh to Dhubri, skirting the western face of the Garo Hills, but this project has now given place to the more comprehensive scheme, which serves a much greater area. The Government recognises the commercial importance of the line, but refuses to guarantee it.

A TRAIN on the New Jersey Central Railroad recently had a narrow escape from wrecking the draw on the Newark Bay bridge, and, possibly, much more serious consequences. The *American News* says a coal train was moving slowly over the bridge ahead of the passenger train, the locomotive of which was within a few feet of the caboose of the other train. Just as the passenger train had passed half-way on the draw, the man in charge, seeing a steamboat coming, began to turn the draw, but was unable to move it more than five or six inches owing to the weight of the car lying across its connection with the bridge. The couplings creaked and groaned under the strain, but successfully withstood it. The engineer of the passenger train, seeing the danger, instantly reversed his lever, and moved the train back off the bridge. Had the locomotive gone ahead a little further, the draw would, in all probability, have swung around with the train on it, the weight of which would have smashed the structure. Of course, the whole proceeding was highly improper and invited disaster. No railway draw should be operated without an interlocking apparatus that would put it out of the power of a careless draw-tender to thus imperil trains and human life.

A SPECIAL session of the Orange Free State Volksraad was opened on the 10th inst. to consider the railway question. Sir John Brand, in his speech on the occasion, urged the imperative necessity of a trunk line through the Orange Free State, connecting the Delagoa Bay and Pretoria line with the Cape railways. The President advocated a conference of the independent States and the Colonies in South Africa to consider the matter, and expressed the hope that the overcoming of the objections in the Transvaal to railway connection westward would be conducive to a federal union between the Republics, which would be the forerunner of a general federation of South African States. The Cape Government Railway scheme as contained in proposals to the Free State Government has been published. It comprehends a line from Bethulie to Vredefort with a junction from Colesberg to Bethulie, and a junction line from Kimberley to a point forty-four miles north of Bloemfontein. There would be 452 miles of railway to construct at a cost of about £2,800,000. At a meeting convened in the Cape Town Chamber of Commerce, the *Colonies and India* says, a resolution was passed in favour of a direct line from Kimberley to the northern border of the Free State, and a Vigilance Committee was elected to watch over the interests of Cape Town in connection with railway extension.

IN a report on the double collision which occurred on the 21st July, at Bishopbriggs station on the Edinburgh and Glasgow line of the North British Railway, when, as a goods train from Croy for Sighthill was shunting at Bishopbriggs, it was run into by a mineral train from Waterside—near Lenzie—for Cowlairs, and whilst the latter train was still standing at Bishopbriggs it was run into by another passenger train from Kilsyth for Glasgow, Major General Hutchinson says: "The immediate cause of these two collisions was the slippery state of the rails for about 1000 yards from the point at which they occurred, this slipperiness having been produced by the lubrication of the rails with oil owing to a leakage from a cask of rape oil in the wagon of a stores train which had passed along the line about half an hour before the first collision, and an hour before the second one. When the stores train stopped at Maryhill east junction the guard observed oil running from one of the wagons, and on examination found that two hoops had come off a cask of rape oil, and that from 20 to 30 gallons of oil had leaked out of it. No blame is, I think, to be attached to the driver, fireman, or guard of the passenger train, who all seem to have done their best to stop their train when they found it unexpectedly overrunning the home signal. The Bishopbriggs station-master also, in my opinion, displayed great want of judgment in not at once, on the occurrence of the first collision, endeavouring to ascertain the cause of the mineral train having so far overrun the home signal, before allowing the signalman to give the special signal for the passenger train to leave Lenzie. There was a fair amount of brake power on the passenger train, but it is still quite possible that, had continuous brakes on the whole of the eight vehicles, instead of on only two of them, been connected with the engine, the second collision might have been prevented. The absence of a speaking telegraph instrument between Bishopbriggs and Lenzie station is much to be regretted

NOTES AND MEMORANDA.

IN a new galvanic battery, described by Herr Friedrichs in *Wiedemann's Annalen*, a series of inverted bottle-shaped vessels have their necks connected by means of a horizontal tube, into which the exciting liquid—say, dilute sulphuric acid and bichromate of potash—flows through a flexible tube from the lower part of a jar, which is raised or lowered to fill or empty the vessels. The liquid can also be let off through a cock at the further end of the connecting tube.

A TEST piece cut from the head or runner of a gear wheel casting by Hadfield's Steel Foundry Company, and neither forged nor rolled, has been bent to an angle of 180 deg. without the least fracture. Lieut. Milligan, of the U.S. Navy, claimed that the bending cold through an angle of 116 deg. without trace of fracture of the test-pieces of steel castings from the rudder frame of a U.S. gunboat showed American steel makers far ahead of anything ever turned out abroad, but this claim is in advance of the facts.

La Nature has recently described and illustrated a steam tricycle designed by MM. Roger de Montais and L'Héritier. It states that the machine will go 9 to 11 miles per hour with one person, and 8 to 10 with two. In front is a small petroleum-heated boiler, and a petroleum reservoir is placed under the seat, holding 10 litres, and said to be enough to last ten hours. A water reservoir, which holds 34 litres, is mounted, carrying a supply for two and a-half hours. Exhaust steam passes into one part of the tank from a small vertical engine.

THE velocipede has arrived at a state of great perfection as a machine now, as shown by recent performances. Messrs. Allard and Oxborrow, at Coventry on Tuesday, surpassed recorded achievements in tricycle riding. The pair, who were the previous holders of the best time up to 10 miles, completed 20 miles 715 yards in the hour, 21 miles occupying 61 min. 43 sec., the present best time for this distance being 67 min. 1⅜ sec. Going on, 25 miles were compassed by the riders in 73 min. 42⅜ sec., this beating the previous best time by 6 min. 25½ sec.

IN a paper "On the Composition of Water by Volume," read at the British Association meeting by Mr. A. Scott, the author says that from various preliminary experiments he was led to conclude that the relation of oxygen to hydrogen in water was not accurately represented by the numbers 1 : 2. Subsequent experiments proved this to be the case, and it is remarkable that narrow risks of being fearfully wrong have for a long time been run, and happened to make no difference. The experiments gave the ratio 1 : 1·997 with small variation; 1 : 2 is therefore wrong by nearly three one-thousandths of one part.

IN a paper on "The Metallurgy of Bismuth," Mr. E. Matthey (*Proc. Roy. Soc.* 42) describes how, in order to separate gold and silver from bismuth, he adds 2 per cent. of zinc to the molten metal, allows the mass to cool gradually, and removes the surface crust. This process is repeated. The whole of the gold and silver is found in the skimmings. The bismuth litharge so obtained is fused in a crucible with borax. The gold sinks to the bottom, being at the same time freed from any base metals by the action of the bismuth oxide. The slag is again fused with addition of bismuth to separate the last traces of gold. The author separates bismuth from lead by means of repeated crystallisations, alloys of bismuth and lead melting at lower temperatures than bismuth itself. Bismuth holding 12 per cent. of lead contained only 0·4 per cent. after four crystallisations.

A RECENT paper by W. Hempel gives the results of analyses of samples of air simultaneously collected by himself in Dresden; by Kreusler, near Bonn; by Morley in Cleveland, North America; by Pusinelli in Para—Belem—Brazil, lat. 1½ deg. S.; by Schneider in Tromsöe, Norway, lat. 69½ deg. N. The samples were taken daily between April 1st and May 16th, 1886, the times being simultaneous in all places, and corresponding to 2.12 p.m. at Bonn. Full tables of the results are given. The mean percentages of oxygen for each place were:—Para, 20·92; Bonn, 20·92; Cleveland, 20·93; Dresden, 20·93; and Tromsöe, 20·95. The maximum observed was 21·00 on April 22nd at Tromsöe; the minimum 20·86 on April 26th in Para. The mean percentage of oxygen in the air as deducible from the whole series of observations is 20·93. During the time these observations were being made, the percentage of oxygen was rather greater near the pole than near the equator.

WRITING on the metallurgy of steel, in the *Engineering and Mining Journal* of America, Mr. H. M. Howe says:—"Chromium, even when alloyed with iron, is very readily oxidised. In puddling chromiferous cast iron its chromium is largely scorified, and, by forming a thick slag, prevents the puddled ball from welding—this appears distinctly due to the oxide of chromium in the slag and not to the metallic chromium in the metal. Thus Riley found that adding 11 per cent. of cast iron which contained about 7 per cent. of chromium greatly delayed the puddling of good gray forge iron; the chromium was found in the slag soon after fusion. Equal parts of this chromiferous cast iron and of hematite pig puddled with difficulty, and the slag was so viscid that the puddled balls could not be formed into blooms. The Bessmer process, possibly because its slags are acid, seems less prone to remove chromium than puddling. At one time the acid-Bessemer steel of Harrisburg had occasionally as much as 0·59 per cent. of chromium."

IN the physical section of the British Association at Manchester, a paper was read by Mr. J. T. Bottomley on "Expansion by Heat of Wires under Pulling Stress." The wires were two fine copper wires. One of them carried about half its breaking weight, and the other about a tenth of its breaking weight. The wires were suspended in a tube, a scale being attached to one, and a pointer moving over the scale to the other. Thermometers were inserted into the tube at various points, and the wires were heated by passing steam into the tube. It was found that the more heavily-weighted wire extended much more than the lightly-weighted one. An amount of permanent elongation remained, but more in the heavily-strained wire. Each time the heating was done there was more and more permanent elongation, and ultimately one of the wires was broken under less than its breaking load in the normal state. Further experiments were made with wires which had been hardened, and the final result is that the coefficient of expansibility for heat of copper wire strained by a certain weight is greater than that of similar wire less heavily weighted.

IN spite of the depression in trade, the growth of traffic nearly everywhere has been continuous except in a few places, and passenger traffic everywhere. The growth of the continental passenger traffic between Dover and Calais, for instance, has been enormous. In 1854 the number of passengers by this route was only 64,687, but by 1886 it had increased to 215,984. In 1855, when the Paris Exhibition was held, the traffic rose to 80,393; but from this date there was a falling off to the extent of 10,000 per annum until 1862, the year of the London Exhibition, when it suddenly rose to 134,050. In 1867, the year of the second Paris Exhibition, the traffic rose to 200,156 persons. From this date there was a decline to the extent of 50,000 per annum, and in 1870, the year of the Franco-German war, the number was 108,184. In the course of the next seven years there was a gradual increase; and in 1878, the year of the International Exhibition at Paris, the traffic reached the enormous total of 260,603 persons. Again there was a subsidence, the average for the next six years being about 200,000. Last year, as stated above, the total was 215,984; and during the first eight months of the present year 160,782 persons had crossed. In addition to the Calais route, there are three other services daily crossing between Dover and Ostend, and over these routes a considerable yearly traffic takes place.

MISCELLANEA.

A NEW Patents Bill has been passed in South Australia, under which the cost of a patent is much reduced, and a new Patents Bill will probably be passed in Calcutta next session.

THE American *Mechanical Engineer* asks, "What has become of the Marchant engine that was to turn the engineering world inside out?" Shall we "give it up?" or shall it be asked in reply, What has become of the Keeley motor?

ACCORDING to the Berlin Bureau of Statistics there are in the world the equivalent of 46,000,000 horse-power in steam engines, 3,000,000 being in locomotives. In engines other than locomotives the United States comes first with 7,500,000 horse-power; England next, with 7,000,000 horse-power; Germany, 4,500,000 horse-power; France, 3,000,000 horse-power; and Austria, 1,500,000. Four-fifths of the steam engines now in operation are said to have been built within the last 25 years.

THE American *Mechanical Engineer* says:—"Persons are prohibited from carelessly exposing dynamite in public places; but the portable engine, which is scarcely less deadly in the hands of incapable persons, is exempt from supervision. Here is what a reckless man did with one lately:—The boiler of a steam thresher exploded near Flint, Mich., blowing Daniel Striga to atoms, fatally scalding Lyman Curtis and Daniel Newcomb, and badly injuring several others, among whom were three young ladies. A fire then broke out, destroying several barns and the season's crops."

THE Colorado Coal and Iron Company gives the following figures as the result of its operations for the year 1886. The output of pig iron, however, is the result of only five months' running, and the steel rails that of only four months' operations. Coal, 615,360 tons; coke, 112,200 tons; pig iron—five months' running—9323 tons; spiegeleisen, 982 tons; steel rails—four months' run only—5872 tons; merchant bar iron, 4240 tons; castings—for their own use only—621 tons; cast iron pipes, 995 tons; nails—kegs of 100 lb. each—53,250 tons; railway spikes—kegs of 150 lb. each—3370 tons.

THE Manchester Waterworks Committee have found themselves in a position to resume the full supply of water to consumers. The Committee have resumed the constant supply at the earliest moment consistent with the prudence and forethought which the circumstances demanded. During the early part of last week some heavy rains fell in the gathering ground, and replenished the reservoirs to an appreciable extent, and the springs are also yielding an increasing quantity of water. Calculating on a continuance of the present yield from the latter source, it is estimated that there is a fifty-four days' supply.

IN a report on the circumstances attending an explosion which took place in an incorporating mill at Lowwood Gunpowder Works on the 6th September, 1887, Major J. P. Cundill, R.A., inspector of explosives, says of the cause of the accident, "A large amount of dust from the powder charges which had accumulated in the upper portion of the mills had not been removed by the washing out process as it was applied, and if it had become damp by dripping from the roof boarding, it had had a week in which to become at least partially dry again. This dust formed considerable incrustations, which caught fire from the spark struck by the hammering (at keys in a crown wheel with the object of removing the wheel), and gave rise to a sufficient body of flame to inflict fatal injuries on the two unfortunate men who were detained in a sort of trap, as it were, between the roof and crown wheel."

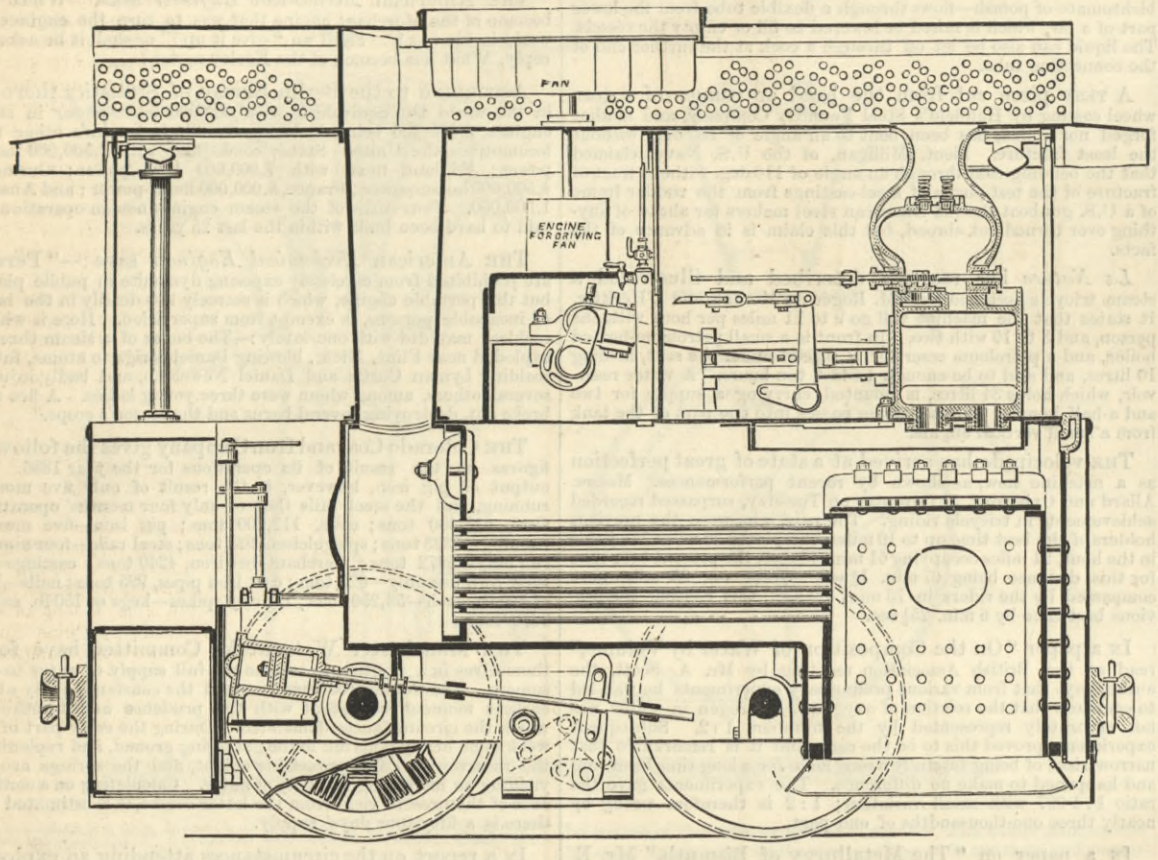
THE Dalton-in-Furness Local Board at their last meeting decided to adopt the gas made under patents of Mr. Hugh Williams, C.E., of Messrs. Andrews and Co., engineers, Reddish, Manchester, for lighting their district. The plant consists of a producer, gasholder, and carburetter. The producer is similar to a small gasholder and tank. The tank is filled with dilute sulphuric acid; and on a perforated tray inside the holder scrap iron is placed. The hydrogen gas thus generated is conveyed by a pipe into the carburetter, where it enters into combination with one of the tar oils, and passes into the service pipes as a highly luminant carburetted hydrogen gas. The gas is stated to be of 65-candle power, and to cost 15s. 5d. per 1000 cubic feet; but this estimate of the cost is by a journal which assumes the scrap iron to be worth 35s. per ton, sulphuric acid 40s. per ton, and light petroleum spirit 8d. per gallon, making the cost for iron 2s. 5d., for acid 5s., and for carburetting oil 8s. The first and last of these materials may certainly be obtained at less than the prices mentioned.

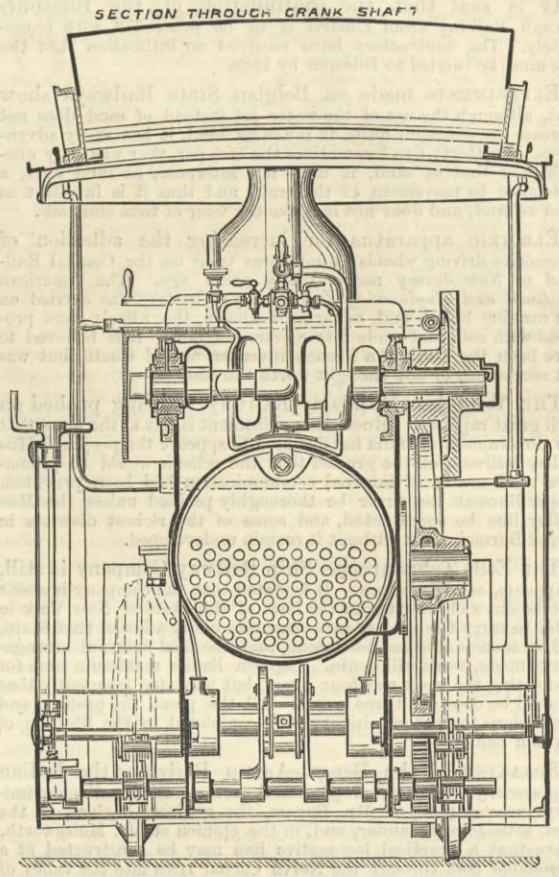
WRITING on the October temperatures, Mr. Wood seems to be ignorant of the meaning of the much-used expression, degrees of frost, for he expresses the hope "that the expression 'degrees of frost' be abolished." He says: "It is absurdly incorrect. There can be only 1 deg. of frost—that is, the point at which water becomes ice. It would be equally accurate, or rather inaccurate, to speak of 220 deg. Fah. as 8 deg. of boiling as to speak of 20 deg. Fah. as 12 deg. of frost. Besides, it leads to endless confusion. An observer reports 10 deg. of frost, and his hearer reports that the thermometer has been down to 10 deg., and so on." A hearer who would report this knows just as much, or as little, when he has heard it as he would if he had been told that the mercury in the thermometer stood at 10 deg. below the freezing point, and Mr. Wood is like many others, who want to alter the terms immediately they have grasped their meaning; but he is quite as inaccurate in saying that there can only be 1 deg. of frost as is the unpretending and unscientific observer when he says there are 10 deg. of frost, for if the freezing point be 32 deg. Fah., then any temperature below that is not the freezing point; 31·5 deg., for instance, is half a degree below the freezing point, and if we may call that half a degree of frost, then we may equally speak of 10 deg. of frost. Moreover, water may be lowered in temperature to below 32 deg. without freezing; and again, the term frost as used by the world and not by the *quasi* accurate few, means a state of atmospheric coldness or absence of heat of greater or less range as expressed by any term representing intensity or by thermal degrees.

THE monthly meeting of the Stockton and Middlesbrough Corporations Water Board, recently held at Middlesbrough, brought to light several matters of considerable importance. The quantity now pumped from the Tees at Broken Scar, for manufacturing and domestic purposes, has reached an average of 61½ million gallons per week, which is above the old, and nearly up to the new, parliamentary limit. The expenditure on capital account for the half-year ending August 13th was £43,276 11s. 8d., which brings up the total cost of the undertaking to £1,191,837 8s. 6d. The principal works of magnitude now on hand are the Hury reservoir and the Sadberge reservoir; a conduit from Sadberge to Stockton, and another from Fighting-Cocks to Sadberge; several mains in connection with the new bridge at Stockton; and certain alterations to the pumping machinery at Broken Scar, and to the reservoir at Fighting-Cocks. The revenue for the half-year was £27,262 8s. 9d., or £1409 3s. 10d. more than that of the corresponding half of 1886. This is attributed to a difference in the number of empty houses in the two principal towns within the domain of the board. The expenditure on revenue account was £26,426 2s. 5d., or £252 4s. 8d. more than in the corresponding portion of last year. A sum of £20,559 17s. 2d. has been declared available for disposal, and payments to that amount have been made to the two corporations and the South Stockton local board. At the Hury reservoir the fine summer has enabled the contractors, Messrs. Walter Scott and Son, to make great progress with the work in hand, and the puddle wall has at last been commenced. The reservoirs at Fighting-Cocks and Sadberge are both making satisfactory progress, and the former will be completed in a short time. The Sadberge and Stockton conduit is finished as far as the village of Hartburn, two miles from the last-named town.

GREIGS TRAMWAY LOCOMOTIVE.

MESSRS. AVELING AND PORTER, ROCHESTER, ENGINEERS.





GREIG AND AVELING'S TRAMWAY ENGINES.

The above engravings illustrate a new form of tramway locomotive, made at the works of Messrs. Aveling and Porter from the designs of Mr. Alfred Greig and Mr. T. Aveling. The object has been to provide a small, powerful, easily-handled condensing engine for working street traffic, and to prevent constant and costly repairs by avoiding the use of underneath engines, side-rods, and small wheels. These things the designers have done, and the locomotive has been running very satisfactorily for several months on the Southwick Tramway, and has shown that it has so far overcome certain difficulties which beset steam tramcar locomotion.

The boiler is of the locomotive type—of steel plates. The tubes are 1½in. diameter, beaded at the fire-box end with Wicksteed's tube-beader. The total heating surface is 148 square feet, and the grate area five square feet. The working pressure is 180 lb. Ordinary gas coke is burnt as fuel. For so small a compass the boiler has very large steaming capacity, and when the coke fire is attended to at the end of four to six miles' run, it needs for the time no further attention.

The engine has two cylinders of 5½in. diameter and 10in. stroke—cutting off at three-quarter stroke. These are placed on the top of the boiler as in an ordinary traction engine. The valve-chests are outside, and the valves are very easily got at. The cylinders are jacketted, and are worked without lubricant.

An important feature of this engine is, of course, the driving gear. A pinion on the crank-shaft 9in. diameter gears into an intermediate wheel 3ft. 4in. diameter, running on a stud axle on the side of the boiler, as shown. This in turn gears into a toothed wheel, 2ft. 3in. on each of the driving axles, which are 4in. diameter. Thus all the wheels are driven without the necessity of coupling rods, and this, especially on such flinty, dusty roads as those at Southwick, effects, it is claimed, a great saving of wear and tear.

Another feature of the engine is the spring gear. Springs, in the ordinary sense, are not used, but the engine runs on a new form of wheel, with spring tires. They are 3ft. diameter. By the use of spring wheels, horn bars and sliding axle-boxes are avoided, and each wheel can give independently of the other and follow the inequalities of the road. Full drawings of the wheels cannot yet be given, but it will be seen that the strong spiral springs are used radially and circumferentially between a pair of discs which hold the tire.

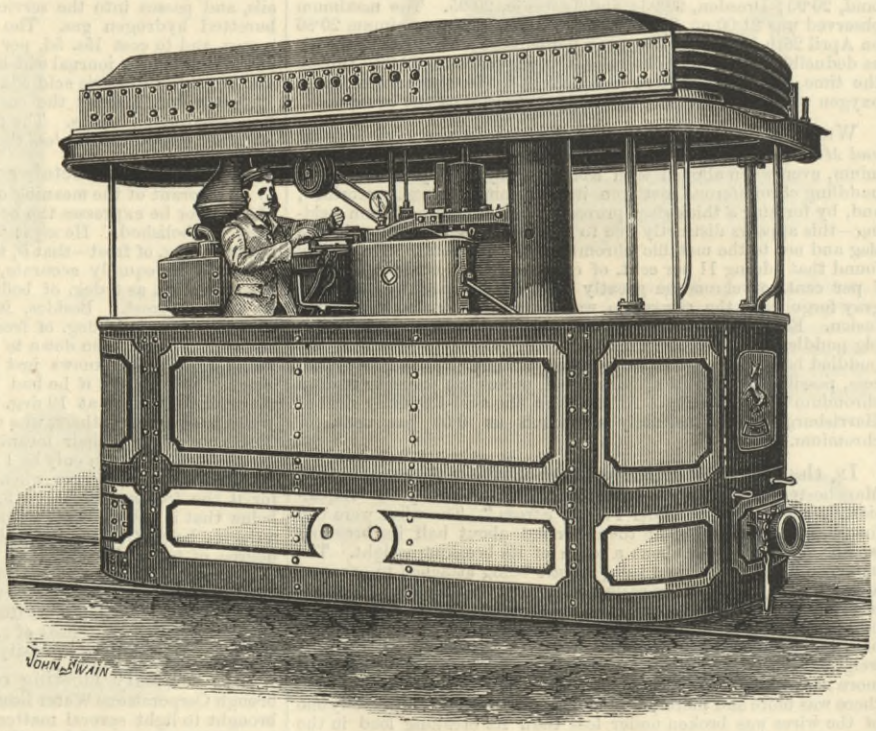
In the condenser there is also a novel feature, namely, the use of a horizontal fan of the Blackman type. This is so placed that it draws air in from the two halves of the condenser, and in forcing it outwards and upwards in a heated condition produces an induced draught up the chimney, which is of some advantage. The exhaust steam is first directed from the cylinder into a tank, which not only allows steam to expand, but also takes any excess moisture or priming from it before it gets into the condenser, which is composed of 1in. diameter copper tubes placed on roof and running transversely to the engine. By using the fan the tubes of the condenser need not be perfectly steam-tight, and they are therefore merely pushed tightly into the longitudinal rectangular tubes forming the condenser sides. The surface of tubes is 208 square feet. The water from the condensed steam and remaining steam, should there be any, pass into a second tank, the steam from this passing up the chimney. To this tank is fixed the pump for supplying the boiler. There is also an injector for feeding the boiler, which takes its supply from a cold water tank.

The engine has in a somewhat more simple manner than usual the hand and steam brake-gear, and the automatic arrangement for shutting-off steam and applying the brake at nine miles an hour.

A speed indicator, driven from the crank shaft, is attached for the amusement of somebody, and helps to make up the complex jumble of ironmongery insisted upon by the Board of Trade rules. As shown in our perspective engraving, the engine is most easily and perfectly under the control of a lad who stands in the centre and has everything under his eyes and within hand reach. The Board of Trade will ask for the duplication of all the regulator and reversing and other levers, placing them at each end of the engine, which is the proper place for the driver.

The engine-wheel base is 4ft. 6in.; gauge, 3ft. 6in.; total width, 5ft. 8in.; length, 11ft. 6in.; height, 9ft. 6in.; weight in working order, 10 tons.

It is claimed for the engine that it has several advantages — The moving parts completely away from dust and dirt; that they are in sight of the driver; that it has no coupling rods; no sliding axle-boxes; that it is a small and compact engine, and that it works with an entire absence of smoke and steam, almost without noise, that it can be built and maintained at much less cost than usual, and that the high piston speed facilitates stopping and starting, a very desirable thing on lines where this occurs so frequently as on street tramways. The engine was passed for passenger traffic by Major-General Hutchinson on Tuesday, the 4th inst.



Death of Professor Kirchhoff.—Professor Kirchhoff, the celebrated physicist and discoverer of the spectrum analysis, died on Monday morning in Berlin. For some years back he had been ailing, but his end came rather unexpectedly. He was born at Königsberg in 1824, and had therefore only reached his sixty-third year. It is now exactly forty years since he entered the University of Berlin as a *privat docent*, and in 1850 he was called to a chair of physics at Heidelberg, where, in company with Bunsen, he carried on those researches which at last resulted in the discovery that at once raised him to the first rank of natural philosophers, and opened a new era in the history of chemical analysis. In 1875 Professor Kirchhoff went to Berlin, where he was made a member of the Academy of Sciences.

MASON'S LEVER CRACKING MOTION STONE BREAKER.

The advantages claimed for this machine—illustrated by the engravings below—over all other lever stone breakers is that it dispenses with the complications known to exist in other machines of its kind, besides having fewer wearing parts. The movement of the jaw is caused by a lever, instead of a toggle joint. It is claimed that it will not alter its movement from what it is set to, so there is no fear of breakages by the jaw gaining too much movement through wear. It also has several kinds of movements for different kinds of work on hard and soft stone, as it is well known that twice the movement is required to break soft stone that suffices when breaking hard stone to get a quantity through. This is done by changing the toggle plate with the different grooves between the bottom of the lever and the swing jaw. The distance between the fast and swing jaw is regulated by the adjustable toggle plate, or by the sliding-bearings in the side of the frame. This machine can also be changed to granulate, so that it will do any kind of work it is possible for a stone breaker to do.

Fig. 1

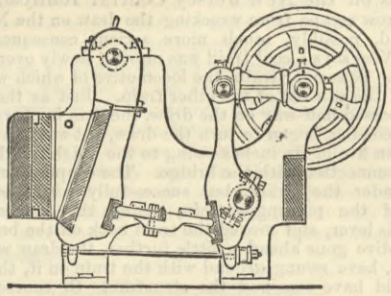


Fig. 2

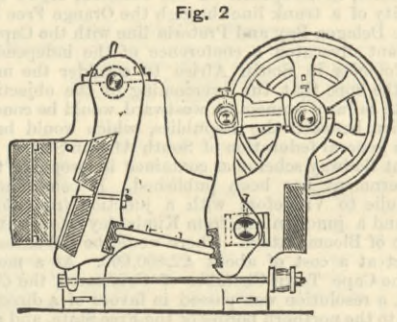


Fig. 1 shows the machine adjustable by a sliding bearing on the side of the frame. In Fig. 2 the adjustment is made by the toggle plate.

Cast Steel Anchors.—We are requested to say that in our report last week under this head the anchors from which the tests given by Lloyd's Committee were obtained were Wasteneys Smith's patent, of which, as stated, upwards of 1000 had been made without one instance of failure.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—William George Parsons, chief engineer, to the Excellent, additional, for torpedo and hydraulic instruction, to date October 1st; William Olive, staff engineer, to the Téméraire, recommissioned October 20th; Thomas A. Morris, chief engineer, to the Lily; William G. Parsons, chief engineer, to the Ready, additional, and for appointment, when recommissioned, to date November 1st; John A. H. Hicks, engineer, to the Téméraire, recommissioned, to date October 20th; Henry W. Metcalfe and Victor E. Snook, assistant engineers, to the Audacious, additional, for disposal, to date October 18th; F. D. Thompson and Thomas H. Pounds, assistant engineers, to the Bacchante, additional, for disposal, to date October 18th; J. H. D. Barry and Walter J. Kent, assistant engineers, to the Bellerophon, additional, for disposal, to date October 18th; James W. A. Parrott, Charles A. Moore, and Alfred R. Pattison, assistant engineers, to the Téméraire, recommissioned, to date October 20th; Henry Laughrin, staff engineer, to the Conquest, to date 17th October; William C. Fincham, engineer, to the Canada, to date 17th October.

THE LEVER DYNAMO AND LAMP.

