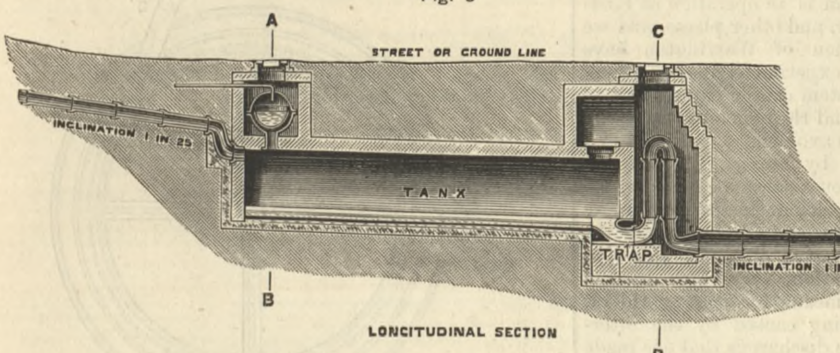
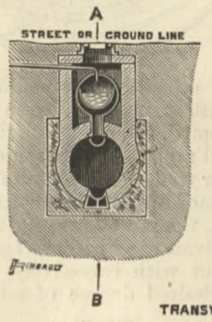
MACHINERY AND MECHANICAL APPLIANCES AT THE INTERNATIONAL HEALTH EXHIBITION.

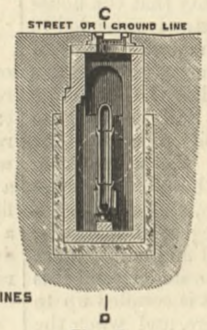
No. VI.

Messrs. Hughes and Lancaster, Chester, the licensees of the Shone patents, have provided in full working order an interesting exhibit of the Shone system of sewerage, showing the action of the automatic pneumatic ejector and the automatic flush tank, the air for working the apparatus being compressed by a Westinghouse compressor, such as is used on locomotives. The exhibit also contains a water-pressure engine—the invention of Mr. W. Donaldson, Victoria-street, S.W.—so that within the small space of 12ft. by 10ft. there is a complete exhibit of the whole system, worked either by steam or water power, unavailing to prevent the generation of foul gas, the greatest difficulty arising when the sewers are empty, owing to the surfaces being coated with slime, which decomposes when exposed to the action of the air. The network of sewers is also extremely costly, as they usually have to be constructed at great depths in excavations sometimes charged with subsoil water. By Mr. Shone's plan it is claimed that these difficulties are entirely avoided. The district to be sewered is divided into small areas, within which gravitating sewers of the minimum size can be laid at good gradients without deep excavations, converging to a point suitable for the establishment of an ejector station, the ejectors being placed below the surface of ground—if necessary under the busiest thoroughfares—without occasioning any inconvenience. The various ejectors are connected together by only costs on a large scale some 20s. per 1,000,000 gallons for fuel, &c.; while the outlay, as regards first cost of machinery, will not be affected by the small quantity required for air-compressing purposes. In this way the actual cost of pumping only comes to about ½d. per hour for a horse-power consumed in a water-pressure engine. To provide uniformity of working, receivers are required, the air being compressed to a slightly greater pressure than is necessary to raise the sewage, but in some instances the mains themselves afford quite enough storage capacity. When the full pressure is attained, a self-acting arrangement stops the air pumps, so preventing useless expenditure of power. As soon as the ejector is filled, an automatic valve admits the compressed air, which forces the fresh sewage either into a rising main under pressure or into a gravitating sewer, and so on to the place where

Fig. 3



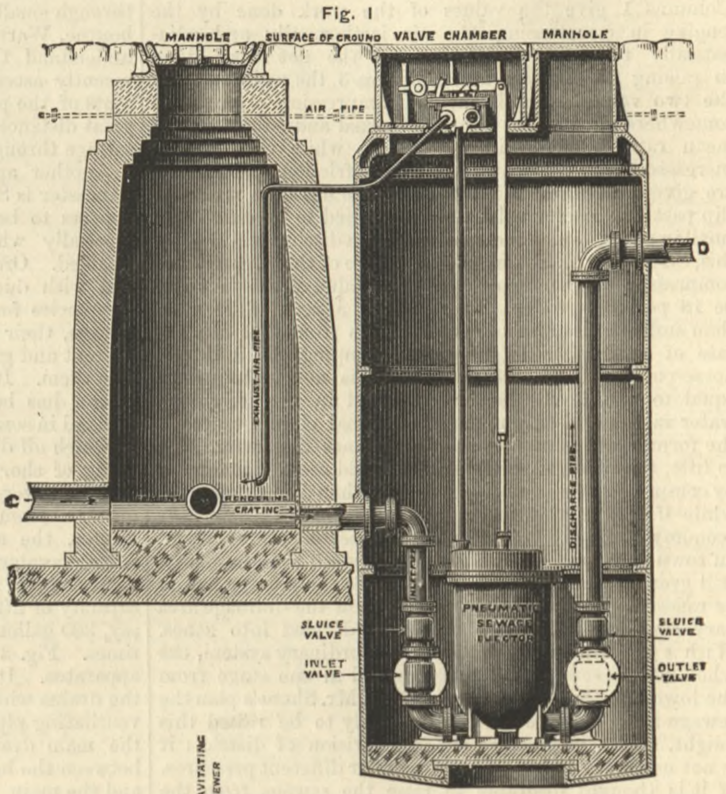




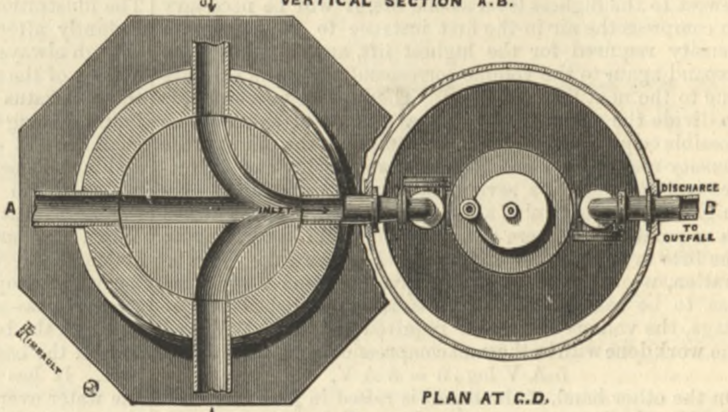
TRANSVERSE SECTIONS ON LINES

Fig. 4 Fig. 5

Fig. 1



VERTICAL SECTION A.B.



PLAN AT C.D.

SCALE $\frac{1}{4}'' = 1$ FOOT

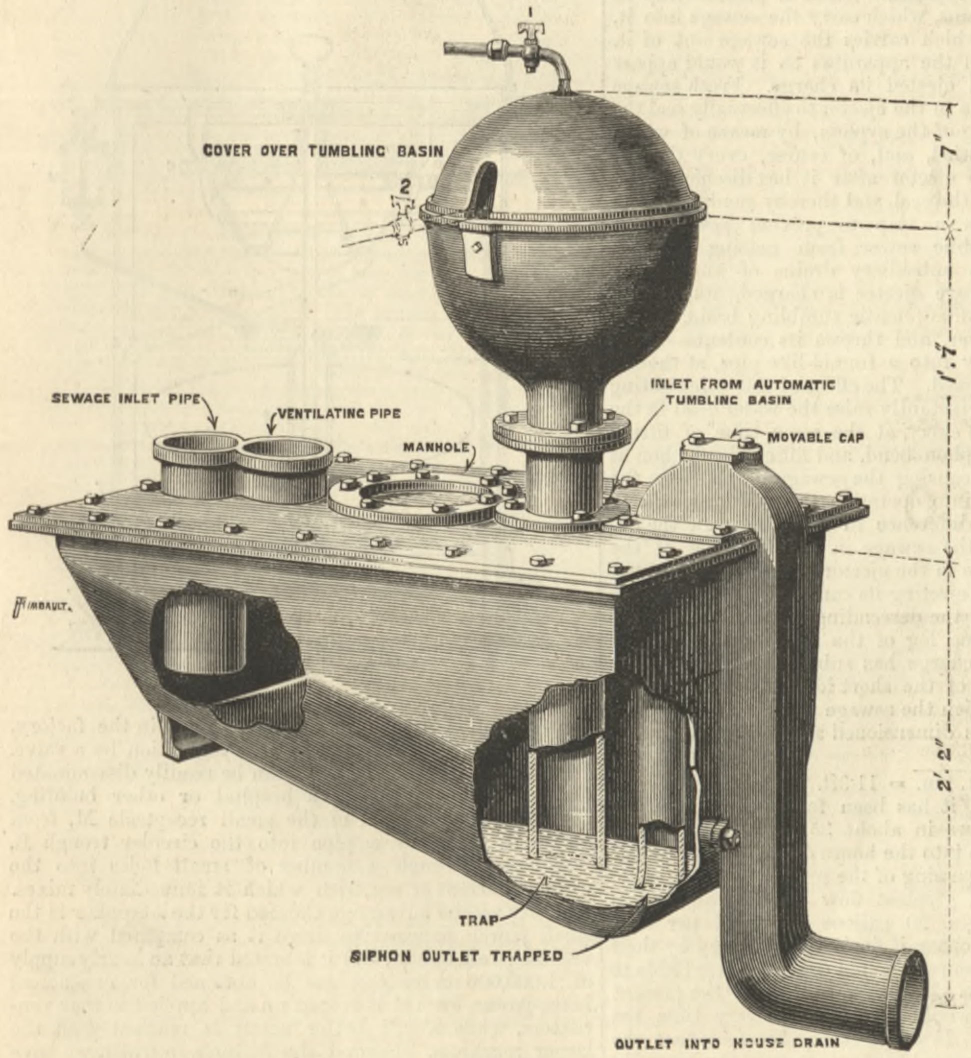


Fig 2

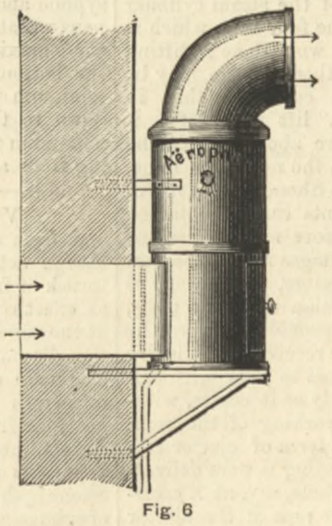


Fig. 6

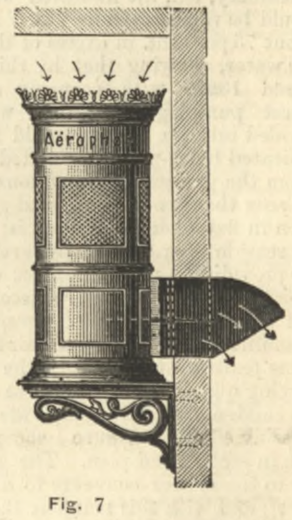


Fig. 7

every machine being self-acting, and only coming into operation when there is sewage to be dealt with. Before entering into a description of the machines, it will facilitate the comprehension of the principles of working if we first give a few particulars of the Shone system of sewerage. Two of the chief points to be aimed at in any scientific method of dealing with sewage are, the avoidance of large sewers at low gradients, in which the height of the liquid is subject to great variation, and the rapid delivery of the sewage to its destination before decomposition has set in to any very great extent. In the ordinary system, when the sewage cannot be directly conveyed by gravitation, the common practice is to construct a network of sewers converging to one point, at which is provided a reservoir of sufficient capacity to maintain a fairly uniform rate of pumping; and, as a rule, this plan necessitates the use of the sewers themselves for storage purposes, the gradients being generally very flat. Under these circumstances, the greatest vigilance, combined with frequent flushing, are mains conveying compressed air from the compressing engines, and no personal attendance is required beyond an occasional inspection. The position of the air compressors is not material. If the local authorities own a water pumping station or gasworks, the air may be compressed at either without increase to the existing staff; and failing this, the pumping plant may be erected near to a coal siding or on some other convenient site. If water power is available, it can be used in place of steam, and in any case the cost of the whole installation is not much affected by the distance over which the compressed air has to be transmitted, as the size of the pipes is so small. When only a portion of the sewage has to be raised, or when the lift is so little that the total engine power required is small, it is more economical to use a hydraulic engine supplied with water from the town mains, because of the inefficiency of steam engines of low power. Water, even if it has to be pumped at a pressure of 50 lb. per square inch, it is to be treated or utilised, the conveyance being so rapid that there is no possibility of the generation of foul gases by decomposition. In using compressed air in this manner it is obvious that the whole of the work done by the compressing engines is sacrificed, and for isothermal compression this is represented by the expression A V log.$_e$ R, where A is the atmospheric pressure on a unit of area, V the number of units of volume of free air compressed and discharged into the receiver by one stroke, and R the ratio of compression. The total work done both by the engine and external air during one complete stroke is A V (1 + log.$_e$ R), the work done by the air being in all cases equal to that required to discharge the compressed air out of the cylinder. It is evident, therefore, that there must be a limiting value of the height to which liquids can be raised on the Shone system, as economically as by direct pumping, and the following table, showing the work done in compressing the air to different absolute pressures in six cases, has been calculated with a view to ascertain this limit:—

Lift in feet.	Isothermal compression.			Adiabatic compression.			Mean value of Columns 3.	Mean value increased by 25 per cent.
	1.	2.	3.	1.	2.	3.	4.	5.
16½	859	706	1·22	900	802	1·12	1·17	1·46
33	1467	1058	1·39	1500	1300	1·15	1·27	1·59
49½	1940	1270	1·53	2150	1657	1·30	1·42	1·77
66	2328	1411	1·65	2700	1970	1·37	1·51	1·89
82½	2650	1512	1·75	3200	2166	1·44	1·59	1·99
99	2938	1587	1·84	3620	2376	1·52	1·66	2·08

Columns 1 give the values of the work done by the engine in compressing the air isothermally and adiabatically respectively; Columns 2 the net work done in raising the liquid ; and Columns 3 the ratio between the two values. As the actual compression is probably somewhere midway between isothermal and adiabatic, the mean ratio is given in Column 4; while these values increased by 25 per cent. to allow for friction and leakage are given in Column 5. No allowance has been made for slip past the ejector valves, as it is stated to be extremely small in proportion to the volume of each discharge. Besides this, Sir Frederick Bramwell, in the case of the Mekarski air compressors at Chautenay, found the value of this factor to be 18 per cent., so that there would appear to be more than sufficient margin to cover the loss from slip. In the case of engines used for sewage pumping, the indicated horse-power of the steam cylinder is not unfrequently equal to double the power estimated in net weight of water raised, and only under exceptional circumstances is the former less than one and a-half times the latter. Up to lifts, therefore, of about 60ft. it would seem that forcing by compressed air is more economical than direct pumping; while if the pumping machinery is of small capacity, the economy is likely to extend even beyond this height. In town sewerage, pumping by compressed air admits of a still greater economy, as in cases where the sewage has to be raised a great height and the levels of the drainage area vary considerably, the area may be divided into zones. With a single pumping station in the ordinary system, the whole of the sewage has to be pumped in one stage from the lowest to the highest level, but in Mr. Shone's plan the sewage from the lowest zone has only to be raised this height. In order to carry out this division of districts it is not necessary to have air mains under different pressures. If it is thought desirable to raise the sewage from the lowest to the highest level at one lift, it will be necessary to compress the air in the first instance to the maximum density required for the highest lift, and to allow it to expand again to the volume corresponding to the pressure due to the next lift, and so on. The best way, however, is to divide the maximum lift into a number of as nearly as possible equal stages, and to compress the air to the density required for one lift, the sewage being ejected successively through the several stages. At first sight this might appear to involve a loss of economy, but it is not so, as in point of fact there is considerable gain in dividing up the lifts in the manner indicated. For the sake of illustration, we will suppose that a given volume V of liquid has to be raised 132ft. If this is accomplished in one stage, the volume of free air required would be 5 V, and the work done with isothermal compression is represented by

$$5 \text{ A V log.}_e\, 5 = 8 \text{ A V.}$$

On the other hand, if the liquid is raised in four lifts, each of 33ft., the free air compressed would be 2 V, and the work done

$$8 \text{ A V log.}_e\, 2 = 5.5 \text{ A V.}$$

If we add 25 per cent. as in the table for friction of machinery, &c., the indicated work of the steam cylinder would be represented by 7 A V for the four lifts, which is about 75 per cent. in excess of the net work done in lifting the water, showing that by this method sewage may be raised 132ft. with economy about equal to that in direct pumping. In this way a lift of 200ft., if divided into six stages, would require about double the indicated horse-power estimated from the net work done. From the preceding description of the Shone system it will be seen that sewers with good gradients can be obtained even in flat districts, and it is therefore specially suited for seaside towns with long level frontages facing the sea. By providing a proper number of ejectors, the sewage is rapidly discharged before decomposition can take place, and any sudden rush of sewage is provided for by the accumulation of compressed air in the receivers. It is this latter feature which enables the ejectors to deal with the varying quantities of sewage as quickly as it comes, without suddenly affecting the rate of working of the compressing engine. Figure 1 shows one form of ejector station in section and plan. The gravitating sewers delivering to the ejector converge to a manhole, say, at a cross-street, and with this manhole the inlet pipe of the ejector communicates. Both inlet and outlet are provided with ball valves, this being the type best adapted for passing sewage matters. The automatic air valve, which in this design is fixed in a cast iron box under the street, is actuated by two buckets, which are fixed to an iron rod passing out of the ejector through a stuffing-box, and which is attached to the main lever of the automatic air valve. The lower bucket is suspended near the bottom with the open end upwards, and the upper one is inverted at the top of the ejector. When the liquid rises and reaches the inverted bucket, the contained air causes it to rise, and so actuate the air valve and admit compressed air to the interior of the ejector. The inlet sewage valve at once closes, and the air pressure forces the sewage through the outlet valve into the rising main. When the surface of the liquid within the ejector sinks below the level of the lowest bucket, which remains full of sewage, its weight, suspended in the air, pulls down the rod, and so reverses the action of the air valve and allows the compressed air to escape into the atmosphere. The sewage delivery valve at once closes, and the ejector again commences to be filled through the inlet valve. The weight of the buckets, when empty, is balanced by the weight shown in the engraving above the valve box. It would seem that Shone's pneumatic ejectors are well adapted for raising liquids in chemical works and breweries, as they can easily be made of materials not acted on by chemicals. They are also adapted for raising heated liquids; and in this case the compressed air would be expanded by the heat imparted from the liquid, and its volume be increased, thus reducing the quantity of air required, and effecting a saving in pumping power. For pumping in mines there would, no doubt, be a benefit from the use of compressed air, which would assist the ventilation; and for irrigation purposes it would often be a great convenience to have a number of automatic pumping stations, all worked with air compressed at one central point, and transmitted in various directions through small pipes. The system is in operation at Eastbourne, Warrington, Winchester, and other places, and we understand that the Corporation of Warrington have recently ascertained, by actual experiment, that the contents of the pails on the tub system can be transmitted to great distances by the ejectors, and the offensive and costly cartage through the main streets avoided.

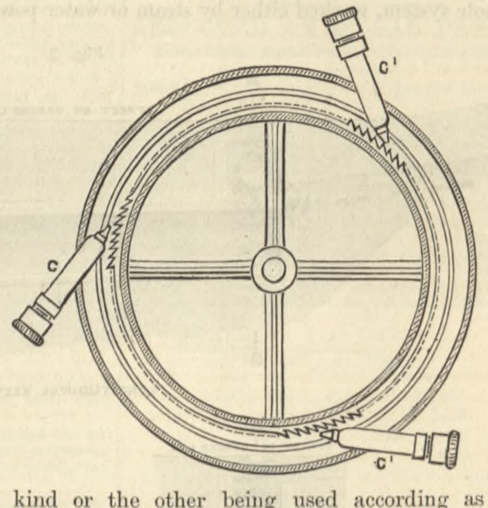
Another apparatus exhibited by Messrs. Hughes and Lancaster is Shone's hydraulic house sewage ejector, which appears to be an exceedingly efficient instrument, more especially when good gradients cannot ordinarily be attained. Ordinary house drains even of small bore, and laid with due regard to inclination, very often become receptacles for, rather than the means for getting rid of, sewage, their foul condition being caused by the intermittent and greasy nature of the discharges that are made into them. It is to overcome this difficulty that the house ejector has been designed. The apparatus is intended to be fixed in some convenient position in the house premises, to which all drains can be made to converge, these drains being of short length, and so inclined that the discharge from a water-closet, for instance, cannot fail to gravitate quickly from the bottom of the soil pipe into the ejector, the same remark applying to the waste from sinks, lavatories, &c. The sewage, therefore, reaches the ejector in a perfectly fresh condition, and if it has a capacity of fifty gallons, while the aggregate discharge is, say, 300 gallons per day, it will be filled and emptied six times. Fig. 2 will enable our readers to understand this apparatus. It will be seen that when it is coupled up to the drains which supply the fresh sewage, and when the ventilating pipe is fixed, and when it is also connected to the main drain, the apparatus forms a perfect trap as between the house drains, which carry the sewage into it, and the main drain which carries the sewage out of it. The illustration shows the apparatus as it would appear instantly after it had ejected its charge. Fresh sewage enough always remains in the ejector to effectually seal the bottom of the short leg of the syphon, by means of which the apparatus is emptied, and, of course, every drop of liquid flowing into the ejector after it has discharged its contents will deepen the seal, and thereby render it more and more perfect as a trap to prevent sewage gas generated in the public sewer from getting through the apparatus to the subsidiary drains of the house. When the house sewage ejector is charged, its syphon action is effected by an automatic tumbling basin, which, when full, topples over, and throws its contents—about two gallons—suddenly into a funnel-like pipe, at the top of which the basin is fixed. The effect of this quick tilting over of the basin is to instantly raise the water head in the pipe. It has also the effect, at the same time, of lifting the water over the syphon bend, and filling the syphon at that point full bore, causing the sewage to fall down the long leg, so bringing into operation the ejecting power of the apparatus. The difference in level between the descending column of the sewage in the long leg of the syphon and the sewage in the ejector is the measure of the power that is at work ejecting its contents. This power is at its maximum when the descending column first reaches the bottom of the long leg of the syphon, and is at its minimum when the charge has subsided in the ejector down to the bottom of the short leg. Theoretically the maximum velocity which the sewage would attain in passing from an apparatus dimensioned as per our illustration would be—

$$V = 8 \sqrt{2\text{ft. } 2\text{in.}} = 11{\cdot}9\text{ft. per second}$$

and from observation it has been found that the whole charge actually escapes in about 35 sec. This sudden inrush of fresh sewage into the house drain would produce an effect equal to the passing of the sewage of 3500 people at the time when the greatest flow obtains, and when the discharge averages 20 gallons per head per day. The main drains of houses, if flushed in this way by their own fresh sewage resources, would be much less liable to get foul from deposits than they are under the present system, and the air would be renewed every time the apparatus is emptied. It would seem, therefore, that the Shone hydraulic ejector would not only prevent the intrusion of sewage gas from public sewers, but would do away largely if not entirely with the nuisance constantly arising from the house drains themselves, while the whole sanitary arrangements would, in each case, be complete within the premises. The engravings, Figs. 3, 4, and 5, show the details of a large public sewer flush tank, which is simply a large brick barrel sewer, to which the syphon is attached at the delivery end. The tumbling basin may be fixed in any convenient place, and in this case must be supplied with water from a stream, or from the main. If the invert levels of the sewers admit of the arrangement, the flush tank may be filled with sewage from a drain discharging into its upper end, as shown in the engraving; but if this cannot be effected the tank itself must be supplied from a stream or from the mains, the rate of supply being adjusted to fill the tank in any desired period of time.

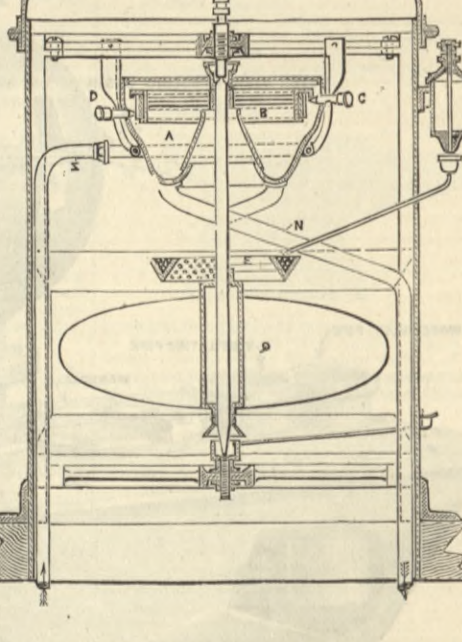
Messrs. E. C. Beaumont and Co., Ludgate-circus, E.C., exhibit three forms of Treutler and Schwarz's patent Aërophor, for which they are the sole agents in this country. The general construction of the apparatus is shown on page 477, Figs. 6 and 7, and the method of application below in Figs. 8 and 9. It consists of a light iron casing, enclosing a screw Q fixed to a spindle supported in anti-friction bearings, which is caused to revolve by a turbine B acted on by three small jets C C C of water, steam, or compressed air, which impinge against buckets on the periphery of the wheel. Unlike ventilators driven with straps, the Aërophor can be fixed in the precise place where it is desired to remove the air or introduce the supply, the motor fluid being easily conducted to the apparatus through small pipes without incurring appreciable loss; and in this way large air ducts, with their friction and other objections, are avoided. Two forms are made, viz., the suction, and the pulsion or air-driving apparatus,

Fig. 8



one kind or the other being used according as it is required to exhaust or to supply fresh air, while in some cases both are adopted, the air being drawn off from the roof or ceiling, and replaced by means of openings in the walls or floor. For trades such as spinning, which require a high degree of moisture in the air for the more perfect finish of the goods, the pulsion apparatus is provided with a moistening contrivance, which impregnates the air introduced from without with excessively fine spray, so thoroughly that any desired degree of moisture, up to 80 or

Fig. 9



85 per cent. of saturation, can be obtained in the factory, the amount being capable of easy regulation by a valve. In the same way disinfectants can be readily disseminated throughout the wards of a hospital or other building, the fluid being placed in the small receptacle M, from which it passes by a pipe into the circular trough E, and issues through a number of small holes into the upward current of air, with which it immediately mixes. Another special advantage claimed for the Aërophor is the small power required to drive it as compared with the volume of air moved, and it is stated that an hourly supply of 1,000,000 cubic feet can be obtained for one actual horse-power, even if it is split up and applied to four ventilators, while a still better result is reached with the larger machines. Beyond the features to which we have specially drawn attention, the Aërophor possesses many other advantages which will be obvious to most of our readers, not the least being its perfect silence and capability of being easily regulated to work at any desired speed, according to the quantity of air to be removed or supplied.

TORPEDO BOAT FOR THE RUSSIAN GOVERNMENT.

The engines illustrated in our two last impressions run at 480 revolutions—too high a speed for pumps. Accordingly the air and circulating pumps are driven by separate engines making about 180 revolutions per minute. We illustrate this machinery on page 484. It consists of two steam cylinders 5in. in diameter, the piston-rods of which are continuous with those of the pumps below them. At first sight it would appear that the cranks work in dog links, but this is not the case, double connecting-rods being used. The feed and bilge pumps are worked direct off the ends of the dog links. All the dimensions and details are so clearly shown on page 484 that minute description is, we think, entirely unnecessary. Everything is made as light as possible by the free use of gun-metal and steel.

LETTERS TO THE EDITOR.

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

THE EFFICIENCY OF FANS.