Fig. 3

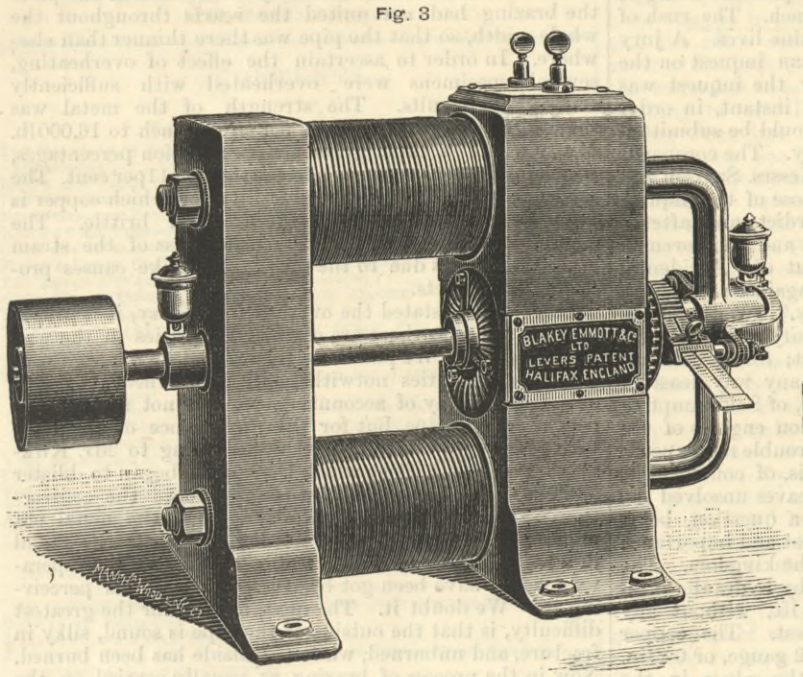


Fig. 1

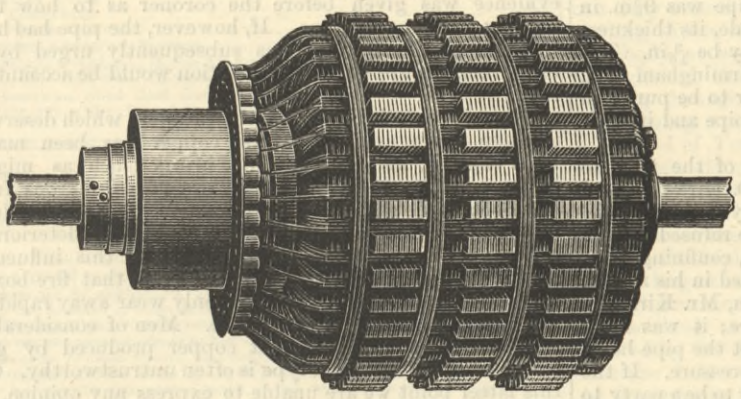
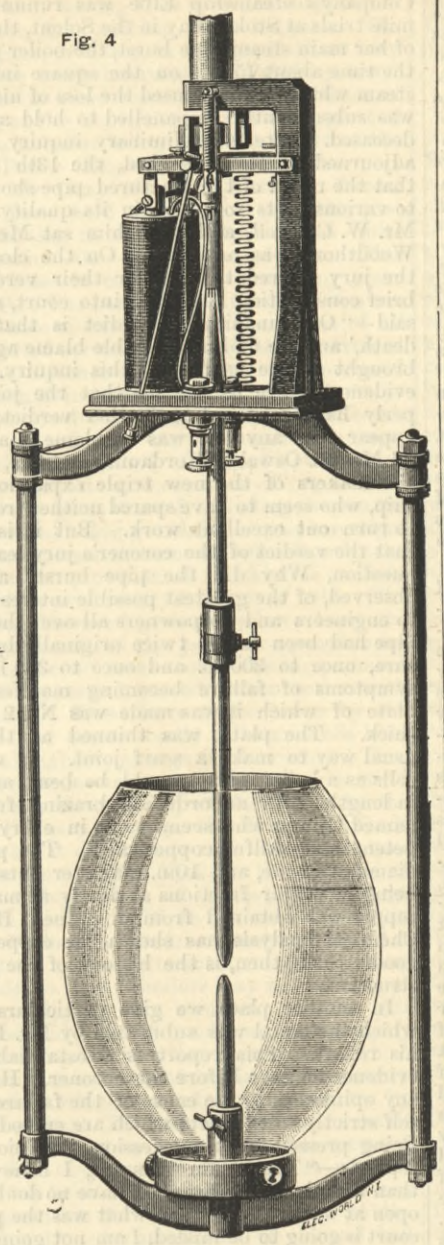


Fig. 4



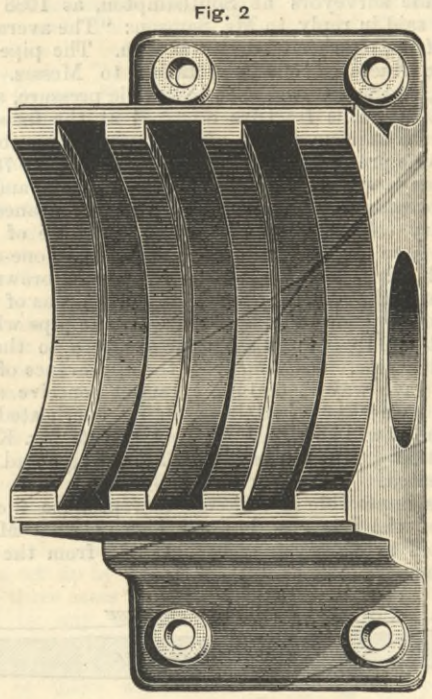
THE "LEVER" DYNAMO AND ARC LAMP.

The machine illustrated by the accompanying engravings is a continuous current dynamo, a feature in which is the use of grooved pole-pieces in the field magnet, and an armature with projecting teeth which revolve in these grooves. By this means the surface of the iron of the armature, which rotates in close proximity to the pole-pieces, is considerably increased, with dynamo-magnetic advantages, which are sufficiently appreciated to need no exposition. Fig. 1 shows the armature, which is of the Paccinotti type, with the projecting teeth, although the invention is also applicable to other well-known types. When the laminated plates are slotted some of the teeth are longer than the others in a radial direction, and when all the plates are put together the longer teeth revolve in the grooves of the pole-pieces, one of which is shown in Fig. 2. Fig. 3 is a view of the dynamo complete. The field magnets are massive and strong enough to overmaster the armature at all times. The dynamo takes up little floor space; the brushes can easily be got at. For larger machines a different design is introduced. The machine has a high efficiency of conversion.

The new type of lamp, illustrated in Fig. 4, has a solenoid in lieu of the electro-magnet in the older type. No glycerine is required in this lamp. The solenoid plunger fits nicely, but freely, in the brass spool of the solenoid, and when it descends there is a slight compression of the air within. A brass link is connected to the plunger and lever, the lever being free to move on a pin fixed in the upright arm of the lamp frame. A spring, adjustable by a nut on the lever, and held at the top by another pin fixed in the frame, draws up the lever into its normal position. The hollowed clutch, surrounding the upper carbon-holding tube, is held by its arms in two sleeves, one fixed to the lamp casting, or frame, and the other movable with the lever. The upper carbon-holding tube slides freely through bearings in the lamp frame, and is protected by an outer brass tube, screwed to a bush at the top of the lamp. By means of this outer tube the lamp is suspended. The thin copper strip, shown in the illustration, transmits the current to the upper carbon. The solenoid is wound with fine wire, and is in a shunt circuit to the carbons. When the current is sent into the lamp, the solenoid powerfully attracts the plunger, lowers the lever, and releases the upper carbon, until the carbons make contact. The spring then overpowers the solenoid, raises the upper carbon, and the arc is struck. As the carbons burn away, the shunt solenoid gradually lowers the lever until the lever is horizontal, when the feeding point is nearly reached. In fact, an equilibrium is established between the attractive forces of the solenoid and spring, and when the arc increases in the slightest degree, the solenoid gradually allows the upper carbon to slide through the clutch, when the spring again arrests further descent, and so on until the carbons are consumed. The regulator is so sensitive that it is only with the most careful attention that the feeding can be seen. The lamp will give a very steady light with cheap American carbons.

An automatic "cut-out" is provided with each lamp, as shown on the farther side of the solenoid. It simply consists of an electro-magnet wound with two layers of coarse wire, one end being connected to the core of the magnet, and the other to the resistance strip and to the negative terminal. The core of the magnet is insulated from the frame, and a flat-headed iron screw passing through the lever comes over the magnet core, but is so adjusted that it will not touch the core until the solenoid has drawn the lever past the feeding point. This would take place if the upper carbon holder stuck, and the lamp failed to feed, and when the flat-headed screw made contact with the core the lamp would be cut out, the current passing through magnet core, its coils, and resistance. The cut-out magnet would continue to hold down the lever so long as the lamp failed to feed, but as soon as the carbons again make contact the spring overpowers the magnet, draws up the lever, and the arc is re-struck. It will be seen that the lamp is automatic in all its functions. The slanting brass wire passing

Fig. 2



through the lever and frame is used in trimming the lamp. By pulling the little knob underneath the frame at the left-hand side, the lever is lowered and the upper carbon holder released.

The Severn, one of the new fast cruisers of the Mersey class, has been added to the active list of the Royal Navy. The Severn, which was launched on September 29th, 1885, is built of steel and has a displacement of 3550 tons, and is fitted with machinery of 6000-horse power, which is capable of propelling her at a speed of 18 knots per hour. The Severn is unarmoured, but is fitted with a steel protective deck. She carries a very formidable armament, consisting of two 8in. long range breech-loading guns, and ten 6in. breech-loading guns, mounted on Vavasseur fittings, three quick-firing guns, and a strong equipment of machine guns. She is also fitted with four tubes for discharging Whitehead torpedoes. The Severn is lighted throughout with the electric light, and is fitted with steam capstans, steam steering gear, and all the latest improvements in shipbuilding science. The cost of the Severn is about £240,000. She is to be placed in the first division of the Medway Steam Reserve, and kept ready for active service.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

Australia: Forest culture in New South Wales.—The United States Consul at Sydney reports:—The Government of New South Wales has for many years been duly impressed with the necessity of taking active steps for the preservation of the useful timber trees of the colony. The soft, straight-grained woods, except in inaccessible places, are well-nigh exhausted, other trees are becoming scarce, and vast forests of one particular kind of tree are unknown in the colony. The report enters into the subject fully, and gives details of areas under forests; common forests and privileges of population in them; destruction of forests—causes and results; exports of timber; forest laws; forest planting, bounties, methods, schools, &c.; functions and organisation of Government Forest Bureau; imports of lumber from the United States; reclamation of sand-dunes or waste places by tree-planting; revenue from Government forests, cost of management, &c.; sources of timber supply; timber regulation; trade in lumber.

China—Upper Yangtze steam navigation.—The United States Minister at Pekin, writing about the Upper Yangtze Steam Navigation Company, of London, remarks:—The only difficulty which may present itself, after the question of navigating the upper river has been solved, is the position the Chinese Government will take. The possibility of this port—Chunking—has caused no pleasure to the Chinese authorities, and their further action in the matter is looked for with some anxiety. I have heard that when the French plenipotentiary in China was negotiating the commercial treaty for Tonking, he endeavoured to obtain the right for France conceded to Great Britain by the Chefoo Convention to send a commercial agent to Chunking, but the Chinese Government peremptorily refused. I have also heard it stated that the concession contained in Section 3 of the Chefoo Convention, allowing British merchants to open establishments or warehouses, or reside at Chunking, so long as steamers have access to the port, was only made by China under the impression that steam navigation on the Upper Yangtze was an utter impossibility.

China.—Prospectus of railway company.—The United States Minister at Pekin sends a report on the proposed Chinese railway company, an extension of the Kaiping Railway, which has been in operation for some years. In 1886 the Kaiping Railway Company undertook to construct a railway from Hsü Ko Chuang at Táng Shan to Yen Chuang, on the River Chi, and raised a capital of £62,963, in 2500 shares of £25 2s. each. The total length of the new railway is 31·14 miles. Recently the Board of Admiralty submitted a memorial proposing a railway from Yen Chuang to Lu Tái Peitang and the north shore of Taku to Tientsin and other places, the length being 28·68 miles. The memorial was approved by the empress and placed on record. The following statement shows the working returns of the existing railway between Yen Chang and Kaiping:—Annual freightage of coal, £7530; from limestone and sundry merchandise, from £2510 to £5020; from passenger traffic, over £2510. After deductions for working expenses and maintenance, the balance will pay a dividend of 5 or 6 per cent., and if all goes as well as expected, 10 per cent. The line, if extended to Taku and Tientsin, will pass through various landing places of the steamers, salterns, towns, and villages, from all of which adequate freight can easily be obtained, the profit on which will be at least equal to that on the Yen Chuang Kaiping section of the line. The company desires to increase the capital by £251,000, divided into 10,000 shares of £25 2s. each. It is to be noted that in the administration of their affairs this company adhere strictly to economy and efficiency untrammelled by official direction and foreign merchants squandering their capital; but the chief aim will be the establishment of an administrative system that will not relax into remissness, or to exist only in name, as some companies in China have done. Shares are to be applied for at the company's head office in Tientsin, and the money deposited in the Hong Kong and Shanghai Bank of the same town. Although the capital that is now subscribed is intended for constructing the Yen Chuang Taku Railway, yet should the line be hereafter extended, any money on hand will be used for such extension, consideration being taken according to the respective priority of the shareholders' applications. The following are among the regulations of the Kaiping Railway Company:—The object of the company is to construct a railway from Yen Chuang to Lu Tái, Peitang, Taku, Tientsin, and other places, the whole length of the line being sixty-two and a-quarter miles. For the future the name of the company shall be the Chinese Railway Company. Whenever the company have to purchase materials, rails, &c., they will notify the different mercantile firms, so that they may hand in tenders for the same, and the tender offering the best article at the lowest price will be accepted. The company will employ the workmen who built the line at Tángshan, also the villagers dwelling in the vicinity, thereby obtaining men of experience and conciliating the people. The manager and assistant-manager of the Kaiping Railway Company are appointed manager and assistant-manager of this company, which will conduct all its affairs upon true business principles, neither carrying on its correspondence officially nor accepting official seals, neither employing runners nor engaging wei-yuans. In all matters requiring consultation the board of directors shall first be convoked for deliberation, and will communicate their decision to the head directors. The officers of the company will never take action without having received the approval of the board of directors. In all matters pertaining to the appointment of managers, the election of directors, the engagement of employés, the management of finances, the payment of dividends, the re-sale of shares and all other matters, the company will conform to the general laws and regulations of corporations in Western countries. Articles 5—14, &c., in the regulations of the Kaiping Railway Company shall be adopted, and whatever has not been provided for in the above Articles shall be supplied from the laws of railway corporation in Western countries, such as are beneficial to the company and adapted to the circumstances of China being selected. After twelve months from the date of commencing operations, the treasurer of the company shall draw up a detailed statement of expenditure and receipts, and submit copies of the same to the shareholders. A date will also be fixed when the head directors, managers, board of directors, and shareholders shall be convoked to jointly deliberate on the company's affairs, to examine the accounts, and to decide upon the dividend to be paid. Afterwards, a meeting for similar purposes shall be convened yearly.

Colombia, trade of.—The U.S. Consul at Carthagena reports that for years he has been sending reports upon the opportunities for business in this country, and the desirability of American manufacturers sending representatives with samples of their goods, with so little success, that he has arrived at the conclusion that they are either utterly indifferent or are totally occupied in filling orders for other countries. This is especially the case in river steamboats. Repeated attention was called in reports

from this consulate that the American boats were not giving the satisfaction they should. The English-built boats consume less fuel, cost less, and are lighter built, as in the case of the Dique Steamboat Company, running light draught steamers between this port and Honda, the head of navigation on the lower Magdalena river. The first steamer of the company was built in the United States. It ran very fast, but consumed an enormous quantity of fuel, and carried but a small cargo. The second boat was built in England ; it runs as fast as the one built in the United States, consumes half the quantity of fuel, and cost half the money. The result is that American-built boats are at a discount here, and the English boat builders are receiving numerous orders. A machine shop for general repairs would pay well. All repairs to river steamers belonging to this port have to be made at Barramquilla, distant by river 160 miles, at great expense and loss of time. There is an absolute necessity for a sawmill. The city needs lighting by gas, and a contract for such can be made with the authorities of this department of the Republic. The city has not an adequate water supply because the numerous cisterns are kept in bad condition. Drove-wells are almost a necessity. Why cannot a manufacturer of such wells send a representative to drive one? If it prove a success he can procure orders for the putting down of drove wells in this city to the amount of £22,600 in this department. On the savannahs, where a million of cattle graze, from January to April water becomes so scarce that the animals have to be driven sometimes twenty miles to wells, and thousands of them die from thirst. Chemical works for the purpose of making extracts are greatly needed. Good steamboat engineers and mechanics are in great demand ; they can earn from £20 12s. to £30 18s. per month.

Germany.—Trade of Wurtembury in 1886.—The early part of the year was marked by a continuation of the existing depression, which may be ascribed to diminution of power of consumption, international protective customs tariff, uncertainty of the political situation. The first of these influences is caused by the continual fall in the rate of interest abroad, and at home the depreciation of the value of agricultural produce and raw materials, coupled with increased production. The unsatisfactory condition of the consuming power was accentuated in Wurtemburg by the severe crisis through which agriculture is passing. These causes were especially disastrous in the agricultural implement industry and in the retail and wholesale branches of the iron trade. The second cause, extension of the international protective system, and the increase of native enterprise, was especially noticeable in Austria, France, Italy, Russia, and Switzerland, and the result has been to doubly increase the international uncertainty of her declining commerce and trade. Every movement in favour of protective duties, reacts in efforts on the part of each country interested to outbid its neighbours, and the duty, which is by way of protecting a nation, produces a re-action on home prices and causes them to assimilate to international ones. Over competition and consequent over-production is the outcome of the former cause. Manufacturers who worked for the export market now compete for the home market, to the detriment of inland traders, and flood the home markets with goods intended for foreign countries. In many trades the keenest competition to German enterprise is among themselves. The uncertainty of the political outlook and the prevalence of war scares had a surprising effect, especially during the latter half of the year, manufacturers being afraid to undertake large orders, notably in the case of machinery and metal wares. The last six months of 1886 showed an advance on the previous year in industry and trade generally. Wages improved, and in some industries the demand for skilled labour was in excess of the supply. The improvement was attributed partly to the influence of business in the United States, and the corresponding recovery of trade in Canada, England, and France, which countries, with the United States, not only had an impulse towards the consolidation of German internal commercial relations, but offer her a productive field for her export industry.

The market for copper, pig iron, and zinc, has reached the lowest level for a long series of years. Prices were so low that the proprietors of blast furnaces had to conclude a convention among themselves to put a stop to the steady retrogression of business. The Customs dues have no influence on the situation. The fall or rise of prices either in Belgium or England left the prices in Germany undisturbed, because the keenest competition was initiated by the German manufacturers among themselves, with the result of a downfall in prices generally. The Protective Customs' tariffs of neighbouring States, especially Austria and Russia, prevented export of agricultural implements, with the result that the goods were cast upon the home market, where the demand was quite inadequate for the double supply. Cast iron goods were in good demand, though the usual complaints were heard of the tariffs of neighbouring countries. Coppersmiths have plenty of orders, though prices do not improve. The only manufactures which did not secure good returns in 1886 were those who made specialities of small dimensions. There was no demand for locomotives, nor stationary machinery. One firm of machine makers assert that the sale price of goods has fallen 44 per cent. since 1876, while the rate of wages has increased 30 per cent. in the same period. Another firm, at Berg, a suburb of Stuttgart, describes the year 1886 as more unsatisfactory than its predecessor, prices continuing to decline owing to over-production, and to English manufacturers being able to keep up an active competition in such goods as locomotives, rolling machinery, steam engines, &c., notwithstanding the customs dues. In the tin-plate trade the price of the raw material receded further than heretofore, owing to the immense production and energetic competition of English firms, who can undersell their German rivals. In the manufacture of tools the year has been most unfavourable, owing to excessive competition and impossibility of coping with foreign tariffs. In the last ten years wages in this branch of industry have risen while hours of labour have been shortened. The Stuttgart Chamber of Commerce concludes a report on the condition of agriculture and trade with:—"The prospect of lasting improvement would be better grounded could only further exactions in international customs tariffs be avoided, and the uncertainty of market prices, which is the outcome of the protective system, be resumed by an equitable establishment of mutual commercial and customs relations, by an increased certainty and stability of the duration of tariffs, and by a reciprocal return to former conditions."

Some of the lovers of the "gentle art" would like to see a man the American *Mechanical Engineer* refers to as follows:—"A man who has a pond at Little Falls has invented an easy way of catching pickerel from the lake. On one bank he has a pulley, and opposite it a windlass to pull an endless cord run over the pulley. A line with a 'spoon' on the end is fixed to this, and he sits by the windlass and trolls. The water is quiet, and no human being is to be seen by the fish. The rapidity with which they strike is great."

THE ELBE CATASTROPHE.

On Monday, September the 19th, while the Royal Mail Company's steamship Elbe was running her measured mile trials at Stokes Bay in the Solent, the forward length of her main steam pipe burst, the boiler pressure being at the time about 150 lb. on the square inch. The rush of steam which ensued caused the loss of nine lives. A jury was subsequently empanelled to hold an inquest on the deceased. After a preliminary inquiry the inquest was adjourned to Thursday last, the 13th instant, in order that the metal of the fractured pipe should be submitted to various tests to ascertain its quality. The coroner is Mr. W. Coxwell, and with him sat Messrs. Samson and Woodthorpe, as assessors. On the close of the inquiry the jury retired to consider their verdict, and after a brief consultation returned into court, and the foreman said—"Our unanimous verdict is that of 'Accidental death,' and we find no culpable blame against any person brought before us during this inquiry." With all the evidence before us, we see that the jury could not properly have returned any other verdict; for it does not appear that any one was to blame in any way, least of all Messrs. Oswald, Mordaunt, and Co., of Southampton, the makers of the new triple expansion engines of the ship, who seem to have spared neither trouble nor expense to turn out excellent work. But it is, of course, clear that the verdict of the coroner's jury leaves unsolved the question, Why did the pipe burst? a question, be it observed, of the greatest possible interest and importance to engineers and shipowners all over the kingdom. The pipe had been tested twice originally by hydraulic pressure, once to 300 lb. and once to 350 lb., without any symptoms of failure becoming manifest. The copper plate of which it was made was No. 2 gauge, or 0·27in. thick. The plate was thinned at the edges in the usual way to make a scarf joint. It was then bent in rolls as a boiler plate would be bent, and it was brazed in lengths over an ordinary brazing furnace by a man named Gilroy, who seems to be in every respect a competent and skilful coppersmith. The pipe was 9⅝in. in diameter inside, and 10in. diameter outside, its thickness being in vulgar fractions as nearly as may be $\frac{3}{16}$in. The copper was obtained from an eminent Birmingham firm. Chemical analysis has shown the copper to be pure and good. Such, then, is the history of the pipe and its construction.

In another place we give particulars of the tests to which the metal was submitted by Mr. D. Kirkaldy, and his report. This report is substantially one with the evidence he gave before the coroner. He refused to give any opinion as to the cause of the failure, confining himself strictly to the facts which are embodied in his report. Being pressed for an expression of opinion, Mr. Kirkaldy replied:—"The steam pressure, I believe; it was more than the pipe could bear. I have no doubt the pipe burst open at once. I can't say what was the pressure. If the court is going to be misled, I am not going to be a party to it." This, of course, does not throw any light on the matter. It was pretty clear from the first that the steam pressure had burst the pipe. The problem is, why did the steam pressure cause the fracture? On this point the tests to which specimens of the pipe have been submitted throw a good deal of light, as does a careful examination of the fracture.

The bursting strength of the pipe of sound copper was given by Mr. Lawrence Steele, one of the principal Board of Trade surveyors at Southampton, as 1088 lb. Mr. Steele said in reply to Mr. Samson: "The average thickness of the pipe that burst was $\frac{3}{16}$in. The pipe in front of the fractured one was taken to Messrs. Oswald's works, and was tested with hydraulic pressure, and burst at 600 lb. This fracture occurred at the forward part. I saw the uninjured part of the burst pipe subjected to hydraulic pressure, and that portion burst at 780 lb. A new flange was attached to the broken part, and it burst at a pressure at 1140 lb., and the appearance was of ordinary coloured copper. The appearance of the pipe which gave way at 780 lb. was that about one-eighth of an inch from the outside there was a dark brown appearance, and the remainder of the fracture was of ordinary coloured copper. The appearance of the pipe which gave way at 600 lb. showed a similar fracture to that on the exploded pipe. Judging from the appearance of the pipe which gave way at 600 lb., I cannot conceive any other cause than that it had been highly overheated." This opinion, it will be seen, is flatly opposed to Mr. Kirkaldy's view, that gentleman holding that the pipe had not been overheated.

It is impossible in a sketch to reproduce the appearance of the fracture, but an idea of what Mr. Steele intended to convey may be obtained from the annexed diagram.

It does not appear that the copper possessed any strength throughout the dark portion; only the silky skin part remained trustworthy to sustain the pressure tending to rend the pipe open. This goes to show that the pipe was overheated during the process of brazing, but we do not mean to imply that the overheating was the result of culpable negligence on the part of Gilroy, the coppersmith. On this point, it is only fair that we should reproduce his own testimony. After having been cautioned by the coroner, he elected to give evidence, and said he never left the pipe, and when he started brazing he continued the work until it was taken off the fire. He was not aware that during the process of brazing that he had overheated the metal. He did not notice in the least when he was brazing that there was any sign of overheating. After he brazed the pipe he put it on the floor to cool, and filed it down for the purpose of rounding it up, and he chipped off the pieces of spelter that had run over the edge. He was quite sure that he saw no signs of overheating. He could not account for the discoloration in the copper. He was perfectly clear that there were no signs of defect or imperfection in the pipe, or he should have drawn the foreman's attention to it. It will be seen that Mr. Kirkaldy found that in one place the brazing had not united the scarfs throughout the whole width, so that the pipe was there thinner than elsewhere. In order to ascertain the effect of overheating, several specimens were overheated with sufficiently remarkable results. The strength of the metal was reduced from about 33,000 lb. per square inch to 16,000 lb. Mr. Kirkaldy's table gives the contraction percentages, which fall from 51·8 per cent. to a little over 11 per cent. The metal, in short, lost all that ductility for which copper is celebrated, and became "rotten" and brittle. The deduction is, of course, that the brittleness of the steam pipe proper was due to the overheating, like causes producing like effects.

Having thus stated the overheating theory, it is proper to point out that there are certain difficulties in the way of accepting it. We put these forward, although we think that the difficulties notwithstanding, overheating is the only feasible way of accounting, we will not say for the rupture of the pipe, but for the appearance of the fracture. The first difficulty is that, according to Mr. Kirkaldy's report, a heat at which the copper began to blister and show incipient signs of fusion reduced the contraction co-efficient, and tensile strength of the metal not much. A burning heat was needed to impair the metal in a high degree. Was it possible that such a temperature would have been got by Gilroy without his perceiving it? We doubt it. The next, and by far the greatest difficulty, is that the outside of the pipe is sound, silky in fracture, and unburned, while the inside has been burned. Now in the process of brazing, as usually carried on, the pipe lies on a fire much like a smith's hearth ; the outside of the pipe is heated, and the spelter and flux, usually borax, are placed inside. We should consequently expect to find the unburned portion inside instead of out. No evidence was given before the coroner as to how the brazing was actually done. If, however, the pipe had had fuel put inside it, which was subsequently urged by a blast, then the appearance in question would be accounted for.

There is one other aspect of the problem which deserves mention. An analysis of the copper has been made by a chemist, and no trace of injury such as might be supposed to result from the use of sulphurous fuel has been detected. We need scarcely tell our readers that sulphur has a remarkable influence in deteriorating copper. What the exact nature of this influence is is not fully understood, but it is certain that fire-boxes worked with sulphurous fuel, not only wear away rapidly, but that the metal becomes brittle. Men of considerable experience assert, again, that copper produced by gas furnaces of the Siemens' type is often untrustworthy. On this latter point we are unable to express any opinion, as no such untrustworthiness has come under our personal observation. The circumstance that the copper was pure and good complicates the whole problem.

It must not be forgotten that this failure of a copper pipe is in no sense a new thing. On the contrary, the cracking of copper pipes at sea is a familiar occurrence to all sea-going engineers. But hitherto, while pressures were small, a crack did not cause disastrous results, because it did not extend. It served as a warning, and the pipe could be temporarily repaired with sheet lead or canvas, and rope yarn, and subsequently either replaced or patched. But with steam of 150 lb. pressure matters are quite different. A small rent no bigger than a crack in a sixpence will extend with lightning rapidity, the pipe being forcibly torn open. These high pressures are new at sea, and indeed on land, and until more experience is gained, it is only too likely that much risk may be incurred. It appears that engineers and shipowners would not be over cautious if they fitted their boilers with self-closing stop valves, which would operate automatically like safety water gauge fittings. The stop valves on the boilers, too, might, in large ships, at all events, be fitted with appliances by which they could be closed from the deck, or, at least, some place which would be accessible even if a steam pipe burst.

An 11-ton howitzer gun, when being fired at the range of Messrs. Armstrong, Mitchell, and Co., at Silloth, on Saturday, burst, the breech and base part of the gun being blown out. Five persons are said to have been seriously injured.

American Steel Cast Guns.—The bids for steel cast 6in. guns for which appropriations were made at the last session of the United States Congress were opened by Commander McCalla on Tuesday, in the absence of Secretary Whitney. The *Army and Navy Journal* says only two bids were received. It is regretted that there was no bid for a gun to be made of crucible steel as contemplated by the advertisement of the department. Contracts will be made for the two guns for which bids were submitted. It is to be noticed that the percentages of the specifications of these bids do not come up to the present requirements of the Ordnance Department for built-up guns. The following is a memorandum of the bids:—Bid for a complete set of rough bored and turned steel castings for a steel cast, 6in., high power rifled gun, by the Standard Steel Casting Company, 5300 dols. Elastic limit, 30,000; tensile limit, 70,000; per cent. of elongation, 10; per cent. reduction of area, 5; weight of finished gun, 15,000 lb.; length of finished gun, 193·53in. The drawing shows a total diameter 25·5in. at the breech, reduced to 22in. for a distance of 8in., and 19·5in. for a further distance of 12in. in front of the trunnion; then gradually reducing to 10·75in. at the muzzle. The powder chamber has a diameter of 7·5in. 29in. full, thence reducing for a distance of 8·5in., giving a total of 37·5in. for the powder chamber. Bids for a complete set of rough bored and turned steel castings for a steel cast, 6in. high-pressure, rifled gun by the Pittsburg Steel Casting Company:—Bessemer steel, 3300 dols.; elastic limit, 40,000 ; tensile limit, 80,000 ; per cent. of elongation, 7 per cent.; per cent. of reduction of ore, 7 per cent.; weight of finished gun, 11,000 lb.; length, 193·53in.; diameter of powder chamber, 7·5in. The greatest diameter of this gun is 22in. in the rear of trunnion, decreasing to 20·5in. near the breech. The diameter of 19·5 in front of the trunnion decreases in a straight line to 9·32in. at the muzzle.

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Ajax.—*According to existing theory based on experiment, the area must be increased in proportion to the* 1·7*th power of the increase of length; or, in your case, the area so calculated would be* 32*in., and not* 20*in.*

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DEATH.

On the 17th inst., at 26, St. Leonard's-terrace, Chelsea, Robert Hunt, F.R.S., late Keeper of Mining Records, Museum of Practical Geology, aged eighty.

THE ENGINEER.

OCTOBER 21, 1887.

THE BOILER EXPLOSIONS ACT OF 1882.

The fifth report on the working of the Boiler Explosions Act of 1882 contains some facts of interest, although the working of the Act seems to do neither good nor harm. The officers of the Board of Trade continue to make "preliminary inquiries" concerning "explosions" of boilers, stills, heating apparatus, and all things of this order, from a marine boiler to a steam pipe; but nothing comes of the reports or of the recommendations. The reports are published by the Board of Trade, which having thus recorded its growl in accordance with the Act, nothing more happens. The owners of the boilers, or those in charge, if alive, have been "happy to give every information in their power," and the affair ends in some cases with the purchase of another old boiler, or the repetition of the old neglect of the essentials to safe boiler using. In the report of the working of the Boiler Explosions Act for the year ending June last Mr. Gray mentions that "no formal investigation has been held during the year, the preliminary inquiry having in each case been found quite sufficient to determine the cause of explosion. This has also been the case in each of the preceding years during which the Act has been in operation, and in some respects it is of course satisfactory that the causes of all the explosions reported upon should have been ascertained without in any one instance necessitating the increased expense which a formal investigation before two Commissioners would have involved. But, on the other hand, this fact has been attended by one serious disadvantage. By the terms of the Act a court of formal investigation has power to order the costs and expenses of inquiries or investigations, 'or any parts thereof, including therein the remuneration of persons holding such inquiry or investigation to be paid by any person summoned before it or by the Board of Trade,' but no provision of this kind is made in cases in which only a preliminary inquiry is held. The consequence is that however gross may have been the neglect or mismanagement of the person responsible for the explosion, there are no means of enforcing payment of any part of the expenses incurred in connection with preliminary inquiries. These have to be borne by the Government, while the person really to blame finds himself exempt from all liability as regards the costs." This, of course, explains to some extent the barrenness of results which attends the working of the Act. As the outcome of a preliminary inquiry, the Board of Trade can only record what it did in any case in a report concluding with a comment by Mr. Traill on the badness of somebody or something. This, of course, ought to be altered, and there surely ought to be no difficulty in putting through Parliament an amendment of the Act empowering existing authority to act upon the report of the Board of Trade, so that offenders may not be exempt from costs their negligence has incurred. As the Act stands, it cannot be said to be of much use, for certainly no good comes of making and printing reports upon which no action is taken; and amendment is the more necessary because the explosions which have obvious causes are by far the largest in number. They are most often the result of negligence or parsimony by some person or persons, and so long as this largest class of offenders are not affected by the Act it is practically a dead letter as far as concerns better provision for the safety of the public. At the present time the persistent users of old and bad boilers and fittings, and the employers of low-waged and incompetent attendants, can say of the Board of Trade reports that they amuse the writers and do not hurt them. This surely calls for remedy. Is it, for instance, in spite of all law, to remain not only possible, but common, for parsimonious steam users to run such risks as those run by the owner of the boiler of a portable engine used at Kettering for sawing, and which was thirty-four years old, and worked until shortly before the explosion in February last at double the pressure it was intended for when quite new? This ancient, overworked boiler held on as long as it could, but when it did give way it became a complete wreck. Take again the risks run by the owner at Weston Conney, Staffordshire, who employed an engine in chaff-cutting until February last, the boiler being reported "completely worn out, safety valve very defective, and the only means of feeding was by pouring water through the safety valve orifice before steam was raised."