SIR,—I have read over Mr. Capell's letter in THE ENGINEER of June 6th, wherein he writes of his harmonious water-gauge. There is no harmony in any one single water-gauge on either the Dudley or Birmingham tests, except the one, acknowledged by Mr. Capell, tested by the South Staffordshire Mining Engineers, and in Test 10 no water-gauge is given, and no readings of the anemometer or skin friction can be taken in the closed test. It is not the proper manner to test any fan with either suction or discharge stopped up. I herewith hand you a sheet, reprinted from THE ENGINEER, and handed to me, on the faith of the Capell fan giving over four times more blast than any other fan in the world. I have corrected the table into plain figures, according to Hutton's Wind and Velocity Tables, and after seeing that from 25 to 115 per cent. is added to the feet per second column in Hutton's Tables, I ask, Where is the harmony?

Mr. G. M. Capell has, for the first time, explained his intermediate water-gauge—and which water-gauge has led him into the trap which he has tried to trap other fan manufacturers with. It is the water-gauge concealed until his last week's letter, except in your impression of February 16th, 1883. I have seen Mr. Capell plotting this water-gauge since its first appearance in your columns of February 16th, 1883—and in which impression you distinctly stated that 7in. water-gauge was raised with a 6in. fan running at 4200 revolutions per minute, with a piece of wood closed over the central orifice. Consequently, if the 6in. fan was raising 7in. water-gauge, it was no rule of efficiency. Had it been running night and day since that time until the present, not one cubic foot of air would have been passed.

On September 3rd, 1883, Mr. Capell read a paper on fans at the Dudley Institute. His explained water-gauge in your last week's impression was concealed in that paper. He asked them for bread; they gave him a stone, and pelted him—see his letter of December 14th, 1883. I need not tell you that any gentlemen induced to read a paper in all such kindred institutions are treated with the greatest courtesy, and generally better than the members themselves.

On November 30th a letter appeared from Mr. Allday, who some years ago sold Mr. Gunther's fans, but now manufactures his own. Mr. Capell replied in return, with a poisoned arrow—see his letter of December 7th, 1883—stuck fast into the back of Mr. Gunther's trade, reckless of what injury he may inflict on that gentleman; and it was done by his intermediate water-gauge. As a proof of this Mr. Gunther could not make a 40in. fan that would not give more than 11in. water-gauge at the speed named by Mr. Capell, unless it was passing some portion of its volume. Mr. Capell says that my remark about a cupola is a mere statement. A few days before he wrote you, he personally admitted to me that his own 30in. fan was blowing into a cupola loaded with fire and coke, while the other fan was blowing into a cupola empty; consequently his rival fan was, just as I explained to you, discharging its volume into the atmosphere. I told him I knew it as well as though I had been present to see it.

He gives you another opinion on what he pleases to call—in his letter of April 29th—my patent low-pressure ventilator. He admits to my face that I have a splendid thing, and that I was just before him with my patent. I will just remind him that it is not my new patent ventilator I should make to give at 580 revolutions 3½ water-gauge through a 20in. tube. It would be one of any types of fan selected out of hundreds of different patterns and types of fan I make, including some of old date so much like his own that it would be a puzzle for many to see the difference between them, HENRY ALAND.

46, Commercial-road, Lambeth.

HYDRAULIC TURNTABLES.

SIR,—It is a little curious that three separate letters from correspondents should have appeared in your last issue referring to the want of novelty in as many pieces of machinery recently noticed in your columns, the respective prior constructions being claimed as three, twenty, and forty years old. In our own case we need hardly state that we should not have brought the special hydraulic turntables made by us to your notice if we had been aware that the idea was not new as applied to the specific purpose mentioned. The arrangement referred to in "J. J. A.'s" letter is no doubt a good one, but we think that placing the spiral guides as close to the ram as possible is preferable for several reasons. The Mersey Steel and Ironworks are to be congratulated on having had such a useful machine constructed, and we trust it is still at work after so many years' service. Is it possible that the time is near at hand when every mechanical contrivance will have been already tried, and when your interesting publication might be called the "Engineers' Antiquarian Record," the chief duty of the editor being to arbitrate on the relative antiquity and the respect due to the age and venerable origin of machinery then in course of construction? Your "Patent Journal" columns would then, of course, be superseded, and might be occupied, as well as your advertisement sheets, by manufacturers eager to prove that their claim to the support of the profession and public rested on the undoubted antiquity of their designs. Your readers would then see with additional surprise and pleasure the interesting expansion joint brought to their notice by your correspondent Mr. R. F. Thompson in your last issue. C. R. PARKES.

East Ferry-road Works, Millwall, E., June 23rd.

THE "HOPE" GUN.

SIR,—In your article on this subject you say that my offer to the War-office "is not a proposal that could be accepted," and you then state certain reasons. Allow me to say that those reasons do not apply to my offer, because (1) the War-office were to name their own conditions of trial; (2) no gun was to be paid for unless and until certified as having fulfilled those conditions; and (3) it was not even then to be paid for if unforeseen objections were raised; but in that case the matter was to be decided by Lord Wolseley as sole arbitrator, or, alternatively, by the Under Secretary of State for War, Sir Ralph Thompson, assisted by Professor Tyndall, F.R.S., as scientific assessor.

My experience of the Ordnance Department is of twenty-eight years' standing, and knowing that no proposal that any human being outside the "gun ring" could possibly frame in the English language would be accepted, I was determined to frame my proposal in such a way that there could be no honest, legitimate objection to it, so that, when the inevitable refusal came, I should be able to unmask the Ordnance Department, and, with the help of the Fourth Estate and a few staunch Members of Parliament, get it reformed or abolished.

It is obvious that in naming their own conditions the War-office might have covered all or any of the points you raise. But they had no desire to get a good gun for the country. Their only endeavour or thought was to prevent any outsider getting inside their fence.

But to show you that I am not afraid of what you say is the only real test of the power and worth of a gun—which I altogether deny—namely, the total energy per ton of gun, I may mention that that test is even more in my favour than the one I took, as my total energy per ton of gun is no less than three times that of the Woolwich gun; and as a further proof that my offer was not rejected on its merits, I may mention that I invited the Ordnance Department to send, at my expense, two officers to witness the trials of the "Hope" gun on the Continent, on one condition, namely, that I should be allowed to see their report. The Department declined the invitation.

I am fighting the battle of the noble army of inventors against official obstruction, official theft, and professional jealousy, and I call upon the Editor of THE ENGINEER to help me, in the interest of all men of science, and of all pioneers, however humble.

Army and Navy Club, W. HOPE.
June 22nd.

HYDRAULIC LIFTS.

SIR,—In your issue of May 16th there is a report upon the exhibits in the International Health Exhibition, in the course of which there appeared a notice of a working model of a patent hydraulic balanced passenger lift, by Messrs. R. Waygood and Co. In the following issue appeared a communication from "Economiser," asking for the publication by Messrs. R. Waygood and Co. of certain data. In the following issue—May 30th—appeared a note from Messrs. R. Waygood and Co., inviting a private conference with "Economiser," but not giving the data asked for by him. In your issue next following—June 6th—"Economiser" declines the private conference suggested by Messrs. R. Waygood and Co., and intimates an intention on his part to pursue the subject further. At the date of this writing no further correspondence has appeared. If "Economiser's" only object is to test the claims put forth by Messrs. R. Waygood and Co. for their patent balanced lift, there would appear to be no ground upon which we could base a request for his attention. If, however, "Economiser" desires to push his inquiries so far as to learn what degree of economy, durability, safety, and certainty of uninterrupted working has been attained by any lift manufactured, we respectfully invite his attention to the lifts manufactured by this company.

We have examined the working of many of the lifts in use in London, and are fully informed as to the manner in which they will compare with our own, in regard to all the points above mentioned. We do not wish, however, to publish any statistics which we have obtained in regard to the working of lifts made by others, but we are perfectly willing to publish any and all details required of the working of our own lifts, and we not only expect, but we earnestly solicit a comparison with any and all other lifts whatsoever, in regard to the points before referred to, and we shall be quite willing to defray any reasonable expense which may be incurred in an effort to ascertain the truth of the statements which will be made in the course of this communication. The question raised is certainly important to those who use lifts, and especially so to those who may be looking forward to their use.

We cite, first, one of our lifts fixed in the building of the Alliance Insurance Company at the corner of Pall-mall and St. James's-street. In this case the travel of the car is 48ft. 4in., the hydrostatic pressure is that due to a head of 69ft., the maximum load raised—at a test made Feb. 23rd, 1883—was 920 lb., the volume of water consumed for each complete journey from the bottom to the top and return is 90 gallons. In this case the water is delivered to the tank at the top from the constant service main in the street without the intervention of any pump or other appliance, and the lift is consequently ready for use at any hour, day or night, and by any person who may choose to use it. In working, moreover, it is noiseless, so that no person is disturbed at night. The cost of working is therefore the cost of the water consumed. In this case the charge for water is not per meter, but the water company have made a fixed rate for the whole building. If we leave out this sum, which would be charged by the water company for the building without a lift, we believe it will be found that the cost of the water does not exceed £20 per annum. This lift has been in use now more than two years, and the repair bills have amounted to £3 12s. 3d. If it were not possible to get the water direct from the street main, and if it were necessary, therefore, to pump the water to the tank at the top, exhaust it into the tank in the cellar, and pump it back again to the upper tank, thus using the same water over and over continually so that there is practically no charge for water, we should have to furnish a pumping power sufficient to raise the water needed for the regular service of the building. If we assume this to be equal to ten complete journeys per hour, it would be necessary to pump 15 gallons a minute 69ft. high. This equals 0·4-H.P; it will be seen, therefore, how small a gas engine would suffice for working the pump. This lift is continuously at work, day and night, without interruption, the only cause for interruption being to perform the necessary packing, and this is very easily and speedily done, at an hour when it is not required for use, by the residents in the building. It will be obvious that with such a low pressure the wear upon the valves and fittings is reduced to a minimum. We believe that such a degree of economy, safety, and uninterrupted working has not been attained with any other machines.

We cite next the four lifts fixed by this company in the Albert Hall Mansions, and we take for our present purpose the No. 4. In this case the hydrostatic pressure is that due to a head of about 100ft., the rise is 65ft. 4in., the water consumed for each complete journey is 100 gallons. We have not tested the maximum lifting power of this lift, because it will do more than the contract requirement, but it is probably about 950 lb. In this case the water is supplied by the constant service main as in the preceding case. If the water had to be pumped in such quantity as to allow ten trips per hour, it would be necessary to pump 16⅔ gallons per minute 100ft. high, which may be called 0·64-horse power.

We next cite the lift fixed for Mr. J. T. Chappell in his residential flats in the Grand-avenue, Brighton. In this case the rise of the car is 60ft. 7in., the water is supplied by direct attachment to the street main—without any tank at all—the quantity consumed for each complete journey is 74·4 gallons, the load raised is 1050 lb. We do not multiply these instances at present. If to the facts above recited be added the further statements that the lifts have worked uninterruptedly since they were fixed—that the cost of repairs has been practically nothing—that they are noiseless and that safety is absolute, we think we will have established the fact that the results shown have not been equalled.

We regret that some contracts for much larger work, and where pumps will be employed, are not yet finished and ready for testing. We need hardly say to "Economiser" that as large machines for use in hotels, office buildings, &c., involve the use of larger cylinders, there is less loss from friction than in smaller motors. In machines of large size for large buildings, and where large loads are to be lifted, we gain as high as 0·84 per cent. effective, leaving only 0·16 lost in friction. In the smaller machines, such as those above referred to, we estimate the loss by friction to be from 0·25 to 0·30 per cent. It will be very easy to establish the truth of the statements just made, and we invite a test by "Economiser."

We will cite one case in the city of New York, and will be happy to furnish in any way prescribed by "Economiser" proper and legal proof of the statements about to be made, and the case cited is in no way exceptional; but we select this one because the position is conspicuous, because the verification can be very easily made, and because the owners have given us the facts now submitted. We only add that the same results are reached in many hundreds of instances in New York, and throughout the United States. The case cited is that of the building called the United Bank Building, at the corner of Wall-street and Broadway, in the city of New York. This building is eight storeys high, it is occupied as offices by financial companies, stockbrockers, &c. Two banks occupy the ground floor. There are two of our standard hydraulic elevators in this building, running from the ground to the eighth floor, a distance of about 110ft. The water pressure comes from a tank in the roof, giving a head of about 130ft. The two elevators exhaust the water into a tank in the cellar, from which it is pumped back again to the tank at the top. The pump used is a Worthington compound duplex steam pump. Each of these elevators makes thirty-five complete journeys per hour, running at a speed of 318ft. per minute; the average load carried each journey, up or down, is a fraction over eighteen passengers, and the number of passengers carried every day is over 11,000. The cost of working these lifts—leaving out of view, of course, the attendants, who would be involved in any case—is obviously the cost of pumping the water, and this has been done by burning 8 cwt. of coal per diem. These two lifts have been in use about three years. They have never been stopped since they were started, nor has any tenant ever been deprived of their use. We have not at hand the cost of repairs. This will be elicited by an investigation. We believe that we are warranted in saying that this cost has been practically nothing. Since the New York Power Company has laid down steam through street mains, this building, with many others, has discontinued the use of its own boilers, and takes steam from the street main direct. If there has been an instance of such a service as this, attained at so low a cost with such a degree of effectiveness and with perfect safety and noiselessness by any other lift whatsoever, we are unaware of its existence. It cannot be difficult for "Economiser" to ascertain the truth of these statements. If they are true, we believe that they constitute an absolute and irresistible proof of the great superiority of the Standard hydraulic elevator over all others.

To facilitate any investigation by "Economiser" or by other engineers, we proceed to describe the Standard hydraulic elevator. An idea of the characteristic features of this elevator is given by Fig. 1. It will be seen that no ram is employed, and no boring of the earth is necessary. The cylinder stands upon a basement or cellar floor in a vertical position, and, with the travelling sheave, occupies a space of, let us say, 18in. by 30in. in ordinary cases. This may be detached from the shaft in which the car moves, and placed at some distance, or it may adjoin the shaft in which the car is, or it may be in the same shaft. It will be seen that in the figure—and in ordinary cases—the piston movement is half that of the car or cage, the gear being one to two. The cage is lifted by not less than four wire ropes, passing over a large sheave at the top, descending thence to the movable or travelling sheave, and thence up to the points of permanent fastening. It will be at once evident from this that the movement of one foot by the piston will cause a movement of two feet by the cage. It will be seen also that the movement of the piston is in opposition to the motion of the car, and that thus the piston makes in itself a part of the counterbalance required to avoid the lifting of dead weight.

In this machine it is a characteristic feature that there is always solid water upon both sides of the piston. The motive power employed is twofold. During the descent of the car, the only power is the weight in the car plus the little surplusage of weight of the car over the counter-balance. During the ascent of the car, the power employed is the pressure of the water upon the top of the piston, whether coming from the tank at the top of the house, or from a direct connection with the street main. On the left of the cylinder, Fig. 1, will be seen a smaller cylinder placed in connection with the larger cylinder at the top and at the bottom. To more clearly show the movement of the water, we refer to Fig. 2. Let t be the point at which the connection is made either with the upper tank or with the street main; C the small cylinder communicating with the large one at the bottom by B, and at the top by H; T is the piston of the valve. This valve can occupy three positions:—First, that designated by $m\,n$; second, that answering to the closing of the port B; third, the position $m'\,n'$. The first position is that for the ascent of the car; the second is to stop the car; the third is that of the descent of the car. To lift the car, the valve is put in the position $m\,n$. In this position the piston descends, and the water is discharged by the passages $f'\,f''$, and the power employed is that which is due to the pressure existing at the beginning of f''; in other words, it is the pressure upon the area of the piston at the point where the piston may be, added to the weight of the column of water below the piston, so that the power is uniform at every point of the stroke, and without regard to the point which the piston may occupy in the cylinder. It is the fact of solid water upon both sides of the piston, and the fact of this uniformity of power at every point of the stroke which, in part, contributes to give this lift its superiority. To stop the car it is only needed to change the position of the valve by means of the hand rope F moving the sheave P, so as to close the port B.

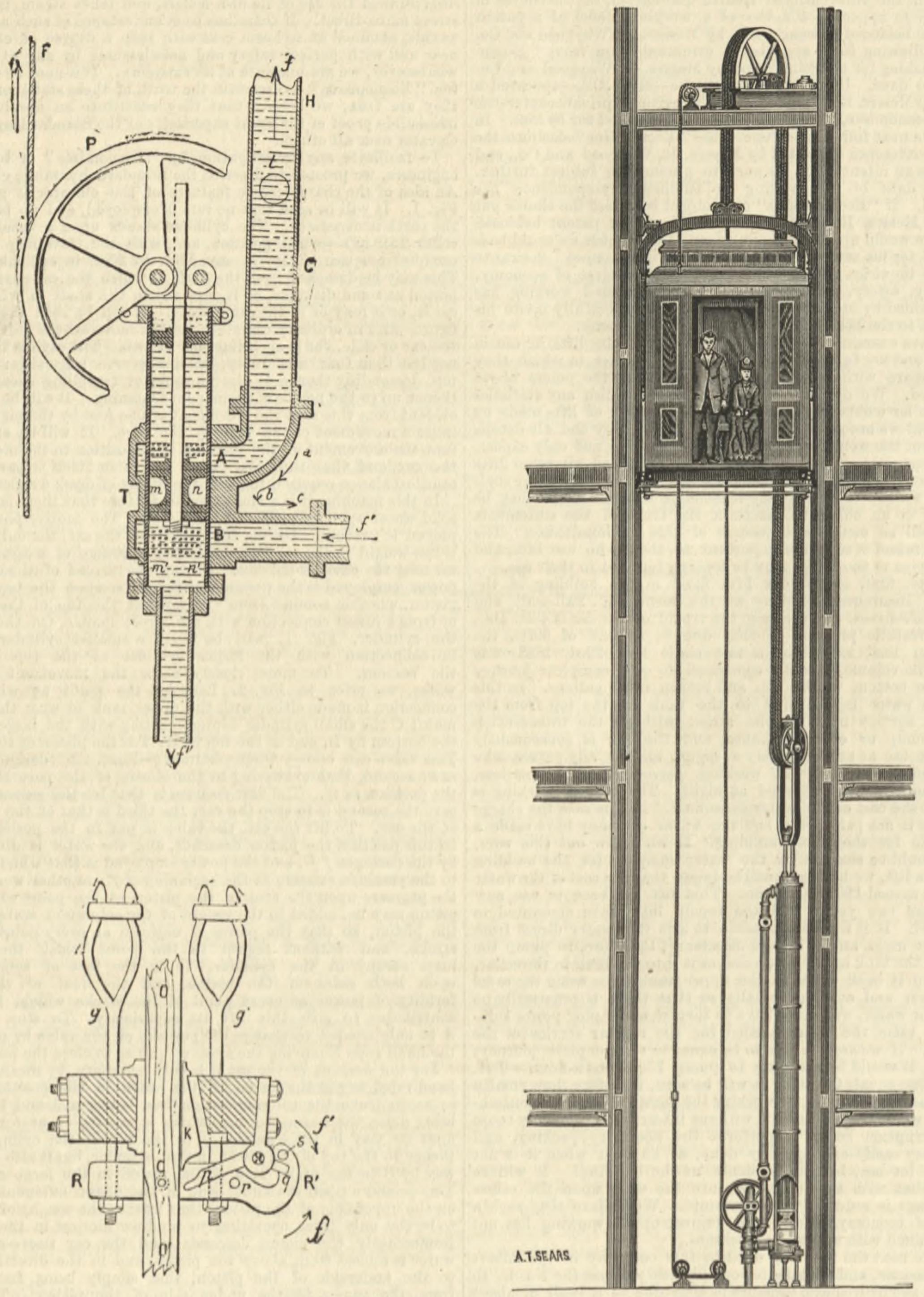
For the descent of the car it is only necessary, by means of the hand rope, to put the piston of the valve in the position $m'\,n'$, so as to leave the communication free between A and B. This being done, the water pressure which is coming in at t not only finds its way in the direction f to the top of the cylinder, and thence to the top of the piston in that cylinder, but it also finds its way by B to the under side of the piston in the large cylinder. This pressure upon the under side of the piston antagonises that on the upper side of the piston, thus leaving the weight of the car to be the only force operating to produce motion in the piston. Immediately the piston descends—and the car rises—and the water is moved from above the piston, and in the direction $a\,b\,c$ to the underside of the piston, thus simply being transferred from the upper to the under side of the piston. The rate of motion will therefore be the rate at which the water will pass from the top of the large cylinder to the bottom by means of the communication H A B. It will thus be seen that when the car is descending it is in itself the cause of all motion in the machinery, and that if the car be stopped when descending by any cause other than that produced by the valve, all motion will cease—the water ceases to move, and that situation remains unchanged until the valve is closed or the car resumes its motion.

The car cannot go beyond the starting point at the bottom nor the stopping point at the top for the following reasons:—First, if the car is left to go by itself, without an attendant to close the valve by means of the hand rope, the valve will be closed automatically by the action of the car itself, notwithstanding the absence of the attendant, and will thus stop at the two extremes. Secondly, when the car reaches the highest point to which it ascends in the building, not only is the valve closed automatically in the way already described, but a follower upon the piston in the large cylinder closes first the port f^1 and causes a gradual stoppage of the outflow of water. Furthermore, the car will not rise beyond the highest point, because the only power employed is the hydrostatic pressure due to the elevation of the tank or furnished by direct communication with the street main; this pressure per square inch of the area of the piston is the only force being exerted, and is met by a power of resistance in the parts many times more than sufficient.

When the car is descending the piston is rising, and the water is being transferred from the upper to the lower side of the piston in the way already described; the only power being exerted, therefore, is the load that may be in the car. The car cannot go below the lowest point—and the piston cannot create a shock upon the head of the cylinder—because the valve will be automatically closed, and because the car will be stopped by the rests provided at the bottom, and there is no power sufficient to create the least injury to the machinery. The car never can over-run the points of stopping—the stopping of the car in itself causes a stoppage of all other parts, and therefore it is simply impossible for the ropes to be thrown off the sheaves in any way whatever.

Fig. 3 represents in part the safety fixtures employed. It has already been remarked that each car is lifted by means of not less than four iron wire ropes. In large machines a greater number of ropes is employed, and it will be at once obvious that as many may be used as may be desired. The ropes are independent of each other throughout their length; each of them is more than sufficient to maintain all the load. In Fig. 1 the car is shown to be lifted by four ropes, two of these are led to the bottom of the car upon one side, and the remaining two are led to the bottom of the car upon the other side, the purpose of the iron girdle at the top being to hold them together in the centre, and to guide them to the overhead sheave; the car therefore can never break away from the point of suspension, because the ropes are fastened to the safety plank underneath the car, upon which the car rests. We need hardly say that it is impossible that four ropes should break at the same instant of time; if, therefore, we suppose that the lift is allowed to go on without examination from year to year, the time will come when, from excessive wear, a rope will break; in this case the car will instantaneously be locked to the guides by the safety fixtures, and it will then be impossible to go down, but there would be ample strength in the remaining ropes to lift the car to the next floor above. Fig. 3 refers to the arrangement of one of the groups of ropes at one side of the car, the other group being of course identical at the other side, any effect produced upon one side being reproduced at the other side by means of the connecting parts.

The car moves upon guides of hard wood at each side O O′. The



AMERICAN HYDRAULIC ELEVATOR.

cables are fixed to the two fastenings $g\,g'$, and these in turn are fastened to R R′, which turns on its axis C. The breaking of one of these ropes, g for example, would cause the piece R R′ to move on its axis C in the direction f, the bolt r would strike the lever p—turning on its axis x—and the shock of the lever p will instantly drive the brass wedge K so as instantly to stop the motion of the car; the iron lever p being toothed, engages in the substance of O O¹ and prevents any slip. The same motion is produced at the opposite end of the car, X being a bar of iron having a similar lever fixed at its opposite end. If, on the contrary, the cable g^1 should break, the piece R R¹ moving in the direction f^1 on its axis C, will cause the bolt S to press upon the lever q, and by means of p, which is part of q, is forced to do the same as before.

The working of the machine will be clear from what has been said. Its extreme economy and efficiency will be shown better by testimony than by argument. We do not pursue the subject further at this time, but shall await with interest any communications or questions which may proceed from "Economiser" or others. The fullest information and the greatest publicity can only result to our advantage.

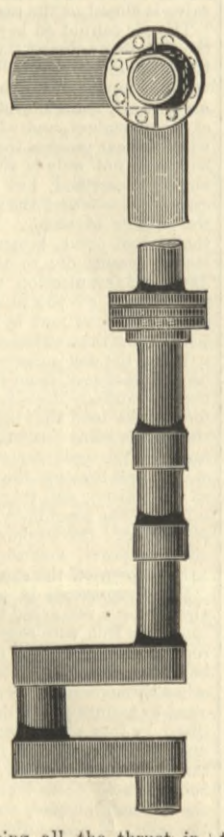
We apologise for our long trespass upon your valuable space.

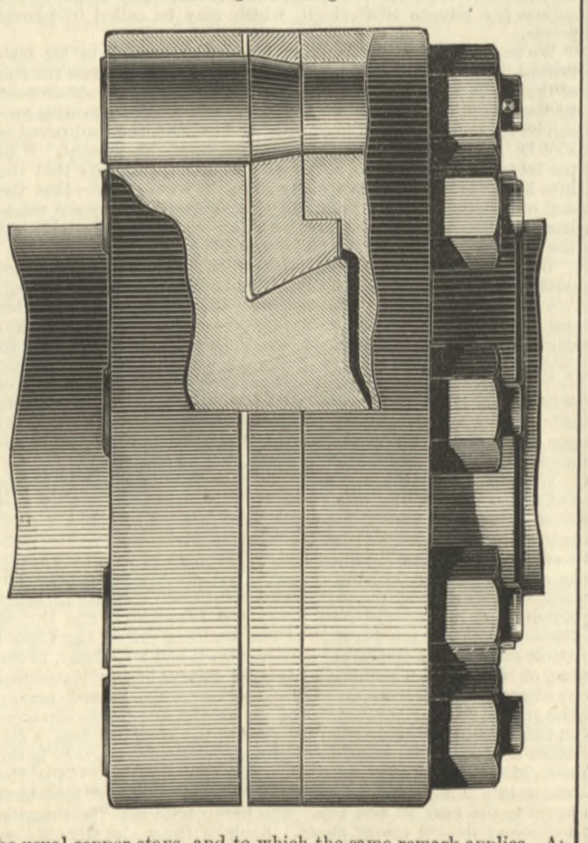
AMERICAN ELEVATOR COMPANY,
Wm. Aug. Gibson, President.

38, Old Jewry, E.C., London, June 25th.

THE BREAKAGE OF SCREW SHAFTS.

SIR,—I noticed your article in THE ENGINEER on flexible screw shafts, and I take the opportunity of sending you a drawing of my patent flexible shaft-coupling, which I have now fitted to eight pairs of paddle engines, each 500-I.H.P., one pair 300-I.H.P., also one pair 70-I.H.P. This arrangement works admirably, and is quite as suitable for a screw or for a paddle engine as the ball-and-socket, and as arranged, is of ample strength for taking all the thrust in backing.





STEPHEN ALLEY.