The report mentions that during the year 1886-7 preliminary inquiries were held in thirty-seven cases, in which twenty-four lives were lost, which is less than in any of the five years of the working of the Act except 1883-4, when forty-one cases represented eighteen lost lives. During the first year of the working of the Act, 1882-3, there were forty-five cases examined; in 1885-6 fifty-seven were examined. There was thus a considerable decrease in the number last year. One of the thirty-seven of the year 1886-7 was a tramway locomotive working on a line owned by the Woodland Colliery Company, and of it the report states that it "was the seventh boiler made by the same firm which has exploded from the same cause, *i.e.*, grooving at the longitudinal seams, since the passing of the Act." The inspector who reported on the case attributes the grooving to the bending action set up by the use of lap joints. None of the boilers in three cases we have referred to were insured or inspected by any boilers' insurance company, but in five cases out of the thirty-seven the boilers were under such inspection; but the report says that only in three of these would more thorough inspection have revealed the defects. The five insured cases included collapsed furnace flues of one Cornish and of one Lancashire boiler, one collapsed fire-box of a vertical boiler, one explosion of a stop valve chest, said to be due to the sudden impact of condensed water which had been set in motion by steam from one of the boilers; and one collapsed tube of a tramway engine on the street car line at Blackburn. This killed one man, and the vertical boiler killed two. The most fatal case of the year was that of the explosion of a donkey boiler on board the Cartago Nova in November, 1886, of which the fire-box collapsed under undue pressure consequent on a defective safety valve, and killed eight men. This boiler had been in 1885 surveyed at Lloyd's, but had not been examined in 1886. It had been deferred for some reason, and the delay probably cost eight men their lives.

As providing statistics and occasionally drawing attention to glaring deficiencies in boiler working or construction, the Board of Trade work under the 1882 Act may be of some use, but unless some method is devised for punishing offenders in plainly preventible cases, the Board of Trade might just as well discharge its officers, cease making reports, and save the taxpayers' money. There is no use in spending money under this Act unless lives can be saved.

THE CALORIFIC VALUE OF COAL.

We very recently and very carefully explained the nature of the processes of combustion and of generating steam. We showed what the theoretical maximum efficiency of coal is; and we explained the conditions which must be observed in designing and working steam boilers in order to get the greatest amount of work out of a given quantity of fuel. Articles similar in character have frequently appeared in this and other journals before; and there is no lack of published information on the subject. In spite of all this, we are still told over and over again that boilers are evaporating fabulous weights of water per pound of coal. In very many of these cases it is obvious that the inventor of the boiler in question, or of some combustion-aiding-smoke-preventing device connected with it, is either deceived himself or is trying to deceive others. But now and then we come across statements of the results of experiments made by highly competent engineers which it is as hard to disbelieve as it is difficult to credit. In one case which came under our notice some months since a boiler was stated to be evaporating 12 lb. of water from about 120 deg. per pound of not very excellent coal. Calculations based on the known thermal equivalent of this coal and of the temperature of the escaping products of combustion showed that the stated result ought to be mythical. However, an independent and extremely careful and competent engineer was called in to test the boiler, and the results he obtained staggered himself. He repeated the investigation without altering the result, and the only conclusion which it is possible to arrive at is that either the boiler primed heavily without giving the smallest indication that it was doing anything of the kind, that less than 12 lb. of air sufficed to secure perfect combustion, or that the thermal equivalent of the fuel used was not correctly stated; that, in other words, the combustion of pound of the coal liberated more than the given number of thermal units. This case is not isolated by any means. We have in several instances heard of as much as 13 lb. of water being evaporated per pound of coal under conditions which appeared to be entirely opposed to any such result being possible of attainment; and yet the statements are made in elaborate form, and by men whose competency and veracity are beyond question. It is well known, for instance, that triple expansion engines have worked with 1·5 lb. of coal per horse-power per hour. Now, the modern marine boiler is not in any way a specially economical steam generator. It is generally hard pushed. The tubes are of large diameter and not very numerous; and we all know that the products of combustion escape very hot indeed. The feed-water is sent in seldom at a higher temperature than 110 deg. Under these conditions, it would appear that the boiler ought not to evaporate more than 9 lb. of water per pound of coal; but 1·5 × 9 is only 13·5, and if we are to take the boiler at 9 lb. of steam per pound of coal, we must rate the engine at 13·5 lb. of steam per indicated horse-power, which is an almost incredibly small figure. Assuming that the engine was perfect within the limits of theoretical perfection possible to a steam engine, and that no losses took place by cylinder condensation, back pressure, &c., the maximum work that could be got out of steam of 150 lb. pressure is equivalent to about 11·8 lb. per horse-power per hour. Deducting this from 13·5 lb., we have only 1·7 lb. per horse-power to cover all losses. We cannot with any approach to accuracy assume that a marine engine uses less than 15 lb. of steam per horse per hour; probably it is more. But 15 lb. of steam is equivalent to an evaporation of 10 lb. of water per pound of coal, which, on the other hand, seems to be excessive under the conditions.

All things considered, while we draw the line carefully between rash statements and very cautious deductions, we are impelled to the conclusion that coal possibly possesses a higher calorific power than has been assigned to it by chemists. There are more ways than one by which its thermal value has been ascertained; but these all in the laboratory depend on the combustion of small, in some instances exceedingly small, quantities of fuel, and it seems to be not impossible that the thermal units developed under the conditions obtaining in a boiler furnace may be diverse from those under which the coal is tested in the laboratory. We put forward this proposition with doubt and diffidence, because the chemist will, beyond question, say that his methods cannot err. So much coal is combined with so much oxygen, and the result must be so much heat. This may be quite true, and yet not affect our proposition. In the laboratory, the coal burned is employed to raise the temperature of a given volume of water, precautions being taken that the whole of the heat generated shall be communicated to the water. The value of the result depends on the accuracy with which this object is secured. But it must not be forgotten that there is in all cases internal work done in the fuel which is not accomplished for nothing, and the work may be greater in proportion in the laboratory than it is in the furnace. We have a complex process in a word, for we have not only to deal with the amount of heat generated, but with the transfer of that heat; and there are certain curious things about the transfer of heat which have never yet been satisfactorily explained, and which we may cite here in order that discussion may throw some light on them.

The nature and action of radiant heat, for example, is very imperfectly understood. It is well known that heat is not a thing, but a condition—that, in other words, it is a mode of motion. Now, radiant heat will pass freely through a vacuum as perfect as a vacuum can be got. If air were present it might be said that the heat rendered itself manifest by causing the motion of its particles. As there is practically no air present in the vacuum, we

are driven to find another explanation, and accordingly it is said that the ether transmits heat just as it does light. This may appear to be begging the question a little; but we may let this pass and assume that the statement is true. How comes it, then, that the further we get away from the source of heat the less efficient are the radiant rays? The answer is, of course, that they are diffused over a larger area. Suppose, however, that there is a limit to the diffusion, but none to the loss of effect—what then? We cannot do better than give an instance to explain our meaning. Many years ago there were on the London and North-Western Railway certain locomotives with abnormally deep fire-boxes. The distance from the grate to the crown plates was little less than 6ft. These engines steamed very badly. There was plenty of draught, and as there was also plenty of room for the mixture of the air and gas, the combustion was nearly perfect. Nevertheless, the engines would not make steam. After many trials with them the grates were raised about a foot up in the boxes, and the engines then made plenty of steam. In the first instance, the fire-box crowns were so far from the grates that the radiant heat was not effective. By bringing the burning fuel nearer to the roof more steam was made. What became of the radiant heat in the first instance? It must be expended in some way or on something. It represented energy, and as such could only be transferred or transformed; it could not be destroyed. It was in the fire-box at first in either case. Why was it not as efficient in the high as it was in the low box? If it was not expended in heating the water in contact with the fire-box crown, then the tube and smoke box temperatures should have been higher with the low than with the high grate, but the converse seems to have been the case. Again, there are certain forms of steam boiler in which the fire is made in a fire-brick furnace outside the boiler, and the flame and products of combustion pass from this chamber to the boiler. We are not now referring to boilers which work in conjunction with iron furnaces, but to special boilers. The scheme has been patented and worked to some extent abroad; but such arrangements are always inefficient to a degree. If any owner, say, of a Lancashire or Galloway boiler, will construct a fire-brick chamber, and putting the grate bars in it, lead the flame and heat from this chamber straight into the furnaces of the boiler, he will find that perfect combustion and no smoke will probably be secured, but that the waste of coal and loss of actual steaming power is very great; and this, although the furnace is so carefully protected with sand or other non-conductors that little heat can be radiated from it. Now in either case, that is to say, whether a pound of coal was burned *in* the boiler or outside it in the furnace chamber, the thermal units set free are the same; why is it that with the chamber the boiler is inefficient and uneconomical? All the heat generated is transferred to the boiler flues in one case as well as the other. How is it that it is wasted in one case and not in the other?

Applying this to the chemical test, it seems to be clear that if the conditions in the steam boiler are more efficient for utilising radiant heat than they are in the laboratory calorimeter, the boiler may give a higher result than theory indicates as possible. This brings us to the principal object which we have in view, namely, to propose that some competent chemists should re-open the whole subject, and, selecting a few typical coals, submit them to careful tests on a much larger scale than has yet been attempted, to ascertain what their true thermal efficiency is. The cost of an investigation of this kind would not be very great, and we have no doubt but that the requisite funds could be easily obtained. There ought to be no more difficulty in obtaining an adequate thermal analysis of a sample of coal than there is in obtaining information concerning the strength of a sample of steel. It has been found of late years that the older methods of testing by simply pulling a bar in two left something to be learned, and often gave anomalous results. In the construction of the apparatus used for testing fuels for heat value there is room for modification and improvement, just as there was in the testing machine. It is, we think, important that new fuel tests should be made under conditions which would give them more practical value. A proof that coal was to a moderate or even slight extent better than it is supposed to be would clear up some obscure points about steam boilers, and establish the reputation for truth and accuracy of observation of some men who would be much the better of this rehabilitation.

SOFTENING WATER BY THE CLARK PROCESS.

In a previous number—Engineer, July 1st, 1887—we commented on the Porter-Clark process for softening water, and its peculiar adaptability for Bristol. That article led to a long and most interesting correspondence, the salient feature of which is that not one of the correspondents speak unfavourably of the system. Why then is it not more widely adopted? We hinted lightly on this in our article, and perhaps we scarcely care to expatiate upon the probable reasons now, but we believe it would be both interesting and useful briefly to summarise the correspondence.

Mr. W. J. Cooper, the analytical chemist, is of opinion that the time for discussing the applicability of the Clark process to the London water supply would come when the present water companies were dissolved, and the whole London service was taken over by a central authority. Perhaps this is placing its possible adoption in a very remote period, and hardly bringing it within the limits of what are called practical politics; but Mr. Cooper nevertheless insists upon the importance of its adoption, especially by the Kent Water Company. Professor Wanklyn, on the other hand, is very much warmer in his advocacy of the system. He points out that with hard water thorough cleanliness is an impossibility, and insists that it is the duty of the chemist to press on the attention of the public the advantages of soft over hard water. Mr. Howatson, who has introduced an apparatus for the Clark process, which is one of several, and overcomes the original objection against the process of occupying too much space, has also contributed a letter. Mr. Howatson's apparatus has been in use with much success at Brussels. He says, "As proof of the advantages to be derived from the use of the Clark process, I may refer to the results obtained by the engineer of the waterworks here (Brussels), and also to the similar experience of a well-known firm of engineers and boiler-makers, who have apparatus which occupies a space of 39in. square by 7ft. high, by which the water is reduced from 29 deg. to 7 deg., with an expenditure of 4½ lb. of lime per day for a 60-horse power boiler." In another case a sugar manufacturer found it almost impossible to continue on account of the hardness of the water at 40 deg. By the lime and soda process the water is reduced to from 4 deg. to 5 deg. He further adds, that on the Continent steam users are not slow to appreciate the advantages of soft water. Another correspondent, signing himself "C. J.," states that Messrs. Bryan, Donkin, and Co., have used a lime and soda process for softening boiler-water, but have never published the details of the process. In a later number there is a very interesting letter from Messrs. Bryan, Donkin, and Co., containing a description of their process, and one from Messrs. J. W. Gray and Son confirming Mr. Howatson's statements, and giving the results of their treatment with water varying from 60 to 90 deg. of hardness, which they reduced to 5 deg. Messrs. Grinson and Co. give an account of a successful application of the Clark process, by themselves, to the treatment of river water for dietetic purposes. This is at Egham. The water is drawn from the Thames, near Staines, above the intake of the London Water Companies; it is reduced in hardness from 15 or 16 deg. to 4 or 5 deg., and then what matters in suspension have not settled out in the time allowed, are filtered through the precipitated chalk that is remaining in suspension. To the question raised by Mr. T. W. Kennard, whether it is possible to treat water by this process, which contains largely mud or sediments in that form, Messrs. J. W. Gray reply that they have found it possible to deal with all waters that have been submitted to them. They add that one of their first experiments in this direction was the temporary erection of an apparatus at a part of the river Thames where the matter in suspension was excessive, and that they received the following report from Mr. Dyer, F.C.S. "The untreated water was thick and turbid, being loaded with mud, of which it contained in suspension 100·3 grains per gallon, of which 18·1 grains was organic matter, and 82·7 grains mineral matter. The treated water was particularly clear, containing less than one-fifth of a grain per gallon of suspended matter."

As will be seen, all these letters are satisfactory, and in praise of the system, a system which has been known and discussed for the last thirty years. The writers are all practical men, mostly engineers who have aided in perfecting the Clark process, but curiously enough none of the gentlemen to whom we referred in an article in which we recommended the adoption of this process in connection with the water supply of Bristol, have afforded any information or explained anything in connection with the question we raised; and yet we venture to think that the professional reputation of these gentlemen is at stake. Either the evidence of Dr. Tidy, Professor Dewar, Dr. Odling, and Dr. Frankland is right, and the statements of our correspondents are wrong, or else the contrary is the case. Are we to assume that the facts in favour of the Clark process are so strong that these eminent chemists feel themselves convinced against their will? If that be the case, would it not be both generous and politic for them to publicly acknowledge their defeat; for we all know that even eminent analytical chemists are, after all, but human, and liable to error. At any rate, their present attitude cannot be said to further in any way the interests of science, and we presume that these are the only interests which these gentlemen have at heart. Either the Clark process is feasible and useful, or it is not. Much depends on definitely settling this vexed question, and when so much is at stake, the interests of the nation as well as those of science, we had hoped that these gentlemen would have come forward and given us their reasons. Perhaps it is somewhat unwise to expect reasons from scientific experts, who generally content themselves with oracular statements; still, we think that in a case of such importance as this, the ordinary forms might have been waived and some condescension shown. As it is, we cannot help feeling that the whole question is left in a very unsatisfactory condition. A sort of ugly doubt oppresses us. Can the gentlemen of scientific eminence have exalted reasons for refusing to come down from their pedestals; are these reasons to be briefly summed up in the words, "We have nothing to say for ourselves;" or is there something more than meets the eye in this ominous silence? At least, no one will dispute the national importance of providing ourselves with a cheap means of obtaining soft water.

We may, in conclusion, refer to the lecture recently delivered at the American Exhibition by Mr. C. E. Parker Rhodes, on "Rivers as Sources of Water Supply," in which he dwelt upon the vast extent to which all over the world man depends upon rivers to supply him with water for domestic and for manufacturing purposes; and speaking of the hardness which characterises most of these waters, he explained, with much force, the great individual and national loss resulting yearly from the great hardness of such waters as the Thames, and the great harm done to domestic consumers as well as to manufacturing and steam-using consumers. He touched various such questions, and urged the necessity of an occasional congress on water supply and purification.

OUR MERCHANT FLEET'S CHANGE.

The official list of the vessels coming into the register of the United Kingdom and the Colonies for the past month shows that the enlarged building, and the diminished loss usually known in the summer and early autumn months have reversed the position since we last commented on it in The Engineer. There were 30 steamships brought on to the register of the United Kingdom for the first time, and it is interesting to glance at these to learn the kind of vessel now being built. The net register tonnage of the 30 was 24,733 tons, and the gross register 38,667 tons. Of these steamers there were 14 which were of less than 350 tons net, and if these vessels—mostly for river use and for special purposes—be taken from the total, it will be seen that there is a fair average tonnage for the others. Indeed, an examination of the list shows that there were 10 whose tonnage was between 2000 and 3000 tons gross, and another was 3920 tons gross. The engine power varies between 4 and 400 nominal. There was added to the Colonial registers in the same month only one steamer other than of wood—of 1183 tons net. Of wooden steamships, 2 small ones were added to the register of the United Kingdom, whilst to those of the Colonies there were 13 added, but they were also of small tonage, 228 tons net register in the total. The sailing vessels added, on the United Kingdom register, were 5 of iron, of large tonnage, 8908 tons in the total, and 24 of wood, of 2126 tons in the total, so that the former class averaged 1780 tons each, whilst the latter were only 88 tons each, and nearly all of the latter class were for fishing and river purposes. Similar remarks apply to the sailing vessels added to the Colonial registers. Coming now to the removals from the registers, we find that 12 iron steamers were removed from the register for the United Kingdom—of 7055 tons net, and 11,752 tons register. There was 1 wood steamer, 27 tons net, removed; 10 iron sailing ships, 10,459 tons net, and 10,775 tons gross; and 33 wooden sailing vessels of 8475 tons net and 8771 tons gross. From the Colonial registers the removals were 2 iron steamers, 545 tons net and 871 tons gross; 2 wood steamers, 70 tons net and 105 tons gross; and 41 wood sailing vessels, 11,620 tons net and 11,889 tons gross. Summarised, then, and taking the gross tonnage more as the measure of the carrying capacity, we find that 58,059 tons were added to the registers, home and Colonial, and 44,228 tons were removed thence. But against the gain is to be set the fact that a larger portion of the tonnage added is for special purpose than is the case with that removed. It it worthy of note that the tonnage added to the Colonial registers was all of wood, except one steamer named; and all the wooden vessels were built outside the United Kingdom except one ship. The home registers show that all the vessels added were built in the United Kingdom, but one steamer had been sold to foreigners and bought back. Out of 30 steamers 22 were of steel and 8 of iron; and out of 5 large sailing vessels 3 were built of steel. These are the chief facts brought out in the register for the past month. They show that there is still a large amount of shipping being built for special purposes, but the total tonnage so added even in this month of usually heavy addition is for the United Kingdom little more than one-half of what was the average for every month of the year 1883. The loss is not changed—and in the present year a much greater proportion has been in the form of vessels which have been broken up—not fewer than 11 vessels having been removed from the register in this method last month. The tendency towards the substitution of steel for iron as the chief material for constructional purposes grows more marked now, and yet in the Colonies especially a not inconsiderable number of vessels of wood is still built. Over a period of months the number of the vessels in the mercantile navy are being lessened, and there is moreover a purgation by the removal of some of the older vessels, as well as by the losses which the sea brings about, and a glance at the fact that there were 31,000 tons of sailing vessels removed last month, and only 15,000 added, whilst the addition of steamships was far more than the loss, is a proof that at present our merchant navy is becoming more and more one of steamships, whilst the sailing vessels decrease in proportion.

NORTH-EAST COAST ENGINEERS.

The address of the President of the North-East Coast Institution of Engineers and Shipbuilders delivered to the members at the annual meeting on Wednesday, the 19th October, may be not unfairly said to be a supplement to his address of last year. Mr. Doxford takes up the question of the amount of work to be done to old steamships to make them efficient. He has procured returns of the work done in re-engining steamers since the beginning of 1886, and shows that seventy-eight steamers have either been re-engined or had old engines altered to the triple compound systems on the east coast, the Clyde, the Mersey, and at Aberdeen, and that the tonnage was 167,306 tons gross. This is estimated at 3 per cent. of the numerical total believed to need the change, and over 5 per cent. of the tonnage. The larger part of the work has been done on the north-east coast. Mr. Doxford also shows that the great bulk of the vessels built or building last year and this year have the triple or quadruple expansion engines. Tables given in the address show that there is a considerable decline in the tonnage of the world in the last year, and that in shipbuilding the tonnage constructed of late shows that we need fear no competition at the present time. With decreasing tonnage and the "possibility of an abnormal demand from America," the outlook for the future need not be discouraging to shipbuilders or engineers. But the demand of five years ago and the high prices must not be expected to be repeated. The question is then asked whether in British shipbuilding there is a keeping abreast of the improvements of the age? It is shown that a large proportion of the tonnage which is built in the United Kingdom is now of steel—a far larger proportion of the total than that of other countries which also build; and the questions of the use of basic steel, of forced draught, and increased piston speed are also dealt with in a manner to show that the shipbuilders of Great Britain are in the van in the use of improvements. The address of Mr. Doxford may be fairly said to be in a more hopeful tone than has at times been heard of late in regard to our shipbuilding industries and their position. But it may be put that it is justified in large degree by the very rapid increase in the freights of steamships which has shown itself for a month or more past, and which proves that the demand for tonnage is now equal to the supply—a change brought about partly by the decrease in the available tonnage referred to, and partly by the need we have for increased importation here, as well as by the enlarged demand of some other countries for commodities. Should that increase in the freights continue, the position of the shipbuilder and the engineer will be more hopeful still.

THE BRITISH WORKMAN IN FOREIGN COUNTRIES.

In a recent article dealing with the causes which seem to have led to certain ill-effects to our shipping trade in the far East, we referred to the tendency apparent among the lower classes of Englishmen to deteriorate when away from the influence of their own country. The remarks we then made have, since we so wrote, received further illustration and accentuation by reports officially made to our Government from various foreign countries. Mr. Archer, Vice-Consul at Porto Alegre, in Rio Grande do Sul, in Brazil, writes that English operatives were obtained for working an earthenware factory in that

neighbourhood. We may presume that those to whom the selection of these men were entrusted exercised every possible precaution to ensure that they should in every way be the most trustworthy to be obtained. Sobriety would be of course one of the chief qualities to be secured, and it is probable that the character of the men chosen was in this respect unassailable. Yet Mr. Archer writes that the conduct of these workmen had been such as to ensure the total failure of the undertaking above referred to, and he further writes that his experience of British workmen in Brazil is very unsatisfactory. "They are generally given to drink, are unsteady, exacting, and overbearing, and are a great contrast to foreigners." He goes on to state that in all the engineering works of Brazil, such as coal mines, gasworks, &c., the British workmen employed are generally got rid of, and their places filled by Germans, Italians, and others. Unfortunately, our own experience but too fully endorses these complaints. We have known in one instance, out of six men chosen with the utmost care in England to fill important posts abroad, and each paid at the rates of £400 and £500 annually, no less than three being dismissed almost within the twelvemonth on account of their drunken habits. Yet these men were selected from quite a superior class of operatives, and were possessed of exceptional skill in their craft. Again, it was but very recently that an engineer of standing was sent to inspect some gold mines in India, the erection of the machinery at which had been entrusted to English artificers who had borne before they left this country first-rate characters. We were told by the gentleman himself that, on his arrival at the mines, he was met first by the foreman of these men, so drunk that he could hardly articulate, and that on further search he discovered the remaining five sub-workmen in even a worse condition. Of course little or nothing had been done, and what had been done was so scamped, that it had to be all done over again by native artificers obtained from local shops, under the engineer's personal supervision. Is it to be wondered at that, with such instances multiplying as they do, foreigners are beating us abroad, even in our own specialities? If some improvement cannot soon be effected in this direction, we shall not fail to find the British workman when abroad deserving of an epithet as opprobrious as is the term "mean white" among the negroes of the Southern States of America.

AN ASSOCIATION OF ELECTRICAL ENGINEERS.

It has been proposed that an Association of Electrical Engineers shall be formed with a view to founding a corporate body whose functions shall be concerted action in all matters in which those are interested who are engaged in the manufacture of electrical engineering machinery, apparatus, and appliances, and in general with the commercial applications of electricity; and also as a means of providing for the desirable frequent meeting of all electrical engineers with the view of discussing subjects of current or particular interest, business questions, or those upon which it is desired that the opinion of the body should be taken with a view to influential action in Parliament or elsewhere. The *Electrician* has called particular attention to the subject, and already it appears that a considerable number of electrical engineers have written in support of the proposal, and of the necessity for an association which shall take the place of a business association instead of one of a scientific character. At the meetings of the Institution of Civil Engineers the trade side of matters are properly kept out as much as possible, and the Society of Telegraph Engineers and of Electricians does this also to a great extent. There are other societies, such as the Iron and Steel Institute, whose discussions and proceedings deal with business questions much more; but what is required is an association which provides the means for carrying out the objects already mentioned, and of providing for frequent meetings at which men can, as at a social gathering, or in body, discuss questions set forth in a programme upon any matter which is exercising the minds of electrical machinery makers, designers, apparatus makers, or those who are engaged in installation work or provision of *matériel* for it. The matters most occupying attention, or upon which discussion may be usefully directed, can often be put before a meeting in ten minutes' speaking, and by men who cannot get the time to prepare formal papers. A properly and vigorously conducted development of the society known as the Dynamicables, but with a more business name, is what is required.

LITERATURE.

London Water Supply: An Analysis of the Accounts of the Metropolitan Water Companies. By Alfred Lass, F.C.A. London: Walter King. 1887.

Mr. Lass's useful publication, giving an analytical view of the financial and other statistics relative to the metropolitan water supply, has now reached the seventh year of its issue. Its pages present an example of painstaking labour, and a model of perspicuous arrangement. This year an additional set of figures is introduced, showing the gross income, expenditure, and profits of the water companies per house supplied. The statutory powers of the companies as to their dividends, and the rates of supply, are set forth in an appendix, including the famous Water Rate Definition Act of 1885, by which the term "annual value" was declared to be synonymous with "rateable value." We may observe that such is not the case with regard to imperial taxation, neither does this famous Act extend beyond the bounds of the metropolis. The new law has palpably affected the revenues of the London water companies, though they are now reviving from the blow so deftly inflicted upon them. Next year Mr. Lass may add to his appendix the Act of the recent Session, prohibiting cutting off a tenant's water supply in cases where the landlord is liable for the rates. This later statute is not calculated to affect the revenue of the companies, neither did they actually oppose the Bill, though they sought to modify its provisions. But they complain that the Act will cause, in some districts, considerable expense and trouble. Concerning the profits of the several companies, Mr. Lass's tables show a remarkable range of difference. Thus, the net profit of the Southwark and Vauxhall Company per 1000 gallons supplied is little more than 1½d., while the New River Company get 5¼d., and the West Middlesex above 6d. These results are arrived at after deducting from the gross profit the amount paid for interest on loans, debentures, and preference stock, in the case of each undertaking. The dividend of the Southwark and Vauxhall Company last year was 6 per cent., while that of the West Middlesex amounted to 10 per cent., in addition to £6014 paid on account of back dividends, and a sum of £29,643 remaining as surplus. The eight metropolitan water companies are now paying more than £142,000 per annum in the shape of rates and taxes, exclusive of income-tax—an amount which represents more than 8 per cent. on the gross income. In addition, water rights, including the annual payments to the Thames and Lea Conservancy Boards, amount to £28,000. The gross income of the companies last year was £1,704,104, or at the rate of 7d. per 1000 gallons, the average per house being £2 7s. 7d. The trading profit per house was £1 10s. After payment of interest on loans and special forms of stock, the net profit amounted to 9·20 per cent. on the ordinary stock and share capital. Such was the average, but the actual net profit on this basis was 10·14 per cent. for the Kent Company, 11·53 per cent. for the New River, and 12·22 per cent. for the West Middlesex, while the Southwark and Vauxhall Company cleared only 5·42 per cent. Going back for a period of six years, we find that water is a little dearer now than it was then, the net water rates having risen by something less than a fifth of a penny per 1000 gallons. Four of the companies, including the West Middlesex, show a decreased rate of charge per quantum. The total capital employed per 1000 gallons supplied shows a decrease in the six years, although the actual amount has risen by nearly £1,500,000, the capital employed last year amounting to £14,180,698. To keep the capital down as low as possible is the object of Parliament; but the companies which extend into the environs of the metropolis must necessarily add to their outlay in order to meet the demand of an increasing population.

ROBERT HUNT, F.R.S.

We regret to have to announce the death of Mr. Robert Hunt, F.R.S. He died at his residence, No. 26, St. Leonard's-terrace, Chelsea, early on Monday, the 17th inst. Mr. Hunt was born at Devonport on September 6th, 1807. His father was drowned with the whole of the officers and ship's company of the Moucheron sloop-of-war carrying despatches, which foundered in the Ægean Sea in the same year. After passing his early years at Devonport, he went to London when about fourteen years of age, and was apprenticed to a surgeon with a view to entering upon a regular course of medical study, but after some years' service his health failed, and he returned to the West of England. In travelling through Devonshire and Cornwall he became a teacher of chemistry and natural philosophy, and subsequently, upon being appointed secretary to the Royal Cornwall Polytechnic Society, he took up his residence at Falmouth, where he remained until, on the invitation of Mr.—afterwards Sir—H. T. De la Beche, he accepted the post of keeper of the mining records in the Museum of Practical Geology, which office he occupied in Craig's-court and Jermyn-street successively until its duties were transferred to the Mines Department of the Home Office in 1883, when he retired from active service. The most important duty performed by this office was the preparation and publication of a volume of Mineral Statistics, which, after a few years of tentative experiment, was elaborated into a complete form about 1853, and thenceforth appeared annually for about thirty years, and usually about six months after the close of the year to which it referred, in which respect it was a striking contrast to the similar returns published in foreign countries, which were often two or more years behind; and not less remarkable was the circumstance that Mr. Hunt's returns were entirely obtained by voluntary effort as the result of his personal influence upon the mine-owners and others at a time when proposals for compulsory returns were everywhere regarded with suspicion and dislike. Much of this influence was due to his extended personal acquaintance with the mines of the country, he having for many years travelled regularly throughout the different mineral districts of the United Kingdom, and also to his extreme kindliness of manner and the readiness with which this great knowledge was placed freely at the disposal of all who sought for information at his office in Jermyn-street. Between 1866 and 1870 he was a member of the Royal Coal Commission, and produced the remarkable volume on the production, consumption, and export of coal, forming vol. iii. of the report of the Commission, a work which was done without intermitting the regular annual volume of general statistics, and with but a small addition to the regular staff of his office.

When living in Cornwall, and during the earlier years of his London life, Mr. Hunt was a zealous investigator of the chemical action of the spectrum, and his published "Researches in Light" is one of the earlier records of systematic investigation in this direction, and among the most important of his discoveries may be mentioned that of the action of light upon chromium salts, which has subsequently been developed in the Woodbury and other methods of photographic engraving. His popular guide to photography, published in 1841, was the first English treatise on the subject, and the "Manual of Photography," which followed in 1851, went through four editions. In 1851 he served as superintendent of the mineral and metallurgical classes of the Great Exhibition, and he filled the same office in 1862. In connection with the former he produced the well-known "Synopsis," which was compiled from notes printed and published between the closing of the Exhibition at night and the opening ceremony on the following morning. He carried on researches on the effect of solar light on plants, and discovered the method of reducing the scorching effect by toning glass with cupric oxide, which principle was adopted with much success in the great palm house at Kew.

In 1855 he undertook the editorship of Ure's Dictionary, and in 1860 published a fifth edition, enlarged from two to three volumes, which was followed by a sixth in 1867, and a seventh in 1875. The latter also in three volumes, but of considerably larger size than the earlier one, was completed by a supplemental volume in 1878. In 1884, shortly after his retirement from active service, he published a large volume on "British Mining," which embodies materials collected during the whole period of his official life and will form an enduring monument of his work.

In addition to scientific or technical works, Mr. Hunt was a considerable contributor to lighter literature. His early "Poetry of Science" was very favourably received, as was also "Panthee, or the Spirit of Nature," a novel with a scientific basis. A later work on the "Drolls, or Popular Legends of Cornwall and Devon," which were mostly collected orally during a pedestrian tour, has appeared in two editions, and forms a standard addition to English folk-lore.

Mr. Hunt was an extremely fluent and pleasant speaker, and in his best years was exceedingly successful as a popular lecturer on physical science. His most important service to education has been the formation of the Miners' Association of Cornwall and Devon, of which he was the secretary and active manager for several years. Probably no similar society has produced such excellent results upon very small means, many of the students gaining worthy success having, through the knowledge acquired in the classes of the Association, risen to places of honour and profit, both in English and foreign mines; while among the former teachers are to be found some of the most prominent mining and smelting men of the present day. Of all the work accomplished by this great-hearted, kindly, and indefatigable man, none will be more enduring than his efforts to raise the condition of the working miners of his native country, and he will long be held in recollection by the large number of those who have benefitted by his unselfish labours.

YORKSHIRE COLLEGE EVENING CLASSES.

On October 12th, Professor Barr gave the first of his course of lectures on "Modern Steam Boilers and Engines" to his evening class in the Yorkshire College, Leeds. Mr. A. H. Meysey-Thompson presided, and the lecture-room was crowded, all the available standing room being occupied. The prizes gained in the evening engineering classes of last session were distributed. The first prize in the applied mechanics class was awarded to Mr. Ernest Scott, and in the steam engine class to Mr. F. G. Heseldin. A number of certificates were also distributed to the students in order of merit.

The chairman, having performed this duty, observed that the attendance at these classes had increased at a very large rate. In 1882 there was a total attendance of twelve students at the evening classes. Last year the total attendance was ninety-six. That showed, he thought, that a considerable amount of interest was being taken in the evening classes.

Professor Barr said that a few days ago Lord Rosebery, addressing a meeting in London, asked, "What are the tendencies of the age?" and remarked that "he had hardly ever heard a speech made in his life without that question being asked." It appeared to the lecturer that in beginning a course of lectures on "Modern Steam Boilers and Engines" it would not be out of place to ask that question in its special bearing upon their subject, and to see whether there was any clearly indicated tendency of the age in regard to engine design. The tendency of the age was to work at higher and higher pressure. In 1840 marine engines were still built to work with steam at 4 lb. pressure above the atmosphere, and it took thirty-five years to raise the commonly adopted pressure to 60 lb. per square inch. It had only, however, taken the last ten years or so to make the 60 lb. 160 lb. in marine practice. Surely, then, there was here a clear indication of the tendency of the age in engine design. To utilise this higher pressure important modifications have been introduced from time to time in the process by which the work was obtained from the steam, the latest of these being seen in the triple-expansion or quadruple expansion engine of to-day. The marine engine of to-day was the highest type of prime mover yet constructed, and must therefore be of great interest to all who were engaged in engineering work of any kind. Having glanced at some of the early attempts at steam navigation, the lecturer passed over a large number of more or less successful experimental steamers, and referred next to the Charlotte Dundas, which in 1802 plied on the Forth and Clyde Canal. This boat, considering the times, was an undoubted success. Pictures of the Comet and of the City of Rome, and also of the engines of the Comet, and of some of the most modern marine engines, were shown on the screen, and Professor Barr remarked that as engineers they might well exclaim with some pride, in the words of Hamlet, "Look here, upon this picture and on this." He referred to the great difficulty, or even impossibility, of assigning the proper share of honour to each of the many workers who by the exercise of great abilities or indomitable perseverance had made the modern marine engine what it now was. That difficulty was especially apparent when they remembered that the theorist on the one hand and the practical inventor on the other had laid the foundations of this progress, and that these had been followed by the scientific engineer, whose knowledge of theory dictated to him the process by which the desired end was to be attained, and whose practical experience suggested the means by which the process might be best carried into effect. Without attempting to forestall the future historian of the rise and progress of the marine engine, he might be permitted to mention the names of three men who, whatever positions might be accorded to them by posterity in connection with this subject, might be taken as typifying the three classes of workers to whom he had referred. The first of these was Carnot, whose theory of heat engines was published in 1824. The lecturer then gave a brief sketch of Carnot's theory, showing the advantage to be gained in economy by the use, in a perfect engine, of steam at a high temperature, and that meant practically steam at a high pressure. The work of Mr. Samson Fox in introducing the corrugated flue must also be recognised, for without that invention the rapid progress made in marine engineering in the use of higher pressures would not have taken place. As typical of the scientific engineer, they had Mr. Alexander C. Kirk, of Glasgow, who first brought the triple expansion engine into successful practice. The theory of the triple expansion engine was described, and examples were given to show the very great economy resulting from its adoption. The lecturer said he had received a letter from Messrs. Duncan Stewart and Co., Glasgow, in which they stated that in a trial made a few weeks ago of the first triple expansion engines which they had built they obtained the very remarkable result of a consumption of only 1·05 lb. of coal per indicated horse-power per hour. Facts such as he had quoted—and many of a similar character could be cited—show very clearly what an immense stride had been taken during the last few years in marine practice. It was greatly to the honour of marine engineers that they had, within the last few years, successfully worked out improvements of such vast importance to the commercial interests of the country. When so much had been accomplished in the direction of economy in marine practice, it was not conceivable that millowners and others who used engines on shore would long be content to look out, as they too often did, for the cheapest and simplest boilers and engines, which, as they say, "any labourer can work," and to pay so dearly for them in annual outlay; and it would not be to the credit of stationary engine builders if they did not study to offer and to recommend to their customers more efficient, and in the end more economical, engines than those which find so large a field in the market at present. In conclusion, Professor Barr observed that he thought no more profitable and no more interesting subject for study during the session could be found than that of modern steam boilers and engines.

The lecture was profusely illustrated by diagrams, experiments, and lantern views. After the lecture the students spent some time in the drawing class-room, studying a large collection of photographs and drawings showing the most recent practice of some of the largest firms of marine engine and boiler makers.

Automatic Shops.—Ingenuity in devising automatic arrangements seems to find for itself an ever-widening field, from the most delicate and intricate movements of the modern types of textile machinery to the simplest processes of every-day life. The automatic delivery machines for supplying postcards, cigarettes, &c., have long been familiar, and now another machine of this class has been introduced by Mr. G. A. Macbeth, of Manchester, which, by a very simple arrangement of a revolving drum with a series of slides brought into position opposite the delivery drawer by an indicating dial, can be made to supply quite a variety of articles. At present they have simply been made to deliver twelve different kinds of sweetmeat, and a number of these machines have recently been put down at the local railway stations; but the principle admits of other modifications by which it might be made practically into an automatic general shop.

COTTON PREPARING AND SPINNING MACHINERY.

MESSRS. ASA LEES AND CO., OLDHAM, ENGINEERS.

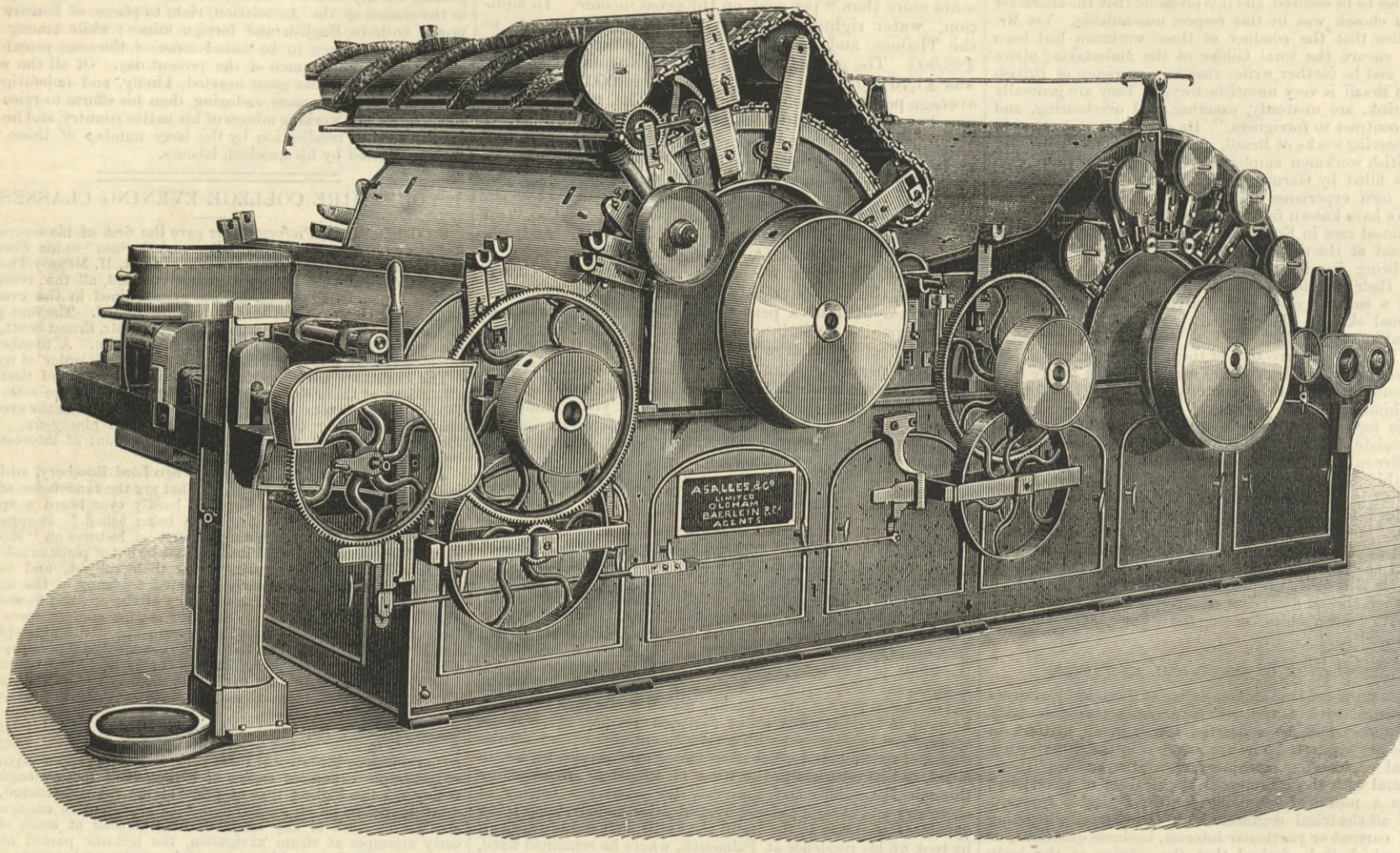


Fig. 1. DOUBLE COMPOSITE CARDING ENGINE.

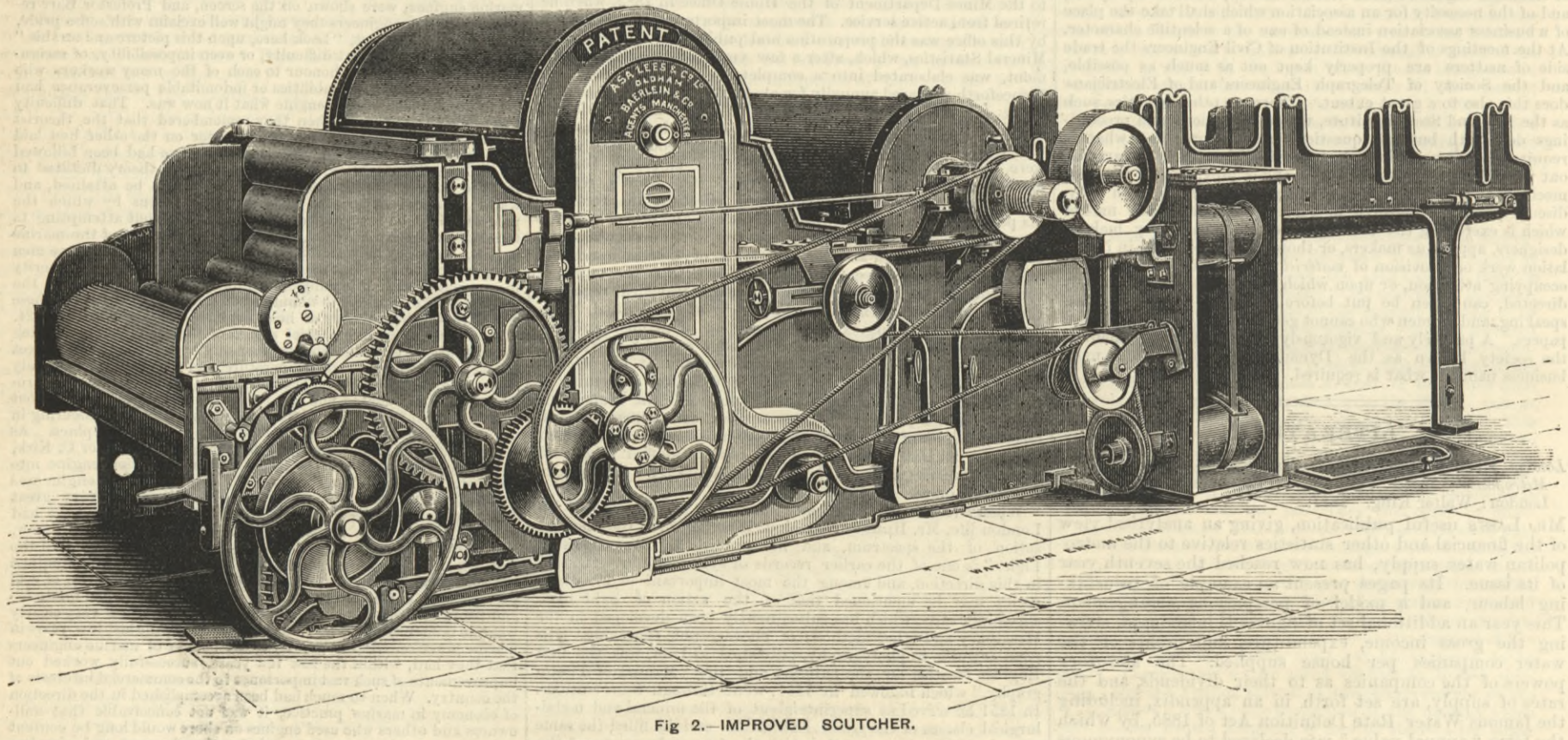


Fig 2.—IMPROVED SCUTCHER.

COTTON SPINNING IN MANCHESTER.

The city on the Irwell—the seat of the English cotton trade—now exports calicoes to India, whereas up to 1787 the same goods were imported from Calicut by the East India Company. In 1770, 4,000,000 lb. of raw cotton were imported into England; and this quantity rose in 1810 to 132,000,000 lb., and in 1868 to 1,464,000,000 lb. There is a record of "Manchester cotton" so early as 1352; but at that time the cotton weft had invariably a linen, woollen, or silken warp, the cotton yarn not being sufficiently strong to withstand the drawing action of the "healds" in the process of weaving. The rapid development of the power loom and spinning frames has had the effect of increasing the population of Manchester and Salford from 20,000 in 1750 to 140,000 in 1816, and to 600,000 in 1881. A marked impetus was given to the cotton industry by the application of steam power to the machines at the beginning of the present century, though its introduction met with great opposition by the operatives. Before that, however, hand carding had been superseded by the better work of the carding engine, invented by Hargreaves in 1764, almost simultaneously with his spinning jenny. The "mule," so called because it is a combination of Arkwright's drawing rollers and the jenny, was brought out by Crompton in 1779. It not only draws but also twists the yarn, so as to produce much finer threads than either the jenny or the throstle. The drawing carriage was made self-acting by Roberts (partner of Sharp, the locomotive builder) and Mason; and in 1785 Cartwright brought out his power loom. In our notices of the works of Messrs. John Hetherington and Sons, which appeared in our impression for September 16th, and of Messrs. Asa Lees and Co., which follows, will be found descriptions of some of the latest forms of cotton machinery.

The Soho Ironworks of Messrs. Asa Lees and Co., near the Clumps Station, Oldham, employ from 2500 to 2700 hands in making machinery for preparing, spinning, and doubling—or twisting—cotton, wool, and worsted, and also special machine tools for the production of this machinery for their own use. The various buildings are four and five storeys high, provided with lifts. The doors open by sliding on rollers up an inclined plane, so as to run back of themselves. A pair of diagonal engines of about 50-horse power, for driving one of the shops, are erected on a stone foundation somewhat resembling a double flight of stairs; and besides the smaller engines for driving different departments, there is a pair of 500-horse power horizontal engines.

The foundry, a long narrow building, is provided with hand travelling cranes of no great height, running on rails, for moving the foundry boxes and heavier castings. As there is much repetition, plate and machine moulding, which do not require skilled moulders, are largely resorted to. The cupolas have transverse or horizontal flues for intercepting dust and ashes, which would otherwise be carried into the atmosphere, by the blast. Round bars for shafting are passed through a mill, with plain rolls for scaling them and taking the "dog leg" or crookedness out of them.

As so many identical machines are turned out, it pays to make special machine tools for their economical production. All the joint faces of machine frames are planed together, or at any rate at one setting; and, in another machine, all the bolt holes in both directions are drilled at the same setting, if, indeed, not simultaneously. Six horizontal rows of draw rollers for slubbing, intermediate and roving frames, consisting of four rollers each, are fluted together in a machine resembling a planing machine. All flats on shafts are cut by the periphery of circular milling cutters, the necessarily curved shoulder being an advantage as regards strength. Small bushes, for the link chains of flat carding engines, are bored and turned out of the solid rod, passing through the hollow mandrel of a lathe, by a succession of tools in a capstan holder.

The taking-in cylinders of carding engines are turned with a comparatively deep but narrow groove running with a slow spiral from one end to the other. This is for receiving the "saw tooth wire," which is drawn tightly into the groove, so as to be jammed therein by the cylinder itself while revolving in the lathe. This saw tooth wire resembles a small band-saw, but is in a continuous length, and has a bulb at the side opposite the teeth, which is the part jammed in the groove. The saw tooth wire is drawn flat with the bulb at one side, on the premises, from soft round iron wire; and the saw teeth are afterwards punched out in a self-acting machine, like that for

making the teeth of saws. When the taking-in cylinder is "clothed" with the saw tooth wire it has the appearance of being—and, indeed, is—studded all over with sharp teeth, slightly inclined from the normal, so as the better to seize the cotton fibres and draw them into the machine. The excessive sharpness of the teeth, however, together with all burr, are taken off by making the cylinder revolve in the lathe, while blocks of wood sprinkled with emery powder are held against it.

The company makes carding engines, both with self-acting revolving flats, as described in connection with Messrs. Hetherington's works, and also with rollers and clearers, or smaller

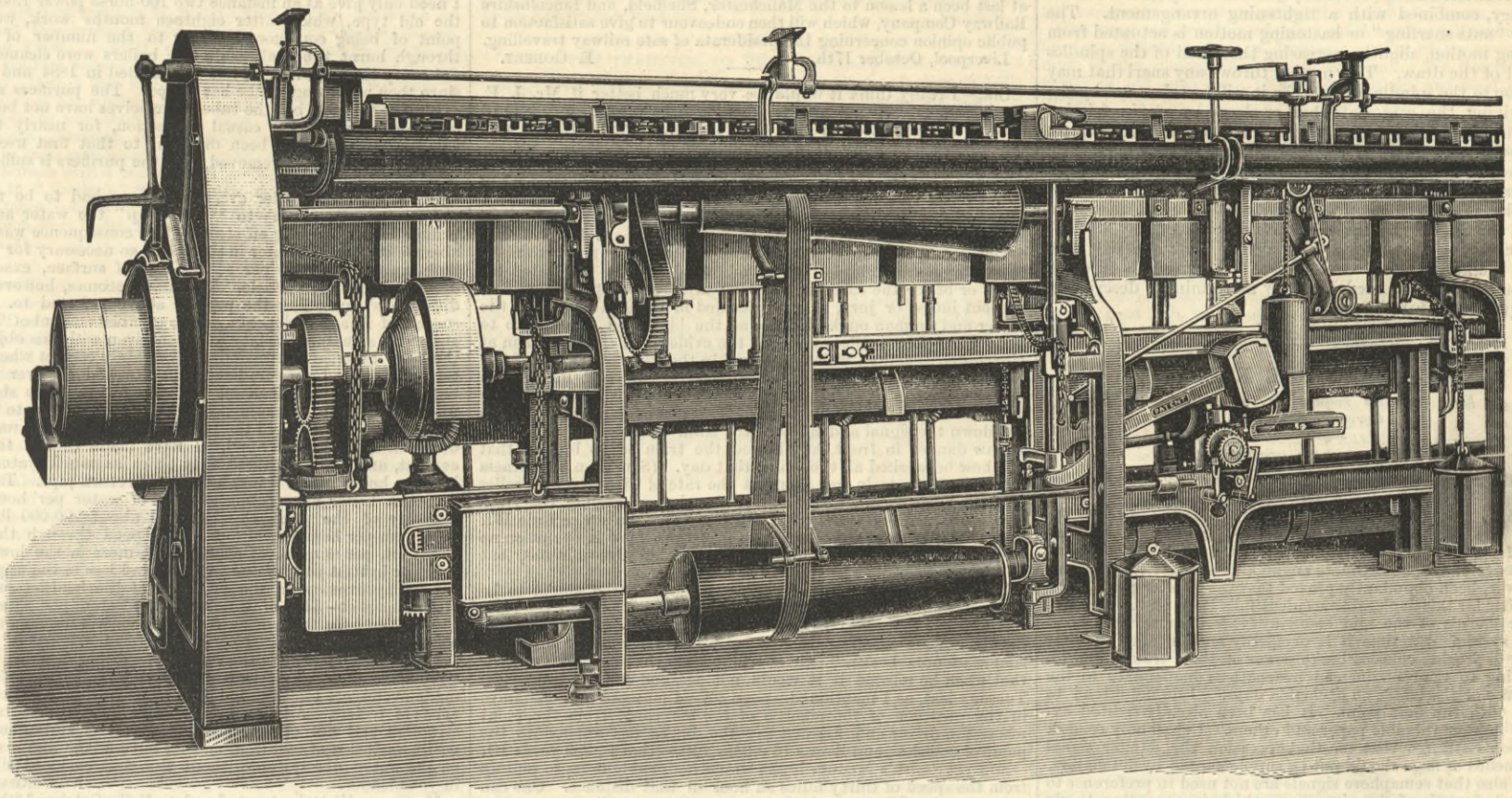


Fig. 3.—SLUBBING FRAME (BACK VIEW) WITH TAYLOR'S PATENT CONE RELEASING MOTION.

rolls revolving above the cylinder, between which the cotton "lap" or fleece passes in the operation of carding. Some double-carding engines are also made, which are coming into general use in the Oldham district, being preferred by many spinners, especially for a low quality of cotton or a large production. Some of these machines have rollers and clearers over both cylinders, some revolving flats over both cylinders, and others, called double-composite machines, rollers and clearers over one and revolving flats over the other cylinder, as shown in Fig. 1.

In the company's improved scutcher, with feed regulators—Fig. 2—the slow motion is driven from the beater shaft by a band, and both the slow motion and the cones of the regulator are driven by one and the same band, which, by means of a tightening frame with carrier pulley, can be kept at the requisite tension to prevent slipping. In this it is further aided by all the driving pulleys being double grooved and the rope passing twice over the greater portion of their circumference. The driving is done by a friction clutch on the beater shaft, and the feed rollers and lap part are started and stopped by a rod running along the side of the machine. The advantages of this combination are that as the feed-rollers and lap part are driven from only one source, the beater cannot become choked by cotton, which would cause a break-down; and indeed this does happen with the ordinary mode of driving, if the strap commanding the slow motion should fall off, break, or become slack; the lap part may be stopped more quickly than with the ordinary arrangement; the cones for regulating the feed may be run at a considerably higher speed than by means of a side shaft and wheels, thus making the regulators more sensitive; and there is great facility for altering the weight of laps by changing the rim pulley which drives the cones. Finished laps weigh about 40 lb., and the average variation is only about 4 oz. If a handful of cotton be taken off the feeder, the feed motion will be increased in a corresponding degree.

In the ordinary working of slubbing, intermediate, and roving frames, the office of which is described in connection with Messrs. Hetherington's works, the attendant has to re-start the machine and run it slowly for a few turns, after it has knocked off, with the winding-on motion out of gear, in order to get some slack roving on the top of the flyer, to be used for attachment to the empty bobbins which have replaced those filled. This action is performed automatically by Taylor's patent cone-releasing motion, which is applied by the company to slubbing, intermediate, and roving frames, a back view of the first of which is shown by Fig. 3. The cone pulleys, which are prominent parts in the figures, are for rendering uniform the speed of winding on the bobbins, by compensating for the constantly increasing diameter, as the speed would otherwise increase as the bobbin becomes filled. With this motion the attendant cannot re-start the frame after the bobbins are full and the frame has knocked off. Fig. 4 shows a back view of a similar machine to that of the preceding figure, but for a more advanced stage, viz., roving. Above are the bobbins made by the slubbing frame, being wound off on to smaller spindles, the speed of winding being kept constant, notwithstanding the increasing diameter, by the cone pulleys above referred to. This machine is also fitted with the patent knocking-off motion, which can be set to knock off at any part of the lift, and ensures the same length being put on each bobbin.

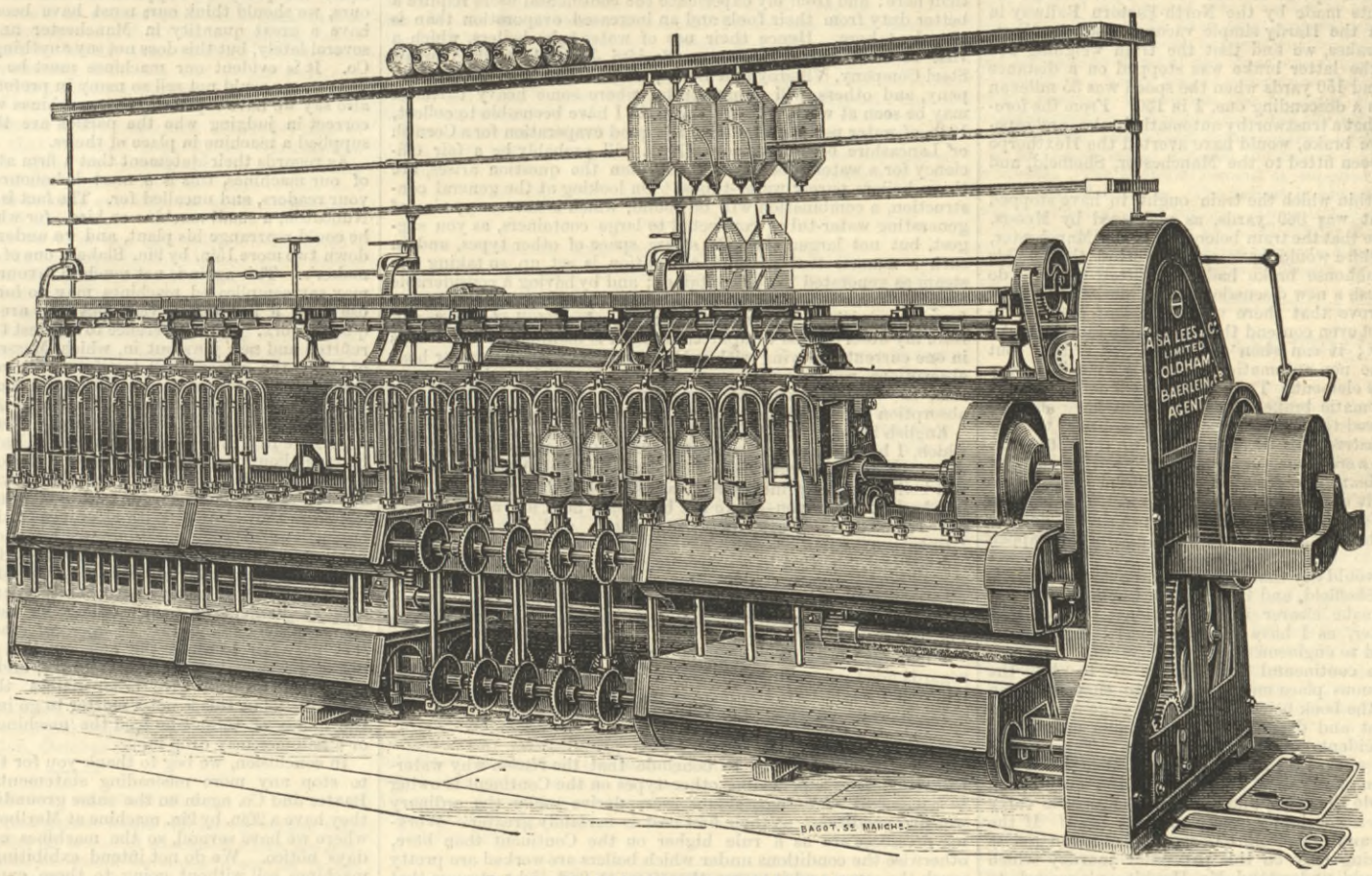


Fig. 4.—ROVING FRAME (FRONT VIEW).

Asa Lees and Co.'s self-acting cotton mule, with patented improvements—shown by Figs. 5 and 6, which represent a front view with the rim or twist pulley at back, and back view with rim at side—is known as the "low headstock," which has the advantage of allowing a longer driving belt than usual, while also ensuring steady running. The headstock or fixed mechanical portion, which is seen more clearly in Fig. 5, stands on strong foundation plates, which carry the "copping" motion or shaper, that which gives the shape to the cop, and answers the form of a copping lathe. The headstock also carries the "mainslip" or rail, on which the carriage slides, so that if the machine should get out of level or square, all the parts follow it, no part being screwed to the floor. The back of the headstock is cast in one piece, by which joints are avoided, rigidity in the main portion of the headstock gained, and accuracy obtained in erecting, because the bearings once bored cannot get out of line. All parts are made to template, planed and finished by machinery, thus ensuring accuracy and stability, which cause the mule to work with less power and more silently than those of ordinary construction. The strapping or governing motion renders the cop bottoms entirely self-acting, as it requires no attention by the minder. To those unacquainted with cotton machinery this motion would require a long description and elaborate diagrams to be intelligible; but it may be explained that a cop is a quantity of yarn wound on a spindle in such a form that it may be removed entire. The quadrant nut ascends in exactly the same ratio as the cop bottom increases in circumference, thus producing an evenly-wound bottom, free from snarls or kinks. The "backing-off" motion, or that for reversing the spindles when the carriage is out, consists of a cam shaped to imitate the spiral coils of yarn on the spindles, whereby it brings down the "faller" or guiding wire in the same ratio as the yarn is unwound from the spindles, thus keeping it tight and free from snarls. The cam is governed by a loose incline on the "shaper" or copping rail, which varies the backing-off as the building of the cog proceeds, thus producing a sound "cop nose" or stiff point when the spindle is removed. The "backing-off" chain-tightening motion is actuated from the "copping rail," and tightens the chain just previous to backing-off. As soon as the carriage commences to go in it moves away from the tightening apparatus and allows the chain to become perfectly slack at the unlocking. The patent connection of drawing-out, taking-in, and backing-off levers prevents all possibility of two motions

fouling one another, as the action of throwing into gear the taking-in motion disengages the drawing-out motion, and *vice versa*, thus avoiding all breakages. These motions in opposite directions succeed each other so rapidly, besides being automatic, that, without this patented improvement, there is great danger of their interfering with one another. By the self-acting strap-relieving motion the cross belt is gradually moved off the fast pulley as the carriage approaches the limit of its outward travel, and is moved on to the loose pulley from 1in. to 6in. before the long lever, or that which gives all these motions described, changes its position. The horizontal taking-in shaft is driven direct from the countershaft by cotton rope, instead of by gear from the loose pulley, combined with a tightening arrangement. The automatic "anti-snarling" or hastening motion is actuated from the copping motion, slightly increasing the speed of the spindles at the end of the draw. This motion throws any snarl that may be found on to the spindle point, when it will be taken out by the drag. Driving the cam-shaft shell or sleeve by an 8in. friction pulley with revolving stops supersedes the additional stops, links, or bell-crank levers of the clutch boxes usually employed, and throws the wearing parts of the friction gear out of action, except during the actual working of about two seconds out of sixty. The patent full cop stopping motion, most useful in weft cops, knocks off the mule when the cops of any desired length are full, so that they are always of the same size, that for which the knocking-off stud is set. The motions referred to above are so complicated that any more minute description would require elaborate diagrams.

LETTERS TO THE EDITOR.

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

THE HEXTHORPE COLLISION.

Sir,—The correspondence columns of your issue for October 14th contained a letter *re* the above calamity, and signed John Hopkinson. This gentleman's intention seems to attempt to exonerate the Manchester, Sheffield, and Lincolnshire Railway Company from all blame, and to attribute the accident wholly to the negligence of the unfortunate enginemen of that railway. It has, however, been abundantly proved that the greater part of the responsibility for this deplorable accident falls back on the heads of the higher officials of the said company (1) for having suspended the block system at a time it is decidedly most needed; (2) for neglecting to provide efficient brake power on their trains; and (3) for supplying to their enginemen instructions inadequate to the requirements of the traffic on excursion days. I do not intend to deal here with the first point. It has been already treated exhaustively in your valuable paper and others. I shall only remark that it seems strange that on that occasion the danger signal given by means of flags should not be supplemented by detonators. How is it also that semaphore signals are not used in preference to the antiquated mode of flag signalling, which is, according to my experience, by no means too conspicuous?

On the second point I must confess my inability to understand Mr. Hopkinson's process of reasoning. What I can make out of it seems to confirm the opinion expressed already more than once that the non-automatic vacuum brake is by all means an utterly untrustworthy contrivance. The driver saw the Midland train 16 chains 52ft. ahead of him; on discovering this, he applied the brake, which did not act as it ought to do. Had it acted properly, the collision would have been averted. But it did not; whose fault is it? Not the driver's, but that of the railway company, who seem to have learnt absolutely nothing from the Penistone accident, and continue to remain perfectly indifferent to public opinion. The distance of 16 chains 52ft. was amply sufficient to stop the Manchester, Sheffield, and Lincolnshire train clear of the Midland train. We have not to go far to find a proof of this. If we look through the accounts of experiments made by the North-Eastern Railway in 1879 on their line with the Hardy simple vacuum and the Westinghouse automatic brakes, we find that the train weighing 163 tons, and fitted with the latter brake was stopped on a distance varying between 139 and 150 yards when the speed was 35 miles an hour. The incline was a descending one, 1 in 130. From the foregoing it is quite plain that a trustworthy automatic brake, and especially the Westinghouse brake, would have averted the Hexthorpe catastrophe if it had been fitted to the Manchester, Sheffield, and Lincolnshire train.