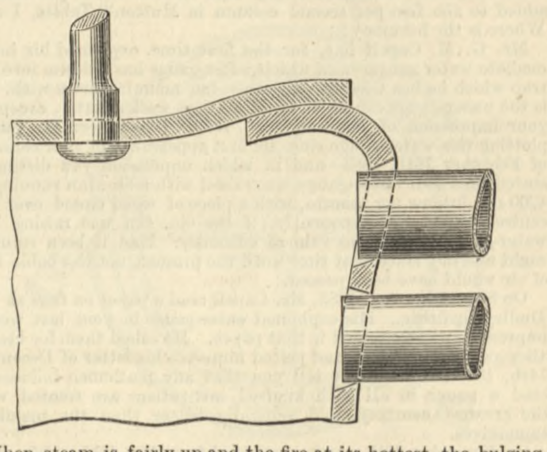
Sentinel Works, Polmadie-road, Glasgow, June 9th.

LEAKAGE IN TORPEDO-BOAT BOILERS.

SIR,—Some years ago a case of leakage similar to that described by Mr. Canning in your issue of the 30th ultimo, came under my own observation; a few remarks on the subject, therefore, may not be out of place.

As your correspondent points out, the boiler figured and described by him is of the locomotive type, but there are several points of difference which are very much in favour of the latter as usually constructed. The boiler in question has, compared with a locomotive boiler, an unusually thin fire-box tube plate, still further weakened by having the tubes pitched very close together, and surrounded by a rigid frame. At the top we have direct screw stays to the shell plate just where the latter is stiffly connected to the barrel by the vertical front plate of the fire-box, as shown in cross section on Mr. Canning's drawing. At the sides there are the usual copper stays, and to which the same remark applies. As the lower part the depth of plate beneath the tubes is very slight, it is straight and rivetted direct to a heavy foundation ring, and is still further stiffened by very short palm stays.

Let us suppose that at the beginning of a trial for rapid steaming, the boiler is suddenly filled with water at nearly boiling temperature; the tubes being thin, will become hot throughout, and immediately expand, forcing the tube plates further apart. Now when a plate of metal is heated more on one side than on the other, it will bulge on the hottest side. The tube plates will, therefore, bend towards each other, that at the fire-box end being of softer metal, and expanding more than the other at the same temperature, will come off worst in the encounter, from which there is no retreat. At the same time, the iron barrel plates, being thicker metal than the brass tubes, will not become hot so soon nor expand so much when heated; this remark also applies to the longitudinal stays shown amongst the tubes. Next, suppose the fire is made up and is being pushed vigorously; under this treatment the copper tube plate begins first to straighten itself and then to bulge towards the fire; then as it becomes hotter it expands considerably in a vertical and also in a horizontal direction; this movement is resisted by the copper stays, the foundation ring, and by the roof stays. As the bottom ring cannot be pushed downwards, the whole of the vertical expansion must be upwards towards the crown plate, which will be bent in front of the first row of stays, as shown—exaggerated—in the following sketch.



When steam is fairly up and the fire at its hottest, the bulging of the tube plate is increased by the internal pressure, as well as by the thrust of the tubes. This will cause the tube holes in the surface next the fire to open slightly, but on the opposite side of the plate they will nip still more closely round the tubes. When the fire is suddenly stopped the tube plate begins once more to straighten itself, thus decreasing its grip upon the tubes until it breaks the joint and lets out the water. This alternate opening and nipping of the tube holes on opposite sides of the plate, caused by changes of temperature in the boiler, is sure to loosen the tubes and assist in making the holes oval. In an old boiler the studs, tubes, and stays become fairly soldered up in their places, and the difficulty of removing them is proverbial; but in case of a new boiler the lubricant used in drilling the holes has not had time to evaporate, and doubtless increases the tendency of smooth brass tubes to slip in their places. This state of affairs is clearly shown by the ring of grease which forms round the heads of the copper stays of a fire-box when in steam for the first time.

The whole secret of the remedy lies in giving more "elbow-room" to the fire-box tube plate. With rapid firing the maximum expansion of the tube plate might possibly take place before a single lb. pressure is raised in the boiler. The stays in the crown plate, therefore, may safely be arranged to allow it to lift as much as it wants. When roof stay bars are used, an allowance of ⅛in. to ⅜in. is always made in the suspension links for this purpose. While the pressure is accumulating, the heat must have ample time to soak gradually and thoroughly into every part of the boiler and its contents. The outside shell plates thus receiving their fair share of heat, will, like the inside box, expand, and lifting with them the crown stays, the latter will come to a bearing with the crown plate just as it begins to feel the load of steam pressure. The first row of copper stays next to the tube plate should not be placed too near to it; a distance of 6in. from its inner surface would be quite safe even for high pressures, provided the outside corner of shell plate is rounded to a fairly large radius. The inside corner of the copper box should have as large a radius as possible, certainly not less than ⅞in. The palm stays shown are very stiff vertically, and might be considerably lengthened; they are sometimes made half as long as the boiler barrel. The front end of one of the longitudinal stays is taken rather close to the manhole, though it will be noted the latter is supported by a strengthening ring.

The lower part of the tube plate could be made more elastic by dishing it forward and using a thinner foundation ring, making a similar arrangement to that shown at the firehole ring. The saving of weight thus effected would allow us to strengthen the tube plate by making it thicker, say ⅝in.; in the neighbourhood of the tubes this would be a great advantage. The longitudinal stays shown amongst the tubes might safely be left out. The tubes would act as stays if ferruled at fire-box end, and should be placed further apart, having ⅝in. to ¾in. metal between the holes; this would be a better circulation, and allow the steam to rise more freely. It will be noticed the tubes are arranged in vertical rows—this is as it should be. To be sure, we should get less nominal heating surface with fewer tubes, but the loss would be more apparent than real. It is doubtful whether the area of metal cut away to insert a tube is not worth more than the whole of the so-called heating surface of the tube itself. It would be interesting to try this by experiment.

In some torpedo boilers the feed-water is sent in close in front of the fire-box. This arrangement is sure to give trouble, and might even lead to danger. It would be interesting to know where the broken tube referred to by Mr. Canning was found—possibly it was near to one of the longitudinal stays, or more probably near one of the palm stays. Also if the crown plate when taken out was "wavey" and the box generally very much out of shape. In conclusion, I may say that when we consider the few years during which the design and construction of torpedo boats have received special attention, we must admit that the amount of progress that has been made and the number of improvements effected are simply marvellous, and it would be a pity if so comparatively trifling a matter as a slight leakage of boiler should interfere with their efficiency.

JAS. HORSFALL.

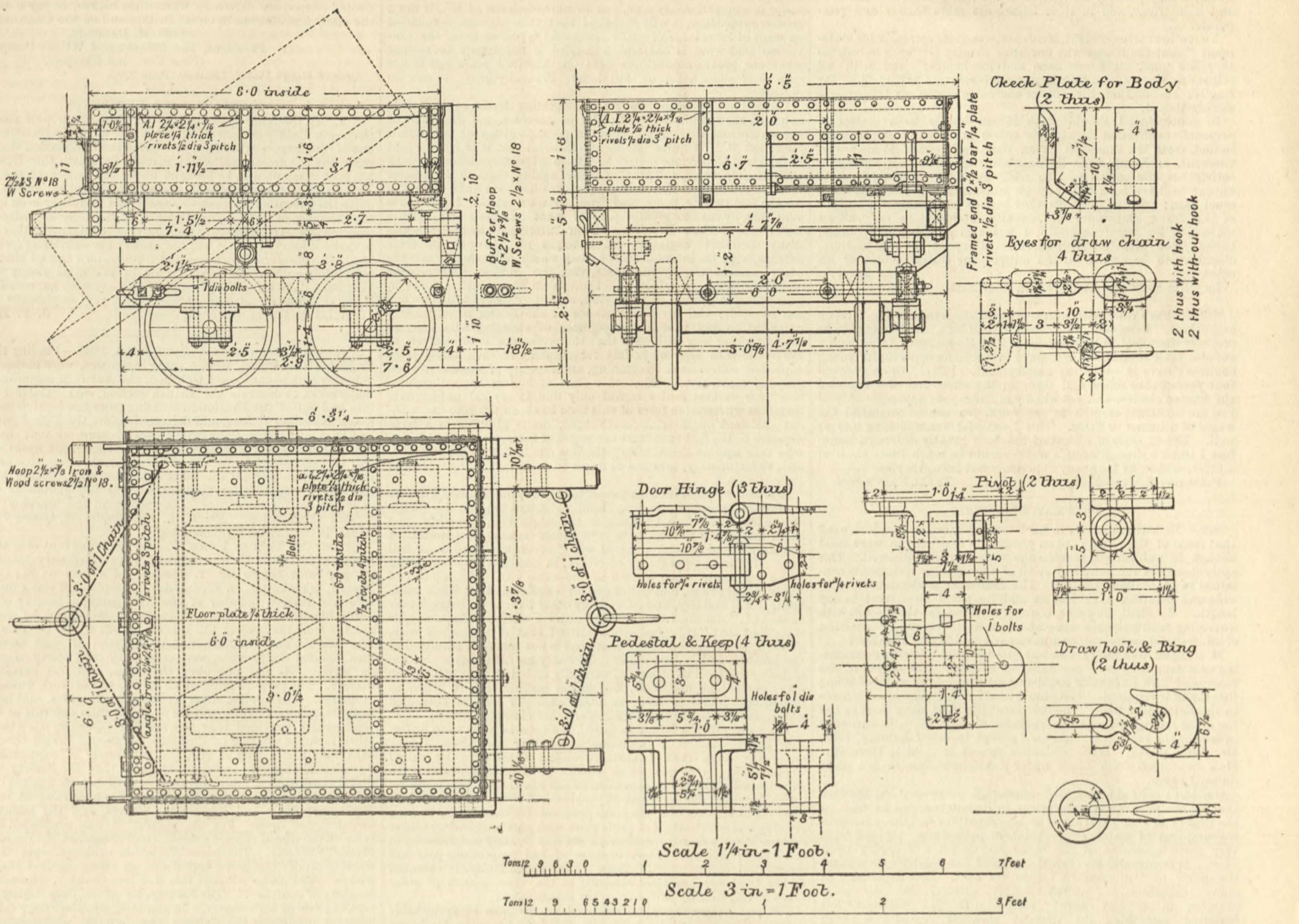
Manchester, June 24th.

THE FUTURE PROSPECTS OF YOUNG ENGINEERS.

SIR,—As the future prospects of young engineers is a matter of vital importance to them, it would be a pity that the discussion opened in your columns should degenerate into a mere question of treatment of engineer pupils, or even into one of the amount of work engineers have to do at the present time. How much they will have to do in the future is an unknown quantity. The facts appear to be these: There are a number of young men, say, up to thirty years of age, who are in want of employment, and, apparently, unable to get it. They vary in ability and efficiency, but have all been educated for the profession of engineers. The question is, How are these men to get employment, and what are their prospects when they have succeeded in doing so? It will, perhaps, be as well to review shortly the education of an engineer. Either his parents or himself decide the class and quality of work to be learned, and since an employer can hardly be expected to give facilities for learning gratis, a premium is either paid, or the apprentice is bound for a number of years. In the former case, I have always found that the works are practically thrown open to the learner, and he has thus every opportunity of studying for himself the whole of the operations carried on in the establishment in which he is an apprentice, as well as a very good one of becoming

CONTRACTS OPEN.—METRE GAUGE TIP WAGONS.

(*For specification see page* 490.)



a skilled workman, either mechanic or draughtsman, or sometimes both. The apprentice who is bound has, as a rule, the opportunity of becoming a very skilful workman, and nothing more, as he is kept tied to his vice, machine, or drawing-board. Both classes of apprentices or pupils are able to attend classes, either at colleges or night-schools—thanks to the munificence of many of our great engineers—where they can get a thorough knowledge of the theoretical part of their education.

From the above it will be seen at once that the efficiency of the engineer pupil will be determined by his ability, education previous to becoming an apprentice, willingness, and application to work. I think it may be taken for granted that no employer will discharge an efficient workman, or in other words, one who is profitable to him, unless he has not sufficient work to employ him upon; and it is also a fact that so loath is an employer to lose a really efficient man that he will rather make some sacrifice himself than do so, if he sees any chance of improvement in his business. But from a variety of causes, lack of ability, bad education, inattention to work, &c., many an engineer student only turns out moderately efficient; he may even turn out thus from not having been a sufficient time an apprentice; in fact, from the great mistake of young men anxious to get on, of having tried to cram too much knowledge into their heads, and to learn how to do too many mechanical operations in too short a time. These men can hardly expect to be employed with the firm in which they have served their apprenticeship, unless such employment has been part of the agreement entered into at the time the apprenticeship commenced, or unless they are willing to undertake any kind of work, and to receive the pay their employer may consider they are worth. In many cases the latter actually takes place, and the man of moderate efficiency becomes in time an efficient mechanic in the department he has entered, and will accordingly receive proportionate pay; and, provided he continues his studies and sticks to work steadily, there is no doubt he will always be able to earn sufficient to live upon, and may eventually become a great man. At the same time, the man who is only moderately efficient may be discharged as soon as his apprenticeship is over, either because he values himself at a higher rate than his employer, or because his employer has no work for him. In this case, if he has behaved in a proper manner towards the firm he was apprenticed to, that firm will give him a character, and allow reference to be made to them as a rule, in case the young engineer gets a chance of employment. But the chances of getting it at his own price are very slight; he must be willing to do anything in the profession he has been trained to, to take the most subordinate position, and until there is a demand for him in a better position he must be content to take the pay his employer considers he is worth, and at which he will be able to supply his place. There is no doubt great difficulty in getting employment in our profession; even if a first-rate engineer gets out of work he will have a difficulty in getting into it again, simply because of the fact that the large profits formerly made by engineers have attracted to the profession an enormous number of labourers; but, nevertheless, though labourers exceed the demand, the demand for really good labourers exceeds the supply, so that let the first-rate man be willing to accept the most subordinate position in that branch of his profession he has been trained for, or even in some other branch, in time he will get the employment, and then by his efficiency he must make himself so profitable to his employers that there is no danger of discharge, and he may eventually rise to a good and honourable position. But the very fact of taking a subordinate position means hardship; is no doubt hard for a man who has been accustomed to earn £5 a week to be obliged to take work that only brings him in 30s. or less a week. But still that is better than nothing, and let him once be earning the 30s., he has more chance of the £5 than he has if he simply prefers to wait on, rather than take anything at the price his employers may consider him worth. It is said foreigners are cheaper and better than Englishmen. Surely this cannot be, for the character of England is belied if her men cannot endure as much or more than a foreigner, and as for being better workmen, it is not so long since an Englishman considered himself equal to three foreigners. And suppose he has degenerated and all others have not done so, surely he has not done so so quickly that he is not equal to one foreigner.

It appears to me, therefore, that those out of employment should strive to get it at any price, no matter how subordinate the position; that any hardship should be willingly endured so long as the work can be secured. If a man of good character applies to engineering firms, offering his services on the above principles, I do not think he will be very long before he receives encouragement. When once employed his prospects rest to a great extent with himself. If he is careful and prudent, and at the same time hard-working, he will be able to put by a little money for the rainy day which will probably come, and will steadily increase in value to his employer, who will be proportionately unwilling to dispense with his services. If he has a mechanical genius, in all probability he will have an opportunity of utilising it to his own advantage and the welfare of the world in general; but even then, judging by the signs of the times, he may not be able to earn more than a competency for himself and family, and some small provision for those he may leave behind. An engineer should bear in mind that his duty is not only to do well whatever he may be called upon to do, but also to be constantly on the watch for methods of benefitting his fellowmen, which will, as a rule, at the same time benefit himself.

T. P. SEVERN, Engineer.

London, June 23rd.

SIR,—It is with pleasure that I read the various letters inserted by some members of the profession on this matter. I think Mr. Audain deserves the best thanks of the younger professional brothers, for it is high time that this subject should be brought before the public and something done.

I quite appreciate the remarks of Mr. James Jones on the insufficient education of English engineers. Some three years ago you granted the hospitality of your columns to two letters of mine on this question. It gave then no rise to any special remarks on the part of your other correspondents, but I think that this subject might be reconsidered a little to-day. I pointed out then the great difference between English and Continental engineers; but although I thought it necessary for English young men to improve their theoretical knowledge, I at the same time showed that a mere theoretical man is nothing unless he has also seen the things done as they are done really, and even got his hand into the work. But it must be remembered that if going through the shops may procure practical knowledge, this alone will not make an engineer—it is necessary but not sufficient.

There are certainly too many people styling themselves engineers; this is one cause why many young men are kept out of employment. I also suggested that examinations, but not of a competitive character, should be instituted to deliver young men some certificates of aptitude for that career they wish to embrace. Universities and other colleges give degrees in engineering, but this will not do as long as the professors are not experienced and well-known members of the engineering profession. The attendance at such a school cannot dispense the future engineer from spending a few months in a workshop; these are the best schools for learning practice. Were those points attended to, young English engineers could find situations abroad. Under the present system, a young man who served his apprenticeship in an English workshop would not find a situation abroad as engineer, because he has little or no theoretical training worth mentioning. Yet English engineers still hold a good reputation abroad, and their machinery is still appreciated. English engineering has not so fallen off in foreign estimation as some seem to think. There are in Europe itself vast fields for engineering enterprise which the undaunted perseverance of Englishmen, joined to their practical sense, could alone work out profitably. The present system of high-paid apprenticeship is a disgrace. It looks to me as if the engineering profession was alone the privilege of the richer classes.

All the young Germans that come over to England only do so in order to get acquainted with English practice—another proof that English industry is not delaying, as is sometimes represented. It would be, in fact, a mistake for them to stay here, unless they are their own masters. Englishmen are patriotic, but perhaps also jealous in these matters. They cannot hear of foreigners being as able as they are. The day is far when we shall be beaten by foreign competition; it will most likely never come, especially if we do as the French and Germans do. Let us take from them what good they may have; in short, let us act as they do with us.

I spent a good deal of time abroad, and have come in contact with many foreign engineers; all that I have seen of them has but confirmed the views I expressed in my former letters.

The future belongs still to England in engineering matters if we know how to reform ourselves. The profession should only admit members of decided abilities and who have a decided liking for the business. Let us give more facilities to young men who like this grand profession, but have no means to reach the aim they have in view, and the success shall be always ours.

E. COBERT, B.Sc.

26, South-street, Longsight, Manchester, June 24th.

SIR,—The correspondence on this subject in your columns has, to my surprise, failed to create the interest which it would seem to claim when one considers the vast number of pupils who aspire some day to become engineers; but experience has taught me that pupils are, as a rule, too easily satisfied with becoming fair average draughtsmen—mere machines, understanding as little practically of what they draw as a parrot understands the meaning of the words it utters. They do not care to attend those classes where alone they can be instructed, and gain that knowledge without which their profession is absolutely valueless. I have had pupils who are now a credit to the profession, but their success is mainly due, as it must always be, to their own industry and energy, combined with an innate love of the work itself. No engineer can devote himself or spare the time, if he has but a moderate practice, to educating his pupils by lectures or otherwise, and no parent possessing common sense would expect such a thing; but much of the lamentable ignorance of pupils when they have completed their articles might be avoided if parents would encourage them to study, and employ their leisure time, partially at least, in seeking to improve their practical knowledge by such means as are amply afforded to any one desirous of so doing. The question of premium or no premium is quite beside the mark. Everything depends on the "young engineer" himself, and if he considers he has done all that is necessary when he can write "C.E., Assoc. Soc. Eng., &c.," after his name, then there is small chance that he will ever earn distinction fairly justifying their use.

If not trespassing too far on your space, I should like to ask your correspondent, Mr. Audain, what reasonable objection there can be to the employment of German labour, seeing that there are several German firms of engineers in London who employ Englishmen and others of various nationalities—men of colour even—if they possess ability sufficient to do the work required of them, and if one seeks for the cause of Germans frequently taking precedence, it may possibly be that, as a rule, they are more studious and industrious, and in their leisure are more thrifty and temperate.

Your other correspondent, Mr. Jones, was quite correct in his statement "that the reason why our firms employ Germans is because they are good mathematicians and mechanics;" and with all respect to Mr. Audain, this is not equivalent to saying that the English are neither the one or the other—such an inference is simply absurd.

In conclusion, I should think it can hardly be a matter of personal gratification to those 200 or 300 in search of employment to find, from Mr. Audain's letter, that they replied to his advertisement, enclosing their testimonials and credentials merely to satisfy his idle curiosity. To their mind, as to mine, it must appear to have been not only an unnecessary proceeding, but a cruel hoax; and as I felt somewhat curious respecting the author of this frank confession, and equally interested in the subject matter of his letter generally, I was considerably disappointed, though not greatly surprised, on calling at 42, Devonshire-chambers, to be unable to find either your correspondent or his office. SELF HELP.

Imperial-buildings, Ludgate-hill, June 24th.

SIR,—I have read with much interest the letters of Mr. Audain and others. I consider the subject a good one, and it ought to be properly discussed in the columns of THE ENGINEER. I thoroughly endorse their remarks in reference to the little opportunity young engineers have in obtaining employment. I have, for one, served four years in the office and three in the shop, and also attended the science classes, and yet when you finish your apprenticeship, if you are fortunate enough to get work, you cannot command the wages of a turner or fitter. This I consider wants looking into as well. The expense of education has been greatly different, therefore I think a draughtsman's wages should be much above those of a fitter, which, as far as my experience has been, they are not.

Portsmouth, June 23rd. TUBAL CAIN'S SON.

PNEUMATIC MALTING.

SIR,—M. Galland states in his letter published by you last week that some of the remarks upon pneumatic malting you were good enough to publish six months ago were lightly considered. This aptly describes the nature of some of the singular statements contained in M. Galland's letter. The discussion of the details of so wide and complex a subject as malting could be carried to any length. We shall, however, content ourselves for the present with correcting such palpable mis-statements as damage the reputation of M. Saladin, ourselves, and pneumatic malting as a whole.

M. Galland does not furnish any proof that the Saladin germinating case cannot by any possibility be covered. Thousands of the readers of THE ENGINEER could suggest a variety of ways of doing this easily if required. The phrase used by M. Galland in reference to the Echangeur that "the interested illwill of some persons has too often triumphed over the ignorance of others," reads curiously in face of the facts. M. Saladin's patent is dated January, 1883, Dr. Linde's, July, 1883. Saladin's patent is valid in Germany. How he copied from Linde under these circumstances is a little difficult to see.

Galland's coke chamber may answer all purposes; but the fact that all the pneumatic malt-houses in Britain can still be told on the fingers of one hand is to be accounted for by the enormous consumption of water, coke chambers necessitate, coupled with very grave ignorance of the common principles of drying upon kilns. It is curious also that M. Galland has hardly ever noticed the defect of "mushrooms" upon his coke. Low organisms of many objectionable species simply abound in any coke chamber in a very short period. If M. Galland has invented something to prevent this, it would be very desirable to know the details of his invention. Why 15,300 kilos. of barley need 10,520 kilos. of moisture per day, is a thing entirely beyond our comprehension. 356 litres of water per minute is a supply which many malthouses could not possibly obtain; and even if they could, the power spent in pumping would be largely wasted. It is very good and accommodating of the air to get so nicely cool in a coke tower in the presence of so much water as M. Galland asserts. At the Health Exhibition at the present moment an Echangeur is working daily which cools a large volume of air 12 to 15 deg.—*i.e.*, to the temperature of the water used—with a consumption of about ten gallons of water per day.

M. Galland speaks vaguely and loosely of his invention of a pneumatic kiln, and he asserts that after three weeks' trial he is satisfied that the work done on his kiln is decidedly better than upon a kiln constructed on our principle. We should be sorry even to doubt a statement seriously made by so eminent an inventor and maltster, but it yet remains to be proved that a small percentage of lactic acid is an evil in malt. It has been proved repeatedly that the too rapid drying of malt is a distinct evil, and of the very numerous patents that have been taken out to accomplish this end, we do not know a single kiln in which any mechanical apparatus for the rapid removal of moisture has proved of practical use. Of the patents upon the same principle, apparently, as Galland's, we have never even seen one in the thousands of malthouses known to us, although those taken by the following patentees might be capable of doing as effective work as that stated by M. Galland, viz., Wheeler, Kay and Stell, Bush, Else, Stead, Bell, Poole, Goff and Strangman, Barnett, Watts, Reynolds, and many others whom we could name. M. Galland, like many others, appears ignorant of the fact that to dry malt properly, more has to be done than simply to remove the moisture, and then "bake" it. Malt drying is essentially a cooking process. The too rapid removal of moisture, and the application of low heats to green malt when moist, exercise influences upon the soluble albumenoids present in the grain of a most fatal character, and destructive of the chief end a maltster should ever keep in view, viz., the adjustment of the constituents of the malt in the best possible form for the perfect reproduction of yeast. If the illustration of this kiln is correct, it possesses obvious defects, which would make the production of soundly dried friable malt difficult, if not impossible. The amount of shovelling in this kiln would obviously exceed that in scores of kilns constructed by us. The statement that the drying is performed with mathematical precision is unsupported by any evidence. That malt can be even maintained for a sufficient length of time at a suitable temperature to ensure stability, with a consumption of 19·8 lb. of coke per metrical quarter, is as absurd as that coke could evaporate 15 lb. of water per lb. in an old egg-ended boiler.

We have the greatest respect for M. Galland and his inventions, which are of incalculable value to maltsters and brewers, and under all circumstances loyally render him the credit his great genius and devotion merit. It is with regret that we have to appear even for one instant antagonistic to him, for apart from any higher feeling, our interests in this matter are almost identical.

H. STOPES AND CO.

24A, Southwark-street, London, S.E., June 26th.

WATER-TUBE BOILERS.

SIR,—In your editorial of June 13th, under the above heading, you call upon me to state the advantages of water-tube boilers. I take the opportunity to do so with pleasure, not, however, with any fear that they cannot sustain themselves upon their own merits. That there have been many engineering blunders committed in the construction of water-tube boilers is doubtless true, and it is none the less true that there have been equally great blunders in designing other types of boilers. No doubt your own extensive knowledge of the history of boilers in this country will enable you to recall dozens of instances where novel forms of shell or fire-tube boilers have been designed, and even been extensively advertised, and yet were proven to have more disadvantages than advantages when tried. Certainly no one will claim that the type is responsible for such blunders. That plenty of people will assert that the Lancashire or the return tubular is the best type of boiler is unquestionably true, but in nine cases out of ten, if not a greater proportion, it will be found that their opinion is founded on want of knowledge of other successful types, or upon the conviction that what is old and well-tried is necessarily best—that what our great-grandfathers used one hundred years ago is not only good enough for us, but better than anything we can do ourselves.

I would not be misunderstood as suggesting that any such motive actuated the author of the editorial in question, and with most of the statements therein I should not perhaps disagree; but permit me to ask if it is quite fair to attribute all that is or may be said in favour of water-tube boilers to interested parties wishing to push their manufactures, and all that is said against them to the noblest motives *pro bono publico*. My experience has been quite extensive for the last twenty years, and from that experience I feel quite sure that by far the greater part of what has been said against water-tube boilers has been from interested motives; while many eminent engineers have taken up the pen in their defence with no interest except that which only should actuate every engineer worthy the name, viz., the greatest advancement and the greatest general good. I have seen many such articles in your valuable journal in years past, signed by names which no one can impeach; and my acquaintance in the States is sufficiently extended to say that every engineer of standing who has no interest either way will agree that the preference is to be given to the water-tube type of boilers for economy of fuel, safety from explosion, convenience in cleaning, and rapidity of steaming, when properly constructed. That this class of boilers has a "reputation" for various faults is not only due to several unfortunate instances where some form of this type has been put into use without sufficient engineering forethought, but is also due in a large measure to the fact that there are scores of interested boiler-makers who talk against them, where there is one to talk in their favour, and, unfortunately, talk has as much to do as fact in the matter of "reputation."

It is not my object in this paper to say anything directly for or against any particular boiler. I am not asked to state the merits of the boiler of which I am one of the originators, and which you do us the honour to refer to in your before-mentioned editorial. I certainly would not claim that it will "never prime and never boil dry." It has the possibility of either, in common with any other boiler ever made, when treated in the same way. If filled full of water it will prime, and if not fed for a sufficient time while being fired, it will boil dry, and so will any other boiler. Whatever may be said of "the class as a whole"—and I shall not dispute your statement that "it is generally admitted that it primes"—I may, perhaps, be permitted to say that that is not generally admitted of the Babcock and Wilcox boiler. Probably no other style or form of boiler has been so often and carefully tested on this point by so many competent engineers, and in no instance has it, when so tested, been found to have as much as 5 per cent. of entrained water, an admittedly low average for other classes of boilers.

The boilers of the Montana failed, not because they were water-tube boilers—and it is questionable whether they deserve that name any more than Lancashire boilers deserve to be called tubular—but for causes which should have been apparent to an experienced engineer on inspection of the drawings, namely, inadequate provision for unequal expansion and contraction. Others have failed because of inadequate provision for circulation, causing priming and overheating of parts even with sufficient water; others because there was no provision to prevent fouling and burning in bad water; and still others because of bad proportions and bad mechanical construction. None of the above faults are essential to the type, nor are they confined to the type, boilers of other types having notably failed from the same causes.

But you have curiously overlooked an instance of remarkable success of a water-tube boiler in this country—the Galloway boiler. The only thing which distinguishes this boiler from its prototype and near relative—the Lancashire—is its water tubes, and they constitute its sole claim and cause of superiority. By them some of the advantages due to the pure water-tube type have been grafted upon the Lancashire—such as thorough circulation of the water, the breaking up and distribution of the currents of hot gases, and a consequent increase in economy of fuel. The pure water-tube type, when well engineered, adds also the element of safety, because of dividing the contents into a number of comparatively small and strong compartments, instead of confining them in one large shell, the giving out of which will cause a general explosion; the element of accessibility for cleaning without necessitating entering the boiler itself, whereby the engineer in charge may personally inspect the thoroughness of the operation, which cannot easily be done in the ordinary types; the element of quick steaming, invaluable in many cases; and the element of ready complete repair by substitution of a new and perfect part for an imperfect one, instead of "soft patches" and hurried make-shifts. This latter element is also a considerable addition to the question of safety, for where a repair is so quickly and easily made there is little temptation to continue the use of a boiler having dangerous defects.

You very truly say that, "There have not been any factories destroyed by tubulous boilers. This much we concede at once. But there have been several bad accidents with them, and not a few lives have been lost." How many lives may have been lost by means of water-tube boilers in this country I cannot say, but in America, where they are in far more extensive use, the number is very small, and remarkably small when we consider the number of crudely conceived and poorly constructed water-tube boilers that have been sold on the general reputation of their supposed safety. With the same blundering in other classes of boilers, there have been hundreds of lives lost to one by tubulous boilers. In the case of the boiler, the history of which I know best, not a life has been lost in eighteen years. That this immunity is not due to want of use, I would say that in that time there have been installed some 300,000-horse power, and that at least 95 per cent. of all which have ever been sold are in use to-day.

You ask for facts as to their comparative cheapness. I will give you one instance out of many. The Belcher Sugar Refining Company, of St. Louis, Mo., found on comparing estimates that on their plant of 3000-horse power they would save in first cost, including buildings and ground, 100,000 dols. by adopting the water-tube over the Lancashire type. There might not be the same difference in this country, but the question of space in cities is very important. You ask for facts as to their economy of fuel. The Oliver Wire Company, of Pittsburg, Pa., found on extensive trial, under similar treatment, a saving of 34 per cent. in favour of water-tube, instead of externally-fired return flue boilers. The Raritan Woollen Company, of New Jersey, found by their yearly coal bills a saving of at least 20 per cent. over Lancashire drop-flue boilers. A case was tried last year in the Superior Court of the State of New York, wherein it was set up as a defence to the payment for a plant of water-tube boilers, that there had been a guaranteed saving of 20 per cent. over any other boiler, which saving had not been proven. After taking testimony, including such well-known and disinterested experts as Chas. E. Emery, C.E., M.E., of New York; Wm. Kent, M.E., of Pittsburgh; and Geo. H. Barrus, M.E., of Boston, and others, the hon. Judge decided that though it was not proven that such guarantee had been given in that case, still it was proven that the water-tube boiler in question "would save 20 per cent. in fuel over other boilers."

In conclusion, permit me to say that the water-tube boiler can hardly be called a failure, with the record of the Galloway in this country, and the Babcock and Wilcox in America and Europe, and in face of the fact that three-quarters of all the sugar refined and of sewing machines manufactured, the largest and most successful steam heating plant in the world, a large part of the woollen, cotton, iron, steel, paper, clock, flour, chemical, oil refining, and other plants, all the Edison and much of the other electric lighting and manufacturing, the cable tramways of San Francisco, Chicago, and Brooklyn Bridge, and hundreds of other kinds of work in the United States, are driven by water-tube boilers, to say nothing of the many installations in Great Britain and on the Continent.

GEO. H. BABCOCK,
President, The Babcock and Wilcox Company,
New York and Glasgow.

Inns-of-Court Hotel, London, June 23rd.

CRYSTAL PALACE EXHIBITION.

SIR,—In reference to the concluding remarks in your account of the above Exhibition last week, allow me, as the representative of one of the largest exhibitors, to express the indignation that I feel regarding the grossly neglectful manner in which this Exhibition has been attempted to be brought under the notice of the public. This Exhibition has now been opened two months, and it is still quite the exception to speak to anyone and find they even know of the existence of such. The directors of the Crystal Palace Company may think it will answer their purpose to take no further trouble to make it known; but it will not answer the exhibitors', who have been at considerable expense and trouble, now to find themselves completely gulled. If things go on in the same sleepy way as they have done up to the present, it will astonish me considerably if the directors do not find matters take a very unpleasant turn.

Brightside Works, Sheffield, June 22nd. J. F. HALL.

ANTWERP INTERNATIONAL EXHIBITION, 1885.—Finding that the English Government, unlike other countries, were indisposed to vote any sum toward the Exhibition, the Antwerp committee have undertaken to decorate the British section, cart exhibitor's goods into and out of the Exhibition building from the local depôts free, if not exceeding 1½ tons, and delivered before the 15th April, 1885, and store and return their empty packing-cases without charge, so that exhibitors will only have to pay for their rent space and the cost of their own installation. The executive committee have also undertaken to pay all the office expenses, staff, agency charges, and cost of publicity for England, so that the exhibitors will be called upon for no outlay connected with the working of the British Commission. Mr. P. L. Simmonds, 35, Queen Victoria-street, is the British Commissioner.

IMPORTANT TRADES UNION CASE.—An important case affecting members of Trades Unions, in which an extraordinary defence was set up, came before Mr. T. Jordan and a jury at the Court of Record, Manchester, on Wednesday. The plaintiff was a machinist who had been a member of the Amalgamated Society of Engineers, Machinists, Smiths, and Pattern-makers, and he sought to recover from the Society £19 18s. for benefit whilst out of work for fifty-two weeks. Whilst acting as foreman of some works, the men, against their wishes, were ordered by the Society to come out on strike. He did not obey the order, and was expelled the Society. The period during which he was out of work was after his exclusion. The Judge, after examining the rules, said he could imagine nothing more iniquitous or illegal than one rule as to piece work, which provided that any member receiving more than any other member working on the same job should divide the surplus with him under pain of fine, and ultimately of expulsion. Mr. Sutton said there was sufficient to show that the Society was an illegal combination, and, therefore a civil action against it could not be held, Further than this, there was a contingent fund for restraining trade and encouraging strikes, and the plaintiff had knowledge of these. Por the plaintiff it was contended that, in spite of the illegal rules, he could recover against the Society as a Friendly Society. The plaintiff, in his evidence, said the men working under him were called out on strike against their own wishes. The Judge: "And this is a free country, where there is freedom of contract!" The Society, he added, was trying to subvert the law of the country. In summing up, the Judge said that, however iniquitous the defence was, however dishonourable the jury might take it for the defendants to set up their own illegality and wrong as a bar to the action, the law must be administered as it existed, but the case might have a good effect in showing working men how helpless they were in joining illegal federations like this. The jury found that the Society was a Trades Union, and gave a verdict for the defendants. The Judge said that as he had the power, he should deprive the defendants of every penny of their costs. He was astonished at the defendants showing their heads in a court of law before a judge and jury. The foreman of the jury said they endorsed every word of the Judge's opinion.

NEW GASWORKS AT CRINDAU, NEWPORT.—On Tuesday week was laid the first stone of new gasworks at Crindau, Wales, by Mr. Greatrex, Chairman of the Board. The first section of the new gasworks at Crindau consists of retort-house of 147ft. in length inside by 65ft. in width. Adjoining and parallel with it is the coal store of the same length, and 40ft. in width. The nature of the sloping ground which has been excavated for these buildings has been here taken advantage of for the construction of the sidings, which will stand immediately above the coal store, running on the natural level of the sideland, and will thus enable the coal to be discharged by means of shoots down direct into the coal store with very little labour. There will be two stacks of retorts, containing in all 144 mouthpieces. For the present, only one of these stacks will be erected. The other will be erected as the demand for gas requires it. The condensers, which will be of wrought iron, scrubbers, washers, and tar tank will be erected in proportion with the capacity of the retort-house just described. These have not yet been commenced, but will be put in hand very shortly. The purifying house, including sheds at either end for lime and oxide, will be of a total length of 147ft., and width 62ft. The purifiers are to be six in number, each 20ft. square, four being for oxide, and two for lime. The building for engine-house, including pump-house, will be 82ft. in length by 40ft. in width, and the boiler-house 40ft. by 35ft. These houses are being built of the full dimensions, to make room for containing all exhausting plant and boilers, pumps, &c., which will be requisite for all the sections of works when completed. The meter and governor-house follows these buildings, and will be erected not far in position from the first gas-holder, which is already very nearly completed. The diameter of the gas-holder tank is 120ft., and its depth from top of coping to paving of tank bottom is 25ft. 7in. The holder, which is erected in this tank, is a double lift, and the two lifts combined will hold half a million cubic feet of gas when filled. The tank is a strong construction, with puddle brick wall and the core left in. To meet the exigencies of a somewhat exposed situation, the framing consists of fourteen cast iron columns, with two rows of neat wrought iron lattice girders. The mains laid into the town are 24in. in diameter. The whole of the buildings will be in red brick, with blue brick facings, excepting key-stones, sills, and coping, which will be of Forest stone. The roofs will be strongly made of wrought iron, and the roof covering of double Roman tiles. Space has been left on the site for the erection of another retort-house, for a duplication, and in some cases a triplication, of the various members of the plant. Ample space has already been left for the erection of two additional gas-holders, which may be larger if required than the one at present erected, and the whole of the sections of the works now begun, when completed, as the increasing consumption of gas may require, will be capable of turning out about 1,750,000 cubic feet per twenty-four hours. The works are being erected to the designs and under the superintendence of Mr. Thomas Canning, the engineer to the company. The contractors for the buildings are Messrs. Henry Hilton and Sons, of Birmingham, and, for the iron roofs, Messrs. Willey and Co., of Exeter. The gas-holder is being erected by Messrs. Piggott and Co., Birmingham, and the gas-holder tank has been constructed by Messrs. White and Co., Evesham.

RAILWAY MATTERS.

IT is estimated that 40,000 workmen will be employed in the completion of the railway to Quetta.

ON the Pennsylvania Railroad the average consumption of fuel for all passenger trains is 56 lb. per train mile.

THE eighteen principal English railways have earned almost exactly a million a week for the twenty-four weeks of the present year.

THE completion of the Andine Railway to the town of Mendoza, at the foot of the Andes, in Mendoza, was the cause of much rejoicing early last month.

THE Society of Engineers visited the extensive works of the Midland Railway Company on Wednesday. We defer notice of the works for another impression.

A CONNECTING link between Portugal and Spain, namely, the railway from Salamanca to the frontier, where it joins the general system of the Portuguese railways, is now expected to be completed in September next.

ACCORDING to a special report by the Engineer-in-Chief for the railways of South Australia, there are in that colony 8¾ miles of double lines and 894½ miles of single lines open for traffic. The cost of building, exclusive of rolling stock, has been £4,795,186, or an average of £5314 per mile.

IN ten years the railways of New South Wales have been almost quadrupled in mileage, whilst the working expenses have risen from 50·8 to 55·1 per cent.; still the net profit resulting from these public works amounted to £764,228, which on the £15,308,493, the total cost incurred, gives a return of nearly 5 per cent.

SOME important railways, the Madrid correspondent of the *Times* says, are about to be laid in the Phillipine Islands. English contractors and manufacturers of railway plant ought to be able to compete in this new outlet for railway enterprise. To-day's—20th—*Gazette* announces that tenders will be received up to October 1st next for the construction of a line from Manila to Lingayen, on the north-west coast of the Island of Luzon.

MANUFACTURERS are hoping to obtain by private arrangement with the railway companies some relief which at present they cannot obtain by Imperial legislation. The London and North-Western, the Great Western, and the Midland Companies have consented to receive in London a deputation from the South Staffordshire Railway and Canal Freighters' Association, on Friday, to discuss the details of the freightage concessions which the Association believe are required to relieve the trade of the district.

ON the 19th inst. the jury on the Downton accident returned the following verdict:—"We unanimously find that Mr. Dent met his death by the accident. We also find that the Salisbury and Dorset line between Downton and Breamore is in a very weak and faulty condition, so much so that it is not safe for a train to pass over it at the speed at which we are of opinion the train was going at the time of the accident. We are also of opinion that the faulty link produced was not broken until after the carriages left the line. We also condemn the practice of making up time between the stations."

A FEW days ago the passengers on the express train running from Czernowitz to Lemberg had a narrow escape. On a bridge between Bobrka and Staresi a beam had been laid across the rails. As the engine driver in the darkness could not see the obstacle, the train rushed at full speed against it. Fortunately, by the tremendous shock, a portion of the beam, which was probably rotten, was broken off and thrown from the rails, so that the engine did not leave the track. As half-an-hour before a goods train had passed the place without finding any obstruction, it is inferred that the attempt was directed against the express.

THERE are altogether on French railways 6893 locomotives, of which 2826 are passenger and 4067 goods engines. There are also 15,432 carriages, of which 3208 are first-class, 5315 second-class, and 6909 third-class, together with 182,089 wagons. As regards the principal companies, the following are the figures:—Northern: 1138 locomotives, 2021 carriages, and 33,971 wagons. Eastern: 922 locomotives, 2359 carriages, and 22,401 wagons. Western: 1045 locomotives. 2881 carriages, and 17,465 wagons. Orleans: 970 locomotives, 2100 carriages, and 20,433 wagons. Paris-Lyons-Mediterranean: 1960 locomotives, 3489 carriages, and 62,200 wagons.

RESIDENTS of the West End of Stoke-upon-Trent seem possessed, our Birmingham correspondent writes, of more modern and sensible notions regarding the value of steam upon tramways than certain members of the Town Council of that borough. A few days ago a deputation from the residents waited upon the Council to ask for the withdrawal of their opposition to the use of steam power on the London-road branch. The tramway had become a necessity, and they desired that this convenience should not be interrupted. The Mayor replied that the Council had previously decided that if steam were used on the London-road line, the company should be called upon to discontinue the double set of rails on another portion of their line. One of the members of the Council has, however, given notice of his intention to move the rescinding of this resolution.

IN his report on the collision that occurred on the 5th April at Chester station, on the London and North-Western and Great Western Joint Railway Company's line, when the Birkenhead 11.40 a.m. train ran against the stop buffers at the end of the Dock platform line, when it arrived at Chester station at 12.10 p.m., and fifteen passengers were reported hurt, Colonel Rich says:—"The London and North-Western Railway Company use the simple vacuum on a few of their trains, and the brakes are applied to the train by creating a vacuum. The Great Western Railway Company use the automatic vacuum, and the brakes are applied to the train by destroying the vacuum, so that the engines of both companies can work trains belonging to either company, but the engines cannot work the continuous brakes on a train made up of carriages belonging to both companies. It is a great disadvantage as regards both safety, efficiency, and economy, that the great railway companies of the kingdom will not adopt a uniform system."

IN a recent lecture "On Fixed Stars," Dr. David Gill wanted an illustration of the distance to Centauri. This is what he said: "We are a commercial people, we like to make our estimates in pounds sterling. We shall suppose that some wealthy directors have failed in getting Parliamentary sanction to cut a sub-Atlantic tunnel to America, and so for want of some other outlet for their energy and capital they construct a railway to Centauri. We shall neglect for the present the engineering difficulties—a mere detail—and suppose them overcome and the railway open for traffic. We shall go further, and suppose that the directors have found the construction of such a railway to have been peculiarly easy, and that the proprietors of interstellar space had not been exorbitant in their terms for right of way. Therefore, with a view to encourage traffic, the directors had made the fares exceedingly moderate, viz., first-class at one penny per 100 miles. Desiring to take advantage of these facilities, an American gentleman by way of providing himself with small change for the journey, buys up the National Debt of England and of a few other countries, and presenting himself at the booking-office, demands a first-class single to Centauri. For this he tenders in payment the scrip of the National Debt of England, which just covers the cost of his ticket; but I should explain that at this time the National Debt from little wars coupled with some unremunerative Government investments in landed property, had run up the National Debt from 700 millions to 1100 millions sterling. Having taken his seat, it occurs to him to ask 'At what rate do you travel?' 'Sixty miles an hour, sir, including stoppages,' is the answer. 'Then when shall we reach Centauri?' 'In 48,663,000 years, sir.' 'Humph! rather a long journey.'"

NOTES AND MEMORANDA.

A METAL which is said to be well adapted for the manufacture of various parts of agricultural implements is made by Messrs. Glueckner, of Tchirndorf, by fusing cast iron and steel together, but the proportions that have been found best are not given.

DURING the week ending June 21st 2615 births and 1371 deaths were registered in London. The annual death-rate from all causes, which had been 19·2, 18·9, and 18·8 per 1000 in the three preceding weeks, further declined last week to 17·8. The 1371 deaths included 41 from smallpox, and 81 from measles. In greater London 3374 births and 1687 deaths were registered, equal to annual rates of 34·6 and 17·3 per 1000 of the population.

THE mean spotted area of the sun was slightly greater in 1883 than during the preceding year, although the faculæ showed a small falling off. For the year 1883 Greenwich Observatory photographs are available on 215 days, and Indian photographs filling up the gaps in the series on 125 days, making a total of 340 days out of 365 on which photographs have been measured. In 1882 the total number of days was 343, viz., Greenwich series 201 days, supplemented by Indian photographs on 142 days.

AT a recent meeting of the Cambridge Philosophical Society, a paper was read by Mr. A. H. Leahy on the pulsation of spheres in an elastic medium. The problem of two pulsating spheres in an incompressible fluid has been discussed by several writers. The author considers the analogous problem in the case in which the medium surrounding the spheres has the properties of an elastic solid. He finds that the most important term in the expression of the law of force between the two spheres varies inversely as the square of the distance between them. This force will be an attraction if the spheres be in unlike phases, a repulsion if they be in like phases at any instant. The next term in the expression varies inversely as the cube of the distance between the two spheres, and is always a repulsion.

A PAPER on some irregularities in the values of the mean density of the earth, as determined by Baily, was read on the 26th ult. by Mr. W. M. Hicks. The author showed that the numbers obtained by Baily for the mean density of the earth depended on the temperature of the air at which the different observations were made; and he exhibited a table showing that as the temperature increased from 40 deg. Fah. to 60 deg. Fah. the deduced mean densities fell continuously from 5·734 to 5·582. He considered several possible causes of error, but showed that they were either inadequate to explain the irregularities, or tended in the opposite direction. The only further suggestion that occurred to him was that Baily's personal equation was a function of the temperature, leading him, as his temperature rose, to estimate distances more liberally.

IN a description of the mowing and reaping machine works of Mr. W. A. Wood the following occurs:—"Statement of materials we consumed in the manufacture of 45,632 machines, our production in 1883. We give only the principal materials used. Pig iron, 10,500 tons; steel, 1000 tons; wrought and cold rolled iron, 4500 tons; malleable iron, 1600 tons; coal, 7000 tons; coke, 1000 tons; moulding sand, 4000 tons; grinding stones, 225 tons; painting material, 490,000 lb.; spring wire, 60,000 lb.; tacks and rivets, 120,000 lb.; brass and composition, 120,000 lb.; screws, 10,000 gross; lubricating oils, 10,000 gallons; lumber, 10,000,000 ft.; cotton duck, 90,000 yards; carriage and plough bolts, 3,000,000. As evidence of the magnitude that the use of self-binding machinery in harvesting grain has attained, we will state that we furnished our customers in 1883, 2500 tons of twine."

THE following contractions have been adopted by the International Metrical Congress at Paris, and are recommended for general use:—(1) Length: Kilometre, *km*; metre, *m*; decimetre, *dm*; centimetre, *cm*; millimetre, *mm*. (2) Surface: Square kilometre, km^2; square metre, m^2; square decimetre, dm^2; square centimetre, cm^2; square millimetre, mm^2; hectare, *ha*; are, *a*. (3) Cubic measure: Cubic kilometre, km^3; cubic metre, m^3; cubic decimetre, dm^3; cubic centimetre, cm^3; cubic millimetre, mm^3. (4) Hollow measure: Hectolitre, *hl*; litre, *l*; decilitre, *dl*; centilitre, *cl*. (5) Weight: Ton (1000 kilogrammes), *t*; metric hundredweight (100 kilogrammes), *q*; kilogramme, *kg*; decagramme, *dkg*; gramme, *g*; decigramme, *dg*; centigramme, *cg*; milligramme, *mg*. Italic letters are used for these contractions, and no stop is to be used at the right of them. The contractions succeed the figures to which they refer, on the same line, and after the last decimal placed, when figures are used which contain decimal fractions.

FROM a paper read before the Royal Institution by Professor J. W. Judd, it appears that the Krakatoa cataclysm destroyed over 35,000 people, but as a volcanic outburst it was comparatively small with that of Tomboro in 1815. The Krakatoa was, however, more violent for the few hours it lasted than the Tomboro during its thirty days. The size of Krakatoa was formerly 33⅔ square kilometres; of that 23 square kilometres have subsided, and 10⅔ square kilometres remain extant. But on the south and south-west side the island has been increased by a large ring of volcanic products, so that the size of New Krakatoa is now, according to the survey, 15½ square kilometres. The size of Long Island was formerly 2·9 and is now 3·2 square kilometres. Verlaten Island has become much larger; it was formerly 3·7 and is now 11·8 square kilometres in size. Of the Poolsche Hoedje nothing remains. In the place where the fallen part of Krakatoa once stood there is now everywhere deep sea, generally 200, in some places even more than 300, metres deep. It is remarkable that in the midst of this deep sea a rock has remained, which rises about 5 metres above its surface. Close to this rock, which is certainly not larger than 10 metres square, the sea is more than 300 metres deep. It is like a gigantic club, which Krakatoa lifts defiantly out of the sea.

AT the meeting of the Chemical Society, June 19th, a paper was read, "On the Magnetic Rotary Polarisation of Chemical Compounds in relation to their Composition," with observations on the preparation and densities of the bodies examined by Mr. W. H. Perkin, F.R.S. In a preliminary note on this subject, read before the Society about two years ago, it was shown that no definite laws could be expected by the ordinary system of comparing the rotary effect of unit lengths of fluid, and that a comparison of molecular lengths—*i.e.*, such lengths of fluid that the ray of light in passing through these should in all cases traverse the same number of molecules—must be made if any relationship in the rotary effect of various bodies was to become apparent. It was further shown, that the rotation due to these molecular lengths may be calculated from observations made on unit lengths by the formula $\frac{r.Mw}{d}$ where r = rotation observed, Mw the molecular weight, and d the density; and that if this number be divided by the number similarly obtained for the standard of comparison—in this case water—the result will be the molecular coefficient of magnetic rotation, or more briefly, the molecular rotation. Examples were then given, calculated from original observation as well as from numbers taken from the papers of Becquerel and De La Rive, fully confirming this view, and plainly showing the existence of definite laws governing the magnetic rotary polarisation. These investigations have been continued, and the present communication embodies the results of the careful observation of about 140 substances belonging to the various classes of the fatty series of organic compounds. From these results it is clear that in a strictly homologous series the introduction of each CH_2 is marked by an increase in the molecular rotation. This constant for CH_2 was found—as the mean of a large number of closely concordant observations—to be 1·023; each series has, in addition, its own initial or series constant, and it was found that when this initial constant has been once determined for a series, by the careful observation of one of its members, the molecular rotation of any other members may be found by the formula—Mol. rot. = s + 1·023.n, where s = the initial or series constant, and n the number of carbon atoms in the molecule.

MISCELLANEA.

THE number of visitors to the International Health Exhibition for the week ending 21st June was 143,122; total since the opening, 712,081.

A PAPER on the extraction of sugar from molasses by means of lime appears in the last number of the *Journal of the Society of Chemical Industry.*

WE are asked by Messrs. Walter T. Glover and Co., to state that they are the sole makers of Bell's rope pulley friction brake, illustrated in our impression of the 6th inst.

THE Lord Mayor will distribute the medals to the successful British exhibitors in the late Amsterdam Exhibition, at the Mansion House, on Monday, the 30th instant, at 3 o'clock.

A NEW monthly periodical, the *Illustrated Naval and Military Magazine*, will appear on July 1st. It is to be devoted to all subjects connected with her Majesty's Land and Sea Forces.

GERMANY has not quite succeeded in copying our torpedo boats, or if they have in copying, they have not in following up our improvements, for other orders have just been sent to this country by the German Admiralty.

THE *English Illustrated Magazine* for July contains an unusually large number of well-executed drawings, amongst which is a small one of the Forth Bridge as it will be, and a very interesting article on "How a Bone is Built," by M. Dural MacAlister, which contains a good deal of mechanical illustration.

IT is proposed to hold an American exhibition in London in 1886. The exhibition is to be truly national in character, and afford the opportunity to Europeans of seeing the American workmen—white and coloured—engaged upon their respective handicrafts. Enquiries may be made of Mr. C. B. Norton, 7, Poultry.

MESSRS. TAYLOR BROTHERS AND CO., Clarence Ironworks, Leeds, have secured the order for locomotive tires from the Scinde, Punjaub, and Delhi Railway Company, to be of their high-class crucible cast steel; and also the Bombay, Baroda, and Central India Railway Company's order for locomotive crank axles, made of their mild steel.

A FAST new steamboat, City of Kingston, of the Cornell Steamboat Company, which recently arrived in New York from Wilmington, Del., has begun making fast trips on the Hudson. The City of Kingston is 255ft. long, 47ft. wide, and has a capacity of 1100 tons. She is to run between West Point, Poughkeepsie, Newburg, and New York, and on her recent trip made seventy-five miles in four hours, but is expected greatly to surpass this rate of speed when fairly at work on the river.

COLONEL GEORGE M. TOTTEN, chief engineer in charge of the construction of the Panama Railroad, died at New York on the 17th ult. Deceased was born in Pennsylvania in the year 1808. When M. de Lesseps went out to Panama, Colonel Totten accompanied him as consulting engineer, and was retained in that capacity. In 1882, the president of the Maryland and Delaware Ship Canal Company also engaged him as chief engineer of that company, and he held this position at the time of his death.