The real distance within which the train ought to have stopped to avoid any accident was 369 yards, as measured by Messrs. Stretton and Barber, so that the train belonging to the Manchester, Sheffield, and Lincolnshire would have easily averted the terrible accident if the Westinghouse brake had been fitted to it. I do not mean to begin afresh a new discussion on the merits of brakes; I simply wanted to prove that there was a sufficient distance to stop the train. I do not even contend that the simple vacuum brake would not have done it; it can when it is in perfect order. But brake power as in the non-automatic vacuum system is a very variable and capricious element. The automatic vacuum brake, or any other reliable automatic brake, could no doubt have stopped the train also, or reduced the consequences of the collision to very small proportions. Instructions have nothing to do with this. Supposing that there were none, or a train stopped in such an awkward station as Hexthorpe from an unexpected cause on an ordinary day, the result might have been the same. The instructions have nought to do with an efficient brake; a driver does in such occurrence what he can, and such a state of affairs can happen to any train.

On the last point I would say that I do not understand how it is that the Manchester, Sheffield, and Lincolnshire Company did not take more trouble to make clearer its instructions; they were of too general a character, as I have heard. Special time tables ought to be distributed to enginemen for such days not too much in advance. On some continental lines drivers are to place the time book in a conspicuous place under the cab, so that they can refer constantly to it, the book being open at that page which gives the times of arrival at and departure from stations, crossing of trains, and other incidents of the journey, &c. The book is printed in plain type, so that it can be easily read at night at the light of the lamp of the glass gauge. Would it be too much to ask English companies to do the same, and see that the drivers carry it into practice, if this is not done already on some lines? If the Manchester, Sheffield, and Lincolnshire Company had given precise instructions, and bearing only on this particular journey which ended so fatally, I should understand Mr. Hopkinson's remark to a certain extent. It is not too much precaution to repeat to drivers day by day what they must pay more particular attention to, and see that they are provided with clear instructions respecting alone the particular journeys they are going to run on that day.

Mr. Hopkinson's remarks on Mr. Albert Kapteyn's letter are out of place. They are not sensible. Mr. Kapteyn makes simply a remark or rectification, which anybody else might have done. As nobody else had done it, he was perfectly right to do it, and it would have been wiser if Mr. Hopkinson had thought twice before writing his ridiculous remark about the W. B. Company. The W. B. does not require advertising. Its own success and the repeated failures of the non-automatic vacuum brake are sufficient advertisements for the W. B.

As for his remarks concerning Mr. Stretton, I should like to know who is better able than Mr. Stretton to act on behalf of the unfortunate men who had not the chance to have witnesses heard, who should give evidence in their favour at the inquests. I should like also to know where is that "independent engineer" who will act on their behalf to come from if the A.S.R.S. are not there to support their members in need of its assistance. We know that in this country there may be two justices, one for the rich and one for the poor, and if the latter is alone he can have but little chance to win his cause against a wealthy interested party. It is not the first time we hear of a railway company putting its responsibility due to the neglect of its directors on the driver, who is not at fault, or not more than his superiors. I recollect having read a few cases of railway accidents occurring in France where engineers-in-chief were sentenced to a term of imprisonment because of their neglect of some regulation, or the absence of the latter had been the cause of an accident. Ought it not to be the same in this case? I do not wish it, however. I simply hope that the inculpated enginemen will be acquitted, and that the Hexthorpe collision has at last been a lesson to the Manchester, Sheffield, and Lincolnshire Railway Company, which will then endeavour to give satisfaction to public opinion concerning the desiderata of safe railway travelling.

Liverpool, October 17th. E. Gobert.

Sir,—I really think it would be very much better if Mr. J. E. Hopkinson—page 307—reserved his remarks upon this case until he is in a position to hear both sides of the question. How, I ask, can he possibly know if a certain line of defence is "utterly absurd" or not before he is in possession of half the facts, and before a single witness on behalf of the driver and fireman has been called? During three whole days—the 12th, 13th, and 14th inst.—I have been engaged at the magisterial inquiry at Doncaster, and certainly never before in my experience have I heard such evidence. With one exception, every witness for the Crown, in cross-examination, broke down, admitted that he neglected his duty, or broke the rules of the company. Mr. Hopkinson seems, without judge or jury, to have decided in his own mind that the driver and fireman ought to have all the blame. I should like to know what your readers think of the evidence of the signalman at Hexthorpe Junction, which appeared in the *Times* of the 13th inst.? Asked "why he lowered the starting signal, he said that before he did so he looked round to see what Coates was doing, and saw him with a red flag in his hand, which meant danger. He then put down the signal and allowed the train to proceed. Although he saw danger in front, he allowed the train to go by, and that was how he worked all the trains that day. (Sensation.) Witness stated that the train was going at the rate of eight or nine miles past the home signal, which he considered was bringing the train quite or nearly to a standstill. He knew that he broke Rule 162, which stated that when the block system was not in operation no train or engine should follow another within five minutes, but he could not tell why he did so."

Does it not strike Mr. Hopkinson that for the signal to be lowered, and the train to be allowed to "go," against the rule, was a great trap into which an engine driver might be easily drawn. Your correspondent says, "The driver knew he had a simple vacuum brake." Of course he did, but he did not know that when he wanted it it would not act and stop his train. On Tuesday last, as I mentioned—page 307—I measured the distance, in the presence of the officials of the company, from the point where the driver and firemen say the brake was applied to the point of collision, and it was 16 chains 22ft.—that is, 359 yards 1ft.—and yet Smith's vacuum brake would not enable them to pull up from the speed of thirty miles an hour in that distance. One can only remark—What a brake! Clement E. Stretton.

40, Saxe Coburg-street, Leicester, October 15th.

WATER-TUBE BOILERS.

Sir,—Your leader on "Water-tube Boilers" ventilates a subject which steam users would do well to look into, but I beg to differ from you in many of your assertions.

Some time since considerable discussion arose in your valuable paper as to why the continental users of steam power were willing to pay higher prices for their plant than in this country, and, if I mistake not, it was conceded that greater economy and durability was gained, which the mill engines at the Antwerp Exhibition displayed; and I think, to a great extent, the same thing applies to the use of boilers, fuel generally on the Continent being dearer than here; and from my experience the continental users require a better duty from their fuels and an increased evaporation than is prevalent here. Hence their use of water-tube boilers, which a visit to such establishments as Société John Cockerill, Warsaw Steel Company, Villeroy and Bocks, Ougree Iron and Steel Company, and others, will demonstrate, where some heavy batteries may be seen at work. From the data I have been able to collect, 10 lb. of water per pound of coal is a good evaporation for a Cornish or Lancashire boiler, whereas 11½ lb. will probably be a fair efficiency for a water-tube boiler; but then the question arises, are these boilers purely water-tubes? On looking at the general construction, a combination will be found, which is necessary, viz., of generating water-tubes connected to large containers, as you suggest, but not larger than the steam space of other types, and in such a manner that a rapid circulation is set up, so taking the steam as generated to the container; and by having a considerable body of water below the level of the water-tubes at the lowest temperature of the boiler they are always kept full of water, and from my observations a rapid circulation is maintained; and thus in one current, carrying with it the continuous ebullitions or heat absorptions, which conduces greatly to the efficiency in evaporation, as when one current comes in contact with another, less absorption of heat takes place, as in non-circulating boilers.

English ideas are undoubtedly in favour of self-contained boilers, which, I believe, are to be preferred—but the loss by brick furnaces is very light—providing a one-current circulation is obtained; and boilers on the principle as used on the Continent—I must here beg to differ from you—have not been used here, and consequently not rejected, and are increasing there, and do not require "tinkering."

I contend, Sir, that in constructing a steam boiler two principles should be developed, viz., an efficient heat absorber and generator with dry steam space and with circulation, a more equal expansion and contraction, which these boilers represent, and which are known as MacNicol's system.

I fear my letter is already too long, but your suggestions as regards good generating surfaces of water-tubes, safety, and wear and tear I might have commented on. T. W. Baker.

12, Wormwood-street, London, E.C., October 12th.

Sir,—It must be safe to conclude that the reason why water-tube boilers are superseding other types on the Continent is owing to some real advantage steam users derive under the ordinary working conditions, as their first cost is certainly greater. Working pressures are as a rule higher on the Continent than here, otherwise the conditions under which boilers are worked are pretty much the same, and it seems therefore at first sight strange that steam users here and abroad should differ in their views on the subject, especially as there are water-tube boilers made in this country quite equal, if not superior, to any made on the Continent.

When, however, it is remembered that the water-tube boiler passed through its experimental stages in this country, and that steam users here suffered from the many failures, which could hardly be avoided in the introduction of a new type of steam generator, then it is not surprising that a great amount of prejudice should exist against them, and that there should be great difficulty in convincing buyers that the improvements made of late are really substantial ones; in fact, it is hard work to get them to look into the matter at all. As, however, high working pressures are becoming a necessity both on land and at sea, there is better prospect for a reconsideration of the merits of the water-tube boiler as it now is.

With your permission I will now refer to the various objections raised in your leader on this subject in issue of 7th inst., with special reference to the boilers made by my firm at the present time. As to repairs, the manner of setting and arranging the furnace is much improved, so as to prevent adhesion of clinkers and loss of heat through radiation. Slight repairs to the brickwork every six months suffice.

The "tinkering" you refer to would no doubt be the tightening up and renewal of joint rings and replacement of burnt tubes. As regards the former, we have done entirely away with them, my patent metal joints being permanent and suitable for any pressure. As regards replacement of burnt tubes, this was formerly a source of considerable trouble and expense where the water was bad, firing heavy, and opportunities for cleaning but few. This is overcome in the most effective manner by Stallwerck's patent feed-water purifier, a description of which you gave in your issue of the 18th July, 1884. The results obtained are most satisfactory, and I need only give as an instance two 100-horse power Root boilers of the old type, which, after eighteen months' work, were on the point of being condemned owing to the number of stoppages through burnt tubes, although the boilers were cleaned throughout every six weeks. Purifiers were added in 1884 and 1885, and since then not a single tube has failed. The purifiers are cleaned every two months, but the tubes themselves have not been cleaned or opened, except for casual inspection, for nearly two years. The feed-water has not been different to that first used, and the quantity of lime, &c., removed from the purifiers is sufficient proof of its bad quality.

In the old Root boiler every endeavour had to be made—and was successfully made—to "bottle up" the water and prevent priming when drawing off steam. The consequence was, however, absence of "solid" water in the tubes, so necessary for insuring a high evaporative duty per square foot of surface, exactly as you describe it in your article. The case becomes, however, entirely different when adding the purifier above referred to. The very success of its action depends on the greatest amount of "priming," and every structural facility has been given with this object. Your theory of absence of circulation is certainly correct when an equal temperature and pressure have been reached all over the boiler, but when steam is drawn off the case alters. The steam draws water with it in ascending, in fact, "priming" into the upper receiver takes place, and the heavier column of solid water presses downwards to the lower end. I have made careful tests of this current, and find that about fifty times as much water as is fed into the boiler passes through the back return pipe. Take, for instance, a boiler evaporating 4000 lb. of water per hour, and the quantity of the water circulating is about 200,000 lb., or 3200 cubic feet per hour, equal to a mean speed through the tubes of about 8ft. per minute—of course much more in the lower rows of tubes or hottest part of the furnace, and less in the upper rows.

The improvement in the efficiency of the heating surface is at once apparent—5 lb. of water is evaporated per square foot of water-filled tube surface, as compared with 4 lb. maximum in the old type.

I hope shortly to give the results of getting a much more rapid circulation, and see no reason why the tube surface shall not be made even more effective than the usual heating surface in other types of boilers. Add to this the increased compactness in construction and use of wrought iron or steel throughout, to the entire exclusion of cast iron, and we have a land and marine boiler on the water-tube system without the drawbacks attributed to it in your leader. Conrad Knap.

11, Queen Victoria-street, London, E.C., October 18th.

RE TEST OF STONEBREAKER.

Sir,—You will no doubt allow us to protect ourselves against the remarks stated by Messrs. Baxter and Co., in your last week's issue, as they are most misleading and incorrect. They commence by saying they wish to correct a few errors of ours in yours of 7th inst., but we fail to see any correction; they also say they do not wish to advertise down an honourable competitor, but this they do, and also take other makers of the Blake's machine with them. Is this just and fair? We ask who was the maker of the Blake machine—surely this is not an error. They now say it was by one of the oldest makers. If this be true, it does not say much in favour of their machine, to allow Baxter and Co. to beat them; and if this party has supplied one in Manchester in place of one of ours, we should think ours must have been a very old one. We have a great quantity in Manchester and district, having sent several lately, but this does not say anything in favour of Baxter and Co. It is evident our machines must be different to what they state or we could not sell so many in preference to theirs; we may also say we have replaced other machines with ours, and if we are correct in judging who the parties are they allude to, we have supplied a machine in place of theirs.

As regards their statement that a firm at Nuneaton returned one of our machines, this is a most dishonourable attempt to mislead your readers, and uncalled for. The fact is we let a Mr. Judkins, of Nuneaton, a small machine on hire—for which he paid us well—till he could rearrange his plant, and we understand he is going to put down two more 15in. by 9in. Blake's, one of ours, and one of another maker's. This again is not much in favour of Baxter and Co. We may say complicated machines may do for corporations who only use them a few days a year, but they are not much use for hard quarry work. With reference to our test trial, our machine was not refitted and new jaws put in, which Messrs. S. D. Pochin and Co., of Croft, the owners, will testify. This company have six of our machines; we also sold several through the trial, besides those sold to the parties who witnessed the trial. As regards our remarks about the Blake's, we again beg to say there is no machine that can supersede it if it is properly made. If Baxter and Co.'s statement be true about the trials they have had to test the quantity their machine will do, why did not their 12in. by 7in. do the same amount of work as ours instead of it taking 46 minutes to ours 25 minutes, not 35 as they state? With reference to the Leicester Corporation having one of their machines, we had not a chance to compete, not knowing a machine was wanted. However, when we were informed they had bought one, we offered to refit an old Blake's machine they have and guarantee it to work as well as Baxter's or have nothing for our trouble and expense. As regards us knowing of any of their machines breaking it is only fair to state the one supplied to our Corporation did not work very long before it broke, and if Messrs. Baxter and Co. wish, we will give other names that have broken their machines; but this is not a matter to go into, as all makers are in the hands of those who feed the machines, and at any time iron or a hammer may drop in.

In conclusion, we beg to thank you for the insertion of this, and to stop any more misleading statements we challenge Messrs. Baxter and Co. again on the same grounds as before. We believe they have a 20in. by 9in. machine at Marlborough; this is near Croft, where we have several, so the machines could be tested at a few days' notice. We do not intend exhibiting at Nottingham, as our machines sell without going to these expenses, and it is no use going in for medals after the late exposure how they have been obtained. We may say at the test we should use the ordinary leather belting as before, and Messrs. Baxter and Co. can use the Lancashire belt if they wish. S. Mason and Co.

Leicester, October 7th.

[We can publish no more letters on this subject.—Ed. E.]

FREE TRADE AND NO TRADE.

Sir,—If "Trader" writes as he states—page 306, October 14th—for information, all that seems predicable from his statements is that one or two points are rather mixed, and the subject of fair rents entirely ignored. Thus:—(1) If it be true "15,000,000 in England get their living from agriculture," it ought to be explained "how only 4,000,000 out of a total of about 45,000,000 derive their incomes from mining and manufactures," when the inference would be the other way, even if the whole population of London, as well as all shipping and shopkeeping classes elsewhere were deducted as middlemen or mere foreign agents. (2) If

"Trader" likes to assume land is depreciated by bad management or otherwise, that argument applies equally to "Trader's" own business, trade; but then comes the difficulty, viz., why should he ask us to suppose a like result must ensue in a special industry, such as the silk trade? Surely he does not wish to contend that any given population consists of something else other than agricultural, mercantile, mixed, or military classes, which have to be treated accordingly by wearers of silk whether imported or made in England? Suppose a democracy with free trade, protection, or an approved mixture by the will of the majority, be the policy, will "Trader" undertake to say that the success of that chosen policy is so far discounted by other factors besides that of a simple majority for the time being that radical reform thereafter becomes an impossibility? If "Trader" cannot hold this, then I fail to see how he can ask your readers to believe that history can teach no lesson about the present from that of ancient Greece, Rome, Egypt, and Persia. (4) If, as "Trader's" friend is made to say, "free traders believe that manufacturers cannot now change their policy, that a big war would inevitably be disastrous to Britain, and that like ancient Rome it will be found within seventy years cheaper to pay than fight," then pessimist free traders must be wrong. Because, supposing the free traders to be practically right in their conjecture, then money would already be of no value, and human skill a thing of the past, while all special knowledge, even in "Trader's" favourite silk business, would be but a myth and a farce!—a case of Herod out-Heroding Herod when there exists so much wool to fall back upon, surely.

October 17th. SLOW COACH.

SIR,—All will agree with "Trader's" first proposition—viz., the happiest country is that which contains the smallest percentage of scantily paid people—but many will demur to his second one—viz., under Protection this country would contain a smaller percentage of scantily paid people than it does now. If this would be so now, it must be due to recent economic changes, for it cannot be doubted that, though wages and trade are not now what they were ten years ago, they are even yet better than they ever were before the Corn Laws were repealed.

Even if the wonderfully prosperous trade that fell to the lot of the generation just past was due entirely to the vigour of its merchants, the talent of its inventors, and the industry of its artisans—and much of it was so due—yet it would be very difficult to show that free trade hindered them. The presumption is all the other way, and the probability is that what suited them suits us also, though we may not know it; but this is a probability only. The manufacture and export of textiles, chemicals, machines, and coals did certainly keep the past generation well employed, but it is quite possible that we henceforth must cultivate other trades that heretofore it may have paid us to neglect.

"Trader" instances silks, and says in effect, at present Jno. Smith, coal miner, Newcastle, sends to Jacques Bonhomme, of Lyons, every year coals to keep his hearth warm, and receives in return a silk dress for his wife, and he asks, would it not be better for the country if Smith sent the coals to Robinson, of Coventry, get his silk dress from him, and so keep an English hearth warm instead of a French one? Well, if the case was as simple as is here stated, and if Robinson's hearth really is cold, it certainly would be better from a national point of view; but the case is not quite so simple. Smith does not only at present buy from Bonhomme one silk dress a year for his wife, he also buys annually one for his wife's sister in Australia, which she pays Smith for in mutton, and another for his brother's wife in America, which his brother pays Smith for in grain. So Smith sends Bonhomme coals per annum for three silk dresses instead of one.

Now, the reason why all these three buy from Bonhomme is that, taking price, quality, and style all into account, his dresses are the nicest, and one reason why his wife's sister and his brother's wife buy through Smith is that Newcastle is a free port where there are no worrying bondings, and payments and repayments of duties. Even if Smith was willing to put himself out of temptation of trading with Bonhomme by putting a duty on his silks, he could not feel sure that his brother's wife and his wife's sister would agree. They would still want Bonhomme's silks, they would find the Government interference with their goods at Newcastle irksome, and they would in a short time send their orders to Bonhomme direct, and Smith would find it more difficult also to sell coals. Whether or not he would come to think that he was paying too dearly for protecting Robinson, and would withdraw the protection accordingly, is a question that can only be answered by trial.

The considerations indicated above regarding silk apply also to all other foreign imports that we receive, partly for consumption here and partly to export again for consumption in our Colonies and in the new countries of the world; our total trade of this sort is immense. It does much to keep our ships at work, and it pays us well. It is not to be risked lightly.

"Trader" also asks: As we do in any case raise £100,000,000 a year in taxes, would it make our exports any dearer if we raised much of this sum—or even all of it—by taxes on imports?

Theoretically it would not raise the prices of our exports, or put us at any disadvantage in any way; but practically taxes on imports are expensive to collect, if only because a strong force has to be maintained to prevent smuggling, and they greatly hinder merchants in moving goods as explained above.

I quite agree with "Trader," however, that part of our national revenue might well be raised by a tax, too low to tempt smuggling, on imports that are chiefly for home consumption; and I have always considered that the abolition of the 1s. per quarter duty on corn was a gross blunder, an act for which no words are too severe.

"Trader" also asks: As 15,000,000 persons live in the United Kingdom by agriculture and only 4,000,000 by foreign trades, why not tax foreign corn, and so aid the many at the expense of the few?

"Trader" is wrong in his figures. We import about two-fifths of the total weight of food eaten in this country, perhaps more, certainly not less—we import two-thirds of our wheat—therefore two-fifths of our people are fed from abroad, *i.e.*, are dependent on foreign trade. Now two-fifths of our people—England and Scotland only—is 13,000,000 persons. The considerations that are involved in this alarming fact will form the subject of another letter if you print this one.

'Trader" has learned much since last year. He no longer thinks that we pay for our surplus imports by the export of gold.

5, Angel-place, Edmonton, October 19th. WM. MUIR.

TECHNICAL EDUCATION.

SIR,—If any public-spirited person would reprint—of course with your permission—the articles on technical education which are now appearing in your columns, he would be doing a service to his country. I am no enemy to education, and though my own has been picked up in a haphazard sort of fashion, it is of a highly "technical" character, and if I had my time over again, I don't know that I should desire to go through the regular "courses," which now find such great favour. There are thousands, nay millions, of persons in this country engaged in manufacturing operations which demand nothing more than skill in handicraft, and who would not do their particular work any better if they possessed the accomplishments of a professor. It has been my privilege to know workmen who were little short of "artists" in their particular line, but to whom reading and writing were matters of considerable difficulty. This was at a time when such accomplishments were less common than they are now. Education certainly enables men to rise to something better, but we cannot all be foremen or masters, and there will always be a vast number of mere operatives, to whom a knowledge of chemistry, physics, the laws of motion, kinematics, hydraulics, and all the rest of it are of no direct use whatever. The men who talk so glibly upon subjects of which they understand nothing entirely lose sight of the fact that every man who has acquired sufficient skill in his particular craft to have earned the title of "a good workman" has, in fact, acquired just that "technical education" which is necessary for him.

By all means let us educate men as far as their capacities will allow, so that they may have something to think about during their leisure hours, something to humanise and soften their hard lives. I am not a teetotaler, nor am I in any way averse to relaxation and amusement, but I venture to say this, that if every workman could be suddenly endowed with habits of temperance and industry, and relieved from the oppressive restrictions of trade societies, more beneficial results would follow than if they were suddenly gifted with all the qualifications supposed to be possessed by the holders of first-class certificates in all the subjects which South Kensington teaches. EXPERT.

THE INVENTOR OF THE CIRCULAR SAW.

SIR,—I was somewhat amused by a paragraph in your last issue taken from the American *Industrial Journal*, which says, "Everyone knows that the common hand saw was invented in America, and now any doubt as to the first circular saw is set at rest." It then goes on to coolly claim the invention of the circular saw for one Captain William Kendall in the year 1820. I have no hesitation in saying that both these claims are utterly without foundation. The hand saw was in use in a primitive form hundreds of years before America was a nation, and the saws of the Grecian carpenter had a similar form to ours in use at present, as shown by a painting still preserved among the antiquities of Herculaneum. The circular saw, there is little doubt, was invented in Holland in the sixteenth century, but there is no record to show who was the absolute originator. We have only to turn, however, to the English patent records to finally dispose of the American claim, as we find in the specification of Samuel Miller, of Southampton, granted in the year 1777, he claims "an entirely new machine for more expeditiously sawing all kinds of wood, stone, and ivory; and the saws used are of circular figure." When writing a book on "Woodworking Machinery" some years ago, I took a good deal of trouble in looking these matters up, and much more might be advanced to dispose of the American claim were it necessary.

Appold-street, E.C., October 16th. M. POWIS BALE.

BROKEN PROPELLER SHAFTS.

SIR,—Such a frequent occurrence has come to my notice of propeller shafts breaking without any apparent cause, that I have made inquiries to find the reason. Within the last few weeks I have heard of four cases where the shaft was broken immediately outside the ship, between the stern post and propeller, all the breaks resembling each other, being straight through the shaft, without the slightest sign of a flaw. In each case the shaft was supported by an outer bearing, secured to the rudder post, which saved the propeller.

A ship being in dock a few weeks ago owing to a similar accident, I took the opportunity to examine this bearing, and found it to be considerably worn horizontally, whilst there was comparatively little appearance of wearing down.

It appears to me that when the ship is underweigh with the rudder over to port or starboard, the pressure against it has a tendency to bend the rudder posts, which supports the outer bearing, sufficiently to throw a strain on the shaft, which ultimately gives way. CHINA.

September 1st.

ELECTION OF WATER ENGINEER OF NOTTINGHAM.

SIR,—It will interest your subscribers to know that out of over ninety applicants for the post of water engineer to the Nottingham Corporation, nine were invited to appear before their committee on Friday, the 14th inst., and, judging from the questions put to the candidates, it was evident that a mechanical experience with waterworks pumping plant was a *sine quâ non*. The following were the selected gentlemen:—Mr. H. J. Clarson, surveyor and manager, Tamworth Waterworks; Mr. L. T. Godfrey Evans, M.E., Liverpool Corporation Waterworks; Mr. J. E. Hughes, London; Mr. W. A. H. de Pape, M.I.M.E., Tottenham Local Board of Health; Mr. C. H. Priestley, Assoc. M.I.C.E., Cardiff Waterworks; Mr. H. Preston, Grantham Waterworks Company; Mr. Whitton, Nottingham Corporation Waterworks; Mr. Willink, Assoc. M.I.C.E., Vyrnwy Water Supply of the Liverpool Corporation Waterworks.

The committee decided by nine to four in favour of Mr. W. A. H. de Pape, M.I.M.E., subject to the confirmation by the Nottingham Council. ARNOLD WYM.

18, Dovey-street, Liverpool, October 17th.

ENGLISH AND AMERICAN LOCOMOTIVES.

SIR,—We have read so much lately of American locomotives superseding the English in our Colonies, that its quite refreshing to read the following extract from the New Zealand *Canterbury Times* of August 26th last:—"The Company—the New Zealand Midland Railway Company—will soon be in a position to commence running trains, and a considerable quantity of rolling stock has been landed and put together. The first engine which arrived has already been used for some time for ballasting work, and its performances even exceeded the favourable impression formed of it on its trial trip. It was built by the well-known firm of Messrs. Nasmyth, Wilson, and Co. to the specification of the company's chief engineers, Messrs. Carruthers and Wilson, and contains first-class material and workmanship in all its details. As a locomotive it has proved very economical to work, using little more than one-third of the amount of fuel usually consumed by engines of similar power. Three other engines of the same class are expected to be landed shortly."

I understand the locomotive exhibited by this firm in the Manchester Jubilee Exhibition is exactly the same as the one described in the *Canterbury Times*. T. D.

Manchester, October 19th.

A PROBLEM IN STRAINS.

SIR,—I notice a few doors down street an example of "X.'s" problem in its simple form. A long ladder tied tightly about the middle of its length to the balcony of the house, to the repair of which it ministers, so as to be considerably curved by the strain of the rope. I need not enlarge on the consequent stiffness under the live load of the bricklayer's mate and his hod. W. A. S. B.

October 18th.

OIL LAMPS V. GAS AT EAST MOLESEY.—The lighting committee of East Molesey recently presented the following report:—"Your committee, in presenting their second annual report on the subject of lighting lamps with oil, have pleasure to inform you that it has been a great success, and given general satisfaction. Fifteen new lamps have been erected during the year in various parts of the parish, much to the comfort of the parishioners, and for which they have expressed their thanks. We have now 127 lamps burning from sunset to sunrise. The illuminating power is much greater than we ever had when burning gas; the lights are steady and bright even on the stormiest and coldest nights. We are agreeably surprised to find that the cost for the year is only £289 13s. 7d., being at the rate of £2 5s. 7d. per lamp, which amount, if compared with the cost of gas, viz., £4 4s. per lamp, will show a saving of £244 14s. 5d. to the parish, being equal to a 2½d. rate. We have also to record that a saving of £20 has been effected in the purchase of lamp-posts and lamps in comparison with what the gas company charge." The report was adopted.

SOCIETY OF ENGINEERS.

ACTON AND EALING SEWAGE WORKS AND EALING NEW STORAGE RESERVOIR.

ON Wednesday the members of the Society of Engineers visited these works, about fifty being present, including the president, Professor Henry Robinson. The party was received at Acton Sewerage Works by Mr. W. Roebuck, C.E., chairman of the Local Board, and Mr. C. Nicholson Lailey, engineer to the Board; at the Ealing Sewerage Works, by Mr. Charles Jones, engineer to Ealing Local Board; at the Ealing New Reservoir (Grand Junction W.W.), by Mr. Alexander Fraser, engineer to G.J.W.W., and Mr. B. Pym Ellis, of the firm of Aird and Sons, contractors for the work. In the evening the Society dined at the Guildhall Tavern.

The large and growing suburban neighbourhood known as Acton, has been obliged to form a drainage system of its own, independent of the metropolitan main drainage. We described these works in our impression of the 16th ultimo, and need not again do so.

The refuse destructors at South Ealing, while generally based on the plan of Myers' destructors, have some distinctive points, by virtue of which Mr. Charles Jones, the engineer to the Ealing Local Board, claims to have attained unusually satisfactory results. The chief of these is the addition of a muffle furnace between the furnace proper and the main shaft, by means of which combustion is rendered more complete. No fuel except tho ordinary house refuse is used, and no objectionable fumes are given off. At this station the sewage sludge of 19,000 people and the house refuse of 22,000 are being dealt with.

The reservoir now in course of construction at Ealing is situated near Hanger Hill, to the north of Ealing, and occupies ten acres of land. The water surface when full will be about six acres, the depth 35ft. to 40ft., and it will contain about 51 million gallons. The level of the top water will be 193ft. 6in. above Ordnance datum. It will be used for the storage of filtered water filled from the pumping-station at Kew Bridge, through a line of 30in. pipes which are connected with the principal mains leading to the west end portion of the company's district. At the reservoir this line of pipes will terminate in a well, in which there will be an inlet into the reservoir and a branch outlet from it, the passage of the water being governed by 30in. hanging valves and 30in. sluice valves. The outlet branch is carried under the bottom of the reservoir, and leads from the lower part of a filter or strainer, the water passing in at the top of the filtered material on its way to the district. The filter will prevent leaves or other extraneous matters from passing into the mains, the water being previously filtered at Kew.

The reservoir will provide for the great increase in the demand for water during the hot weather in the London season, and will at all times prove a great convenience in case of accident to the machinery at the pumping station, as from the elevation it will command the greater part of the West End district. The ground occupied by the reservoir is on the slope of a hill, the south or upper end being at about the level of top water, while the ground at the north or lower end is at the level of the bottom of the reservoir; the excavated material—about 150,000 cubic yards—is used for the formation of the banks, and there will be no surplus to remove. The banks have been formed with slopes 1½ to 1, except at the north end, where the bank will be 65ft. high; the outer slope at this part is 2½ to 1. The whole of the ground consists of clay, and the banks are formed of this material; the bottom and internal slopes are puddled and punned, and covered with concrete 1ft. in thickness, composed of Thames ballast and Portland cement in the proportion of 6 to 1. The internal slopes will be paved with Condy's vitrified bricks on edge in cement, and will finish with a vertical well 5ft. 6in. high, and a coping of hollow terra-cotta blocks. The filter is circular, 65ft. internal diameter of brickwork in cement, faced with vitrified brick, and coped in a similar manner to the reservoir. The filtering material will be fine gravel, laid on perforated iron plates. There will be a hand-rail round the reservoir and filters. On the top of the hill there is a somewhat remarkable geological formation, which has been the cause of considerable trouble and expense. The ground at this part is full of pot holes of gravel resting on sand and silt, into which the gravel appears to have been pressed, possibly by the action of ice. This sand, on being exposed, particularly in wet weather, cannot be made to stand at any slope, and it has been found necessary to construct a heavy wall of concrete at the base of the south slope of the reservoir, to prevent the falling of the surface-ground and avoid damage to the public road and the adjoining reservoir. The work is being carried out under contract by Messrs. Aird and Sons, the total cost being £36,000, including pipes, sluices, and other ironwork. The Portland cement is supplied by the Burham Company, near Maidstone. The ballast is obtained from the Thames, and is landed at Kew Bridge. The vitrified bricks and terra-cotta coping are manufactured at the Great Western Potteries, Torrington, North Devon. The valves are from Messrs. Laidlaw and Sons, of Glasgow; the hanging valves by Messrs. Oakes and Co., Alfreton, Derby.

LAUNCHES AND TRIAL TRIPS.

THE screw steamer Asturiano went down the Mersey on the 1st inst. for her official trial trip, after having her machinery converted from the compound to the tri-compound system by Messrs. David Rollo and Sons, Fulton Engine Works. She has been supplied with new boilers working at a pressure of 150 lb. per square inch. The diameters of the new cylinders are 21½in., 34in., and 55in. respectively, the length of stroke being 36in. The engines will exert a much greater power now than previous to converting, and we may state that the engine-room has been reduced two feet in length from what was considered necessary for the compound engines. In carrying out this conversion Messrs. David Rollo and Sons have not added to the main framing, but have produced a triple-cylinder three-crank engine occupying less space, and on the same framing as a compound engine of about 200 less indicated horse-power. On Saturday the engines gave every satisfaction, working with great smoothness when running full speed. The Asturiano is a vessel of 1804 tons gross. She is 275ft. long, 34·2ft. beam, and has a hold depth of 24·8ft. She is owned by the Atlantic and Eastern Steamship Company, of which Messrs. John Glynn and Son are the managing owners. The whole of the work has been carried out under the superintendence of Mr. George Hepburn.

The screw steamer Waverley, whose machinery has recently been altered to the triple expansion system, was taken on her trial trips last week. She formerly had boilers working at 80 lb. pressure, and with cylinders 41in. and 78in. diameter, and the alterations have involved the substitution of new boilers of steel, carrying steam at 160 lb. pressure, and the addition of two new cylinders placed on the top of the former cylinders. On the trials the engines developed nearly 2000-horse power, and worked with remarkable smoothness at sixty-four revolutions per minute. It is expected that a great economy in fuel consumption will result from the alteration, which has been carried out from the specification of Messrs. Flannery and Blakiston.

On Saturday afternoon Messrs. Schlesinger, Davis, and Co. launched from their shipbuilding yard at Wallsend a large steel screw steamer named the Kate B. Jones, which is of the following dimensions:—Length, between perpendiculars, 270ft.; breadth, moulded, 37ft.; and depth, moulded, 21ft. 8in. The vessel is built on the cellular bottom principle for water ballast in holds, has a long raised quarter-deck with long bridge and topgallant forecastle, with full poop above the quarter-deck aft. Shifting boards will be fitted in each hold for the carrying of grain cargoes. She will be rigged as a topsail schooner with two masts, and will also be supplied with one of Alley and McLellan's patent combined steam and hand steering gears, fitted in the wheel house on bridge amidships. Hastie's screw steering gear will be placed on the poop

COTTON PREPARING AND SPINNING MACHINERY.

MESSRS. ASA LEES AND CO., OLDHAM, ENGINEERS.

(*For description see page* 336.)

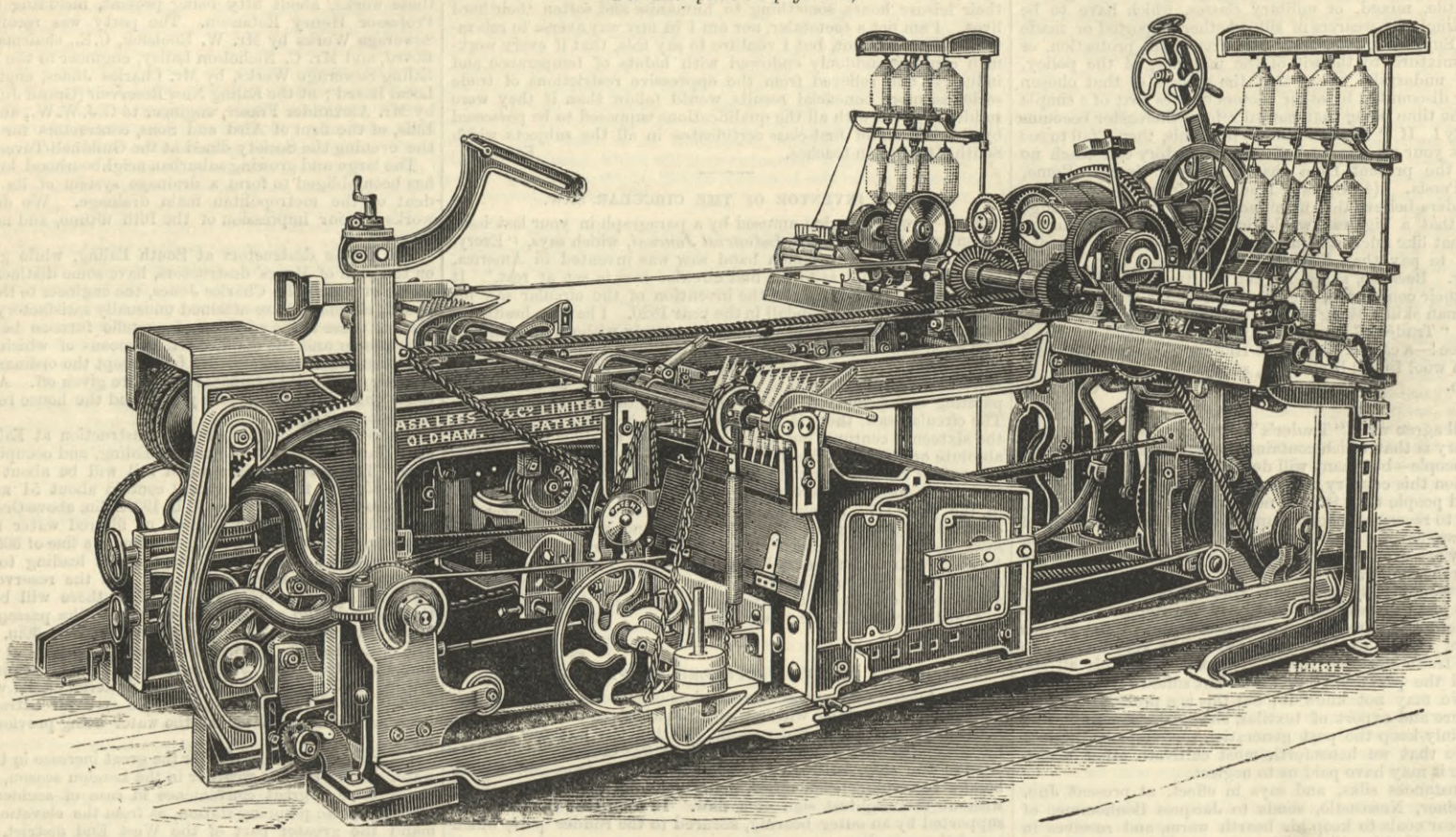


Fig. 5.—SELF-ACTING COTTON MULE (FRONT VIEW) RIM AT BACK.

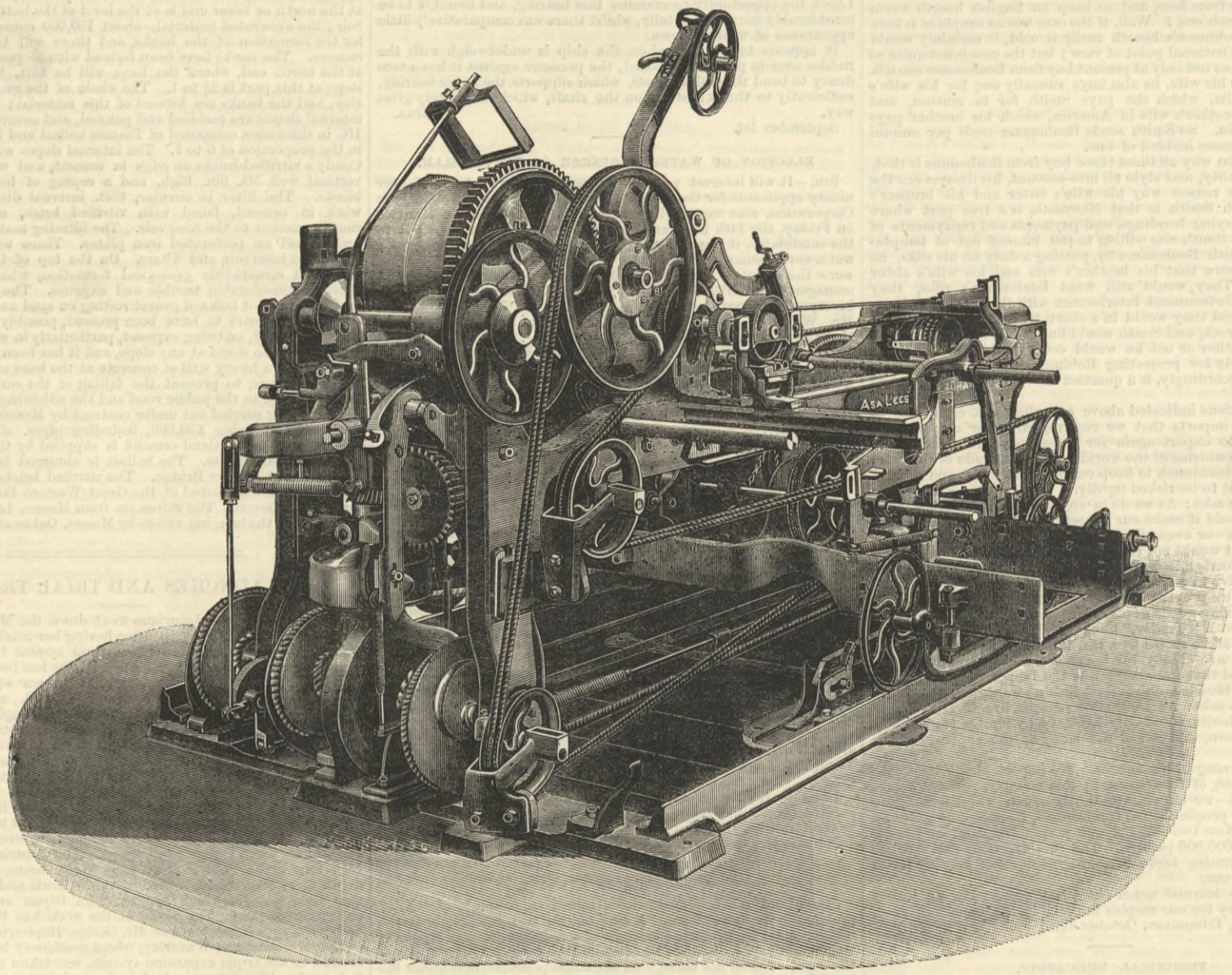


Fig. 6.—SELF-ACTING COTTON MULE (BACK VIEW) RIM AT SIDE.

aft. The vessel will also have one of Emerson, Walker, and Thompson Bros.' patent capstan windlasses fitted on the forecastle; four powerful steam winches will be supplied for the rapid loading and discharging of cargo. The Kate B. Jones classes 100 A1 in steel at Lloyd's, and has been built under special survey. Captain Thomas, who has superintended the construction of the vessel, will take command of her. The engines are of 180 nominal horse-power, having cylinders 21in., 35in., and 58in. in diameter, and 39in. length of stroke, of the triple expansion description, and will be immediately put on board by the North-Eastern Marine Engineering Co. at their works, Wallsend. This is the second vessel built by Messrs. Schlesinger, Davis, and Co. for the same owners, Messrs. Jones and Thomas, of Cardiff.

Messrs. Raylton, Dixon, and Co. have launched a steamer built for foreign owners, which was named the Eugalia. The vessel is of steel, and of the following dimensions:—Length over all, 183ft.; breadth, 26ft. 6in.; depth moulded, 15ft. 1in.; and she will have a dead-weight capacity of 750 tons. She has water ballast throughout on the MacIntyre system, and accommodation for captain and officers at after end. She will be fitted with triple-expansion engines of 80-horse power, by Messrs. Blair and Co., of Stockton.

A screw steamer named the Viceroy was launched from the yard of Messrs. William Doxford and Sons at Pallion on Saturday afternoon last. She has been built for Mr. William Kish, of Sunderland, for the general trades, and is entirely of steel, built to Lloyd's 100 A 1 class. The principal dimensions are: Length between perpendiculars, 275ft.; breadth, 39ft. 6in.; depth moulded, 21ft., with cellular bottom fore and aft. The engines are triple expansion three cranks, with all Messrs. Doxford's latest improvements, the cylinders being 21in., 35in., and 57in. diameter respectively and 39in. stroke, and they are supplied with high-pressure steam from large boilers. She is fitted with Lynn's steam steering gear and Hastie's screw gear aft, and four winches by Messrs. Welfords, of Pallion, multitubular donkey boiler, and with all apparatus for cargo purposes. The cabins are tastefully constructed in hardwood and Lincrusta Walton in the poop aft, and give most comfortable quarters for captain and officers. The crew and firemen have exceptionally large and comfortable quarters at fore end of bridge. The poop deck is caulked with Tagg's caulking. We understand the vessel is already chartered to load 2000 tons coke for Bilbao early in November, which will be within four and a-half months from the date of order, and considerably within the contract time for delivery. The vessel has been surveyed during construction by Captain Hern on behalf of the owner, and will sail under his command.

An American paper says an empty benzine barrel is apparently as dangerous as a full one. A teamster threw one off a load lately, when it exploded with great violence. The barrel blazed up fiercely, and had it been inside the works, would have done considerable damage.

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

(*From our own Correspondent.*)

From the reports brought to the Birmingham market to-day (Thursday) and to the Wolverhampton market yesterday, it appears that the ironmasters' quarterly meetings have not been so productive of orders.

The orders received by the marked-bar firms are insufficient to keep the works fully employed, and the tendency is not much towards improvement. Under these circumstances, the firms have to utilise their plant on the manufacture of second-class qualities, for which the price varies from £6 per ton.

The prices of iron manufactured by Messrs. N. Hingley and Sons, Dudley, are for the new quarter as follows:—Netherton crown best horseshoe, £7; best rivet, £7 10s.; best best plating, £8; crown best best, £8; crown treble best, £9, all at works. These prices apply to rounds and squares of ½in. to 3½in., not exceeding 27ft. lengths, and flat bars 1in. to 6in. wide, not exceeding 25ft. lengths. Angle iron up to 8 united inches is £7 10s., and tee iron £8 per ton.

Messrs. Philip Williams and Sons, of Tipton, quote their iron at:—Mitre bars, ⅝ round or square to 3in., or flats 1in. by ⅜in. to 6 by 1in., £6 15s.; Mitre bars, ½ to $\frac{9}{16}$ round or square or plates ⅞in. or 1in. by ¼, £6 15s.; Mitre hoops, 2in. to 1⅝in., not thinner than 16 w.g., £7 5s.; Mitre strip iron, from 2½in. to 6in. broad, not thinner than 14 w.g., usual lengths, £7 5s.; Mitre singles, £7 10s.; doubles, £8 5s.; lattens, £9 5s.; angle iron, not exceeding 8 united inches, £7 5s.; best iron, 20s. per ton extra; bars cut to exact lengths, 5s. per ton extra; Mitre plating bars, £7 5s. The quotations of the Wednesbury Oak Crown brand are 20s. per ton less than the above.

The list of Messrs. W. Millington and Co., Summerhill Ironworks, stands at: Bars, £7; small rounds and squares, £7 10s.; $\frac{5}{16}$in. bars, £8; ¼in., £8 10s.; No. 5, £9; $\frac{3}{16}$in., £9 10s.; No. 7, £10 10s.; No. 8, £11 10s.; and No. 9, £13. Best bars they quote £8; double best, £9; and treble best, £11. Plating bars and cable iron are £7 10s.; best ditto, £8 10s.; double best, £9 10s.; rivet iron, £7 10s.; best, £8 5s.; double best, £9 15s.; angles, £8 to £8 10s., and on to £9 10s., according to quality. Boiler plates and sheets, £8 10s.; best, £9; double best, £10; and treble best boiler plates, £12. Common bars remain at £4 15s. to £5 per ton, and coopers' hoops to £5 5s. to £5 7s. 6d.

The association formed in the tube strip trade for the maintenance of a uniform price is a strong one, and embracing the following fourteen firms:—John Bagnall and Sons, the Cleveland Iron Company, the District Iron Company, W. and G. Firmstone, N. Hingley, Hingley and Smith, J. T. and W. E. Johnson, the London Works Iron Company, the Monmore-lane Iron Company, the Pelsall Coal and Iron Company, John Russell and Co., Roberts and Co., W. and J. S. Sparrow, and R. Thomas. Such a combination should, if it is adhered to, guarantee the success of the venture, more especially since the £5 per ton demanded, is considered as being anything but exorbitant.

The sheet iron makers have strengthened their position by making known the large extent to which they are engaged. The full prices are in nearly every instance now being secured, and consumers experience such difficulty in placing orders that they show no reluctance in making concessions. Doubles and lattens are in exceptionally brisk demand, and so fully occupied are the mills upon these gauges that the margin of price between singles and doubles is very small. The quotation for 20 gauge is £6 5s., and 24 gauge remains £6 7s. 6d. to £6 10s. per ton, and for 27 gauge £7 7s. 6d. to £7 10s. Numerous orders at these rates have been booked forward to the end of the year.

Galvanised iron prices are this week maintained on the advanced quotations, which are higher than those of midsummer by 20s. per ton. But there are a few firms who offer no objection to the granting of concessions. The Association figure for 24 gauge f.o.b. Mersey is £11 for ordinary qualities, bundled, but plenty of business is being done at £10 10s. An extra of 30s. to 35s. per ton is demanded for 26 gauge, making the figure £12 to £12 10s., f.o.b. Mersey. For 28 gauge a further 20s. is demanded. A good demand is being experienced from Australia for a superior brand of 26 gauge at £14 per ton, f.o.b. Thames. The advance in the price of black sheet iron and spelter are not, the galvanisers assert, fully compensated by the advances which they themselves have declared. In October last year spelter was being bought at £14 5s. per ton, and the price is now £16 10s. to £16 12s. 6d., while black sheets have also risen between 8s. 9d. and 10s. per ton.

A good business is being done in iron and steel thin sheets for stamping and working-up purposes. The home demand is steady and a large inquiry is experienced from India, Australia, Canada, and the United States. On account of this last-named market there is a considerable demand for steel sheets for stamping purposes of gauges ranging from 14 to 26 gauge. Good American orders are being placed for steel sheets of 20 gauge at about £10, but special makes cannot be procured from Staffordshire makers under £12 10s. per ton. Buyers name £14 10s. for 26 gauge. This price, however, is insufficient for some makers.

Steel keeps buoyant, and numerous negotiations commenced at the quarterly meetings are in process of completion. The order books are now so well filled that makers are becoming independent. Even with their present orders they find rapid execution difficult. The price quoted this week for blooms by the Lilleshall Company, of Shropshire, which has an abundance of orders, is £4 10s. to £5 per ton; while for some descriptions of superior billets as much as £7 17s. 6d. is the figure. Imported steel is in brisk request. Bessemer plating bars from Sheffield are £5 10s. to £6 2s. 6d. per ton. Superior quality bars of Sheffield make are £9 to £10, and Swedish Bessemer ditto, £14. Mild steel bars from Wales, suitable for rolling into best thin sheets, are £5 2s. 6d. for best qualities, and £4 17s. 6d. for Bessemer qualities. For Sheffield cast steel prices range from a minimum of £20 per ton to a maximum of £60 per ton, delivered into this district, for tool-making purposes. The quality most largely used is that for which from £26 to £35 is demanded. Current prices of steel rails are given by Birmingham buyers as £4 2s. 6d. to £4 5s. per ton, and sleepers about £7 10s. per ton.

Northampton pigs are 36s. at stations, or 36s. 6d. delivered to works here; while Derbyshires are 37s. to 38s. delivered to consumers; and Lincolnshires, 40s. to 41s. Wigan part-mine pigs are quoted 40s.; native pigs vary from 50s. for hot blast; all-mines down to 30s., to 29s. for cinder qualities. Hematites are not quite so strong as a quarter ago, and contracts at present prices are booked as far as six to nine months ahead. West coast sorts are 53s. to 55s. per ton, and Welsh 52s. 6d. delivered here.

Large sales of Northampton ironstone are reported to furnace owners in Derbyshire, and smaller sales to owners in the district. The price on trucks is 2s. 6d. per ton, at which consumers are prepared to place good orders. Lancashire purple ore, obtained mainly from the Runcorn district, is quoted at 11s. 9d. to 12s. per ton, delivered here. Hematite purple ore is quoted 23s. 6d., and annealing ore for founders' uses, 30s. per ton. Coke vendors report a moderate business with local and Northampton furnace proprietors, mainly of Derbyshire qualities of coke. Prices show considerable fluctuation. Durham foundry cokes are 21s. per ton, and Derbyshires about 13s. 6d. per ton.

The death is announced this week, at the age of 74, of Mr. James Horsfall, the former proprietor of the well-known wire-works at Hay Mills, Birmingham. Mr. Horsfall, who was in partnership with Mr. Webster, of Penns, was the inventor of a patent process for treating steel wire which deprived it of its crystalline brittleness, and gave it a tenacity which rendered it suitable for use in musical instruments and for ropes. The discovery practically led the way to the present large trade in mining ropes and cables. The firm manufactured the wire which was used in the construction of the Atlantic cable.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—It is again much the same report that I have now had to make for so long past; the iron trade of this district continues in a very depressed condition, with no present or prospective sign of improvement. Both in common pig iron, hematites, and finished iron the demand would seem to be falling off rather than increasing, and prices, if not quotably lower, are weaker. In pig iron the continued downward tendency of Scotch and Middlesbrough brands has necessarily a depressing effect upon the market; and buyers, who have firm offers for anything like quantities can find sellers at very low figures. For hematites the demand continues very slow, and with the large production now coming upon the market, prices are being forced downwards. In the manufactured iron trade the falling off in the pressure of shipping orders is, as I have previously anticipated, bringing about a quieting down, and prices are rather easier.

There was about the usual average attendance on the Manchester iron market on Tuesday, but there was only a very slow business doing. Pig iron still meets with but very poor demand, with prices if anything easier, especially in the outside brands offering here, such as Scotch and Middlesbrough. For local and district brands prices remain much the same as last quoted. Lancashire makers still hold to 38s. 6d. and 39s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester, although any actual sales at these figures are confined to occasional small parcels for special customers. Derbyshire foundry iron is still quoted at 40s., less 2½, delivered equal to Manchester, and at this figure is firm. In Lincolnshire iron the attempt to get a slight advance upon the very low prices which have recently been taken has not been responded to by buyers; so far, the effect has simply been to check further operations, and although makers' quotations remain at about 36s. 6d. to 37s. 6d., less 2½, for forge and foundry delivered equal to Manchester, something under these figures would have to be taken to effect sales.

For hematites there is still only a slow sale in this district, and prices are easier; the average quotations for good No. 3 foundry, delivered into the Manchester district, remain at about 52s. 6d., less 2½, but in most cases sellers would be very ready to entertain offers at under this figure.

There is no very material change to report in the manufactured iron trade, but the tendency is in the direction of lessening activity. The pressure of shipping orders is beginning to fall off, and as there is no increased home trade coming forward the result is a quieting down at some of the forges, with, if anything, a slight tendency to give way a little in price to secure orders. Quoted rates are, however, unaltered, and remain on the basis of £4 17s. 6d. for bars, £5 5s. for hoops, and £6 7s. to £6 10s. for sheets delivered into the Manchester district.

In most branches of engineering there is a moderate amount of work stirring, and the returns I get from the trades union societies with regard to employment show that if there is no improvement, the number of unemployed members on the books does not increase to any appreciable extent. Taking both sides of the question, it may be said that trade remains in a very unsatisfactory condition. Machine tool makers are perhaps getting a little more work, and for Indian railways there has been some considerable grist coming to the mill for railway plant, locomotive and carriage building; but taking all the new work that is to be got, there is no real improvement in trade, and the prices which have to be accepted are quite as low as ever.

With the approach of winter, the falling-off in the pecuniary support they have so far been receiving, and the fact that the employers are steadily filling their works with hands obtained from other districts, the men on strike in the Bolton engineering trades are showing a decided anxiety to come to some settlement. During the past week or so various proposals have been put forward as a sort of compromise, but they have so far had the defect that the men have aimed at imposing special conditions in their own interests, which, of course, the employers have declined to accept. About a month ago the employers offered fair terms for a settlement of the dispute, which were rejected, and their present feeling with regard to the matter may be gauged from the fact that old hands who had left their tools in the shops have been requested to take them away. There is no doubt that any fair and reasonable settlement of the dispute would have been willingly accepted by the employers, who would prefer to have their old hands rather than strangers; but it is very doubtful whether they will now consent to any material abatement of the terms on which they were prepared to settle the dispute a month or so back.

The winter session of the Manchester Association of Engineers was opened on Saturday last, and the president—Ald. W. H. Bailey—delivered an interesting address, in which he dealt with the Government control of steam boilers with special reference to the Bill which has been introduced by Lord Stanley for the registration and inspection of boilers. This Bill makes provision for utilising the present boiler insurance companies and the associated steam users' organisation for boiler inspection and registering purposes, and the provision that the Board of Trade might appoint a lay committee comprising users of boilers and members of scientific societies, who should assist in the administration of the department, Mr. Bailey regarded as a very good feature, which he thought the Manchester Association of Engineers might well take into consideration. In concluding his address, Mr. Bailey pointed out that it had been urged by those who objected to the present system of boiler inspection, that it was a system of purchasing indulgences; that some of the insurance companies simply received the fees and did not make the proper inspection, while at the same time they took all the risk from the shoulders of the boiler owners by paying compensation in case of accident. On the other hand, the trades union advocates looked for safety in a system of registering the boiler attendants, their proposal being that no person should be permitted to tend a boiler unless he had undergone the ordeal of examination and obtained a certificate. In Lord Stanley's Bill it was proposed, instead of giving a certificate to the men, that a certificate should be given to the boiler, and taking the proposed Bill altogether, although it might certainly be improved in details, he thought the President of the Board of Trade had shown a strong desire to deal with the steam users fairly. The Bill appeared to rest on a basis of common sense and public utility, which, subject to amendment in some of its details, should commend it to the favourable consideration of users of steam power. In the discussion which followed the President's address, Mr. James Walthew, who said that for the last twenty years he had been in a position to note the influence for good which the various boiler insurance companies had brought to bear upon the manufacture and working of boilers, urged that it was highly important that a measure on the lines of the proposed Bill should become law. Mr. Lavington Fletcher, following in much the same lines, submitted that inspection tended to bring boilers up to one good standard, and urged that we were bound to try and arrest the loss of life at present taking place by securing a complete inspection of boilers, not by the Board of Trade, but by private agencies. Mr. Rawlinson thought we were already travelling along in the right path, and that the causes of boiler explosions were being steadily removed without any great bother in the matter being necessary. Mr. West thought that some one should be made definitely responsible for the proper working of boilers in use, and he was in favour of a general systematic inspection of boilers, which should be made compulsory, and that those who used the boilers should pay for the inspection. Mr. Hartley contended that a thorough boiler examination was absolutely necessary, and further pointed out very significantly that some of the boiler insurance companies ought to be protected against themselves, as boilers were frequently insured year after year without any inspection whatever, and the keenness of competition very often led to a boiler which had been condemned by one company being accepted by another. Mr. Longridge, although he admitted that he was not very happy in the thought of putting themselves in the hands of the Board of Trade, was of opinion that ultimately the question of inspection must come into the hands of the Government. He would, however, suggest that as a preliminary step there should be a registration of all the boilers in use. It would then be easy to find out how many were under inspection and how many were not, which would enable them to form a better judgment as to the necessity for further legislation. A vote of thanks having been passed for the address, the president, in responding, suggested that a committee of the Association might be appointed to consider the question and present a special report.

In the coal trade the better qualities for house fire purposes are in active demand, with, in most cases, a slight advance upon last month's prices being got, but other sorts for ironmaking and steam purposes still meet with only a very slow sale, and are plentiful in the market with no appreciably better prices being got. Engine classes of fuel move off fairly well, and it is only the common sorts of slack that are really a drug in the market. At the pit mouth prices average 9s. for best coals; 7s. to 7s. 6d. seconds; 5s. 6d. to 6s. common house coals; 5s. to 5s. 6d. steam and forge coals; 4s. 6d. to 5s. burgy; 3s. 6d. to 4s. best slack; and 2s. 6d. to 3s. common sorts.

Shipping continues very quiet, and it is difficult to get more than 6s. 6d. to 6s. 9d. for steam coal delivered at the high level, Liverpool or the Garston Docks.

Barrow.—The hematite pig iron trade occupies a somewhat remarkable position at the present time. There is a fair demand from all quarters, but business has of late been devoted mainly to the purchase of warrants, which have been actually selling at a price as low as the cost of production. On the other hand, makers are busy and well sold forward, and are for the most part very firm in their transactions. There is a lower quotation for iron, but this does not represent actual sales. Prices vary from 42s. 6d. to 44s. 6d. for Bessemer iron in parcels consisting of equal portions of Nos. 1, 2, and 3 quality net, f.o.b., but sales are noted as low as 41s. 9d. per ton. It is considered evident on all hands that prices will soon advance, as, although stocks ars still largely held, needy sellers are getting fewer, and prices must soon return to a level which, while affording profit to the maker, will at the same time leave a margin for those who have speculated on iron and have held it for some time in view of a rise. The output of the district is well maintained, and there is as much iron going into consumption as is being produced, while the stocks held do not represent more than about a three months' consumption at the present rate. The steel trade is remarkably steady, and is likely to continue to be so as long as makers are so well sold forward and the orders so plentiful. The business doing is, however, not considerable, as makers are resisting the present disposition in the direction of lower prices, and are not selling in consequence. It is clear that as raw material is improving in value the price of pig iron and steel cannot possibly go the other way. There must be a change for the better in prices shortly, and the sooner the better for the district, if makers carry out their threat and begin to reduce the output in face of a good demand. Heavy sections of rails are quoted at £4 2s. 6d. per ton net, f.o.b. A new rail mill of a powerful description has been started this week by Messrs. Charles Cammell and Co, Workington, which will practically double the producing power of these already large works. The mill is a duplicate of the one which has been at work for some time, and will roll about 3000 tons of rails per week. This will represent a very considerable increase in the production of the district, and will enable West Cumberland to compete to a very considerable extent in the steel trade of the world. There is a good trade doing in billets and in bars, and the mills in these departments are very briskly employed. There is not much doing in steel for shipbuilding purposes, but it is noticeable that enquiries are increasing, and it is believed some large parcels will be bought by local makers. It is also satisfactory to note that shipbuilders are likely to become busier, and that their trade in the future will be largely confined to steel-constructed ships, in which local plates and other classes of steel will be used. Iron ore is very firm in tone and sales are still few, as raisers are sanguine of higher values in consequence of the improved freights from Spain to South Wales and the East Coast. The coal and coke trades are steadily employed, and the returns of metal exports show very large averages.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The skate makers are beginning to prepare for the winter. This business is usually in the hands of the joiners' tool manufacturers, who find the speciality useful for filling up the autumn and early winter season. Skate making has for some years been a decaying industry, mainly owing to the flood of inferior productions which overstock the market. This season, I am afraid, will not differ from the others in that respect. Already, I hear, the German-made skate is being freely delivered in Sheffield. If report is true, nearly 40,000 have been ordered by two firms, and these are not of the ordinary quality, but of a popular and high-class patent skate. This German invasion affects Sheffield industry in a serious fashion. It prevents the manufacturers employing their plant and machinery during the duller months of the year, and it deprives the artisans of employment at a time when they need it most.

Railway material continues to be freely ordered, both on home and foreign account, and the advance of 5s. per ton secured a month ago is maintained. Several of the manufacturers are booked well into next year for certain classes of rolling stock, though they are quite prepared to undertake fresh work. The principal distant markets are the Colonies, India being the leading customer for nearly all kinds of rolling stock, including engines and carriages. The home business has also been increasing of late.

No extra orders of any consequence have been received recently for war material. Some of the heavier work in armour-plates has now been delivered, and though the two producing companies are still well engaged, there is a perceptible diminution in the pressure upon these important departments. Marine forgings are in plentiful request, particularly for ocean-going steamers. Considerable additions have been ordered for the Atlantic lines, and the shafting, &c., has mainly come to Sheffield firms.

The awards at the Adelaide Exhibition have been published in advance of the official announcement. They show that the Exhibitors from Sheffield and Rotherham have done extremely well. Our leading cutlery, edge tool, sheep-shear, and plated goods, as well as in wire ropes and cables, and stove grates, have all succeeded in carrying off first orders of merit, which is the highest distinction given. It is gratifying to find English firms so successful in the Colonies, for whatever may be said about their lukewarmness in the past, they have certainly striven very hard during the last two years to meet every possible business requirement of our cousins across the seas.

Speaking to his constituents last Monday, Mr. C. E. Howard Vincent, C.B., M.P., stated that in February he took several leading representatives of the steel and iron trades in Sheffield to the Secretary of State for War, and on the 28th of that month Mr. Stanhope assured them that three-fourths of all gun forgings, large or small, required by Government should be given to the trade. That pledge, he went on to say, had since been ratified, and he was glad to hear a considerable order had been divided over the great Sheffield works. A still more important point was that an independent testing department was to be established. This is regarded here as very essential. Given fair employment for their machinery, and impartial tests, the future of our large establishments would be assured.

Mr. John Bramall, a well-known Sheffield manufacturer, was interred here on the 19th inst. He was at one time a most prosperous steel and file manufacturer. Amassing a fortune of £60,000 he retired from business, and casting about for some source of investment, unfortunately went into shipping, which he did not understand, and lost every penny. He was an estimable and

honourable man, and during his misfortunes had the sympathy of the whole community. At the meeting of his creditors it was stated that he had lost the whole of his fortune, and they showed their sympathy with him by voting £200, with which to furnish a new home, and granting him his immediate discharge.

The cutlery and plated goods firms are beginning to feel the effect of Christmas and New Year. Last month business was exceedingly quiet. Orders are now beginning to come in freely, chiefly for the London market. The country trade is as yet rather languid. Though the hotel proprietors and lodging-house keepers in the northern watering-places have had an unusually good season, there has been little business done in replenishing stocks of cutlery or "E. P." Merchants have allowed their shelves to get very bare, and a brisk winter and spring trade is anticipated in consequence. For years the dealers have been "holding off," using the manufacturers' premises as their warehouses, and ordering by parcels-post.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

Business in Cleveland pig iron is at present almost at a standstill, and it is scarcely likely that sales of any magnitude will take place so long as prices continue to fall as they are at present doing.

The reports received from Glasgow are very unsatisfactory, and have a depressing effect on the market generally. Notwithstanding the fact that many important ports will shortly be closed for the season, exporters will hold their orders in the hope of being able fulfil their commissions on still more favourable terms. It is somewhat difficult to ascertain the actual price of No. 3 g.m.b., as so few sales have lately been made. For prompt delivery most merchants would accept 32s. 6d. per ton, or 6d. less than a week ago; but buyers will not at the moment pay more than 32s. 3d. Makers who for the most part are not in immediate need of orders keep out of the market; but one or two who are not so well provided have reduced their quotations to 32s. 9d., and are prepared at that figure to book for delivery to the end of the year. Forge iron, though decidedly firmer than No. 3, has fallen 3d. per ton during the week, and is now obtainable at 31s. 6d.