THE report on the composition and quality of daily samples of the water supplied to London, for the month ending May 31st, 1884, by William Crookes, F.R.S., William Odling, M.B., F.R.S., F.R.C.P., and C. Meymott Tidy, M.B., F.C.S., says:—"Of these 189 samples of water, the whole were, without exception, clear, bright, and well filtered. The quality of the water supplied to the metropolis during the past month, as indicated by its state of aëration, and high degree of freedom from colour and excess of organic matter, was excellent. Its perfect filtration was shown by the absence of even a trace of suspended matter in any one of the numerous samples submitted to examination."

MESSRS. SIEMENS, BROTHERS, AND CO., of Berlin, have recently constructed some small arc lamps which will work in parallel, and do not require more than two ampères of current and an electro-motive force of 40 volts. The upper carbon descends by its own weight, and passes as it is consumed through a hole pierced in a copper disc, the diameter of which is slightly smaller than that of the carbon. The lower carbon is pushed upwards by the action of a spring in a copper tube. A solenoid regulates the length of the arc by its action on a core, to which the upper carbon is attached. The *Electrician* says, "The idea is to employ these instead of incandescent lamps, the arc lamps being more economical."

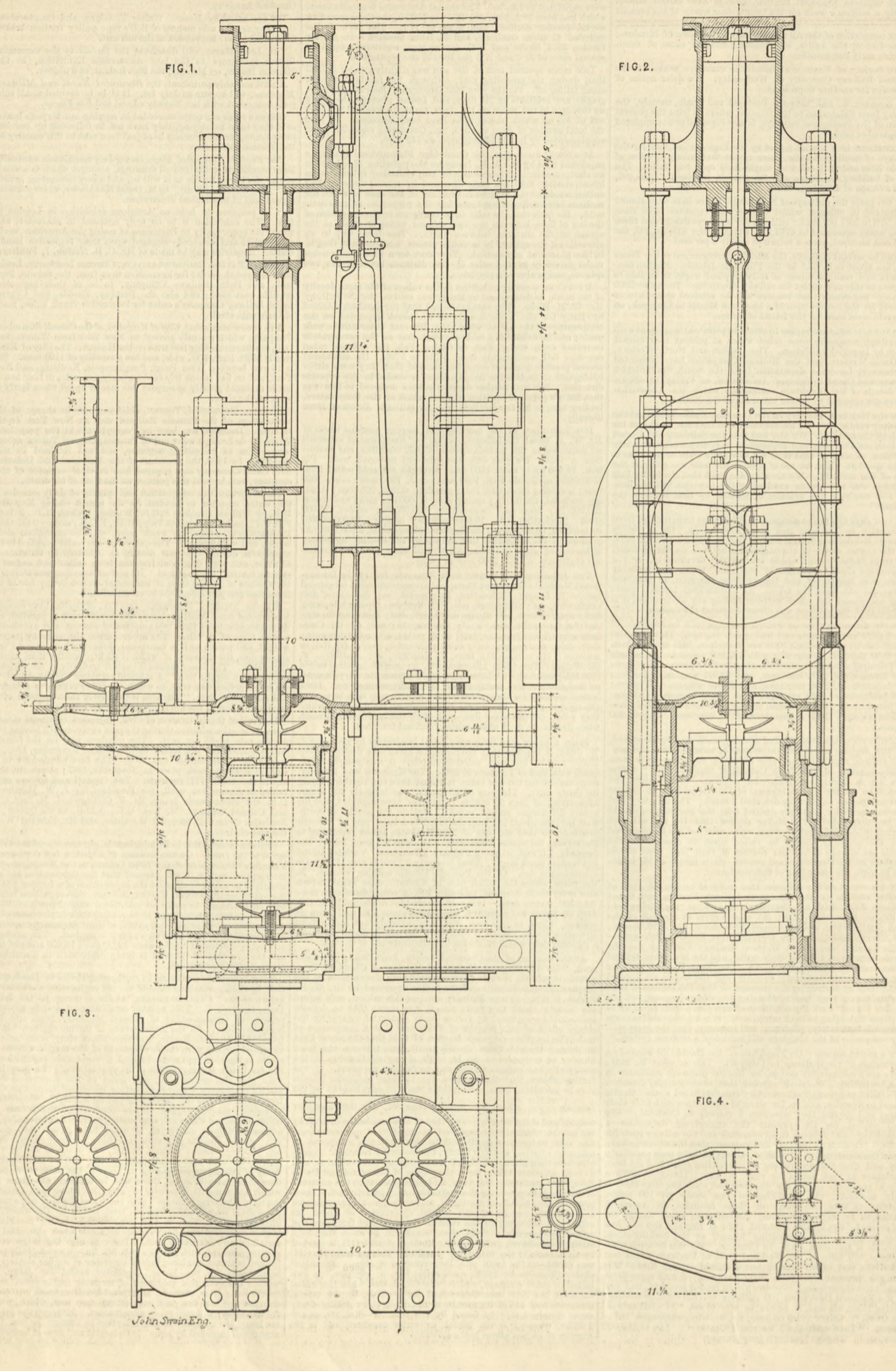
THE roll of the Institution of Civil Engineers continues steadily to increase—the addition during the past twelvemonth having been at the rate of 4⅔ per cent. The numbers now on the register, without students, are 3833; on the 30th of November, 1862, the gross total of all classes was 1000. The first admissions to the class of students took place in November, 1867; at present there are on the books 777 students. The Council and officers entertained at dinner last week, the President Sir J. W. Bazalgette, C.B., the other guests being, Mr. F. Collingwood, M. Inst. C.E., and Colonel Gzowski. M. Inst. C.E., A.D.C. to the Queen; Sir Frederick Bramwell occupied the chair, and Mr. Edward Woods the vice-chair.

SEWAGE interception in Birmingham is, our correspondent writes, again to the front. On the occasion of a visit, a few days ago, of a number of members of the Town Council to the Montague-street interception works, it was learned that the Corporation are next month to be asked to sanction the expenditure of a further £35,000 in completing the works. This expenditure, the committee believe, will enable them to make an additional annual profit of £6000. The money would be devoted to increasing the completeness of the pan system as it at present exists, without necessarily involving any extension of the scale on which it is applied. The sewage is now being defæcated on between 12,000 and 13,000 acres of land, and the question of disposal is being dealt with in a manner of commensurate magnitude.

SOME interest is awakened in engineering circles in London just now by the approaching close of the old engineering works, so well known as the "Canal Ironworks," at the entrance to the Isle of Dogs, London, E. This notable establishment stands second in priority in London—that of Messrs. Maudslay, Sons, and Field being the oldest—for the manufacture of marine engines. It was founded by the late Messrs. Seawards above sixty years ago, and advanced rapidly with the development of the marine engine and steam navigation, and soon obtained a world-wide reputation for the excellence and magnitude of its productions. The proprietors were able, far-seeing men, and many of the improvements in marine machinery were originated or developed from the Canal Ironworks, such as the feathering paddle-wheel, the direct-acting—Gorgon—marine engine, surface condensing, the return tube boiler, improved slides and cam motion gear, lifting propeller, and numerous details, nearly all of which have passed into general use. A vast amount of general machinery for lead rolling, dredging, brewing, cement making, &c. &c., was designed at the Canal Ironworks, and sent to all parts of the world. Although the decay of marine engine making in London, has prevented the extension of the old house, there will be amongst the tools some which have merits deserving of attention; here was originated Seaward's hoisting "sheers" with the travelling back leg, a modern example of which, 100ft. high, in iron, stands on the wharf. An interesting tool, also, is the large vertical boring machine for largest size cylinders; Seaward spent £5000 upon this, and it is certainly an admirable tool. There is also the large vertical slotting machine, with a stroke up to 5ft. 2in.—a wonderfully powerful and compact machine; indeed a number of similar slotters have been made by the house, especially useful for large forge work. The extensive collection of screwing tackle must not be overlooked; it is, perhaps, unsurpassed, and extends up to 8in. diameter. There is a peculiar erecting shop roof, which, wonderful in its day, will still repay examination. Although the premises are large, the quantity of general plant in modern lathes, &c., is now much exceeded by some of the largest and newest houses.

RUSSIAN TORPEDO BOATS.—AIR AND CIRCULATING PUMPS.

(For description see page 478.)



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TO CORRESPONDENTS.

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W. J.—*A delivery valve is quite unnecessary.*

AN IGNORANT USER OF STEAM POWER.—*Simply a spring inside the piston ring.*

THE INVENTOR.—(1) *Yes.* (2) *The fees will be the same as under the old law.* (3) *Yes.*

INVENTOR.—*Theoretically, you can get foreign patents without an agent. Practically, you will find it impossible.*

DRAUGHTSMAN.—*You will find the process described at p.* 279, *April* 19*th*, 1878, *and p.* 298, *April* 26*th*, 1878. *You can, however, now buy paper ready sensitised for the purpose.*

G. H. C.—*So far as we know the only degrees in civil engineering to be obtained in the United Kingdom are those of Trinity College, Dublin, and the Queen's Colleges of Ireland, Belfast, and Cork. The University of London—Burlington House—does not grant any degree in civil engineering. University College, London—Gower-street—in its department of engineering, grants a certificate, but this is only to be had by attending a course at the college for at least two years.*

A SUBSCRIBER (Birmingham).—*It is not easy for us to say whether you would gain anything or not, because we have not all the facts before us. Theoretically, the Woolf engine—yours—is just as economical, or rather more economical, than the engine with cranks at right angles and a receiver, but the right-angled engine will give you more regular turning. Again, you may not now be working your engine to the best advantage as regards point of cut-off, action of valves, and so on. If your engine were altered all this might be made right, when the benefit would be attributed to the change in the angle of the cranks, to which it would not really be due. Send us a set of diagrams and we can advise you further.*

ENAMELLED STILLS.

(*To the Editor of The Engineer.*)

SIR,—I shall be much obliged to any of your readers who will tell me where I can find a maker of enamelled stills. D. P.

June 21st.

MILD STEEL ROLLING.

(*To the Editor of The Engineer.*)

SIR,—Can any reader of THE ENGINEER of good practical experience tell me if there is any economical advantage in rolling plates, sheets, and bars from mild steel—such as Bessemer or Siemens-Martin—over malleable iron as usually piled in the rolling mill? What quantity of ingot or slab is required to produce one ton of finished plates, sheets, or bars? E. E.

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THE ENGINEER.

JUNE 27, 1884.

COLONEL MAITLAND ON THE GUNS OF 1884.

WE call attention to the paper read by Colonel Maitland, the Superintendent of the Royal Gun Factories, with the accompanying drawings, as a most valuable summary of the gun question at the present time. Any paper of Colonel Maitland's would command special attention, but several circumstances combine to give peculiar weight to this. Writing as Superintendent of of the Royal Arsenal Gun Factories, with the Secretary of State for War in the chair, supported by the Surveyor-General of Ordnance and the Director of Artillery, Colonel Maitland's opinions are delivered *ex cathedra* in an unprecedented manner; so much so, that we regard the reading of the paper thus as a bold move for the authorities to take, and one which is only justified by thorough confidence in their position. Discussions at the United Service Institution are sometimes free and lively, and there is nothing to prevent independent men from being as outspoken as they please. When once the glove was thrown down and the lists of discussion were opened, there was a grand opportunity for the advocates of Krupp's, Whitworth's, Palliser's, Hope's, or any other rival system which has all to gain and nothing to lose, to attack the Government position. To defeat the Superintendent of the Gun Factories, backed by all the official authorities, and in the audience of most of the men of the country who know much about ordnance, would be a feat that might give real satisfaction to an ill-used inventor. There was nothing to prevent this but the strength of the position and the ability of the lecturer. It follows, therefore, that if Colonel Maitland held his own, the country has the best possible guarantee of the soundness of our position on the important matter of ordnance at the present time. We think that without question our position is a sound one. We know of no system to be preferred to our own; nay, we are not prepared to suggest any feature that we wish to see embodied in the designs approved for future manufacture. Our guns may not have been invented by British artillery officers. They may even be adaptations of the inventions of foreigners, but so long as they are the best we have reason to be satisfied. It is consoling to know that even if inventive talent be lacking to us, the best guns are not. When we wrote on this subject in 1880 we gave a series of articles on various systems of construction, including Krupp's, Whitworth's, Palliser's, and Vavasseur's, as well as those of Elswick and the Royal Gun Factories—see THE ENGINEER for June 25th, July 9th, and July 30th, 1880. We concluded our review by observing that "the introduction of built-up steel guns was a mere question of time," because in the form of cylinders built up into a gun the very qualities that had once recommended our wrought iron Armstrong guns were secured in a higher degree in steel in this form, and that consequently nearly all the arguments for the former would tell in a greater degree for built-up steel guns, which might be adopted by our authorities in the shape they had then assumed without any inconsistency. Two features in the system of building up now adopted, we think, call for notice. It is the fact that the longitudinal strain is taken off the inner tube and thrown on to the jacket which surrounds it at the breech, and that the latter is by a system of locking rigidly attached to the trunnion hoop or whatever corresponds to it. These features were especially advocated by Vavasseur. Anyone who cares to refer to the drawings we gave in 1880, which, with the exception of Krupp's gun, we obtained from the manufacturers themselves, may see that the first-mentioned feature did not exist in the Gun Factory, Elswick, or Krupp's design, while it is exhibited in that of Vavasseur—p. 21, July 9—and on that page is described as a special feature of his gun. Our words were, "Vavasseur's method of holding the trunnion hoop to the breech is peculiar to this gun, as is the hold of the breech-closing gear to the steel jacket." We expressed our conviction at some length of the soundness of this, and gave our reasons. We will not trouble our readers with any quotations, but we may point out that in the sections given on p. 488 of the Elswick, Gun Factory, and Krupp guns, it will be seen that in each case the breech piece rests against the jacket surrounding the outer tube, and longitudinal strain is taken off the inner tube and thrown on to the jacket. In the two former the connection with the trunnion hoop is that advocated by Vavasseur; but the Gun Factory without question always had this last feature, or a still more solid trunnion and breech connection. Colonel Maitland very handsomely acknowledged any good element taken from any system; as, however, Vavasseur's name was not mentioned, we think it fair to accord him credit for what appears was an important feature—indeed one which was noticed as such by Colonel Maitland.

With regard to the credit to be accorded to those who have contributed to the present excellent designs, we may observe that many have borne a share. The building up of guns, which forms the foundation of everything, in principle resembles that first successfully carried out by Sir William Armstrong. Whitworth and Vavasseur have, in the face of all discouragements, patiently worked at steel hoops until they have brought them to exhibit powers far beyond anything that could be hoped for in iron. To Krupp is due not only the credit of success in the use of steel on a very large scale, but also of practically exhibiting on a great scale the enormous advantage that breech-loading possessed when applied to modern guns of much length. For the actual proportions of these guns we hold we are not indebted to him. The experiments made on burning powder by our own committee were worked out in a remarkable way by Captain Andrew Noble. The sectional density of our projectiles is more nearly that first adopted by Krupp than any other maker, unless it be Whitworth. Finally, Colonel Maitland calls attention to the fact of how much we owe to the French in our system of breech-closing and obturation. In justice to Palliser, we must observe that we have long had in our possession a formal proposal of his of a system of breech-closing almost identical with the French before the latter was known in this country, but this does not refer to our obturation, for which De Bange alone deserves credit. The success obtained in powder was fully described by Colonel Maitland, and we have nothing to add on behalf of Waltham Abbey or the Rhenish Westphalian Company. The proportions of the powder chamber are specially those of the Gun Factory. To return to the general question, however, we have described our position as "sound;" but while this is undoubtedly true, it is not everything. Colonel Maitland spoke of the advantages of deliberation. "Having waited the longest, we have got the best," he said; but he confesses the gain in quality has certainly involved a loss in quantity. We have at this moment very few first-class guns, and we are behind France and Germany in the manufacture of large steel tubes. We are both behindhand at present, and also we cannot make progress easily in very large guns. We are waiting for steel which we find it difficult to get. Elswick's three breech-loading guns of 110 tons weight are a bright feature in the picture. It may be seen by the table accompanying Colonel Maitland's paper that they are the most powerful weapons as yet designed—exceeding the Krupp 119-ton guns in total energy by 4863 foot-tons. There are, however, but three of these pieces ordered. This being so, we would call attention to the closing words of the paper—"We have a good type of gun, but we are behind in numbers." Money and time are needed to arm us efficiently. This means that Government adapters have done their part—Colonel Maitland, by the way, uses language which does not intimate how much of this work was his own—and it is for the country to vote the money necessary to push on without further delay. Colonel Maitland says we have not been caught napping, but we are not yet out of the wood. It has been our task this spring to call attention repeatedly to the serious condition into which the armaments of the country are falling. We have spoken strongly, and in doing so we have only quoted the warnings that have been uttered by every authority on the subject. Strong, burning words have been spoken by earnest men again and again. They have not been answered because they were based on the unanswerable logic of facts. They will have been of small use if we only have them to refer to after some terrible national humiliation has befallen us, to show that our professional advisers were not in fault, and that the nation has to suffer for its own neglect.

EGYPT.

THE last issue of the minutes of the "Proceedings" of the Institution of Civil Engineers—vol. lxxvi.—contains a paper by Mr. W. Anderson on "The Condition of the Delta of the Nile," which possesses especial interest at the present crisis in Egyptian affairs. Mr. Anderson was professionally employed to visit a part of the Delta altogether outside the track of ordinary travellers; and the effect of what he saw and experienced moved him to write the article which the council of the Institution has published as one of the "Selected Papers." Mr. Anderson has long had an intimate knowledge of Egyptian affairs; and the object of his paper is to show that the resources of Egypt have been destroyed at their very source by the gross neglect, which has for a long time existed, of the drainage, irrigation, and ways of communication upon which the prosperity of a purely agricultural country entirely depends. It seems inexplicable that so little attention is directed by statesmen and financiers towards the real weakness of Egypt. Colonel Scott-Moncrieff, the present head of the Public Works Department, is, indeed, quite alive to the real wants of the country, and so recently as June 18th, the *Times* published the substance of a note furnished by him to the Legislative Council, in which he expresses his opinion that the rate of the land tax is excessive in the present impoverished state of the country, and the neglected condition of the public works; and in earlier notes, addressed to the financial advisers of the Government, he points out clearly and forcibly that defective drainage, defective irrigation, and the almost total absence of cheap modes of communication, are at the bottom of the poverty which presses so hardly on the fellaheen, and which, because of the apparent necessity of reducing the rate of interest on the loans, seems likely to be the cause of grave misunderstanding between England and France. Notwithstanding the circumstance that the defects which Mr. Anderson has pointed out, and which Colonel Scott-Moncrieff has deplored, are sufficiently notorious, they seem to be ignored by the statesmen who have undertaken the regeneration of Egypt; at any rate, no remedy for the evils named forms a distinct and emphatic part of the contemplated reforms; while the proposal to evacuate the country in three years is a practical abandonment of the only measures that can restore prosperity, because it is absurd to suppose that the drainage, irrigation, and ways of communication of the country can be put right in so short a period.

Egypt is intersected by innumerable canals, mostly of large capacity, capable of carrying efficient inland navigation; and yet Mr. Anderson found that in rainy weather communications were completely stopped, and, under the most favourable circumstances, it cost 26s. per ton to move farm produce by canal thirty-three miles to a port on the Damietta Nile! In the extensive system of canals which exists, there are very few permanent works for regulating the flow of water, and locking traffic through where a difference of level occurs. The barbarous plan adopted is to make earth banks across the canals, and throttle or shut off the water by that means; of course rendering trans-shipment necessary at each dam. Is it possible that the vast array of works necessary to give Egypt the same facilities for disposing of her produce which other competing countries enjoy, can possibly be carried out in three years—and if the English are to leave in that time, what will become of the works which they will hardly have had an opportunity of even inaugurating, and under what discouragement must our engineers act, with the dreary prospect of relapse to native misrule so immediately before them? It is a wonder that the French, generally so keen in pecuniary matters, have not looked at the problem from this point of view; they are equally interested with ourselves in making the country as productive as possible, and it is certain that this can only be done by engineering works, and not by financial nostrums.

The paper before us dwells at some length on Colonel Scott-Moncrieff's attempt to make use of the Barrage for the purpose for which it was built—namely, damming back the water above the forks of the Nile, so as to irrigate Lower Egypt without having recourse to pumps. The difficulties and dangers of the attempt are pointed out; and we may add that it is uncertain, supposing even that success attends Colonel Moncrieff's efforts, whether the natural height of water thus obtained will command even a considerable portion of the lands of the Delta by gravitation. If it does not, then the money expended on the Barrage will be money thrown away, because it will not remove the wasteful methods of raising water now in vogue, and which will have to be retained, and will be almost as extravagant, even if the lift be much reduced. Colonel Scott-Moncrieff rightly states, in the note which appeared in the *Times* of the 18th, that the local pumping machines are worked at a cost of 20s. per acre; but it is a well-established fact that large pumping stations under Government control will supply water from the lowest Nile level to command the land at all times at one-tenth that sum—that is, at 2s. per acre—and effect, in addition, a large saving in the maintenance of long arterial canals and release a great deal of forced labour. The Ministry of Sherif Pacha was fully alive to what we have just stated, and published a scheme which, if carried out, would certainly have assured the permanent enrichment of the country, although it is to be noted that in that exhaustive report the improvement of the ways of communication is not even mentioned.

The cultivated lands in Egypt are peculiar in their nature. The infiltration from the Nile every season tends to wash up the deleterious salts which impregnate the subsoil; these salts can only be kept down by steady irrigation and drainage; any failure, of the former especially, not only does immediate harm to the growing crops, but inflicts injury on the land, which is not got over for a year or two. It is for this reason that any scheme for the amelioration of the agricultural prospects of Egypt, if it is to be worthy of England, must be one by which the engineer will place the land absolutely beyond all risk of being injured by want of drainage, or of irrigation water at a sufficient height to command the fields, and will improve the means of communication so that the cost of carriage to the ports of shipment will not exceed that of European countries; and, if Egypt is to be saved, this work must be done immediately on a sufficient scale, because long neglect has to be atoned for—neglect which, in the native Government, was to be expected, but which, if it can be charged to us, will be nothing short of criminal indifference to th welfare of a defenceless people, of whose country and government we have taken forcible possession.

We have looked in vain in the Prime Minister's recent statement for any allusion to the condition of the public works. The sole measure of the fitness of the country to be abandoned by us will be its condition of "peace and order." Not one word is said about the state of the oppressed and impoverished peasantry; not one word about effecting any permanent good by which the name of England will be gratefully remembered. We trust that the nation will look at the matter in a proper light, and will recognise the fact that the only real internal danger lies in the discontent which arises from neglect by the Government of the means by which alone agricultural and commercial prosperity can be assured, and will look rather to wise administrators to check disorder than to the presence of an armed force. In writing thus we have no political bias. But we cannot shut our eyes to the fact that Egypt is a country in which English engineers could find employment for years to come. The engineer is *the* great civiliser. Nothing that the politician, or the soldier, or the sailor can effect is to be compared for a moment with the work that the members of our profession can accomplish; but for this time is essential, and the announcement that English influence will be withdrawn from Egypt in three years is quite sufficient to deter engineers from taking any part in the regeneration of the country. Without them nothing will be effected; and any Government which shuts its eyes to this fact will commit a grave mistake. With politics properly so called we have nothing to do, they fall beyond the scope and province of this journal; but we are very fully impressed with the conviction—forced home by the inexorable logic of facts—that the engineer is the great reformer, the great regenerator of modern times; and without entrenching in any way on the field of politics, we must express our regret that this fact has not been more fully recognised by the Government than would appear to be the case.

WATER POWER.

We have recently received several letters on the subject of water power, the writers of which have apparently found much that is attractive in the article on, "Hurdy-gurdy Wheels," which appeared in our impression for May 30th. Our attention is drawn by others to the utilisation of the tides as a means of obtaining enormous quantities of power; and some of our correspondents seem to think that we waste valuable gifts because we do not utilise every river and mountain torrent in the country. We cannot answer all our correspondents directly, and, under the circumstances, we think it may be worth while to put a few simple facts concerning water power before them. It is difficult to persuade those who are not skilled in hydraulics that the volume of water which comes leaping through a large sluice or precipitates itself down a rock represents no more power than can be had from a few pounds or hundredweights of coal. Figures, however, cannot lie in this connection; and such of our readers as care to follow us to the end will, we think, see that it is the easiest thing possible to be led away by the sight and sound of a waterfall which is of insignificant power. We met with a case some years ago in which a man built a large flour mill six stories high, intended to take twenty pairs of stones, solely on the strength of a fall of water about 9ft. high. The volume of water tumbling down seemed to him immense; in reality there was just 8-horse power net to be had. He found this out before the floors were laid in the mill, and it remained for many years unfinished. In another instance heavy machinery was actually laid down for rolling iron. There was a 14in. bar mill, a 20in. sheet mill, a hoop mill, and a rod mill; there were seven water-wheels, and the gross power of all the water available was equivalent to 38 indicated horse-power. Such mistakes are by no means of rare occurrence, although not made on so large a scale. A firm without much experience in this class of work made and guaranteed a turbine to give out 90-horse power. They altered the wheel in various ways, and failed to comply with the demands made on them. Then an engineer was called in, who ascertained that there was not more than 20-horse power of water available for nine months in the year, and that in wet seasons the most that could be got did not exceed a total of 90-horse power. We could extend this list of examples of miscalculation, but it is, we think, not necessary.

The power to be had from any fall of water depends on the weight of water and the height. A horse-power represents 33,000 lb. lifted or suffered to fall 1ft. in a minute. Let us assume that we want to get 12-horse power net; it will not be safe to provide less than 20-horse power of water. Some wheels will require less, but in this matter it is always necessary to be on the safe side. Let us suppose that the fall is 10ft., just a nice height for a breast wheel. Now, 33,000 × 20 = 660,000 foot-pounds per minute, and $\frac{660,000}{10} = 66,000$ lb. of water, which is the quantity that must be delivered every minute on to our breast wheel to fall 10ft. A cubic foot of water weighs 62·5 lb., and $\frac{66,000}{62\cdot5} = 1056$ cubic feet. If we further assume that this water is delivered over a weir, the depth of water on the weir being 6in., the discharge per foot run of weir will be about 74 cubic feet per minute, and $\frac{1056}{74} = 14\cdot2$ft. This represents a very tolerable stream. If the depth on the weir was 18in., the length of the weir would be little short of 3ft., and the cascade would present dimensions which would easily lead the unwary into believing that it represented three or four times the true power. All this water, after after all, can only give out the power to be had from a small portable engine; and allowing the somewhat extravagant estimate of 5 lb. per brake horse per hour, a consumption of 60 lb. of coal per hour—a little over a quarter of a ton per day—would do as much as the waterfall. To put it in another way, a horse could easily draw as much coal as would develope all the power of our fall of water for four or five days. Of course the water falls night and day, while we assume ten hours to represent a day's work of the steam engine. But in not a few instances the night work would be useless, simply running to waste.

Twelve horse-power is a very insignificant amount of energy. Let us see what a fair sized cotton mill would need. Let us assume, as before, that the fall is 10ft., but the power needed is 500 horses. For this we shall need no less than 1,650,000 lb. of water, or 26,400 cubic feet. This, running 2ft. deep, would require a weir 45ft. 6in. long to discharge it. A cascade over 45ft. long and 10ft. high, the water rolling over its crest 2ft. deep, is no contemptible spectacle, and in this country there are very few places where anything like it can be seen all the year round.

The few figures we have given will suffice to show that on moderate falls an enormous volume of water is required to give anything like a useful amount of power. Let us suppose that the cotton mill we have just cited was to be driven by tidal power; space enough must be provided to store all the water that would be needed to run the mill for, let us say, three hours. The storage reservoir being filled while the tide was running, and being emptied as the tide falls, we must provide for a total quantity of water equal to 26,400 × 60 × 3 = 4,752,000 cubic feet. A basin 500ft. long by 200ft. wide, must be 48ft. deep to hold it. Spread out 10ft. deep, this vast volume of water would cover 475,200 square feet, or nearly 11 statute acres. These figures show the magnitude of the works that would be needed to utilise the tides on even a comparatively small scale. When we compare them with the plant required to supply steam power, thelatter sinks into insignificance. The great draw back to water is the difficulty of obtaining it just where power is wanted, and the expanse of the works which are essential when much power is needed. It may be safely said that in England there is no water power worth having; in Ireland there is a great deal, but it is questionable whether it is or is not worth having at the price that must be paid for it. In Europe there is a good deal of water power well worth paying for; and some—as, for example, at Bellegarde—which does not seem to be obtainable at a sufficiently low price to permit it to compete with steam. The factory must be taken to the power, and to make this pay in the majority of instances it would be necessary that the power could be supplied for almost nothing, which would mean that no means would exist of paying interest on the capital expended in the construction of mill dams, sluices, races, water wheels, and such like.

INDIAN RAILWAY GOVERNMENT CONTRACTS.

From time to time the Indian Government advertise in our columns for tenders for materials and plant of various kinds for Indian railways. The advertisements supply little information, and practically nothing would be known of the precise nature of the demands made by Government were it not that we publish under the head of "Contracts Open" drawings of the railway carriages, bridges, locomotives, and so on, for which tenders are asked. No steps are even taken by the authorities to make known the names of the contracting firms, or the amounts of the tenders received. This is entirely opposed to the practice which obtains in civil life. Thus, for example, corporation engineers, to say nothing of numbers of their professional brethren, always send to the technical press lists of the amounts of the various tenders they receive for work to be executed under their supervision. This is useful in various ways which readily suggest themselves; and it is desirable that the same system should be pursued in all cases where the Government are purchasers. There is an idea in existence—whether well-founded or not makes no difference, for the mischievous result is the same—that special firms are favoured by the Government, and that it is quite useless for firms outside the charmed circle to tender for any Government contract. This delusion—if it be one—could at once be disposed of by the regular publication of the names of the tendering firms and the amount of their tenders; and it would not cost the Government a penny, for the technical press would willingly give publicity to what would be very interesting information. The practical secrecy with which the Government conducts its operations leads now and then to the putting of awkward questions. Thus, on Monday night, in the House of Commons, Mr. H. Fowler asked the Under Secretary of State for India whether his attention had been called to statements that large contracts for ironwork for Indian railways have been entered into by the India-office with foreign firms; and whether he could inform the House as to the amount of these contracts, the reasons why they had been entered into, and the proportion they bore to contracts for railway ironworks placed in this country with home manufacturers. On the same subject Mr. Anderson asked the Under Secretary of State for India whether, with reference to the statement that no work except two contracts for axle-boxes, value about £5600, had been given to foreign makers, he had been made aware that in 1883 there had been at least one contract for 249,000 wrought steel transverse sleepers, value about £70,000; whether he was aware that last May another contract was given for 100,000 more of these steel sleepers, value about £22,000; whether, in estimating comparative costs of home and foreign manufacture, allowance was made for difference in quality, extra cost of inspectors and engineers visiting works, &c.; and if, on the completion of either of those contracts, he would lay upon the table a paper showing the accurate cost as compared with what it would have been if the lowest offer of a British manufacturer had been accepted.

Mr. Cross's reply was conclusive enough. We wish we could add that it was equally satisfactory. He began by stating that he was glad he had an opportunity of stating the facts—the publication of lists of tenders which we have suggested would give him just the opportunities he wishes for—and he went on to say, "Since I stated to the House that orders for axle-boxes had been placed abroad, 10,000 steel sleepers have been contracted for at £7 12s. per ton, the lowest British tender being £8 12s. 6d. This contract was made on the 26th of May last. The India-office made no foreign contract for steel sleepers in 1883, and the contract for 249,000 referred to by the hon. member for Glasgow is imaginary. The only foreign purchase in that year was 37 tons of Swedish iron. I learn, however, that the directors of the Southern Mahratta Company bought 99,600 steel sleepers from a foreign firm. The contracts for railway work entered into by the India-office since June, 1877, amount to £6,594,385, of which £53,833 has been placed with foreign firms; and in these contracts due consideration has been given to the extra cost incurred by our inspectors in visiting foreign works. The quality of the work is equal to English work, and the specifications are the same. I shall be quite willing on the completion of the contract for sleepers to lay upon the table a paper showing the saving to the Government of India on this contract as compared with the lowest English tender. I may say that the traditions of the India-office are strongly against placing contracts abroad; still, on some occasions, even the India-office must depart from tradition. I may also inform the House that steel sleepers are somewhat novel in England, and that several of our greatest English manufacturers have declined to make them or tender for them. At present German prices are considerably below English. As, however, these sleepers may in the future be very generally used by the Indian Government and by the Indian railway companies, I hope that our great English firms will not allow foreigners to distance them in fair and open competition."

It is quite possible that the 99,600 Mahratta sleepers formed the foundation on which Mr. Anderson's superstructure of 249,000 sleepers was built up. There is nothing, of course, very serious in the fact that £53,833 has been spent by the Indian Government out of England for railway materials, out of a total of £6,594,385, between June, 1877, and May, 1884; but there is ground for distrust at least, in the fact that in May as much as £76,000 worth of sleepers was purchased abroad. It will be noticed that official reticence has stepped in and prevented Mr. Cross from stating to whom the contract had been awarded, and we trust that Mr. Anderson will take steps to elicit the facts from the Government. We wish to know what foreign firm was competent to make steel sleepers at £1 0s. 6d. per ton less than they could be made here during a period of almost unexampled depression in the iron and steel trade. We are sorry to say that with some firms in this country it is held to be right to make Governments pay longer prices than those which any private buyer can afford to give. If extravagant demands have been made, then the sooner the facts are published the better; they will act as a warning in future. There is, however, another aspect to this matter. It sometimes happens that apparently trifling concessions are made to contractors, which really represent no small advantages. It would be as well that the circumstances under which this sleeper contract was, or rather is, to be carried out were made known. For example, the port of delivery should be stated; its locality may make a very great difference. Thus, for example, if it were stipulated that the sleepers should be delivered in London, a Belgian firm could probably beat a north-country English firm, because the sleepers could be delivered in London by sea at a less cost for transport than would be incurred by the English firm using the railways. It is, of course, very easy to say that the specification was the same for English and foreign houses; but there is always a little outside the specification, and it is well known that this little may make a great difference in favour of the contractor. Possibly Mr. Cross does not know all the facts himself; it is just as well that he should ascertain them. As we have already said, it seems quite unaccountable that English makers should be undersold by foreign rivals to the extent of over £1 per ton. Of course, the serious aspect of the case is that the example thus set will be followed. Nothing is wanting to complete the ruin of our iron trade but the circumstance that we can be largely undersold for manufactured articles. Our pig iron trade may keep active, but if the iron only goes abroad to be worked into steel, and sheets, and plates, and bars, and rails, by our foreign competitors, while our own mills are standing idle, it represents a condition of affairs which is not healthy. Altogether the little story told by Mr. Cross is calculated to make thoughtful people uncomfortable, if not absolutely unhappy. Possibly, if all the facts were before us, we might regard the matter with more equanimity. As the story stands, either contracts are awarded by Government without due care for the interests of home manufacturers; or competition by foreigners is growing in importance after a very alarming fashion.

THE PROPOSED SOUTH STAFFORDSHIRE SEWERAGE SCHEME.

THE large engineering scheme suggested by Mr. Walter Williams, the chairman of the South Staffordshire Mines' Drainage Commissioners, for the disposal of the sewage of thirteen local authorities in the mines drainage area, took on a more definite form at an adjourned conference between the authorities and the Surface Drainage Committee of the Commissioners in Wolverhampton, on Wednesday. Mr. Williams suggests that Parliamentary powers be obtained for a South Staffordshire Conservancy Board of five members, representing the two interests involved, to have full control of the surface drainage of the area including the Commissioners' present surface drainage works. The Commissioners believe that sites are obtainable on their streams where the water may be turned out into tanks for the quiescent precipitation principle, where the detritus and sewage can be arranged. Storm water can only be dealt with by allowing it to pass the side tanks. All the sewerage not provided for by existing systems in populated areas would be carried down by the storm waters and dealt with by collecting tanks on the site of a stretch of water at Wednesbury known as Elwell's Pools, the effluent being carried still further down for filtration upon a site below. Such is the scheme, which it is estimated would cost about a quarter of a million sterling less than separate schemes by the local authorities, and which they are to consider among themselves in three weeks at Wolverhampton. Should they decide to fill in the outline thus presented, engineering advice of the first order will be obtained, for hitherto only friendly opinion has been forthcoming. The local authorities are the more likely to fall in with the suggestions since the system advised has been that most generally recommended by their own engineers when called in to advise upon individual sewerage schemes. The importance of a proposal affecting a population of nearly 400,000 persons, and property of the rateable value of nearly a million sterling, is too patent to require comment, nor should there be difficulty in obtaining from Parliament the required partial suspension of the Pollution Act and Public Health Acts.

THE NEW COAL SLIDING SCALE.

WHILST the miners of the Midlands have rebelled against an award of an arbitrator as to the amendment of their wages, it is interesting to notice that the miners of the county of Durham have agreed to a new sliding scale. There are many reasons that could be urged why a sliding scale is preferable to arbitration. It is quicker in operation, cheaper in its working, and above all, the decision given is one that is free from all supposition of bias or partiality to either side. An arbitrator may be so biassed, but the basis of the sliding scale is usually settled on by the two parties to it, and it then works automatically, so that for the period for which it is defined it is as fair as can be, while there is at the end of that period the opportunity to improve it as its experience may have shown to be needful. The coal trade, too, would seem to be one that is very suitable indeed for the operation of the sliding scale system, because the labour is tolerably constant, and bears a given proportion to the price of coal at different times. Under these circumstances the sliding scale should not have been allowed to lapse in Durham, for the basis could have been changed if needful; but that lapse having taken place, the miners do well to revive the scale after a few months waiting. This is what has been done, and it is to be hoped that both in Fife and in the Midland coalfield that example may be followed. It enables both mineowners and miners to join in the fixing of the basis of the scale, and it then remits the exact determination of the wages paid to an automatic system that is free, fair, and unbiassed in its decision, though sometimes its movements are not quite so quick as those of the trade that it follows. In the coal trade there is increasing competition, both district and international, and it would be a gain to our employers and workmen if they could have that guarantee that sliding scales give of adaptation to the price of the wages, and that also of continued work whilst the adaptation proceeded.

THE GHOST OF THE SEASON.

THIS is the title, given in the current number of the *Journal of Science*, to an article by "Argus" on the same subject, only treated from another aspect, as that on "The London Water Supply and its Critics" which we recently published. We give an abstract of it here. On the Royal Rivers' Pollution Commission, to which reference is made at the outset, we are pointedly brought in contact with one of its fundamental dogmas which, it is stated, may be fairly embodied in the following words:—"If a river be once polluted by sewage water, the water of that river was for ever unfit for dietetic purposes, and no practical distance of flow would render such a river safe." This dogma is professedly based upon the experiments of Professor Frankland. He had made analyses of water taken from different portions of a polluted river, and has told us that as it flows its proportion of pollution—*i.e.*, of organic impurities—remains substantially the same. He has also, after determining the impurities in a sample of sewage, mixed similar sewage with water and shaken it up with air in a bottle, in order to ascertain if the impurities were to any extent destroyed by oxidation! It is difficult to imagine how any man accustomed to scientific research, and acting in good faith, could persuade himself or try to persuade others, that this experiment in the least degree reproduced the condition found in a river. In a river there is doubtless, as in the bottle, contact with water and exposure to light; but in the river there are agencies which are absent in the bottle. There are animals of low grade which devour the filth; there are vegetables—all water-plants—which, whenever the sun shines, and even under the influence of diffused daylight, give off oxygen, and oxidise, or in common language burn up the impurities. Both these agencies, "Argus" repeats, were wanting in Professor Frankland's bottle, whilst they were present more or less in every river. In the Thames above London they were certainly not wanting.

Attention is then directed to experiments made on the river Oder about Breslau, on the rivers Passaic, and Brandywine, in Delaware, and on the river Vesle, about the town of Rheims; and it clearly pointed out that the water of each river works itself pure again below the town through which the stream passes. Then "Argus" goes on to say:—"The dogma of the Commission is, to some extent, based upon the analytical method used by them, or, more strictly speaking, by Professor Frankland. I am not about to enter upon a discussion of this method, or to undervalue it in comparison with any other method. But as Dr. Percy Frankland, the son of Professor Frankland, and author of the paper read before the Society of Arts last month, asked his audience to condemn the A B C process for the purification of sewage upon the strength of an analysis made by that method, I am compelled to bring forward a certain historical fact.

"In the beginning of the year 1872 the Native Guano Company, proprietors of the A B C process, were beginning to treat the sewage of Leeds. A formal trial of forty-eight hours was made under the superintendence of the Sewage Committee of the Leeds Town Council. Every hour a bottle of effluent water was taken and tested by officials of the council, and at the end of the forty-eight hours the contents of the bottles were poured into a large vessel, and thoroughly stirred up together. It is, therefore, evident that any two samples of water taken out of this vessel must have been identical. Two Winchester quarts were filled with this water by the officials of the Town Council, sealed, and despatched to Prof. Frankland for analysis.

"The one was forwarded direct to London, whilst the other was sent to a gentleman in Bedford, who at once sent it on to Professor Frankland. Neither of these bottles was ever in the custody of any person connected with the Native Guano Company. The results of the analyses of the two samples were in course of time received by the Leeds officials, the one directly and the other *viâ* Bedford, and are indeed instructive. They are here subjoined. The originals, duly signed, are in existence, and can, I am told, be produced if needful.

Results of analysis expressed in parts per 100,000.

Number of sample.	Description.	Total solid impurity.	Organic carbon.	Organic nitrogen.	Ammonia.	Nitrogen as nitrates and nitrites.	Total combined nitrogen.	Previous sewage contamination.
A..	—	107·7	2·179	0·566	1·550	0·372	2·214	1·618
—	Bedford water	108·4	2·012	1·017	1·020	0·062	1·919	0·870

Number of sample.	Description.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Suspended matter. Mineral.	Suspended matter. Organic.	Suspended matter. Total.
A..	—	14·6	7·9	40·7	48·6	0·68	0·54	1·22
—	Bedford water	14·0	2·2	32·8	35·0	1·82	0·06	1·88

"Thus it will be seen, if we turn to the most important points, that in these two identical samples the one which had come direct from Leeds is represented as containing nearly double the amount of previous sewage contamination which was present in the other. Again, whilst the difference between the two samples in total solid impurities and in chlorine is trifling, the difference in organic nitrogen is nearly 50 per cent, that in ammonia nearly 30 per cent., and that in nitrogen, as nitrates and nitrites, above 80 per cent. What can we think of analytical methods by which such results are reached? Yet it was in the face of such methods of analysis that the A B C process for the purification of sewage was condemned by the Rivers' Pollution Commission. It is on the faith of one of these analyses exhumed, so to speak, for the occasion, that the old condemnation was repeated on March 13th.

"I have here to complain of something very like intentional unfairness on the part of Dr. Percy Frankland, as regards his attack upon the A B C process. The man who, professing to have given any serious attention to the sewage question, can yet endorse the statement of the defunct commission, that "after treatment by this process the effluent sewage is very little better than that which is obtained by allowing raw sewage to settle in subsidence tanks," is, to say the least, guilty of most culpable rashness. It is surely singular and significant that Dr. Percy Frankland should have contented himself with this old analysis, and never have taken the trouble even to inquire whether it and the conclusions based upon it were applicable at the present day."

DEATH OF MR. H. TOMLISON.—With much regret we have to announce the death of Mr. Tomlison, the engineer and manager to the Cambridge Waterworks Company. He had been failing in health over four years, and became more seriously affected during the past winter and spring, but still he was able to undergo much bodily and mental exertion until last Sunday fortnight. Then for a few days he was in a very critical state, from which he had considerably recovered up to early on Monday morning last, when he suddenly succumbed to an outburst of pulmonary hemorrhage. Mr. Tomlison has been connected with the Cambridge Waterworks Company twenty-one years, and has throughout rendered most valuable service in extending and perfecting the works of the company. He was very young when appointed to take office; but the directors foresaw, as time has proved, that he was a man of great scientific acquirements and practical skill, and it is with profound regret they lose the assistance of so much esteemed and valuable an officer. His ability as engineer and manager to the Cambridge and Trowbridge Water Companies earned him the entire confidence of the directors and others connected therewith, by whom he was held in the light of a personal friend. His engineering skill has not been confined to Cambridge alone. He devised and carried out the waterworks at Trowbridge, Melksham, Frome, and Devizes; and his was also the scheme for the Warminster Waterworks and the reconstruction of the Ely Waterworks. He was also the engineer to the Frome Local Board Sewerage scheme. Mr. Tomlison was born at Walton-le-Dale, and was in the fortieth year of his age, and had been for many years a member of the Institution of Civil Engineers.

SUAKIM-BERBER RAILWAY.—The Royal Engineers have inspected the stock of railway material in store at the Royal Arsenal, and it is to be forwarded at an early date to the Red Sea, for the purpose of forming the nucleus of a military line to be constructed from Suakim to Berber. A ship has been selected for its conveyance, and is expected to arrive at Woolwich in the course of this week. Two small locomotive engines which were purchased about two years ago for a Government railway at Cyprus will form part of the equipment, and others are ordered to be supplied by contract. They are adapted to the narrow gauge tramway laid down at the Royal Arsenal, and when the Cyprus railway was countermanded about twelve months ago they were placed at the service of the Works Department, in which they are at the present time daily employed. All the railway plant is designed for the same narrow gauge, and the whole of the material is remarkably light. The rails are in 21ft. lengths, and weigh 26 lb. to the yard. The sleepers are formed of ¼in. iron-plates, with an "M" section, and are 6in. wide by 3ft. long. The rails will be laid to form a line only 18in. wide, and will be attached to the iron sleepers by a simple grip. The engines are of 15 or 20-horse power, and can draw about 40 tons. Not more than 50 tons of railway iron are at Woolwich, but orders have been sent out for 150 tons more of the same pattern. It is calculated that the whole line can be laid down in about three weeks after the material is landed. There is no apparent exertion in any other preparation for the proposed expedition. A number of wagons belonging to the second line of the 1st Army Corps have been brought out of store for inspection and repair, and most of the manufacturing branches have some work on hand for Egypt, but the Commissariat Department, which is generally the busiest in times of preparation, has relaxed even the slight strain that was evident a few weeks ago. A special equipment of 40,000 rations of every kind for man and beast has been prepared and put aside, being intended, it is said, for a small expedition in Natal, and the Commissariat stores have ready huge piles of packages labelled "Alexandria," but only such as are constantly being sent to the army of occupation.

THE HEAVY GUNS OF 1884.

By COLONEL E. MAITLAND, R.A., Superintendent Royal Gun Factory, Woolwich.*

ON Friday afternoon, June 20th last, Colonel Maitland, R.A., Superintendent of the Gun Factories, read a paper reviewing the present position of the gun question. This may be regarded as the most authoritative expression of opinion that we can have. As such it was delivered with the sanction of the War Department. Lord Hartington took the chair, supported by Lord Northbrook and Mr. Brand, the Surveyor-General of Ordnance, and Mr. G. Rendel. Among many prominent in connection with the question in one way or another, we noticed Mr. W. H. Smith, late First Lord of the Admiralty, Lord C. Beresford, General Reilly, Director of Artillery, and Colonel Hay, Adjutant-General, R.A., Colonel Nolan, Sir W. Codrington, Captain Andrew Noble, of Elswick, Mr. Whinfield, of Messrs. Whitworth's, Mr. Longsdon, Herr Krupp's representative, Herr Kraftmeier, of the Rhenish Westphalian Powder Company, Col. Moncrieff, Captain Palliser, Mr. Lynall Thomas, Colonel Hope, Admirals Hamilton and Boys, late Directors of Naval Ordnance, General Smyth, Commandant of Woolwich, Sir F. Bramwell, Sir Cooper Keys, Colonel Inglis, and Colonel Schaw, Fortification Branch, Colonel Lyon, Colonel Noble, Colonel Woolsey, and artillery and naval officers in large numbers. We give the paper in full, with the exception of a few diagrams.

In the spring of this year the Council of the Royal United Service Institution did me the great honour of asking for a lecture on the subject with which my work is chiefly connected, viz., ordnance. The Secretary of State for War cordially granted permission, and, moreover, most kindly consented to take the chair on the occasion. I felt, therefore, that the time had now arrived for as clear an exposition as I could lay before you—and through you before the public—of the present state of this subject, which is of national importance, setting forth the causes which had led to the necessity for the re-armament of our naval and military forces, the progress now made in that re-armament, and the comparative efficiency of the heavy guns of 1884 in England and in the other chief countries of the world. As time is short, you will pardon me for being exceedingly brief in summarising the chief causes which have led to our re-armament. Putting aside all minor considerations, many of which have frequently formed fertile matters of controversy, I state at once that the chief causes are three:—(1) Improvement in powder; (2) Improvement in mechanical appliances; (3) Improvement in production of large masses of steel. It will, perhaps, be said that if this be true, these considerations should affect other nations besides our own, and that the great continental Powers should be re-arming extensively also. To which I reply that this is exactly what they are doing, and have been doing for some time past. This re-armament is being carried out rather more gradually than ours, and the changes they are making are less radical, but none the less are they thoroughly re-arming. It may be admitted that during the latter part of the seventies England fell behind in the artillery race, but not to the extent that is supposed by many who have not thoroughly studied the subject. As a matter of fact, the old short breech-loaders of the Continent are just as obsolete now as the old short muzzle-loaders of England, and up to about 1875 or 1876 the British artillery was as good as anybody else's. Then came a period of comparative stagnation, and we fell to leeward. During the last three years we have been endeavouring to make up our leeway. One point we have in our favour. In a science which advances as fast as artillery has been doing of late years, the Power which waits longest before committing itself to a new manufacture has the best of it, always supposing that it is not caught napping by an important war. It is not necessary to explore the debateable land of the might-have-been; it is sufficient for our purpose to know that we have not been caught napping by an important war, and I hope to show you to-day that the result is that having waited the longest we have got the best of it. I come now to the improvement which has taken place in powder. It must be remembered that the weight of the gun is the limiting element of power in nearly all cases. It is easy to carry about powder and shot, but the gun is one and indivisible, and taxes the appliances of transport to the utmost. Hence, as long as guns have no special counter-balancing points of advantage or disadvantage, the proportion between the energy attained by the projectile and the weight of the gun forms a convenient way of comparing the excellence of various designs. It is briefly called "energy per ton." Conversely, the description of powder which enables a gun to realise the greatest energy per ton without exceeding the pressures which it is constructed to bear, will be the best for that gun, irrespective of the quantity of powder expended in producing that result. There are cases, no doubt, where the size or weight of the cartridge becomes a serious consideration, but as a rule it is of little importance when compared with the advantage of increased power. With breech-loaders that powder is found to be the best which satisfies the following conditions. It should fill the chamber of the gun as completely as is consistent with facility of loading. It should burn slowly at first, till the projectile begins to move, gradually setting up just the maximum pressure suitable to the gun; it should then burn faster and faster as the projectile travels onward through the bore, so as to keep up the pressure as long as possible, and give the greatest amount of energy. A low maximum pressure long sustained is the great desideratum of the artillerist, and no one will attain any measure of ballistic success who fails to recognise this fundamental maxim. Diagram No. 1 shows clearly the amount of progress which has been attained in slowing the powder and producing energy per ton of gun. The ordinates represent the pressure of the gas measured in tons per square inch; the abscissæ show the length of travel of the projectile along the bore measured in calibres. The fine curve indicates the pressures with quick burning powder, the medium curve with medium powder, and the thick curve with slow powder. The quick and medium powders were used in short guns, and the dotted portion of their curves is merely added to show how little gain would have resulted from increase of length. The slow powder is used in long guns, and the amount of pressure kept up to the muzzle indicates that we can go still further in the direction of length with advantage. The area included by these curves of course represents the work done by the powder, nearly all of which goes to produce energy in the projectile. It at once becomes evident that to get an increased ratio of power to weight, we had to turn thickness of metal at the breech into length at the muzzle; that is, to lower the pressure in the chamber and keep it up longer in the bore. We sometimes hear statements to the effect that the road to improvement lies in the direction of using very quick powders, and making enormously strong guns to withstand the highest pressures powder can give in a closed vessel, viz., about 42 tons per square inch. This system, from an engineering point of view, is no doubt right as causing the least consumption of fuel; but it is utterly and entirely wrong when seen from the artillerist's standpoint. The artillerist cares little for the amount of fuel consumed, but a great deal for the weight of the machine consuming it. Now, when guns are fired with powders giving different pressures, it is found that the rise in energy of projectile at the muzzle is not nearly in proportion to the rise in pressure in the powder chamber. High pressures are extremely capricious and uncertain in their effects, and no precise rule can be laid down; but taking our usual service maximum pressure with slow powder at 17½ tons per square inch, and substituting an equal quantity of a powder violent enough to give 35 tons per square inch, I should not

* Read before Royal United Service Institution.

ENGLISH AND FOREIGN HEAVY GUNS.

FIG. 3 — 40 %/m (15·75 in.) B.L. GUN, 119 TONS. KRÜPP 1884.

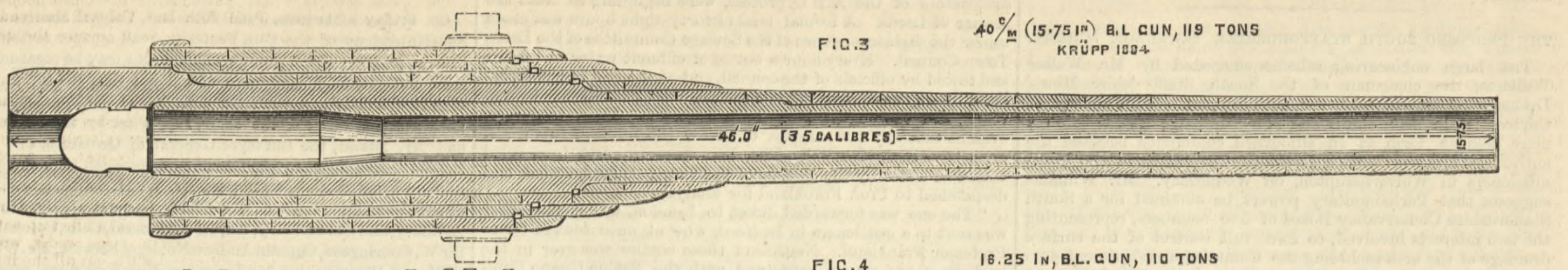


FIG. 4 — 16.25 IN. B.L. GUN, 110 TONS. E.O.C. 1884.