Stevenson, Jaques, and Co.'s current quotations: "Acklam Hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire," Cleveland, No. 3, 34s. 6d.; "Acklam Basic," 35s.; refined iron, 48s. to 63s., net cash at furnaces.

Warrants have receded in value from 32s. 7½d. to 31s. 9d. per ton; nevertheless, speculators do not seem inclined to operate.

Messrs. Connal and Co.'s stock of pig iron at Middlesbrough stood on Monday last at 328,234 tons, representing a decrease of 559 tons during the week.

The stormy weather which prevailed last week greatly interfered with the shipments, and brought them to a figure which is considerably below the average. Up to Monday night only 38,312 tons had been exported, as against 42,152 tons in the corresponding portion of September.

A lamentable accident has just occurred at the Seaton blast furnaces, near West Hartlepool, whereby three men have lost their lives and others are still in a dangerous condition. A furnace had, it appears, just been blown out in order to be re-lined, and a number of men were working round it. From some cause, as yet unexplained, an explosion took place within, whereby a portion of the side was blown out. The men were caught by the flames which burst forth, and were struck by more or less heated bricks and other materials, and dreadfully burned. Until the inquests have all been held the facts will not be completely known. The prevalent opinion at present is that water must somehow have found its way into the still heated interior of the furnace.

The members of the Stockton and Middlesbrough Corporation Water Board are not in a very comfortable state of mind. Their general manager, Mr. D. D. Wilson, has just presented them with a report, in which he says:—"The comparatively short time remaining within which the Water Board must complete certain of the works authorised by the Act of 1876, and the very serious consequences which will ensue if they are not completed within the specified time, or that time as extended by Parliament, make it imperative that the Water Board should carefully consider its position, with a view to taking such steps as the circumstances require." It appears that the consumption of water for manufacturing purposes has been for long increasing, until now it exceeds 62,000,000 gallons per week. Occasionally it has been close to the parliamentary limit of 66,000,000 gallons. Should there be any considerable increase in the consumption, owing to the expected extension of steel works or otherwise, the supply to consumers may have to be restricted, or heavy penalties will be incurred. To get over these difficulties the Board has decided to apply for fresh parliamentary powers in the coming session, and it has instructed its two clerks to prepare at once the draft of a bill setting forth what is required.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

The Glasgow pig iron market was much depressed at the opening of the present week, and warrants were as low as 39s. 9d., the lowest price touched during the present year. But in consequence of reports to the effect that a number of good orders had been received by ironmasters for shipment to Italy and America, and also because the past week's shipments turned out better than was expected, the tone of the market afterwards exhibited a certain improvement. The shipments amounted to 9391 tons, against 6531 in the same week of last year, and the larger proportion of the quantity sent abroad went to Italy, Canada, and the United States. Rather more iron is now being sent into the warrant stores in Glasgow. Since last report, an additional furnace has been placed on hematite at the Clyde ironworks, the total now in operation being 84 against 69 at the corresponding date.

The current values of makers' pigs are as follows:—Gartsherrie, f.o.b. at Glasgow, No. 1, 47s., No. 3, 43s.; Coltness, 51s. 6d. and 43s.; Langloan, 48s. and 44s. 6d.; Summerlee, 49s. 6d. and 42s.; Calder, 47s. 6d. and 41s. 6d.; Carnbroe, 43s. and 39s. 6d.; Clyde, 45s. 6d. and 40s. 6d.; Monkland, 42s. 6d. and 38s. 6d.; Govan, at Broomielaw, 42s. and 38s. 6d.; Shotts, at Leith, 47s. and 44s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 47s. 6d. and 40s. 6d.; Eglinton, 42s. and 38s. 6d.; Dalmellington, 43s. and 39s. 6d.

The week's arrivals of Middlesbrough pigs at Grangemouth have been 4910 tons, against 7425 in the same week of 1886. These imports show a total increase this year of 16,096 tons.

The new contracts that are being placed with the Clyde shipbuilders have brought a number of steel orders into the market, and for these there has been extreme competition, which threatens to result in a material reduction of prices. This circumstance is regarded as unfortunate, seeing that quotations had already been forced to a low level.

The past week's shipments of iron and steel goods from Glasgow embraced £541 worth of engines, £2436 sewing machines, £2163 machinery, £3330 steel goods, and £19,864 general iron manufactures.

The malleable trade continues fairly active, and there is no change in price. There is a good demand for both iron and steel sheets. Bars are in fair request for the home market.

In the coal market there is a fair business passing. Home orders are increasing, but not quite so rapidly as a week or two ago, when the weather was colder. Prices are without change. There has also been a certain slackness in the shipping department. From Glasgow 14,739 tons were despatched; Greenock, 519; Ayr, 9652: Irvine, 2676; Troon, 6780; Ardrossan, 3539; Burntisland, 6842; Leith, 5172; and Grangemouth, 18,573; the total of 68,492 comparing with 63,395 in the corresponding week of 1886.

The threatened adoption of an idle week by the colliers, as recommended at last week's National Conference at Edinburgh, does not occasion any apprehensions among the coalmasters. The last time the restriction was resorted to in Scotland, it had the effect of enabling the coalmasters to clear away from the pitheads enormous quantities of stuff that, in other circumstances, they could not have disposed of at any price. For this material they obtained good prices. They did not suffer on account of a scarcity of good coals so far as their obligations under contracts were concerned, because all contracts of any importance now contain a strike clause, the effect of which is to allow the coalmaster to supply the best material he can at the enhanced price given to it by the general scarcity in the market. If the idle week is adopted the same thing will be repeated, and the masters will be the gainers and the men the losers by this action of the latter.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Swansea has just escaped a great misfortune. In its immediate neighbourhood the Landore Works give employment to over two thousand men, and as the place has a high repute, trade is generally brisk there. Last week a dispute with the smelters necessitated a stoppage, and the action of forty-six men—for this is their number, all told—completely prevented all operations. I am glad, however, to add that two or three days' idleness and reflection brought the smelters before Mr. Roberts on Tuesday, and on Wednesday a restart was effected on the masters' terms. The temporary stoppage at Landore nearly caused a commercial panic throughout Swansea.

Local iron works are well employed, and even if the rails turned out are not numerous, a good deal of miscellaneous work is being done, amongst which blooms and steel bars figure considerably. This week a cargo of 2100 tons of blooms was cleared from Newport, Mon., for Philadelphia and Baltimore. Newport also sent 350 tons tin-plates to the same direction.

Tin-plate continues to be the most busy industry in connection with the iron trade. The pig iron used annually in tin-plate manufacture now amounts to 750,000 tons, and over two millions and a-half tons of coal. Notwithstanding, the demand for tin-plates is well sustained, and exports and large prices have of late been a little weaker, and this a well-informed authority suggests is due to the Scottish pig iron trade, which has been drooping.

During the past week the clearance of tin-plates from Swansea amounted to 71,000 boxes. This was an exceptionally large export, and has left a reduced stock to meet demand.

Swansea Exchange was well attended on Tuesday, and the report given of the Birmingham quarterly meeting was that it was a large and a busy one, and trade hopeful. The tone at the Exchange was firm, and masters indicated a preference for withholding make rather than to accept lower figures. The prevailing figures for tin-plates were as follows:—Iron coke tins, 12s. 6d. to 12s. 9d.; Bessemer, 12s. 9d. to 13s.; Siemens coke finish, 13s. to 13s. 6d.; charcoal, 14s. 6d. to 17s. 6d.; ternes, 23s. to 26s. 6d. double box. It was somewhat unusual to see a decided drop in wasters, which were offered for 1s. per box less than late quotations. Other quotations at the Exchange were as follows. I give them as fair indications of those prevailing in the whole district.

Steel rails, large, £4 5s. to £4 7s. 6d.; merchant bars, £4 7s. 6d. to £4 10s.; Landore hematites and Cwmavon no change, late quotations prevailing. Steel sheets, £7 10s. to £8 10s.; blooms, Bessemer, £4 5s.; bars, £4 15s.; Siemens, £5 2s. 6d., less, in most cases, 2½ for cash.

Iron ore continues to excite attention, and a fair demand continues, though the principal ironmasters, judging from stocks, are well bought. Dowlais and Cyfarthfa hold considerable quantities, and if even a stoppage of supplies were to occur they could go on a considerable time. The prices quoted at the three ports are pretty well the same, 12s. to 12s. 3d., with an extra price for picked cargoes. I see Swansea quotes, ex ship at that port, for special quality, 13s. 6d.

Coalowners have now an anxious time of it. There is a sense of insecurity with their own men, and a growing opposition from the North of England.

The feeling of uneasiness amongst the steam coal and house coal colliers continues. Representative men are busily engaged, meetings are frequently held, consultations are constant, and to a great extent the deliberations are private and little or nothing is allowed to transpire.

It is currently reported in Cardiff circles that the North of England coal and steamship owners are elaborating a plan by which they hope to divert a good deal of the Welsh coal trade into their channels. This will consist in putting their steamers at the service of the northern coalowners, and taking them away from the Welsh coalowners.

One cannot seriously imagine that such an idea is entertained, but it is so stated, and in influential circles in Cardiff; and it is urged against this that a movement should at once be inaugurated, by which the Welsh coalowners should acquire a good fleet of steamers, and thus be independent.

It is very likely that the note of alarm will prompt the steam ship building trade; but if the Welsh coal is found to be better than that of the North of England, and the price is not so widely different as to tempt to the use of the inferior coal, there need not be any great anxiety. It will be time enough to fear when the best coals are gone and seconds only in use.

Prices of best coals remain tolerably firm, and quotations at port for best kinds are from 8s. 6d. to 9s. 6d. The Pacific Steam Company has been placing contracts for 20,000 to 30,000 tons delivered at Birkenhead. This is a case in point. If any great company like this stipulates that the contract is to be for Welsh coal, it is evident that to put other coal on board will be to incur risks which courts are not slow to condemn and punish.

House coal is improving in demand, and prices are certain to advance. Small bituminous is scarce, and sells readily for 5s. 9d., while small steam is again getting into demand and prices are better. After a quantity has been sold for as low as 3s., prices are now 3s. 9d., and firm at that.

Pitwood is steadily advancing. At Swansea prices are 16s. 3d. on trucks; Cardiff quotations, 15s. 9d., but advancing.

In Cardiff a good deal of comment has been passed on the treatment received from coal buyers in Dieppe. The complaint urged by Dieppe is coal short, and it is nothing unusual for a vessel to be mulcted in £5 for the deficiency. If this should continue some radical change will have to be adopted.

It is expected that something decisive will be made known next week in relation to the sliding scale. The Ferndale scale examiners have decided from the examination of books that wages are to remain unaltered. This will affect about 3000 men.

NOTES FROM GERMANY.

(From our own Correspondent.)

The position of the iron markets is thoroughly firm as far as prices are concerned, if the demand is not quite so brisk as it was, which, however, is not alarming, as it is simply caused by buyers having for the present covered their immediate wants. The principal change to note is a rise of M. 1 p.t. on all numbers of foundry pig iron. The result of the tendering for steel rails, &c., at Altona was that no Belgian house offered, because in that country the works are not in want of orders just now, notably Cockerill and Co., who are full for some months on Dutch and Danish steel rails; that three English houses did tender, one at M. 123½ free Altona, one at 124 free Hamburg, and another, name not known, through an agent at Nüremberg at 115·75 free at Altona, and that Krupp offered the lowest at 112·50 at Essen, but when the difference of freight is added, the price would be M. 3 higher than that of the unknown English firm. For fish-plates and small iron articles the Westphalian works offered at from M. 104 to 127·50 p.t. On the 13th inst. at Hanover 5410 t. of rails and 1200 t. of steel sleepers were tendered for by the Westphalian works at M. 117 and 118 at works; Bolckow, Vaughan, and Co. 123·60 at Bremerhaven, and 124·60 at Harburg. The Osnabrück works offered M. 115 for the sleepers. Again, on the 14th inst., 6275 t. of rails were given out at Erfurt, and to-day 10,500 t. of rails and small ironwork will be offered at Bromberg, so that in the month of October 50,000 t. of steel rails, and about 15,000 t. of sleepers in all will have been given out by the State railways alone.

As there is no material change in prices this week, and the general condition of the market is pretty much the same as the last, the report of the Düsseldorf Chamber of Commerce for 1886, just made public, has been substituted, without further apology, verbatim in the place of the usual trade details, because, as Düsseldorf is the most important iron and hardware centre in Germany, and all the other centres of iron industry are more or less reflections of it, it gives a thoroughly good and authoritative picture of the state of the iron industry of the whole country.

"For some years past," says the report, "the iron industry has been continually getting worse, particularly as regards prices and lessening of employment. The latter is partly to be ascribed to the unjustified increase of production where the demand was wanting." This is an opinion I have several times expressed in these "Notes," but the chamber could have gone further and said that the German iron industry was laid out on altogether a too large scale for the capacity of the people or their external relations. The fact is that, when Germany became united, the vanity of the individual at becoming an item in a great country and the conceited idea of being filled with more science than any other people caused him to believe he could beat creation, and far too much money was put into coal and iron undertakings, machine shops, and so forth. The dismal report of the Düsseldorf Chamber is the moral to all this, and therefore worth perusal.

It goes on: "And partly also to a competition from abroad which has sprung up, accompanied by an increase of custom duties in those countries, which has shut us out of these old and important fields for the sale of the products of our industry.

"One chief reason for the receding of prices and the long-continued want of employment is to be found in the struggle which is continuously going on between the ever-increasing employment of mild steel made by the Thomas-Gilchrist, out of phosphoric pig iron, and wrought iron made by the puddling process. This struggle will probably at no distant date end in favour of steel, which for a number of articles is used in unlimited quantities, and is cheaper than iron. To the last cause especially is to be ascribed the gradual sinking of the Rhenish-Westphalian blast-furnace industry, which produced, specially, pig-iron of superior quality, the demand for which has decreased, as that for phosphoric pig for mild steel making has increased. The prices, then, of best sorts of raw iron have gradually fallen to such a point that for a long time past the blast furnaces have been working at a loss. Whilst in 1882 it cost M. 65 to 68 p.t. at the works, it has fallen to 37 to 39, without the works having been able to reduce the cost of production.

"In the fourth quarter of the year 1886 an increased demand from North America brought a slight improvement, which caused a rapid rise in prices, because the stocks at the works were low, and at about the same time a combination of all the crude iron works took place. Whether this convention is in a position to maintain the rise of price instituted in the autumn seems doubtful, looking at the state of the pig iron trade and the receding position of the iron markets in general.

"Also in the rolling-mill branch the prices of most rolled articles have, from the beginning of the year till the autumn, been steadily and by jumps receding, despite the fact that the works had sufficient employment. Only in the last quarter of the year came a rise in the prices, caused by the greater demand from the United States.

"During the year 1886 the wrought iron tube works were not, on the whole, sufficiently employed. One reason for this is found in the general slackness in all quarters, but the chief one is the circumstance that from year to year the field for the sale of the products of our works is being continually narrowed. Russia and Austria were at one time considerable customers, but now this has almost entirely ceased, because competition against the native works has become impossible in face of the high import duties now imposed. Again, the sale to France has become continually less, since there, as well, new works have been established, and it is much to be feared that that country will shortly be completely closed against our tube industry. The prices were, as a rule, lower than the year before, and it has only been in consequence of a combination of all the German works having been formed that in this country, as well as abroad, the prices did not come down to less than the tubes cost to make. The rise in the prices of crude and wrought iron exercised no favourable effect on wrought iron tubes.

"The steam boiler manufacture has had to contend against a continual want of regular employment all the year through, inasmuch as in comparison to the year before only a few larger establishments were carried out for want of sufficient enterprise in capitalists to find funds to increase existing or create new industrial works. Another cause as well which is inimical to the boiler manufacture is the increased use of gas motors. Whilst in this manner the demand lessened, a number of small makers who had recently sprung up came upon the market with offers which scarcely covered the cost of production. The results of public tenders which have been published have brought to the knowledge of experts how cheapness, and a desire at any price to receive the orders, have been considerations, without the slightest regard to the great responsibility which attaches to boiler making, irrespective of whether in the end the recipient or the maker becomes a sacrifice to this hazardous competition. The boiler making industry is always the first to feel the effects when other important branches of trade were depressed, and therefore it is only necessary to point out amongst others the unfortunate condition of those of iron, coal, and sugar, to understand the unfavourable results of the steam boiler manufacture during the past year.

"The building of locomotives is becoming from day to day more deplorable and profitless; the few State locomotives which were given out were only to be obtained at prices under the cost of making, and the prices of those for private parties and for abroad have gone down in the same ratio. Our next neighbour, Holland, is seeking with all its force to make its own requirements, at least tramway locomotives, which were formerly offered to works in this town, so that that country is almost entirely lost to us. In consequence, a larger number of hands would have had to be discharged from our factories, if at some of the public tenderings for locomotives orders had not been taken at prices below those of production. As a natural consequence the general slackness of trade must have been severely felt by the wagon factories; besides this, since the State has taken over the railways, it has become possible to better utilise the rolling stock, which has had a paralysing effect on demand, and few trucks have been ordered, whereas in former years the building of wagons gave abundant work. A part of this falling off in the trade was able to be recouped by taking orders for passenger coaches, post and covered wagons; but against the great competition, it could only be done in many cases where the prime cost was hardly covered.

"Nothing could be delivered abroad, in spite of the most strenuous exertions, to keep the workmen employed, and a further sacrifice in price was made. The improvement in the iron trade lately observable will, it is to be hoped, continue, and ultimately be to the advantage of the wagon trade. The raw materials, with the exception of the finer woods, which are imported from America, Norway, and Sweden, are all drawn from native sources."

In order not to make my "Notes" this week too long, the concluding portion of the above report is reserved for the coming week.

AMERICAN NOTES.

(From our own Correspondent.)

NEW YORK, October 6th.

INTERIOR iron advices show that a heavy demand is in progress, and that mills and furnaces will be in no danger of accumulating stock for months to come. Much of the activity in the States is due to the extraordinary demand due to railroad building, and to the construction of manufacturing establishments, houses, public and private, &c. This year's building operations will absorb 400 million dollars, of which New York represents 70 millions alone.

The heavy ship and boat-building orders continue. Bar, plate, and sheet mills are busy. Pipe makers have formed a syndicate to control competition. Rail makers fix prices and production next week. Latest 1888 orders were at 35 dols. Copper is active at 10·50. Lead production is increasing. Tin-plate distribution is depleting stocks. The industries are all prosperous. The railroads are crowded with traffic, and cars are scarce on all the great trunk lines. Railroad construction in the Dominion of Canada is being pushed more rapidly than in the States. The Knights of Labour, representing a membership of 600,000, are in session this week. The financial stringency is over.

NEW COMPANIES.

THE following companies have just been registered:—

Cardiff Pure Ice and Cold Storage Company, Limited.

This company was registered on the 10th inst., with a capital of £10,000, in £10 shares, to store and deal in ice, in or near Cardiff. The subscribers are:—

	Shares.
M. Morgan, 18, High-street, Cardiff, solicitor	1
J. J. Neale, West Canal Wharf, Cardiff, fish merchant	1
H. West, West Canal Wharf, Cardiff, fish merchant	1
*R. Wain, Penarth, Cardiff, wine merchant	1
J. Thomas, Canton, Cardiff, clerk	1
Wm. McDonald, 25, Oakfield-street, Cardiff, accountant	1
*F. Spiller Lock, St. Andrew's-place, Cardiff, contractor	1

The number of directors is not to be less than five, nor more than seven; qualification, £100 in shares or stock; the first are the subscribers denoted by an asterisk, and Mr. Gabriel Lloyd; remuneration, £50 per annum, and such further sum as the company in general meeting may determine, whenever the dividends exceed 10 per cent. per annum.

Cleveland Salt Company, Limited.

This company was registered on the 11th inst., with a capital of £75,000, divided into 6000 preference and 1500 deferred shares of £10 each, to trade as salt borers, salt, alum, gypsum, and limestone miners and manufacturers. An unregistered agreement of the 10th inst., between Bolckow, Vaughan, and Co., Limited, and James Hart—for the company—will be adopted. The subscribers are:—

	Shares.
James Hart, Clairville, South Norwood, agent	1
F. C. Ford, 61, Tyrwhitt-road, S.E., clerk	1
E. R. Morgan, 50, Ladywell-road, S.E., clerk	1
W. H. Adams, 168, Friern-road, S.E., accountant	1
W. C. Horton, 7, Moncrieff-street, Peckham, accountant	1
E. T. Botwright, 23, Sutton-place, Hackney, accountant	1
F. P. Shuckard, 44, Melbourne-grove, Champion-hill	1

The number of directors is not to be less than three; qualification, shares of the nominal value of £500; the subscribers are to appoint the first. The remuneration of the board is to be at the rate of £100 per annum in respect of each director.

Dunbar's Patent Cask Machinery Company, Limited.

This company was registered on the 11th inst., with a capital of £40,000, in £10 shares, to acquire certain invention of improvements in machinery or apparatus for the manufacture of hogsheads, casks, barrels, kegs, and similar articles. The subscribers are:—

	Shares.
*F. Walford, 65, South John-street, Liverpool, oil merchant	1
R. E. Walford, Stamford Bridge, Chester	1
*Major W. J. Barker, 228, Parliament-street, Liverpool	1
*A. Dunbar, 105, Newsham-drive, Liverpool, barrister	1
A. C. Smith, 77a, Lord-street, Liverpool, solicitor	1
E. A. Ould, 31, James-street, Liverpool, architect	1
*S. H. Holme, Lord-street, Liverpool	1

The number of directors is not to be less than two, nor more than five; qualification, twenty-five shares, or £250 stock; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Lachman and Company, Limited.

On the 12th inst. this company was registered, with a capital of £20,000, in £1 shares, to trade as sewing machine manufacturers and mechanical engineers, and for such purposes will adopt two unregistered agreements, the first dated 2nd August, being between the Commercial Overseaming Sewing Machine and Manufacturing Company, of San Francisco, U.S.A, and Arthur Lemoine Denman—for this company—and the second dated 16th ult., between A. Lemoine Denman—for this company—and Messrs. Orland Doré Orvis and Orel Dighton Orvis. The subscribers are:—

	Shares.
J. G. Durant, 5, Guildhall-chambers	1
J. Fraser, 5, Guildhall-chambers, clerk	1
T. Durant, jun., 5, Guildhall-chambers, solicitor	1
E. Kohlen, 61, Fore-street, machinist	1
T. E. Nettleship, 1, Mildmay Park, N.	1
J. A. Oliver, 10, King's-cross-road, clerk	1
F. W. Thornton, Royal Hill, Greenwich, clerk	1

The number of directors is not to be less than two, nor more than five; qualification, £1000 in shares or stock; the subscribers are to appoint the first two. The company in general meeting will determine remuneration.

Steamship "Bencroy" Company, Limited.

Registered on the 10th inst., with a capital of £25,600, in £100 shares, to acquire and work the steamship Bencroy, of Liverpool. The subscribers are:—

	Shares.
J. Hoult, South Castle-street, Liverpool, steamship owner	1
E. Pyke, Preston, corn merchant	1
E. Finlay, 5, Chapel-street, Liverpool, merchant	1
A. G. Smith, 4, Chapel-street, Liverpool, cotton broker	1
M. Clover, 28, Chapel-street, Liverpool, shipbuilder	1
T. C. Edmondson, South Castle-street, Liverpool, steamship owner	1
S. J. Clarke, Aintree, Liverpool, accountant	1

Mr. Joseph Hoult is appointed managing agent.

Valencia and Liria Railway Company, Limited.

This company proposes to acquire a concession from the Spanish Government, granted on or about the 20th August, 1880, to Rafael Valls y David, of the right to construct a railway from Valencia to Liria, in Spain. It was registered on the 12th instant, with a capital of £72,000, in £10 shares, with the following as first subscribers:—

	Shares.
Hy. John Walton, 7, Eastcheap, secretary to a company	1
W. H. White, 21, Mincing-lane, clerk	1
A. Whale, Milkwood-road, Herne Hill, clerk	1
G. J. Gray, St. Clement's House, Clement's-lane, accountant	1
J. Kearse, 36, Mark-lane, shipper's agent	1
H. Becker, 147, Cheapside, merchant	1
H. C. M. Daniel, 7, Poultry, secretary to a company	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first, and act *ad interim;* remuneration, £500 per annum.

Wern Tin-plate Company, Limited.

This company was registered on the 12th inst., with a capital of £20,000, in £5 shares, to trade as iron, steel, and tin-plate manufacturers. The subscribers are:—

	Shares.
F. Cory Yeo, Swansea, colliery proprietor	1
D. Bevan, Neath, colliery proprietor	1
J. Roberts, M.E., Swansea	1
D. G. Thomas, Ystalyfera, grocer	1
J. Beynon, Ystalyfera, draper	1
J. Clee, Ystalyfera, merchant	1
W. Hopkin, Pontardawe, commercial traveller	1
J. A. Thomas, Swansea, solicitor	1

The number and names of the first directors will be determined by the subscribers; qualification, twenty shares. The company in general meeting will determine remuneration.

GAS-LIGHTING BUOYS.—In the contest between gas and oil as lighthouse illuminants the victory (says a correspondent of the *Times*), on the whole, remained with the oil, because the latter proved to be much the cheaper of the two, and capable of being more easily produced and simply managed. But in connection with our coast-lighting system the friends of gas illumination have succeeded in applying it with good effect to some of the buoys and to some of the beacons erected in isolated situations, from which no light had previously been exhibited, and which did not require the attendance of watchers. The gas used for the illumination of buoys is made from once-refined paraffin. It is subjected to special treatment for purification when made, and is of high illuminating power, equal to about 45 candles when burned in the London standard burner. The cost of making the gas varies from 8s. to 11s. per 1000 cubic feet. The system of manufacture of the oil-gas is that of the Pintsch's Patent Lighting Company. In buoy work it is necessary to have a small gas-works at some readily accessible position in the locality. The oil is vaporised in cast iron retorts, and is carried off as gas to a small gasometer bell. The whole apparatus need not occupy a larger superficial area than about 40ft. by 16ft. From this gas-holder it is forced into strong cylindrical holders at a pressure of 150 lb. on the square inch. When filled, one of these holders will contain 3700ft. of gas compressed into a cubic space of 370ft. Two such holders are usually conveyed from the gasworks to the buoy or beacon to be replenished, and the gas is transferred to the receiver of the buoy *in situ*. The quantity of gas passed into the receiver is sufficient to keep the buoy or beacon alight for two months, burning day and night. By means of an automatic regulator the company have succeeded in so effectually controlling the outflow that the gas always issues at the burner at five-tenths water-column pressure, no matter how great or how little the pressure in the receiver may be. Thus the steady exhibition of the light is insured. The flame is protected by a specially designed lantern, over which waves may break and winds blow without the efficiency of the light being impaired. Gas-lighted buoys have been placed by the Trinity House Corporation at the Ovens, the turning-point into Gravesend Reach in the river Thames; at the East Oaze, Sheerness Middle, and Maplin Spit, all dangerous shoals at the Thames entrance. The Mersey Docks and Harbour Board have also placed some gas-buoys to aid vessels at night through the difficult navigation of the approaches to Liverpool. The Clyde authorities have largely adopted the gas-lighting system, having placed no fewer than nine lighted buoys between Port Glasgow and Dumbarton, besides sundry gas-lighted beacons and two gas lightships. The Garmoyle lightship is now made a gas-light boat, and the expense of a crew saved. The system is also in use in Canada, France, Germany, Russia, Sweden, Italy, Holland, and the United States.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

11th October, 1887.

13,729. SCYTHE BLADES, B. S. Harrison, Dronfield.
13,730. EXPLOSIVES for USE in FIRE-ARMS, T. G. Hart, London.
13,731. WINDOW TICKET HOLDER, &c., W. Burgess, Brighton.
13,732. PITCH CHAINS for DRIVING BICYCLES, T. C. Pullinger, London.
13,733. WARPING SHIPS, J. Wilson, Newcastle-on-Tyne.
13,734. METHODS of GENERATING HEAT, K. R. Kilbourn, London.
13,735. CIRCULAR OSCILLATING ROUNDABOUT, T. Hurst, London.
13,736. ELECTRIC SPINNING MACHINES, A. S. Kimball and G. L. Brownell, London.
13,737. BILLIARD REST, T. Baylis, Redditch.
13,738. PRINTING or DECORATING on TIN PLATES, T. H. Rees, London.
13,739. PRESS-PLATES, J. M. C. Paton and J. Wilkinson, Manchester.
13,740. FIRE-PROOF CURTAINS, C. M. Duplany, Birmingham.
13,741. AUDIBLY SIGNALLING on RAILWAYS, H. J. Peddie, Glasgow.
13,742. VENEERING FELT HAT BODIES, R. L. Hilton, Manchester.
13,743. INDIA-RUBBER TEXTILE FABRICS, P. M. Matthew, jun., Edinburgh.
13,744. ROUNDABOUT, E. Handslip, South Shields.
13,745. EXTINGUISHING APPARATUS for LAMPS, F. R. Baker, Birmingham.
13,746. AMMONIA, B. J. B. Mills.—(*T. B. Fogarty, United States.*)
13,747. SULPHATE of AMMONIA, B. J. B. Mills.—(*T. B. Fogarty, United States.*)
13,748. WATER REDUCING VALVE, J. B., W., and E. Whiteley, Halifax.
13,749. UNIVERSAL COMBINATION AUTOMATIC DELIVERY MACHINE, J. Bowie, London.
13,750. MOTIVE-POWER ENGINES, T. McCarter and T. Cooper, London.
13,751. FEEDING BOTTLES, A. C. Henderson.—(*E. L. P. Létièvre, France.*)
13,752. INFUSING and STRAINING TEA, &c., S. Crosse, London.
13,753. DUPLEX PUMPS, C. Cornes and S. C. Harris, London.
13,754. COMPENSATING POST-OFFICE RESISTANCE BOXES, H. L. Callender, Cambridge.
13,755. GIVING WARNING of EXTINCTION of LIGHTS, J. P. Robertson, Woodside.
13,756. AXLE-BOXES, A. J. Boult.—(*F. B. H. Bouter, United States.*)
13,757. BINDERS for PRESERVING SHEET MUSIC, R. H. Baker, Liverpool.
13,758. ELECTRICAL APPARATUS, A. J. Boult.—(— *Smith and — Kemble*, ——.)
13,759. SPADES, P. Lien, Liverpool.
13,760. TUBES, C. While, London.
13,761. WOOLLEN SHOES, A. J. Boult.—(*A. M. Baumhauer, Germany.*)
13,762. APPLYING PHOTOGRAPHY to SILK, J. B. Cuming and W. Wills, London.
13,763. DEVICES for BOLDING UP DAMASK, &c., J. G. Elliott, London.
13,764. MOULDS for CONFECTIONERY, J. C. Mewburn.—(*W. E. Coleman, United States.*)
13,765. MELTING SNOW, A. Heutschel, Glasgow.
13,766. ADAPTING ELECTRICITY to AUTOMATIC ADVERTISEMENTS, A. W. Armstrong, London.
13,767. ADAPTATION of ELECTRICITY to AUTOMATIC APPARATUS, A. W. Armstrong and B. W. Warwick, London.
13,768. SOLES of BOOTS, E. Pitt, London.
13,769. SYPHON for AERATED WATERS, G. S. Fleming, London.
13,770. ANCHORS, H. F. Hiron, London.
13,771. TANDEM BICYCLE, V. H. Muller, London.
13,772. AUTOMATICALLY SUPPLYING SCENT, E. Parr and E. Edwards, London.
13,773. MILK FLOAT, A. H. Hayes, London.
13,774. WIRE FENCING, M. H. Newton, London.
13,775. PAPER for DRESSING RAZORS, R. Leighton, London.
13,776. BEARING, W. J. Payne, London.
13,777. HAY COCKING MACHINES, A. M. Clark.—(*T. Hale, United States.*)
13,778. AUTOMATIC ELECTRIC SIGNALLING, W. Walker, London.
13,779. WIRE BELTING, J. E. Emerson and T. Midgley, London.
13,780. HEATING WATER, H. H. Lake.—(*N. H. Daniels, United States.*)
13,781. REFUSE BURNERS, W. Mann, London.
13,782. DUSTBINS, G. Willsmer, London.
13,783. STOPPING BOTTLES, &c., H. J. Haddan.—(*J. Says, Spain.*)
13,784. METAL LETTERS for ADVERTISEMENT, J. Willing, London.

12th October, 1887.