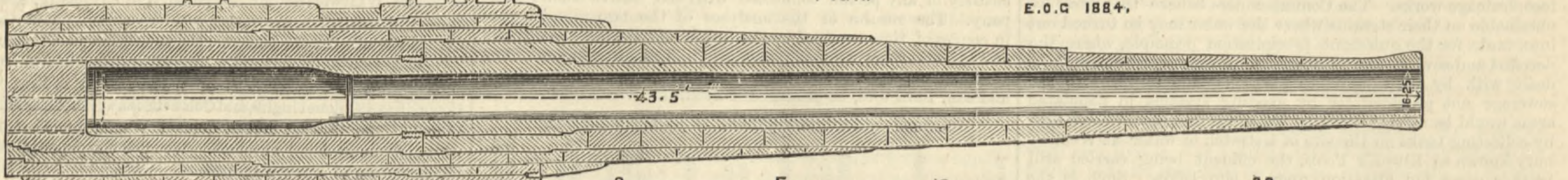
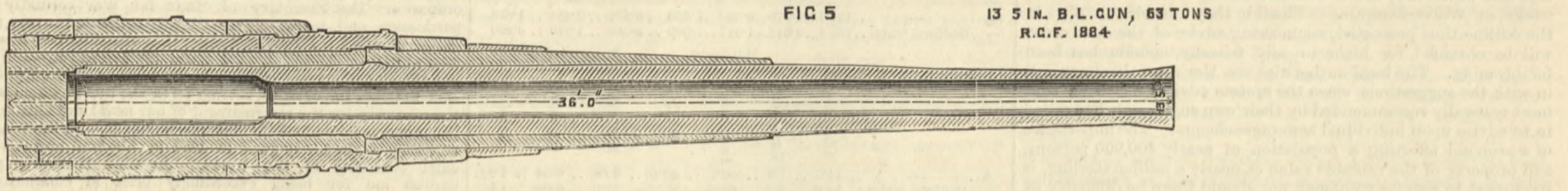


FIG. 5 — 13 5 IN. B.L. GUN, 63 TONS. R.G.F. 1884.



expect to realise an increase of energy of more than about 20 per cent., though the pressure has been doubled. But doubling the pressure necessitates doubling the strength of the breech, and hence of adding about 80 per cent. to the weight of the gun. Besides this, high pressures give rise to many inconveniences, the breech fittings and the firing arrangements are apt to be burred, set up, and jammed; the shell and shrapnel are liable to be broken up in the bore unless made so strong as to reduce seriously their capacity for holding bullets or powder. Hence I think it is clear that slowing the powder is a most important improvement. There are two reasons why this improvement in the powder renders breech-loading an absolute necessity. First, the guns have to be made so long that loading from the muzzle becomes practically impossible on service. Second, the slow powder cannot be made to burn in the most effective manner unless the projectile be held fast by a strong band which prevents it from moving till a pressure of from 1 to 2 tons per square inch is set up in the chamber. This can only be done in breech-loading guns, and hence they are capable of developing greater power than can be obtained from muzzle-loaders of equal weight. I am aware that two or three years ago, when breech-loading was young in England, this view was strongly combated by some of our most able artillerists, who held that muzzle or breech loading *per se* made no difference in the power of a gun; but now I think its correctness has been established by frequent experiment, and will hardly be questioned. Here it may be seen how, by coming last to breech loading, England was able to build on Continental experience and improve upon it. In 1880 we were using for our heavy muzzle loaders either Waltham P^2 or German prismatic powder, which gave, when proved in the 38-ton muzzle-loader guns, pressures of about 19 tons, and velocities of 1560 f.s. Directly the Royal Gun Factory came to breech loading, the unsuitability of these powders became apparent to us, though the German prismatic powder was specially manufactured for Krupp breech-loaders. The superintendent of the Royal Gunpowder Factory at Waltham was promptly asked to make a powder which should give about 800 f.s. velocity in the 38-ton gun, with a pressure of not more than 5 tons, using the same charges as with the German prismatic. This modest request would probably have met with derision if regarded simply from an engineering point of view, as involving an absurd waste of fuel; but Colonel Brackenbury tackled the matter very successfully, and, after some preliminary trials, produced an admirable powder, which attained celebrity under the name of H_3. This powder was nearly useless for muzzle-loaders, but when fired in heavy breech-loaders gave by far the best results then known. A modification of it has now been introduced and issued for service as C_2; since that time the Germans have taken a fresh departure, and have quite lately produced a powder which seems to be a little better than C_2. It is known as cocoa powder, and its composition is a secret. The speciality of this cocoa powder is that although it lights with great regularity and burns very slowly at first, yet when the projectile has got fairly under way it burns with tremendous rapidity. In the 19-ton 9·2in. guns it has about the same ballistic excellence as the best lots of C_2; that is, it gives about the same pressures and velocities all the way up the bore, but it takes only 170 lb. of the cocoa to produce the results attained by 200 lb. C_2. These charges give about 2050 f.s. velocity to a projectile weighing 380 lb., the pressure being about 17 tons in the chamber. Thus the extra 30 lb. of C_2 are required to give off gas as the projectile travels through the bore, to balance the quicker final burning of the cocoa. Darwin tells us, in one of his charming books, how the probosces of the Madagascar moths tend to lengthen in successive generations so as to reach the honey-dew of the orchids, while the nectaries of the flowers tend to deepen continually to force the moths to push their heads in and exchange the fertilising pollen. So we find, in the struggle for existence, the guns growing longer and longer to get the best effects from the slow powder, while the powder tends to grow slower and slower to meet the wants of the guns, in accordance with the eternal principles of evolution. The next point is the improvement made in the mechanical appliances of guns. With a breech-loader the first necessity is a thoroughly satisfactory system of closing the breech. This was certainly not accomplished by any nation till after the Franco-German war of 1870. Krupp then entirely remodelled his breech fittings, and introduced the form now universal in his modern guns. The French Marine improved the details of their existing system in like manner, and the French land service, after a long series of experiments, retained their system of closing the breech, but adopted an entirely new method of obturation invented by De Bange, of the French Artillery, to whom I am very pleased to have this opportunity for expressing my gratitude. The great Elswick firm also adopted the French system of closing the breech, but applied a method of obturation of their own. Thus, during the seventies four really serviceable methods of working the breech and sealing the escape of gas became available, and one of the great objections to breech-loading disappeared. The two first causes named, *i.e.*, the improvements in powder and breech actions, settled the questions of breech-loading *versus* muzzle-loading; the third cause of re-armament, viz., the production of steel in large masses, affects construction only. Were large masses of steel not available, we should still have to re-arm with breech-loaders; but the old system of construction would, no doubt, be retained, and the change we have made would not be of so radical and complete a character. In bringing forward the Army Estimates in March, Lord Hartington stated to the House of Commons that, "With regard to the supply of heavy guns for the Navy, fair progress has been made in the present year. During the present and the past two years, we have been undergoing a double transition; first, from the muzzle-loader to the breech-loader; and in the next place, in the material, from wrought iron to steel. Twenty years ago another transition took place, which was of an exactly opposite character. Twenty years ago we reverted from the breech-loader, the more complicated gun, to the muzzle-loader, or more simple gun, retaining the same material of manufacture. At that time the largest guns in the service were of 7 tons weight, firing 30 lb. of powder. In the change from the muzzle-loader to the breech-loader the guns are of 40 tons weight, firing 400 lb. of powder. The Committee may therefore imagine what has been the difficulty, and the necessity there has been for hesitation and caution in undergoing such a transition under such circumstances. The main difficulty has been to obtain sufficiently large steel forgings for these immense weapons. There are in France and Germany several firms which have been able to supply steel forgings of the size, and also of the quality, required for these guns; but up to the present time the demand has been a new one to the English trade, and there has been great difficulty in obtaining from the English trade steel forgings of the size and quality required." This precisely sums up the case, and shows how the improvements introduced into the manufacture of large masses of steel have affected our re-armament. I speak in general terms of the material of which our new guns are made simply as steel, because I wish to avoid entering at all upon the vast question of the innumerable qualities and attributes of this wonderful substance. Although its manufacture is still far from perfect, and will probably not be reduced to anything like an exact science for many years, yet sufficient is known about it to afford matter for many lectures, and I cannot venture in the short time now at our disposal to touch the subject at all. For the purposes of the present lecture I must ask you to take steel as steel. On the occasion just referred to, speaking of the progress made in our re-armament, Lord Hartington went on to say, "We have supplied, or in a few days shall have supplied, to the Navy 10 guns of 43 tons and 12in. bore, 18 of 18 tons and 9·2in. bore, 8 of 18 tons and 8in. bore, 171 of 4 tons and 6in. bore; besides 190 smaller guns of 2 tons and under, making a total of nearly 400 new breech-loading guns. Those first in hand were of mixed steel and wrought iron, while the later guns are entirely of steel. There has been some advantage in the delay in the adoption of the new pattern of breech-loading ordnance. We have had the advantage of the experience gained by France and other Powers, and it is believed that we have now obtained a system of breech-loading of a simple and efficient character. In addition to the guns I have enumerated, there are in hand, under construction for the Navy, three guns of 110 tons, four of 63 tons, and three of 43 tons, besides a very large number of smaller guns in various stages of progress. At the same time there are under construction for the land service ten guns of 43 tons, four of 26 tons, and other guns of smaller size." This brings the state of affairs down to about three months ago, since which time the manufacture has been steadily proceeding, but of course no important change has been made. I will now endeavour to give you some idea of the relative excellence of the latest types of heavy guns at home and abroad, selecting three separate features for comparison as being of a crucial character. These features are:—(1) The system of breech-loading and obturation; (2) the construction; (3) the power. First, the Krupp system of breech-loading. This consists of a round-backed wedge, which is pushed in from the side of the breech and forced firmly home by a screw provided with handles; the face of the wedge is fitted with an easily removable flat plate, which abuts against a Broadwell ring let into a recess in the end of the bore. On firing, the gas presses the ring firmly against the flat plate, and renders escape impossible as long as the surfaces remain uninjured. When they become worn the ring and plate can be exchanged in a few minutes. The vent passes through the facing plate to the rear of the wedge. The gun is fired by a frictional vent sealing tube, which is screwed by the fingers into the vent, and unscrewed after firing. This form of breech-loading has a decided advantage in loading by hand at elevation, which may sometimes be required, as the weight of the wedge is not working against closing the breech, as in the case with interrupted screw systems. It has, however, several counterbalancing

FIG. 1. — 7 IN. B.L. GUN 10 TONS. BREECH ACTION. SCALE 1/10

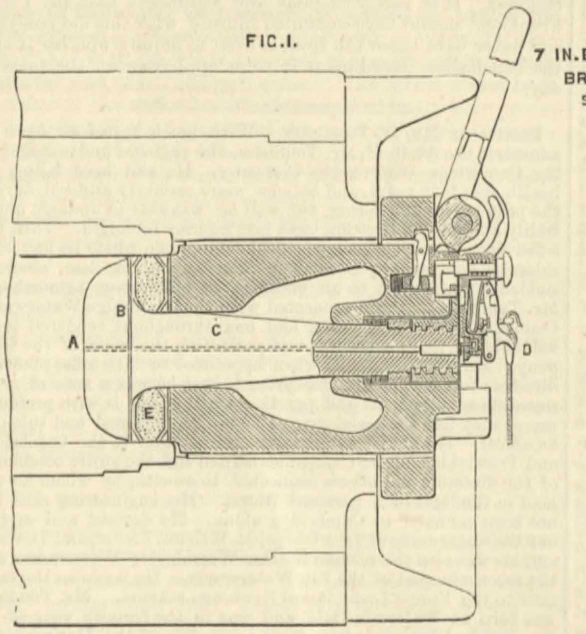
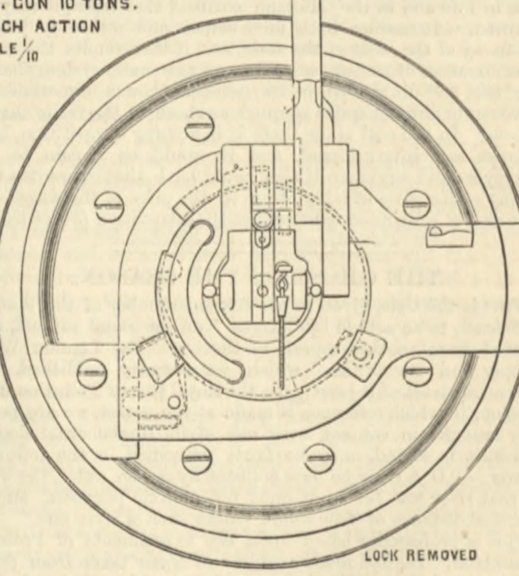


FIG. 2.



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disadvantages; the handles at the side are very liable to be damaged by the enemy's fire or otherwise; the length of the gun is necessarily greater in proportion to the length of bore; the recess for the Broadwell ring somewhat weakens the wall of the chamber; the gun can be fired even though the wedge is not pushed properly home, and the breech has to be opened after a missfire, or if the tube is exchanged without opening the breech, it may be unsafely replaced; moreover, the longitudinal strength depends on the soundness of the single piece of steel through which the wedge passes. Still it must be admitted by all unprejudiced persons that the Krupp ordnance, taking system, construction, and material altogether, are not easily to be beaten. Secondly, the French marine system. Here the bore is continued to the rear extremity of the piece, the breech end forming an intermittent screw—that is, a screw having the threads intermittently left and slotted away. The breech block has a similarly cut screw on it, so that when the slots on the block correspond with the untouched threads in the gun, the block can be pushed straight in, and the threads made to engage by part of a revolution. In the French marine the escape of gas is stopped very much as in Krupp's system; a Broadwell ring is let into a recess in the end of the bore, and a plate on the face of the breech block abuts against it. The vent bush passes through the screw, and is fitted with a lock at the rear for firing percussion tubes. It is so arranged that the gun cannot be fired unless the breech block is screwed properly home. The parts are all protected behind the gun, and the only disadvantage seems to be the recess required for the Broadwell ring, which weakens the wall of the chamber, and necessitates a corresponding increase in the area of the face of the breech screw upon which the gas acts, thus increasing the longitudinal strain beyond that unavoidably due to the size of the powder chamber. As in Krupp's guns, the parts liable to wear are very dependent for their duration on cleanliness and freedom from dust and grit; but when worn they are quickly and easily replaced. Thirdly, the French land service system. Here we have the interrupted screw as in the marine, but the escape is sealed in quite a different manner. A stalk passes through the breech block, its foot being secured on the exterior. The stalk has a mushroom-shaped head projecting into the bore. Round the neck of the stalk, just under the mushroom, is a collar or pad of asbestos secured in a canvas cover. When the gun is fired, the gas presses the mushroom against the asbestos collar, and squeezes it against the walls of the bore. It is found that this cuts off all escape. In this obturation we have no weakening of the walls of the gun, and no increase of longitudinal strain, but the bore is slightly shortened by the protrusion of the mushroom head into the chamber. Its great advantages are that the soft pad adapts itself to the gun surface, against which it presses, regardless of dust, grit, bruises, or other imperfections. The parts can be replaced easily and quickly; they are also light and inexpensive. The vent passes through the mushroom head and stalk to the rear, and the gun is fired by a simple friction tube, pulled from the side. This arrangement is defective, as the gas soon wears out the vent, necessitating a new mushroom; while the frame of the firing tube is blown forcibly out, clinging to the hook of the lanyard, and proving a source of inconvenience to the firer. Fourthly, the Elswick system, which consists of a flat-backed cup abutting against the slightly rounded face of the breech plug. The lips of the cup rests against a copper ring let in the walls of the bore. On firing, the gas presses back the cup against the rounded end of the breech block, and thus forces the lips hard against the copper ring. The cup takes up very little room in the chamber, but is very sensitive to grit and dirt, so that, as well as the copper ring, it requires renewal at uncertain and often frequent intervals. The cup itself can be replaced in a few minutes, but the copper ring takes several hours to extract and renew; the instructions given lay down that a special cup is to be inserted, and two rounds fired with it so as to fully expand the ring, which is then to be trimmed to fit the reserved cups. The firing arrangement consists of a removable needle holder, which carries a percussion tube nearly to the end of the bore; the needle passes from the tube to the rear of the breech screw, and is there struck by a hammer actuated by a lanyard. There is a safety arrangement which prevents the hammer from striking the needle till the breech is properly closed. The chief objection to this plan of firing lies in the difficulty of training men to pull the lanyard in such a way as to give sufficient force to ignite the detonator. Fifthly, the breech action we began with, viz., the French interrupted screw. The Elswick obturation was selected. I do not know exactly why, but I believe under the idea that the gas would not be able to eat its way between the cup and the copper ring, which therefore would never require to be taken out and renewed. We changed the firing arrangement to one having a removable vent head carrying a friction tube; it was provided with a safety arrangement which prevented the lanyard from being hooked to the tube till the breech was properly home. As experience showed that the copper ring did require to be renewed from time to time at very uncertain intervals, and as this was a serious operation, experiments were forthwith instituted with the De Bange obturation, and with such success that it speedily established itself, and was adopted for all the new guns—*vide* E, Fig. 1. Sixthly, our present breech closing arrangement, as applied to the steel 7in. guns—*vide* Figs. 1 and 2. It has one great theoretical defect—it appears extremely complicated. This, however, is not quite so serious as it seems at first sight, for not only is it difficult for the parts to get out of order, but any or all of them can be exchanged in two or three minutes. The vent A passes through the mushroom B and stalk C as in the French land service gun; a clutch box on the rear end of the stalk carries a percussion lock D similar to that of the French marine. The safeguards which cause the apparent complication of the action are numerous. The tube cannot be struck by the hammer, even though the lanyard be pulled, till the breech is screwed home. Should there be a missfire, the slide is drawn back to permit the exchange of the tube, and the new tube cannot be fired till the slide is pushed properly over the tube again. Should the slide not be properly pushed over the tube before loading, the action of closing the breech forces it home; but should the tube be sticking so far out of the vent that forcing the slide home would break it, and perhaps explode the detonator, the slide yields, and the attempt to screw the breech-block home reveals the error. Should the thumb slip in cocking, the hammer will not fall on the striker so as to explode the tube, but on a projection which is removed when the lanyard is pulled. Thus, by coming last, we have been able to select and combine the best features of the French systems, land service and marine, making, perhaps, a few trifling improvements of our own.

The next point is construction. The experimental breech-loading guns first designed followed implicitly the system of construction which owed its origin to Sir W. G. Armstrong, and which, though subsequently modified in several ways in the Royal Gun Factory, will ever be associated with his name. This was the system of wrought iron coils shrunk over each other and lined with a steel tube, which had been adopted for the long discarded vent-piece breech-loaders, and afterwards for the muzzle-loaders up to and including the 80-ton and 100-ton guns. This construction had a long day of success, and its cult was not rudely disturbed till the close of the seventies. Early in the eighties—the revolutionary eighties—however, it was found impossible to vie any longer with the stronger material which was in general use in Germany and France. Guns of wrought iron could not be made to possess the same power as guns of steel without an important excess of weight. Efforts were made to preserve the advantages of the coil construction by employing a mild steel largely alloyed with manganese, which could be made to weld satisfactorily, and experiments were carried out in the Royal Gun Factory with wrought iron coils, steel coils, and forged steel hoops. These resulted in the complete victory of the forged steel hoops, and in April, 1882, the first English heavy breech-loader, a 12in. of 43 tons, entirely of forged steel, was proposed by the Royal Gun Factory. The matter was so important that it formed the subject of an elaborate inquiry by the Ordnance Committee, who took evidence from the principal experts of the country, and whose recommendations have proved of great value to the service. They decided upon a general type of gun, which was based upon a design submitted by the Royal Gun Factory on the 21st July, 1882, and all the guns since made for the British Government have conformed substantially to this type. But before describing it, I will take some of the continental guns, the constructions of which are earlier in date. First, the 70-ton Krupp gun of 1881. The great German manufacturer keeps the sections of his guns a profound secret, and hence the drawing I am going to point to must not be taken as authentic. During a visit to Essen in 1881 I saw the parts of his guns in the machines, and lying about, and I hope he will forgive me for having taken furtive measurements with an umbrella and by the eye sufficient to enable me to make a tolerably close guess at the construction. It should be said here that the Russian heavy guns are either made by Krupp on designs of similar character to this, or copied by the Russians in their own steel. Krupp's latest design is for a heavy gun weighing 121 tons, and 35 cals. long—*vide* Fig. 3. I venture to fill in the construction on the assumption that no radical change has taken place in the Essen principles since 1881; but again this must be taken as guesswork as regards the actual dimensions of the parts. This is the heaviest gun in the world, and four are being made for the Italian land service. It will be observed that the tube forms a lining extending from the muzzle to the face of the wedge, and that it is recessed at the end of the bore to receive the Broadwell ring. Over the tube is shrunk the breech-piece in which the wedge plays. Over the breech-piece are shrunk several hoops. Every portion is made of the finest gun steel. In this construction the whole of the metal over the powder chamber comes into play to sustain the transverse strain, which is transmitted from the tube to the breech-piece, and from the breech-piece to the superposed hoops. Neither hoops nor tube, however, assist in bearing the longitudinal strain, which is entirely taken by the breech-piece. I suppose Krupp has satisfied himself that this gives plenty of strength, and that there is no chance of a dangerous defect, but I confess I should prefer to have a second string with guns of such great size in case anything went wrong with the breech-piece. Secondly, the latest heavy French naval guns, the 34 cm. and 37 cm. of 50 and 70 tons respectively. The 34 cm. gun consists of a very thick tube or body strengthened with layers of hoops. As in Krupp's guns, the whole of the metal comes into play transversely, but the longitudinal strain is taken by the tube alone. Personally I do not like this construction. I think too much depends on the tube, and any failure of this part, which is, moreover, specially subject to the erosive action of the gas, would be disastrous in the extreme. Whether General Dard, the designer of this gun, found it difficult to obtain satisfactory forgings big enough to make the 37 cm. guns on the same construction I do not know, but Le Creusot and St. Chamond can turn out forgings of 70 or 80 tons weight, and therefore I am inclined to suspect that General Dard preferred to trust less implicity to the tube in these larger guns, and therefore thinned down the central forging and introduced a breech-piece between it and the hoops, which to my mind is a very decided improvement, as being put on with shrinkage it places the metal in a better position for resisting the transverse strain, and affords far greater security against longitudinal rupture. Every part is of steel. Thirdly, the Italian naval 100-ton breech-loader of 1882, manufactured by Sir W. G. Armstrong, Mitchell, and Co., of Elswick. In this construction the tube is in two parts, held together longitudinally by a key-ring in halves. The breech screw plays in the tube, over which is shrunk a steel breech piece supported by two layers of thin hoops, and a thick outer wrought iron coil. The middle and forward parts of the tubes are supported partly by steel hoops and partly by wrought iron coils. This construction was never repeated, though the experiments with it at Spezzia were very successful. It is introduced here as showing with remarkable clearness the nature of the transition which has been taking place in construction. Fourthly, I give you the typical design submitted to the Ordnance Committee by the Royal Gun Factory on 21st July, 1882, and recommended by them to guide future manufacture. This particular gun weighs 12 tons, and is 8in. in calibre. Here the tube is thin and extends to the rear only sufficiently far to receive the obturator. Over the tube is shrunk a breech-piece, which is supported by exterior hoops. In this construction the whole of the metal assists in bearing the transverse strain, but the breech-piece does all the longitudinal work. This is not particularly objectionable in a medium sized gun of 12 tons, but would, I think, be so in very large ordnance; as you will presently see, with our heavy guns further provision is made for taking the longitudinal strain. The tube which is subject to erosion by gas is relieved from longitudinal strain, and is moreover so thin that a crack in it would not imperil the safety of the gun; while the form given to the breech opening renders it easy to bore out the eroded surface after long continued firing, and to insert a thin lining into the tube itself, as shown by the dotted lines, thus giving the gun a fresh life. With breech-loaders on the interrupted screw system, the longitudinal strain is found to act most dangerously about the position of the front threads, and it will be seen that at this point the metal of the breech-piece becomes thicker and stronger than in the more forward part over the chamber, while a strong hoop extending to the extreme rear of the gun clasps the breech-piece tightly over the screw and prevents any tendency to open. Fifthly, the Armstrong 100-ton guns now being made for the Lepanto, the great Italian war vessel. The design has superseded that of the 100-ton breech-loading gun mentioned above, and has been kindly sent to me by Captain A. Noble. Sixthly, in Fig. 4 we have the section of the Elswick gun of 110 tons. This magnificent piece of ordnance is being manufactured for the British Government at the works of Sir W. G. Armstrong, Mitchell, and Co., Newcastle-upon-Tyne. It is entirely of steel. The tube is thin, and extends only to the obturator, and the breech-screw works in the breech-piece, which is shrunk over the tube as in the typical design above mentioned. Three layers of hoops reinforce the breech-piece. Here also every part of the metal over the chamber assists in supporting the transverse strain. The breech-piece is assisted in supporting the longitudinal strain by the peculiar distribution of the hoops. A long hoop provided with stout shoulders forms the rear part of the first layer. Its front shoulder engages the rear shoulder of a long hoop, which forms the front part of the second layer and carries a front exterior shoulder against which the trunnion hoop, forming the middle part of the third layer, abuts. Hence we have a direct pull from the trunnion hoop to the shoulder on the breech-piece. For the sake of clearness I speak of the trunnion hoop, but in reality there are no trunnions—the exterior of the hoop forms two rings which are held in a strong band attached to the slide. To prevent the inner tube from moving forward in case the friction between it and the breech-piece should become relaxed on firing, a metal of the character of phosphor bronze is run into a serrated recess at the front of the breech-piece. In building up this gun the trunnion hoop forms a kind of watershed, so to speak, that is, all the hoops behind it are put on from the breech, and all in front of it are put on from the muzzle. To assist friction in keeping them in place, phosphor bronze is run into a serrated recess under the trunnion hoop. It will be observed that in this design several important improvements have been made in the 100-ton gun manufactured for the Italians in 1882. The Lepanto gun shows an intermediate step in the transition. The tube is thinned down and fitted into the breech-piece which receives the breech screw. The joint in the front part of the tube is got rid of. The material of the gun is entirely of steel, cast and forged. The system of obturation is changed from the cup to the pad, and the powder chamber is made shorter and thicker. Fig. 5 represents the section of the 63-ton guns now being made in the Royal Gun Factory. They are entirely of forged steel, which, with the exception of some of the smaller parts, comes from Sir J. Whitworth and Co., who have, so far, met our requirements better than any other maker. In this design the tube is thinned down at the breech, and the breech-piece, which is shrunk over it, receives the breech screw, as in the typical gun of Diagram 15. The metal is disposed in fair conformity with the transverse strain expected, and considerable weight is saved in front of the trunnion ring. All the metal assists in taking the transverse strain, except a very small layer, of which only half assists, as will be seen presently. Over the breech-piece a hoop extending the full length of the chamber is shrunk on, and the weakness of a joint at this important part is avoided. An exterior hoop of fair length reinforces the breech still further. You will observe a novel feature in the disposal of the hoops, so as to secure the greatest amount of longitudinal strength.