13,785. BALL BACK BUTTON SHANK for GLASS, &c., R. Vann, Birmingham.
13,786. FIXING SHEETS of GLASS, &c., T. W. Helliwell, Halifax.
13,787. CORRUGATING METALLIC TUBES, W. and T. Blackwood, Edinburgh.
13,788. REMOVING PERSONS from STREET CAR TRACKS, J. Rhodes, Birmingham.
13,789. DRIVING SEWING MACHINES, F. S. Willoughby and F. C. Lynde, Manchester.
13,790. TRAMWAY ENGINE GUARDS, H. Westman, Birmingham.
13,791. FISHING LIVE BAIT CAN, S. Allcock, Redditch.
13,792. MAKING PAPER from ESPARTO STRAW, J. Robertson, Manchester.
13,793. TRAPS or SNARES, G. E., C. B., and T. A. Hughes, Wolverhampton.
13,794. GLOBE LAMP, J. Lucas, Birmingham.
13,795. MOTORS ACTUATED by LIQUIDS, N. Niciotis, Manchester.
13,796. HANGING DOORS for EASY EXIT, W. J. Hopkins, Worcester.
13,797. SYRINGES for HYPODERMIC INJECTIONS, W. Wiley, Birmingham.
13,798. WORKING FOG SIGNALS, T. and D. Lewis, Mansfield.
13,799. BRAKES of LOOMS for WEAVING, J. Turner, Halifax.
13,800. BOTTLE STOPPERS, J. Brocklehurst, Manchester.
13,801. DISPENSING with CHECK STRAPS in LOOMS for WEAVING, J. Marshall, Halifax.
13,802. BICYCLES, &c., A. Austin, New Southgate.
13,803. ROTARY EXPANSION, &c., VALVES, J. Landells, Northumberland.
13,804. PHOTOGRAPHIC CAMERAS, A. Bilson, Birmingham.
13,805. ELECTRIC BATTERIES, H. M. Musgrave, Glasgow.
13,806. STOOL, G. J. Harcourt, London.
13,807. DUPLEX and TRIPLEX COMPOUND BLAST FANS, R. J. Hodges, London.
13,808. VENEERING, &c., HAT BODIES, J. E. Mills and T. Ashworth, London.
13,809. PASTEBOARD, &c., BOXES, J. and C. Blyth, London.
13,810. AUTOMATIC DELIVERY BOX in connection with SWITCH-BACK RAILWAY, G. J. Gayler, London.
13,811. WASHING ENGINE WASTE, J. H. Williams and M. W. Hydes, Liverpool.
13,812. ROTARY NUMERICAL PRINTING MACHINES, J. M. Black, London.
13,813. COLLAR STUD, F. Pudney, London.
13,814. WRITING, J. Hickerson, London.
13,815. STIRRUPS, H. Lumley, London.
13,816. ENEMAS, T. F. Lynch, London.
13,817. COMPRESSING PRODUCE into BALES, J. S. Collitt, London.
13,818. COFFEE POTS, J. S. Stringer, United States.
13,819. BOTTLING STOPPERS, G. H. Aylett, London.
13,820. MACHINES for TWISTING MATERIALS, H. B. Arundel, London.
13,821. ELECTRICAL SWITCH, J. R. H. Williamson and the Manchester and District Edison Electric Light Company, Manchester.
13,822. CHOPPING MACHINES, J. Etherington, London.
13,823. MILK CANS, T. Gilbeart, London.
13,824. VICES, P. Gontard, London.
13,825. SECURING COLLETS and NUTS, E. Partridge, London.
13,826. FLUSH CISTERN APPLIANCE, C. B. Smith, London.
13,827. SELF-ACTING BRAKES, A. J. Sendell, London.
13,828. HOLLOW FIREPROOF SLABS for PARTITIONS, G. Humblet, London.
13,829. PREPARATION of MILK, W. R. Barker, A. L. Savory, and C. Ekin, London.
13,830. WASHERS for PACKING JOINTS, F. W. Durham, London
13,831. ROLLERS for TRAMWAYS, F. S. Marsh, London.
13,832. LANDING NETS, W. H. English and F. M. W. Gutch, London.
13,833. VALVES for CLOSING the TAP HOLES of BEER CASKS, &c., W. H. English and F. M. W. Gutch, London.
13,834. LIQUID METERS, S. A. de Normanville, London.
13,835. EXTINGUISHING FIRES, C. B. Burdon and J. Clark, London.
13,836. WALKING-STICKS, A. M. Clark.—(*W. A. Wolff, United States.*)
13,837. LONGITUDINALLY GROOVED WIRE, H. H. Lake.—(*P. Clifford, J. Coupal, and J. E. Bertrand, United States.*)
13,838. GIVING VALUE in EXCHANGE for COINS, J. S. Wallace, London.
13,839. BENZOYL SULPHONIC IMIDE, A. G. Salamon, London.
13,840. YEAST and VINEGAR, A. H. Huntley, Newcastle-on-Tyne.
13,841. SIGNALLING at NIGHT, G. G. Francis.—(*J. W. Hayward, Newfoundland.*)
13,842. TOBACCO PIPES, J. Notton, London.
13,843. GUNS and PROJECTILES, T. J. Hovell-Thurlow-Cumming-Bruce, London.
13,844. INSTANTANEOUS PHOTOGRAPHIC SHUTTERS, T. R. Dallmeyer, London, and F. Beauchamp, Tottenham.
13,845. STARTING RACE HORSES, H. H. Leigh.—(—. *Finigan, United States.*)
13,846. ATTACHING BUTTONS to LEATHER, H. H. Lake.—(*E. P. Merwin and W. E. Bennett, United States.*)

13th October, 1887.

13,847. GRAVITY SWITCH-BACK RAILWAYS, J. F. Elliston, London.
13,848. PROCURING FLAME by means of ELECTRICITY, T. Francis, Bristol.
13,849. NEEDLE POINT GRINDING CARDS, J. Sykes, Halifax.
13,850. ORNAMENTATION of FABRICS, &c., B. Ware, Luton.
13,851. SLIDE VALVES of STEAM ENGINES, &c., A. Case, Sheffield.
13,852. REVERBERATORY FURNACES, J. Spencer, Glasgow.
13,853. TELEGRAPHIC APPARATUS for TRANSMITTING ORDERS, &c., G. A. Calvert, Glasgow.
13,854. LADIES' DRESS IMPROVER, G. W. Mohrstadt and G. M. Gibbs, Birmingham.
13,855. AUTOMATIC STOP and LET-DOWN MOTION, J. Vaughan, J. Walker, and T. Wolstencroft, Hurst.
13,856. SECURING KNOBS to their SPINDLES, A. Heath, Birmingham.
13,857. AUTOMATIC HORSE-FEEDER, H. Jephson, Derby.
13,858. INLAID DESIGNS or LETTERS in ARTIFICIAL MARBLE, J. B. Rottenstein and H. A. Cousins, London.
13,859. FASTENINGS for SECURING RAIN PIPES, &c., H. Steven and J. Walker, Glasgow.
13,860. COOKING RANGES, H. Steven and J. Walker, Glasgow.
13,861. PACKETS for DELIVERY by AUTOMATIC SELLING MACHINES, F. C. Lynd, Manchester.
13,862. GAS LAMPS, R. W. Pugh, Manchester.
13,863. SAFETY APPARATUS applicable to CAGES, &c., E. Ormerod, Manchester.
13,864. INCANDESCENT ELECTRIC LAMP HOLDERS, F. H. Royce, Manchester.
13,865. VALVES of CORNETS, &c., J. Bossi, Bath.
13,866. CINDER SCOOP and SIFTER, C. T. Jones, London.
13,867. RUBBER CASTERETTE, B. Silcock, Birkenhead.
13,868. RAISING CUT PILE FABRICS, W. Evans, Manchester.
13,869. PAINTERS' TIME-SAVING BRUSH BINDER, O. S. Evans, Brierley Hill.
13,870. LETTING-OFF MECHANISMS of LOOMS, E. R. Merrall and W. Rhodes, Keighley.
13,871. AUTOMATICALLY OPERATING the CUT-OFF or EXPANSION VALVES of STEAM ENGINES, R. Wilby, Halifax.
13,872. TYPE-WRITER, G. F. Priestley, Halifax.
13,873. ORNAMENTING METALLIC BEDSTEADS, J. Middleton, Birmingham.
13,874. COLOUR PRINTING MACHINES, W. and T. S. Conisbee, London.
13,875. LOCKING RAILWAY SWITCH-BARS, W. T. Leach, Sheffield.
13,876. ANCHORS, G. F. Simms, Birmingham.
13,877. STREET GULLIES, W. Bird, London.
13,878. SHIPS' BOATS, A. T. Dewar, London.
13,879. PHOTOGRAPHIC CAMERAS, E. V. Swindon and J. Earp, Liverpool.
13,880. DISCHARGING, &c., GAUGED QUANTITIES of LIQUIDS, T. S. Cockcroft, Liverpool.
13,881. VELOCIPEDES, &c., S. Watts and R. J. Powell, London.
13,882. EXTENDING the RANGE of PROJECTILES, W. T. Chamberlain, London.
13,883. SELF-ADJUSTING TELESCOPIC CURTAIN RODS, J. R. Mally, London.
13,884. BULLET EXTRACTOR, A. M. Gordon, London.
13,885. VARNISH, A. G. Wass, London.
13,886. MOUNT for PHOTOGRAPHS, W. D. Wilkinson and F. Fowler, Birmingham.
13,887. CHANGE MONEY MAT, F. B. Bowyer-Lane, London.
13,888. MATTRESSES for BEDS, J. E. Preston, London.
13,889. VALVES for AIR COMPRESSORS, R. R. Gubbins, London.
13,890. ELECTRIC BATTERIES, D. Urquhart, London.
13,891. VERTICAL STEAM GENERATORS, J. J. Tinker, London.
13,892. CARDS for CARDING WOOL, J. Moseley, H. Fairclough, D. Moseley, J. F. Butterworth, and B. Blundstone, London.
13,893. CAPS for TRAVELLING, A. Gottlieb, London.
13,894. MECHANICALLY CONVEYING LIGHT ARTICLES, M. C. Denne, London.
13,895. COMPRESSING TRUSSES of HAY, &c., H. Harris, London.
13,896. DYEING of WOOL TOPS, A. J. Boult.—(*W. S. Alexander, United States.*)
13,897. CONVERTING MARINE ENGINES into TRIPLE EXPANSION, G. Rollo, Liverpool.
13,898. ROVING FRAMES, W. P. Thomson.—(*F. Ollinghaus, Prussia.*)
13,899. CHAIN BELT DRIVING MECHANISM, C. W. Herbert, London.
13,900. MUSIC DESK and VIOLONCELLO CASE, T. W. Snagge, London.
13,901. CARDS for CARDING WOOL, J. Moseley, H. Fairclough, D. Moseley, J. F. Butterworth, and B. Blundstone, London.
13,902. PAVING, &c., R. Punshon, London.
13,903. THERMO-ELECTRIC GENERATORS, R. Kennedy, Glasgow.

13,904. Heating or Cooling Buildings, A. Fehlen, London.
13,905. Elastic Looped Fabrics, &c., A. J. Black, London.
13,906. Elastic Tyres, G. Spencer, London.
13,907. Cards for Carding Wool, J. Moseley, H. Fairclough, D. Moseley, J. F. Butterworth, and B. Blundstone, London.
13,908. Compound Taps, H. C. Willmott, London.
13,909. Screw Propellers, F. W. Dunaway, London.
13,910. Sleeve Links, C. Jackson, London.
13,911. Packing Greasy Substances, F. W. Waide, London.
13,912. Fastening Window Sashes, &c., A. Osterberg, London.
13,913. Twine, E H. Haskell, London.
13,914. Sifting Apparatus, H. Simon, London.
13,915. Economising the Consumption of Gas, F. Stanton, London.
13,916. Gas Engines, C. Davy, London.
13,917. Hair Combs, A. F. Wileman, London.
13,918. Folding Shutters, &c., W. W. Bostwick, London.
13,919. Cards for Carding Wool, J. Moseley, H. Fairclough, D. Moseley, J. F. Butterworth, and B. Blundstone, London.
13,920. Machines for Making Drain Pipes, J. and B. Craven, London.
13,921. Cycles, J. Y. Johnson.—(*C. Barisien, France.*)
13,922. Lighting and Heating, J. Y. Johnson.—(*C. Bertou, France.*)
13,923. Button Fastener, T. M. Cannon, London.

14*th October*, 1887.

13,924. Opening Bottles, W. S. Crawshay, Putney.
13,925. Combined Curry Comb and Brush, R. Furney and W. Furney, Birmingham.
13,926. Saving Fine or Flour Gold in Milling, &c., W. H. Penning and H. G. Owen, London.
13,927. Treatment of Peat, A. Schleipen, Paris.
13,928. Automatically Opening Doors, J. Hind and F A. Sharp, Nottingham.
13,929. Steel Chains, T. R. Weston, London.
13,930. Tricycles, T. W. Gorton, Tamworth.
13,931. Reversing Gear, G. H. Fish, London.
13,932. Safety Guard for Bicycles, A. Wilson, Westminster.
13,933. Connecting Branch Pipes to Main Pipes, J. Wotherspoon, Glasgow.
13,934. Producing Fancy Hems on Fabrics, R. Crawford, Belfast.
13,935. Applying Power to Cycles, J. Donkin, Bournemouth.
13,936. Rockers for Chairs, &c., J. Taylor, Rochdale.
13,937. Grappling Apparatus, T. Bowden, London.
13,938. Ventilating Mines, M. Adams and J. Jenkins, London.
13,939. Life-saving Apparatus, J. Gregory and F. Gilfort, Birmingham.
13,940. Gas Lamps, R. W. Pugh, Manchester.
13,941. Beating Eggs, &c , E. Griffin, London.
13,942. Rolling Mills, G. Thomas.—(*C. Angstrom, Sweden.*)
13,943. Filtration, J. H. Porter, G. Porter, and J. Porter, London.
13,944. Bleaching Textile Fabrics, J. S. Knott, Levenshulme.
13,945. Vertical Plate-bending Machines, J. Barrow, Edinburgh.
13,946. Opening, &c., Fanlights, H. Whiteley, London.
13,947. Horseshoes, A. Fieldsend and J. Jackson, Sheffield.
13,948. Steam Engines, J. Maxwell, Edinburgh.
13,949. Boxes, &c., L. A. White and A. E. Blow, Manchester.
13,950. Saving of Waste of Material in the Tempering of Steel, M. Darnbrough and E. Darnbrough, Drighlington, near Bradford.
13,951. Fixing Glass and other Roofing, W. Howitt, London.
13,952. Naves of Wheels, S. Andrews and F. E. Andrews, Liverpool.
13,953. Electro-motors, D. T. Piot, London.
13,954. Closed Conduits, W. E. Irish, London.
13,955. Treatment of Sugar Cane, S. Fiske, London
13,956. Bathing Apparatus, A. R. Commandeur, London.
13,957. Cleaning Pulverulent Bodies, J. Lipmann, R. Bielschowsky, and E. Bielschowsky, London.
13,958. Bit and Attachments for Horses, E. K. Crocker, London.
13,959. Telegraph Form Books, A. Sloan, Glasgow.
13,960. Spring Jack and Lightning Arrester, A. Coleman and H. F. Jackson, London.
13,961. Mechanism for Turning Leaves of Books, T. W. Tetley, Sheffield.
13,962. Machanism for Overhead Sewing, B. Rudolph, London.
13,963. Buckles, H. H. Lake.—(*G. W. Moores, U.S.*)
13,964. Coverings for the Feet, W. Peddie, London.
13,965. Binder for Parcels, A. B. Lennox and J. H. Wharton, London.
13,966. Instruments for Indicating Speed of Shafts, P. Cardew, London.
13,967. Brushes for Generators, W. T. Goolden and A. P. Trotter, London.
13,968. Accordions, O. Weidlich, London.
13,969. Machines for Sewing Straw Braid, J. Y. Johnson.—(*The Wilcox and Gibbs Sewing Machine Co., United States.*)
13,970. Electricity to the Human Frame, M. Nightingale, London.
13,971. Fire-resisting Compounds, J. Davenport, London.
13,972. Brake for Railway Train, J. T. Hewitt, London.
13,973. Strong Rooms and Safes, G. H. and H. W. Chubb, W. H. Chalk, and G. G. Exton, London.
13,974. Electric Alarm for Varying Levels, A. Siegmann.—(*C. Morohn, Germany.*)
13,975. Pointing of Fire-arms, H. S. Maxim London.
13,976. Preventing Bursting of Water Pipes by Frost, W. H. Moore, London.
13,977. Joints for Iron Pipes, O. Elphick, London.
13,978. Electric Firing Gear for Guns, A. Noble, Newcastle-on-Tyne.

15*th October*, 1887.

13,979. Windguards for Chimneys, &c., W. B. Taylor and G. Holley, London.
13,980. Unshrinkable Fabrics, T. H. and H. Blamires, Huddersfield.
13,981. Rubber Water-tight Armour-plate, J. Ubsdell-Thorns, Tunbridge Wells.
13,982. Lozenges and Boiled Sweets, D. Pearson, Liverpool.
13,983. Sulphate of Soda, D. Herman, Liverpool.
13,984. Locking Printing Block, S. S. Bromhead. —(*J. M. Hawkes, United States.*)
13,985. Cuspadores, S. S. Bromhead.—(*J. L. O'Connor, United States.*)
13,986. Combined Double-action Rudder and Brake for Vessels, S. S. Bromhead.—(*J. C. Witner and J. R. Breueggeman, United States.*)
13,987. Gas Regulators, A Glover, Liverpool.
13,988. Ball Taps, W. H. Foster, Halifax.
13,989. Cylinders of Drying Machines, L. Bridge, Halifax.
13,990. Coffee Pots, H. Y. Dickinson, London.
13,991. Gas Motor Engines, W. Taylor and A. Histon, Elland.
13,992. Screw Propellers, T. Leith, Edinburgh.
13,993. Combustion of Fuel, W. Wilkie, Glasgow.
13,994. Regulators for Electric Arc Lamps, W. Brierley.—(*E. Pabst, Germany.*)
13,995. Collecting Dust in Mills, J. Buchanan, Glasgow.
13,996. Water Purifiers, &c., G. Rodger, London.
13,997. Outside Seats for Vehicles, T. Browett, Manchester.
13,998. Sliver Cans, J. Sutcliffe and E. Ashworth, Manchester.
13,999. Photographic Photometer, J. Sturrock, Dundee.
14,000. Manufacture of Ammonia, &c., F. Bale, Droitwich.
14,001. Manufacture of Ammonia, &c., F. Bale, Droitwich.
14,002. Propelling Vessels at Sea, V. St. L. S. Kelly, Devon.
14,003. Paper Stiffenings, S. and F. S. Hess, London.
14,004. Converting Iron into Steel, S. Dawes and W. Smith, London.
14,005. Handles for Cricket Bats, F. H. Ayres and J. Turner, London.
14,006. Abdominal Belt, L. M. McEwan, Brighton.
14,007. Locking Collets and Nuts, R. W. Gardner, London.
14,008. Exercising the Muscles of the Fingers, W. M. Smith, London.
14,009. Cutting Sugar Cane, A. J. Boult.—(*L. Bon, Cuba.*)
14,010. Planing Boards, F. Myers, Liverpool.
14,011. Candle Lamps, D. Herman, Liverpool.
14,012. Partitions of Electric Piles, W. P. Thompson.—(*H. E. de Rufz, France.*)
14,013. Flexible Tubes, E., J. Vernauden, C. d'Espine, and E. Achard, London.
14,014. Cooling Beer, E. Jasmin, London.
14,015. Electrically Lighting Miners' Lamps, C. Auty, London.
14,016. Railway Signalling Apparatus, H. E. Williams, London.
14,017. Machines for Swaging, &c., Horseshoes, R. R. Gubbins, London.
14,018. Hooks for Fastening Wearing Apparel, H. G. Speering, London.
14,019. School, &c., Seats, W. J. Barnes, Bristol.
14,020. Runners for Umbrellas, F. A. Ellis, London.
14,021. Locks, Latches, and Furniture, C. D. Douglas, London.
14,022. Type-writers, W. S. Simpson, London.
14,023. Regulating Temperature in Dwellings, &c., A. B. Willway and E. Moon, London.
14,024. Secondary Batteries, &c., N. de Benardos, London.
14,025. Unfastening and Fastening Doors, G. H. Chubb and G. G. Exton, London.
14,026. Looms for Weaving, H. H. Lake.—(*J. T. Cree, United States.*)
14,027. Gas-engines, T. B. Barker, London.
14,028. Rolling Glass, G. F. Chance, London.
14,029. Electrical Tramways, &c., F. C. Allsop, Bexley.
14,030. Imparting Rotary Motion to Projectiles, G. A. Biddell, London.
14,031. Automatically Delivering Goods, E. Powell, London.
14,032. Automatic Coin Freed Apparatus, P. Everitt, London.
14,033. Brushes, W. Irmer, London.
14,034 Treating the Barks of China Grass, E. Casper, London.
14,035. Bath, &c., Fittings, G. R. and C. A. Rollason, London.

17*th October*, 1887.

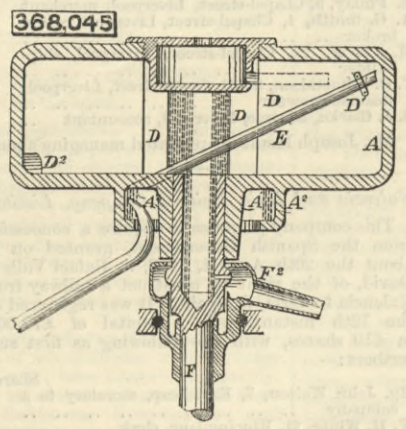
14,036. Fencing, C. Bennett, Braunston.
14,037. Setting Coins in Brooches, E. H. Durban and W. N. Last, Birmingham
14,038. Rotary Pump, E. Schindler, London.
14,039. Van Boxes and Cases, D. Rylands and J. Wegg, Barnsley.
14,040. Hydraulic Packing Machinery, E. L. Bellhouse, Manchester.
14,041. Automatic Drain Cocks and Valves, E. Holt, Radcliffe.
14,042. Taps, A. Pritchard, Kidderminster.
14,043. Fire Extinguishers, &c., R. Watkinson, Manchester.
14,044. Horseshoe Spikes, J. N. Lester, Wolverhampton.
14,045. Frames for Windows, S. Tuddennam, London.
14,046. Extracting Arsenic from Oil of Vitriol, &c., G. E. Davis, Manchester.
14,047. Checking Apparatus, F. S. Willoughby and F. C. Lynde, Manchester.
14,048. Gas Motor Engine, J. Middleton, Glasgow.
14,049. Automatic Winding Gear, J. Walker, Beeston Hill.
14,050. Suspending Plaques, A. and G. Tuck, M. Myers, and J. Lowe, Birmingham.
14,051. Railway Points, J. R. Nixon, West Hartlepool.
14,052. Cleaning Hung Sash Windows, T. Law, Glasgow.
14,053. Domestic Oil Lamps, W. Devoll, Erdington.
14,054. Electro-chemical Process, D. G. Fitz-Gerald, London.
14,055. Type-writers, A. Hamburg, London.
14,056. Hinge, J. E. Beanland, Halifax.
14,057. Advertising Machine, T. Johnson, Halifax.
14,058. Egg Whisks, T. Dussieux and T. Zeitz, Sheffield.
14,059. Calculating Machine, J. C. Bredin and H. G. Cobb, London.
14,060. Washing Dasher Dolly, J. Waddington, London.
14,061. Saving Persons from Drowning, J. Johnson, London.
14,062. Automatic Medical Electrical Apparatus, E. Pullar, London.
14,063. Self-contained Electrical Firing Projectile, D. Boyd, London.
14,064. Feeding Bottles for Infants and Invalids, G. W. Cork, London.
14,065. Date Calendars, H. C. Capell and J. Young, London.
14,066. Circular Knitting Machines, A. Brewin and J. Marriott, London.
14,067. Driving Gear for Velocipedes, I. Ahronsberg, London.
14,068. Allowing Locks to be Operated on the Insertion of Coins, J. H. Faulkner, London.
14,069. Pulley Blocks, T. Melvin, Tottenham.
14,070. Carriage Wheels, M. W. Matthews, London.
14,071. Loop Holder, H. Coppin, London.
14,072. Metallic Eyes of Spade Handles, J. Mills, London.
14,073. Hydraulic Lubricators, J. S. Stevens and C. G. Major, London.
14,074. Puzzle Boxes, A. M. Clark.—(*L. P. Vandier, France.*)
14,075. Sewing Machines, A. F. Wileman, London.
14,076. Distributing Sand from Vehicles, B. S. Cohen, London.
14,077. Keyed Musical Instruments, &c., I. Lutz, London.
14,078. Glazing of Greenhouses, &c., H. Elliott, London.
14,079. Stamping Machines, A. Saiju, London.
14,080. Menu Holders, S. Clark, London.
14,081. Cutting Sheets of Metal, A. J. Boult.—(*Walser*, ——.)
14,082. Catches for Cupboard Doors, C. Rettie, Liverpool.
14,083. Extinguishing Oil Lamps, J. Spooner, Manchester.
14,084. Kettles, W. H. Daniels, London.
14,085. Manufacture of Naphthaline, H. J. and G. H. Fenner, London.
14,086. Manufacture of a Metallic and Fibrous Packing, W. H. Eastwood, London.
14,087. Heating Children's Food, A. V. Palmer, London.

SELECTED AMERICAN PATENTS.

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

368,045. Centrifugal Liquid Separator, *C. A. Backstrom, Trenton, N.J.—Filed January 15th*, 1886.

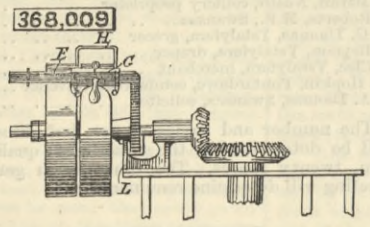
Claim.—(1) In a centrifugal machine, the combination of a separating bowl or vessel having a series of vertical blades, one of which is imperforate, an outer annular discharge receptacle, and a discharge pipe communicating therewith, with the depending chambered spindle communicating with the bowl and provided with a discharge port, and a receptacle embracing the spindle and having a discharge pipe, substantially as specified. The separating bowl A^4, having at its bottom the hub A^1 and the depending annular inwardly-flanged discharge receptacle A^2, and a pipe E arranged within and at one side of the centre of the bowl to communicate with the said receptacle, substantially as specified. The combination with the bowl A, having the vertical blades D, each provided with a port D^2 and the imperforate blade D^1, of a discharge pipe E and a depending chambered spindle F



having the lateral discharge port F^2, substantially as specified. In a centrifugal machine, the combination, with the separating bowl, of a depending chambered spindle, each having unobstructed communication with the other and each having a discharge opening, that of the spindle being laterally disposed, whereby an annular body of a lighter constituent may be delivered by gravity from the bowl directly into the spindle, substantially as specified. The combination, with the bowl of a centrifugal machine, of a depending chambered spindle having unobstructed communication with that part of the bowl into which a lighter constituent of a liquid is collected by the action of centrifugal force in separating it from a heavier constituent, and having a discharge port extending laterally through the wall of the spindle, substantially as specified.

368,009. Belt Shifter, *C. Ross, jun., Brooklyn, N.Y. —Filed April 26th*, 1887.

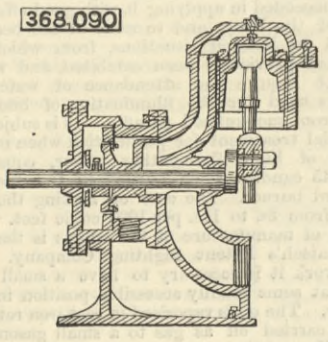
Claim.—The combination, in a belt shifter, of the slide G, the belt guide H, the holder L, and the bar E,



bent substantially at right angles and having one arm adjustable in said holder, substantially as and for the purpose specified.

368,090. Water Motor, *F. A. Hinds, Watertown, N.Y.—Filed March 23rd*, 1887.

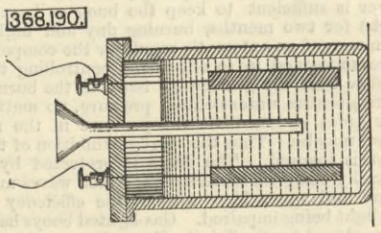
Claim.—The combination, with the cylinder, of the long piston formed with the cup-shaped head, the pivot bolt extending transversely through the said head and the outer end of the pitman, the annular cup-



shaped packing ring, the metal retaining ring secured to the piston head on the inner edge of the cup-shaped packing ring and extending around the ends of the transverse pivot bolt, and the passage for conducting water behind the piston head, substantially as set forth.

368,190. Art of Converting Chemical Energy into Electrical Energy, *W. E. Case, Auburn, N.Y.— Filed April 20th*, 1887.

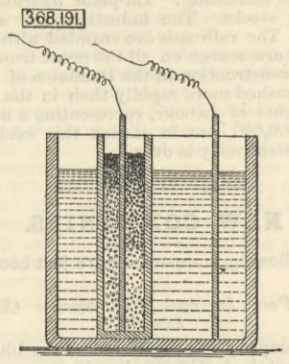
Claim.—(1) The improvement in the art of converting chemical energy into electrical energy, which con-



sists in chemically attacking carbon in a galvanic cell without the application of heat. (2) The improvement in the art of converting chemical energy into electrical energy, which consists in causing the oxidation of carbon in a galvanic cell without the application of heat. (3) The improvement in the art of converting chemical energy into electrical energy, which consists in subjecting carbon to the action of an unstable oxygen compound in a galvanic cell without the application of heat. (4) The improvement in the art of converting chemical energy into electrical energy, which consists in subjecting carbon in a galvanic cell to the action of an unstable oxygen compound formed in the electrolyte in said cell without the application of heat, substantially as described. (5) The improvement in the art of converting chemical energy into electrical energy, which consists in subjecting carbon in a galvanic cell to the action of an unstable oxygen compound in solution in a liquid electrolyte in said cell without the application of heat, substantially as described.

368,191. Galvanic Cell, *W. E. Case, Auburn, N.Y. —Filed April 20th*, 1887.

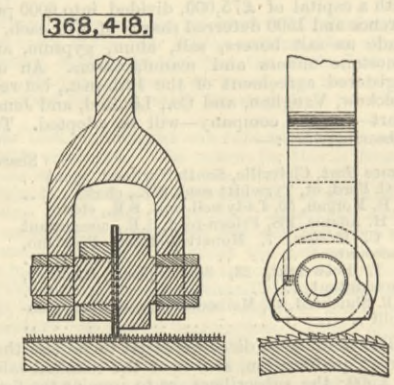
Claim.—(1) In a galvanic cell, a positive element of carbon and an electrolyte in which by the exercise of the chemical affinity of its constituents is formed a gas containing oxygen in unstable combination and capable of reacting on said carbon without the application of heat, substantially as described. (2) In a galvanic cell, a positive element of carbon and an electrolyte in which by the exercise of the chemical affinity of its constituents peroxide of chlorine is formed, substantially as described. (3) In a galvanic cell, in combination with an electrolyte containing peroxide of chlorine, a positive element of carbon, substantially as described. (4) In a galvanic cell, a positive element of carbon and an electrolyte of sulphuric acid containing peroxide of chlorine, substantially as described. (5) In a galvanic cell, in combination with an electrolyte containing peroxide of chlorine, a positive element of carbon and a negative element of platinum, substantially as described. (6)



In a galvanic cell, an outer vessel, an electrolyte therein containing peroxide of chlorine, a conducting body in said electrolyte, a porous inner vessel, and a body of carbon in comminuted form in said porous vessel, substantially as described. (7) The process of oxidising an element of carbon in a galvanic cell, and thereby producing an electric current in a circuit including the electrolyte and other elements of said cell, which consists in adding chlorate of potash to sulphuric acid in said cell, in which acid said elements are immersed, and thereby forming peroxide of chlorine in the presence of said carbon, substantially as described.

368,418. Manufacture of Toothed Cylinders, *H. I. Moulton and W. H. Clarkson, Philadelphia, Pa. —Filed April 30th*, 1887.

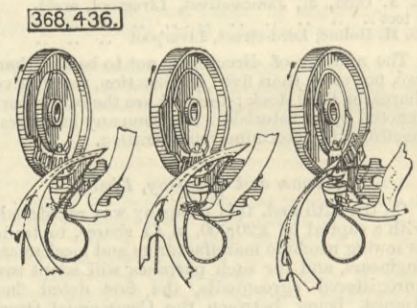
Claim.—(1) As an improvement in the manufacture of toothed cylinders for textile machinery, the mode herein described, which consists in first forming a multiple thread on said cylinder, then winding independent toothed strips in the spiral grooves thus produced, and then applying pressure simultaneously to all of the threads of the set, so as to calk them against the bases of the toothed strips, all substantially as specified. (2) The within-described tool for calking toothed cylinders of textile machinery, said tool con-



sisting of a bar and a spindle carried thereby, and having two or more calking discs, all substantially as specified. (3) The combination, in a calking tool, of a spindle, a series of discs carried thereby, and an interposed washer or washers for separating said discs, all substantially as specified. (4) The combination, in a calking tool, of a spindle, one or more calking discs rigidly secured thereto, and a bar having bearings in which said spindle is free to turn, all substantially as specified.

368,436. Grain Binder, *W. N. Whiteley, Springfield, Ohio.—Filed March 30th*, 1886.

Claim.—(1) In the knotting mechanism of an automatic grain binder, the combination of a tyer wheel, a cam track thereon having a cut-away portion, a tyer bill, a tyer bill pinion having a flattened portion adapted to engage with said cam track, a projection on the tyer bill gear, and another cam track on said tyer wheel, with which said projection engages, said parts operating substantially as set forth, to permit backward rotation of the tyer bill within proper limits for the purpose of facilitating the shedding of the



knot. (2) In the knotting mechanism of an automatic grain binder, the combination, with the tyer bill revolving backward to allow the force of the discharging bundle to strip the knot from said tyer bill, of a projecting lug carried by the tyer bill shaft, a tyer wheel, and a suitable cam, against which said lug rests for the purpose of confining the backward revolving movement of the tyer bill within proper limits. (3) In the knotting mechanism of an automatic grain binder, a spring cam for closing the tongue of the tyer hill, provided with a front extension inclined to act as a guide for assisting in guiding the cord to its proper position across the tyer bill for the purpose of facilitating the tying of the knot. (4) In the knotting mechanism of an automatic grain binder, a vibrating knife arm and cord guide having a downward projecting ridge formed upon its under side, in combination with a tucker finger, substantially as and for the purpose set forth.