The hoops abutting against one another endways are linked together by outer hoops. The exterior of the inner hoop carries a ring which is slotted away so as to leave alternate projections and intervals. The interior of the outer hoop carries a corresponding ring, which is also slotted away, so as to leave alternate projections and intervals. The outer hoop, expanded by heat, is passed over the inner hoop, so that the projections pass through the intervals; it is then turned, so as to bring the projections of one hoop exactly in line with the projections of the other, thus preventing any longitudinal movement. The intervals are then filled up with long steel wedges, which are forcibly driven in. One wedge would be sufficient to prevent any circumferential shift, but all the intervals are filled up, so that the strain from the interior on firing is directly transmitted to the whole of the outer hoop. You see that half the metal of the layer represented by the thickness of the wedges is not available for resisting the transverse strain. This is made up by slightly increasing the thickness of the outer hoop. By this device the gun is stiffened at the joints, and held together longitudinally from the extreme breech end to a point far up the chase—an advantage in point of strength and safety possessed by no other design with which I am acquainted. Coming last to steel breech-loaders, England has been justified in fearlessly adopting the metal, which has been thoroughly tested by German experience. She has also adopted a construction which bears a certain similarity to the French, but is modified somewhat as in Krupp's guns. Having thus taken what seemed to be best of other people's, we have added a little of our own in the matter of locking all the parts of the gun together. It would be unpardonable in a manufacturer not to adopt what he thought the best, and if I saw anything which satisfied me better than this 63-ton design, I should certainly try to get it; hence you will, I am sure, pardon me for saying that I think that, coming last, we really have got the best forged steel construction known. I use this expression to avoid including constructions which involve the employment of wire, which may, perhaps, supersede those consisting entirely of forged steel. It is perhaps hardly correct to include them among the guns of 1884, as they are chiefly experimental; but I believe some have been made, and actually issued, for service to Chili, by the firm of Sir W. G. Armstrong, Mitchell, and Co. Competitive designs have been prepared for the War-office by the same great firm and by the Royal Gun Factory for guns of this kind, and I have received Captain A. Noble's kind permission* to show you a section of the 18-ton wire-gun proposed by Elswick. The tube is thinned down inside the breech-piece, which is shrunk over it, and receives the breech screw. Instead of being reinforced with steel hoops, the breech-piece receives great transverse support from a steel flat wire or ribbon which is wound round it like thread on a reel, but at considerable tension. This wire breaks at 60 tons per square inch. Thin protecting hoops of steel cover the wire and form the exterior of the gun. Here all the metal over the breech assists in supporting the transverse strain, but the longitudinal strain falls entirely on the breech-piece. The great obstacle to the employment of wire in a gun has always been the difficulty of getting sufficient longitudinal strength; no means has yet been devised of putting on high class wire to give both longitudinal and transverse strength. A portion of the wire may be put on, as was done in one construction most ingeniously by Sir W. G. Armstrong, so as to give longitudinal strength, but then it becomes useless transversely. That device has been abandoned in this design, and hence the longitudinal strength is rather low. A Royal Gun Factory design was submitted at the same time. In this construction the tube extends the whole length of the gun, and receives the breech screw. It is protected from the erosive action of the gas by a thin lining, which extends from the obturator as far as necessary up the bore. The breech end of the tube is much

A.—Comparative Powers of Breech-loading Guns of 1881-1884.

Nature of gun.	Date.	Weight of gun.	Weight of charge.	Weight of projectile.	Ratio of $\frac{\alpha C}{\alpha B}$	$\frac{W}{D^3}$	Muzzle velocity	Muzzle energy.	Perforation of iron at 1000 yd.	Energy per ton of gun.
		Tons.	Lbs.				Ft. sec.	Foot-tons.	Inches.	Ft.-Tns.
French, 34 c.m. (13·38in.)	1881	52	362	926	1·07	0·39	1968	24,808	22·9	478
French, 37 c.m. (14·56in.)	1884	71	543	1180	1·02	·38	1955	31,272	24·5	440
Krupp, 40 c.m. (15·75in.)	1881	71	485	1715	1·21	·44	1703	34,502	23·8	486
Krupp, 40 c.m. (15·75in.)	1884	119	615	1632	1·31	·42	2017	46,061	29·2	387
Elswick, 17in...	1882	100	772	2005	1·34	·41	1832	46,600	28·5	460
Elswick, 16·25in	1884	110	900	1800	1·69	·42	2020	50,924	30·5	513
Royal Gun Factories, 13·5in.	1884	63	625	1250	1·78	·51	2050	36,415	28·6	569
Royal Gun Factories, 9·2in. (wire)	1884	19	330	380	2·32	·50	2520	16,730	23·2	880
Elswick, 9·2in. (wire)	1884	18	200	380	1·85	·50	2200	12,759	20·0	709

thickened over the breech screw, so that this is the strongest part longitudinally. Over the chamber is wound a high-class flat wire, which confers immense transverse strength, but does nothing longitudinally. This wire breaks at 100 tons per square inch. Over the wire are shrunk two long hoops of forged steel, which transmit the longitudinal strain from the rear end of the tube to the trunnions, by means of two systems of locked projections. In this construction the whole of the metal over the chamber assists in supporting the transverse strain. The longitudinal strength is divided about equally between the tube and the outer hoops, and is ample. In considering the probability of forged steel construction being supplanted by those containing wire, it must be borne in mind that the lighter the gun in proportion to its power, the more work is thrown on the carriage in checking and absorbing the recoil. There is some doubt whether a practical limit has not already been reached in this respect with the latest patterns of forged steel guns; that is to say, any further reduction of weight in proportion to power may be found to necessitate more than a corresponding increase of weight to the carriage. Should experience prove this to be the case, there will be little advantage in the introduction of wire, except in certain special cases, such as siege howitzers, &c.

Our third and last point of comparison is the power developed by the various types of ordnance which have been brought before you. In this respect we have had nothing to learn from abroad. We owe much to the labours of the Explosives Committee, and much to the admirable experiments with fired gunpowder in closed vessels which were carried out in 1874 by Captain A. Noble, of Elswick, and Sir Frederick Abel; but our chief superiority is due to the practical results obtained with enlarged powder chambers and lengthened bores during a searching trial at the Royal Gun Factory in 1873; from these causes our ballistic knowledge has long been fuller and more complete than that of any of the continental authorities; and it was really owing to this circumstance that England's guns held their ground as long as they did under the double disadvantage of being wrought iron muzzle-loaders instead of steel breech-loaders. The principle of chambering—that is, of enlarging that part of the bore which contains the explosive—depends upon a peculiarity in the action of powder charges which is not very generally known or

* A section of an Elswick 43-ton gun, partly made of wire, may be seen in THE ENGINEER of July 29, 1881.

understood. I will endeavour to make the facts clear to you. Supposing I fill a chamber which measures 3·15in. in diameter and 18·6in. in length with R.L.G.^{2} powder, at a density of 35·6 cubic inches per lb., as in the proof charge of the 12-pounder muzzle-loading field gun, the pressure will be extremely capricious, varying from about 26 tons to 37½ tons per square inch; the velocities will vary also, but to nothing like the same extent. Next, supposing I fill a chamber which measures 7in. in diameter and 18·6in. in length with 20 lb. 3 ozs. of R.L.G.^{2}, at the same density as before, as in the 7in. muzzle-loading gun, I shall get fairly regular pressures and velocities; the pressures will be about 22 tons only, varying about a ton above and below, although the densities of the charges are equal, and there is more than five times as much powder in the charge which gives the lower pressure. This anomalous result arises from the shape of the chamber. It is found that long narrow chambers favour the development of "wave pressures," as they are called, in a surprising degree, and experience has clearly shown that to get the best effect out of the charge, the chamber should not be longer than from three to four times its diameter; with a powder which is slow in proportion to the size of the gun, it is generally safe to approach four diameters in length; but with a powder quick in proportion to the size of the gun, it is often dangerous to exceed three diameters in length. The cause appears to be that as soon as the charge is lighted the gas first evolved travels through the chamber from end to end with great rapidity, and sets up a dynamic action of a vibratory or wave character. But if it is asked why increasing the diameter of the chamber should mitigate and indeed remove this action, I have to confess frankly that I do not know. In the cases given the gas has just as far to travel, and to acquire momentum in, but it seems to lose the intensity of its rush from end to end when afforded increased space laterally. Many efforts have been made to overcome this difficulty, and to obtain satisfactory combustion in long narrow chambers by means of extensive air spacing, or by introducing central tubes of zinc and other substances; but the results have not been very promising, and in the Royal Gun Factory we have kept all our chambers short and thick, so as to consume the charges under the most favourable conditions. Hence it follows that if we wish to employ a charge which is too large to be contained in a portion of the bore four calibres in length, we must increase the diameter of the chamber. In practice, when designing a gun for a given charge, I start with the equation—$7 \pi r^3 = C$, where r is the radius of the section of the chamber, and C is the cubic content required. This, of course, gives the dimensions of a chamber 3½ diameters long, which are subsequently adjusted as required. There are also certain incidental advantages in shortening the cartridge by chambering; the length of travel of the projectile, and consequently its velocity at the muzzle are increased. The shell has not to be rammed so far in, and the cartridge is more compact and serviceable. The disadvantage lies in the necessity for making the gun stronger, and therefore heavier, over the powder charge; in fact the breech must be that due to the size of the chamber and not of the bore. Still the ballistic advantages outweigh this, and as you see by the table A, the chambered guns beat all others in energy per ton. There is one more point where chambering will probably prove of great service. The special duty of all very heavy guns, either for land or sea service, is to get their projectiles through armour. Of late years the armour question has undergone very great change. The guns easily mastered the wrought iron plate armour of the seventies, whether solid or in layers, but the use of steel which has become general in the eighties, has checked the artillerist's victorious career. Plates made either entirely of steel or of wrought iron faced with steel—the plates known as compound—are very difficult to get through or to smash if thoroughly well supported by firm backing. They break up the chilled iron shot, which splash harmlessly on the surface, while the steel shot fired at them usually break if too hard, or flatten out if too soft. We are trying to find the shot material which will prove most effective against this improved armour, and till this is accomplished we shall be unable to say with certainty what proportions should be given to the projectiles. The smashing or racking effect of a very heavy projectile of large diameter, striking with moderate velocity, may prove more effective than a lighter shot of smaller diameter and high velocity, or the reverse result may take place. We can adopt our chambered guns to suit either scheme. Since the calibre does not bear any fixed relation to the diameter of chamber, we can either enlarge the bore or reduce it by a thin lining, at pleasure, without interfering with the powder charge or its stronghold.

To recapitulate the principal points alluded to in this lecture, having come last among the Great Powers to steel breech-loaders, we have been able to select the best points from the various systems worked out by others. The material is that proved admirable chiefly by German experience; the system of breech-loading is that of the French land service; some parts of our present construction have been tested in Germany and some in France, while we have been able to improve on both, and solidify the whole structure in a marked degree. Not being hampered by the necessity for utilising old material, we have been able to devote all our energies to new guns of the best quality, instead of repairing and altering old guns of inferior type, as is being largely done all over the Continent. We have, moreover, greatly extended the ballistics of our guns, and have conferred on them unsurpassed power in proportion to their weight. It is true that in numbers we are behind, but having the best types, all that is required is money and a little more time. The money will no doubt be forthcoming at the good pleasure of the country, which must not hesitate to pay its war insurance. The time is more serious; a heavy gun cannot be made under about fifteen months, and the only way to economise in this respect is to put up sufficient plant to permit of a considerable number of heavy guns being under manufacture at the same time. This has been done to some extent, and the next two or three years will see us in a very different position as regards numbers. Still there is much more to be done, and I will conclude by earnestly representing that though sufficient confidence may not have been felt two or three years ago to justify the heavy outlay which was seen to be necessary to rapid re-armament, yet that now the time has arrived for the country to face the question seriously, to grant the money, and to push the manufacture.

In the discussion which followed, Admiral Hamilton and Admiral Boys spoke briefly, the latter asking for definite information as to the length of the life of a new type breech-loading gun.

Mr. G. Rendel then questioned Colonel Maitland's conclusions as to the proportions of a powder chamber. He noticed that Colonel Maitland apparently limited the length to 3½ diameters, to avoid wave pressures, but that he admitted the loss in increased diameter and strain on gun. Mr. Rendel had taken the case of the 43-ton gun, with 12in. bore and 16in. chamber, and had calculated that if the same capacity of chamber were obtained by simply lengthening the 12in. bore, the gun's weight might be reduced from 43 to 36 tons—a great consideration in the Navy. Colonel Maitland had said that in such a case the strain on the carriage would be increased. Mr. Rendel found that this would only be increased from 275 to 320 foot-tons, which need involve little more than an increase in size of the hydraulic buffer. On the other hand, the gain in reduced diameter by having no enlarged chamber was very great; it helped to the same end as the abolition of trunnions, namely, the bringing of the two guns in a turret close together, so as to approach the condition of a double-barrelled gun. By this the couple with which the recoil of each gun acted with a tendency to rotate the turrets was decreased, and further, the whole turret might be decreased in diameter. He thought that wave pressures would not be developed with really slow-burning powder. The 100-ton breech-loading gun at Spezzia had a chamber over five diameters long, yet it exhibited no wave pressures. Further, Mr. Rendel maintained that the advantages of reduced diameter were such that we ought to try all devices for igniting the charge, so as, for example, igniting it in several places.

Colonel Hope remarked that he was glad to find none of the wrong opinions of the official text-books of 1879 put forth by Colonel Maitland. Colonel Maitland had asked for an explanation of the wave pressure set up in long chambers. This Colonel Hope could supply. He (Colonel Hope) had dealt with the question practically, and had burnt charges 15 calibres long without wave pressures being generated. He had ignited charges at 140 places simultaneously. His shot moved before his charge was all ignited. Sir William Armstrong had, he considered, attempted something in this way when he lit his charge by means of a vent opposite to the front close to the projectile, but the result had been to blow out the breech of the gun. The fault we have constantly committed has been to treat the powder as an explosive, although we have long since learned that it is not an explosive. In fact, as regards the ignition of the charge we have not advanced one step since the Battle of Crecy. When a small portion of powder just below the vent is converted into gas it drives the remainder forward and compresses it, so that when it ignites in, say, half the space it originally occupied, it produces double the pressure contemplated. Thus a wave is set up that the gun cannot withstand.

Sir F. Bramwell objected that Colonel Hope had, indeed, given an explanation of wave pressure when absolute length is increased, but he had not explained the question raised by Colonel Maitland, which was one of the relative length and diameter. In the diagram shown were two charges of the same absolute length; the difference was in diameter. The gun with larger diameter had the longer projectile, and the greater resistance on each square inch of cross section, yet the pressure in the bore of smaller diameter was the greater. He confessed that he did not understand why the relation of length to diameter told in this way, and he had as yet heard no explanation of it.

Herr. Kraftmeier spoke of the progress made with brown prismatic—*i.e.*, cocoa—powder, especially in an effort which was being made to suit it to field guns. The prisms were 1in. in diameter and ¾in. in height. Experiments were not yet concluded. He trusted that when the money referred to by the lecturer was voted that powder might receive its share of it.

Captain Palliser observed that Colonel Maitland's commendation of a system of construction, consisting of steel hoops of comparatively moderate dimensions, was very important in its application to the case of such arsenals as might be established by colonies. He—Captain Palliser—had just been consulted with regard to an arsenal to be established at Quebec.

Sir William Codrington moved the adjournment of the debate to Thursday, June 27th, which was carried.

CONTRACTS OPEN.

BELLARY-KISTNA AND CUDDAPAH-NELLORE RAILWAY, METRE GAUGE.

The work required under this specification comprises the construction, supply, and delivery in England, at one or more of the ports named in the conditions of tender, of iron and woodwork for underframes and bodies, with all requisite bolts and nuts and rivets complete, for putting the work together in India, and fixing the bodies to the underframes, for fifty earth or tip wagons. All fastenings, bolts, nuts, and rivets are to be supplied in quantities sufficient for putting all the work together in India, with an allowance of 20 per cent. extra for waste. The contract does not include wheels and axles. These parts will form the subjects of a separate contract. The contractor whose tender is accepted must make all such copies of the drawing exhibited as are necessary, and must prepare, at his own cost, from the specification, and from the instructions of the Inspector-General of Railway Stores, a complete set of working drawings, which are to be in every respect approved by the Inspector-General, and must be completed before the work of any part of them is commenced or any of the material for them is ordered. The general construction of the wagons is shown on drawing No. E1176, which may be seen and copied at the office of the Director-General of Stores, India-office.

Materials.—The whole of the materials used for this contract are to be of the best quality, and subject to the approval of the Inspector-General. No other material than wrought iron is to be used, except where specified otherwise, or shown on the drawings. All draw hooks, eyes, rings, and chains for the draw gear are to be forged from Staffordshire chain iron of the best quality. No iron of foreign manufacture is to be used throughout the contract. The iron must be of such strength and quality that it shall be equal to the undernamed several tensional strains, and shall indicate the several rates of contraction of the tested area at the point of fracture that follow, namely:—

	Tensional stength per square inch. Tons.	Percentage of contraction of fractured area.
Bars and rods	24	20
Plates	22	10
Channel, angle, and T-iron	22	15

The iron castings for the axle pedestals are to be sound and clean, and are to be made of a strong mixture of metal of such quality that bars 3ft. 6in. long, 2in. wide, and 1in. deep, when placed edgeways on bearings 3ft. apart, will stand a weight of 30 cwt. suspended from the centre without breaking.

Manufacture.—Every piece of iron and wood shall be manufactured with such accuracy that any piece may be used without dressing of any kind in the place for which it is designed in any of the wagons. The angle irons forming the joint between the floor, sides, and end plates are to be made and welded into one piece. The top outside angle irons must be made each in one piece, the pieces at the ends forming closing irons for the end flaps, being cranked round and not welded on. The draw hooks and chain eyes are to be forged out of the solid, and all bolt holes in them are to be drilled, and are to be provided with two chains, each 3ft. long, as shown on the drawing. The top and bottom halves of the pivots are to be forged out of the solid, and the eyes of both parts are to be faced on both sides in a machine; all holes in them are to be drilled and the pins turned. The eyes of all hinges and hinge feet are to be forged out of the solid and welded on to the arms not less than 6in. from the centre of the eye, and the eyes of both hinges and hinge feet must be faced on both sides in a machine, all holes of every kind in them being drilled and the pins turned. The cast iron pedestal bearings are to be bored out to receive the axle journal, the top of the pedestal is to be faced up perfectly true and square with the axle journal, the holes for the bolts may be cast, but they must be perfectly true and square with the top of the pedestal, and must be cleaned out with the file; any pedestal in which the journal bearing top and bolt holes are not true with each other will be rejected, the pedestals are to be fitted with wrought iron keep plates as shown on the drawing. Generally all surfaces tinted red on the drawing are to be bored or turned and finished up smooth and bright, whether mentioned in this specification or not, and all pieces of iron not bored or turned must be cleaned up with the file, and finished up in first-class style. All rivets that are rivetted up in England which are found to be loose, or to have cracked heads, or to be in any other way defective, must be cut out and replaced by others. Generally all workmanship must be of the very best class. All nuts are to be square, and must fit so tightly on their bolts that they cannot be turned by hand. Whitworth's standard gauges must be used in turning all pins, boring all holes, and forging or finishing all bolt heads and nuts, and all bolts and nuts must be screwed to his standard pitch, the bolts to a length of three diameters. The side, end, end flap, and floor sheets may be punched, provided the holes in each plate are punched either simultaneously or through a template clamped and fixed to the sheet which contains all the holes required in the sheet; the bars and angle irons connected with the sheets may be punched, provided the holes in each of them are punched through a template as above described, or they may be punched in the usual manner.

Erection.—One wagon is to be built and rivetted complete and approved by the Inspector-General as a pattern before the rest of the contract is proceeded with. The whole of the bodies are to be rivetted up complete with the end flaps, and all attachments rivetted to them, and the timbers bolted to their places. All the wooden underframes are to be framed and bolted together by the tie rods. The pivot brackets, draw chains, check plates, and cast iron pedestals are to be fitted and bolted to their places on every wagon, and then taken down and packed. Every detail must be tested by gauges at each stage of its manufacture, and be to the satisfaction of the Inspector-General. Every wagon must be completely erected, in order that the accuracy of the work may be tested, and should any in accuracies be found in any wagon so erected, the whole of such in accurate work will be rejected.

Painting, packing, and marking.—After the parts of each wagon have been inspected and approved, they are to be marked to their places in some manner to the satisfaction of the Inspector-General; each piece is then to be carefully cleaned from all rust, and all iron and woodwork is then to be painted with one coat of red lead and linseed oil, and is afterwards to have one coat of good oil paint, proper time for drying being allowed between the application of each coat. All the under frames and under-frame ironwork must be finished black. A complete description of the method of packing and delivery follows.

Drawings.—The contractor is to supply, without charge, with his second delivery, seven complete sets of general and detail tracings of the wagons, on tracing cloth. These tracings must be made to a scale approved by the Inspector-General, and must not exceed 25in. in width, and are to be delivered rolled up on a wooden roller, and not folded in any way. The contractor is also to supply, without charge, twenty large, well-executed, unmounted photographs of the pattern wagon when completely erected, taken from at least two points of view.

Tenders to be in by 2 p.m. on 1st July.

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

(*From our own Correspondent.*)

The threatened strike and lock-out of colliers in South Stafford shire and East Worcestershire is still the chief topic which engages the market's attention. The notices that the masters have served upon the men expire on Saturday next. The men continue to maintain a bold front, declaring that they will not accept the reduction which those notices enforce. Indeed, the men's leaders have now taken refuge in the statement that, as the notices were given in the middle of the week, and not on the regular pay day, they are illegal, and consequently not binding.

Upon the broad question of drop or no drop, the leaders are stating that a reduction of wages at the present time means that "the miners and their families are to be half starved;" and they further assert that "there is to be no corresponding reduction in the prices of coal." "Therefore," they point out, "the masters, and not the consumers, would get all the benefit."

At a few of the collieries the men have, the leaders state, been informed that their wages are to be reduced not 4d., but 6d. per day or stint; and they repeat their contentions that the principal evils of the trade just now are selling coal for slack, over-weight, and underselling. These practices they desire to put down. The masters are firm in their determination to have the arbitrator's award observed. It is understood that Mr. E. Fisher-Smith, the agent of the Earl of Dudley, has informed the Coalmasters' Association, of which his lordship is not a member, that he is fully prepared to lock-out the men if the leading members of the Association will act in unison with him. This being Mr. Smith's decision, the other firms are only too glad to co-operate, believing that the men's leaders have become so overbearing that a lock-out would be beneficial rather than otherwise.

A large meeting of coalmasters was held to-day—Thursday—in Birmingham. Mr. Cochrane, chairman of the association presiding, at which it was unanimously resolved that the colliers be not allowed to resume work after Saturday excepting upon the terms of Mr. Rowland's award. The meeting recognised the principle of subsidising firms who may be compelled to pump water. Mr. Fisher Smith wrote stating he was in full accord with the action of the meeting.

The quarterly meetings of the iron trade are fixed to come off in Wolverhampton on Wednesday, July 9th, and in Birmingham on Thursday, July 10th. In the face of these gatherings being near at hand, and in consequence of stock taking—now that Midsummer Day has turned—having begun, merchants are withholding somewhat the placing of new orders of magnitude. This week, therefore, the works are running chiefly upon hand-to-mouth contracts. Sheets and bars are the sections mostly demanded. Competition for orders keeps keen, alike from Yorkshire, Lancashire, and the North of England, and prices are still very low.

On 'Change this afternoon in Birmingham the opinion was entertained that there will be no declared alteration in prices at the quarterly meetings, but that the Earl of Dudley's bars will be re-declared at £8 2s. 6d., and those of the other "list" houses at £7 10s. to £7. All-mine pigs will at the same time, probably, be re-announced as 60s. for hot blast and 80s. for cold blast sorts.

The threatened colliers' strike has not made consumers wishful to buy iron in advance, nor has it had much effect upon the demand for coal, as the ironmasters know that they will have open to them the undisturbed supplies from Cannock Chase and from other outside districts. Prices are without much alteration upon the lists given in my last. Medium bars are £6 10s., and common, £6 to £5 15s. Hoops are £6 5s. to £6 10s. at works; gas strip, £5 15s. upwards. Sheets, singles, are £7; doubles, £7 10s.; and lattens, £8 10s. easy. Pig vendors reported to-day only a quiet business. The considerable sales that are sometimes experienced during the fortnight before quarterly meetings were to-day absent. Consumers are fully of opinion that they have nothing to lose by waiting. Part-mine native pigs were 45s., and cinder sorts, 40s. Northamptons were 42s. to 42s. 6d., and Derbyshires, 43s.

So satisfied are Messrs. Nettlefolds with the working of the Clapp and Griffith's process of steel making at their axle works near Wellington, Shropshire, that they have determined to erect at once another converter, upon the same principle.

Mr. Percy C. Gilchrist, one of the inventors of the basic steel process, and Mr. L. G. Fitzmaurice, the manager of the new works of the Staffordshire Steel and Ingot Iron Company, have taken out a joint patent for the easy fixture and removal of the Bessemer converters, when in the course of regular work one has served its purpose, and another is waiting with a new lining to be dropped into its predecessor's place.

The iron and steel wire manufacturers of Birmingham state that the reductions which they recently announced in prices are far larger than is proportionate to the drop in wages obtained at the close of the recent strike. It is the belief of Mr. F. Nettlefold that if the workmen and masters act together, they will be able to win back much of the trade which has left this district and England for the Continent.

Certain of the bridge and gasometer builders are busy on contracts for home and export, but pipe and other ironfounders have not an average amount of work. Bridge builders note that the East India Railway Company is inquiring for the supply of steel superstructures for the two central piers of the Hooghly Bridge. Also that the Midland Railway Companys want ironworks for the reconstruction of a bridge over its line near Bredon station, on the Birmingham and Gloucester branch.

The vice and anvil manufacturers of Dudley—which is the seat of the trade—are complaining that British goods are being driven out of the continental markets by the prohibitory duties, and certain of them fear that "unless something is speedily done," the European markets will be in a great measure lost to us.

Divided opinions are entertained by traders in the Birmingham district concerning Mr. Chamberlain's reply to the influential deputations of manufacturers and others which waited upon the right hon. gentleman last week relative to the proposed new Railway Bill. Some consider the reply fairly satisfactory, while others still strongly hold the opinion that Mr. Chamberlain should especially withdraw that part of the measure which deals with terminal charges. The Birmingham Chamber of Commerce have decided to shortly convene a meeting of the freighters to consider certain of the provisions, and the Council of the Dudley Chamber resolved on Tuesday that terminal charges should be confined to extra services rendered by railway companies over and above what was granted by Act of Parliament.

It has been determined that the autumnal session of the Associated Chambers of Commerce which is to be held this year in Wolverhampton shall open on September 30th.

The Birmingham and Wolverhampton Chambers of Commerce have just refused the prayers of the Liverpool Chamber asking for their opposition to the Manchester Ship Canal, and instead they have decided to continue to give the Bill their support.

With the exception of Leeds—and Leeds, it has to be remembered, is right in the middle of a coal-field producing gas coal—the Corporation of Birmingham claim that they are now supplying gas consumers with light at a cheaper price than any other Corporation in the kingdom, namely, an average, after the discount has been taken off, of 2s. 1d. per 1000ft. Yet, by the profits which the Gas Committee and the Water Committee have annually handed over to the Corporation, the rates of the borough have been reduced since 1880 by very nearly 1s. in the pound. The ratepayers are, however, now demanding that for the future a larger proportion of the annual gas profits shall be devoted to the interests of the existing generation, and it seems likely that the Gas Committee will before long accede to the request.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The iron trade of this district continues all though in a depressed condition, and there is still an absence of any encouraging feature in the future upon which to base any hope of improvement. Weakness continues to characterise the market throughout, and it would seem as if the persistent downward tendency of prices could only be arrested either when a point has been reached at which it is utterly impossible to produce iron at less money, or makers determine to relieve the market of the present pressure of surplus supplies by a reduction of the output. There is certainly nothing to indicate that the demand for iron is of itself likely to give a firmer tone in face of the present means of production, and with the failure of low prices to bring forward any weight of buying, the blowing out of furnaces, and the closing or running of forges on short time, seems to be the alternative which most commends itself to ironmasters.

Very little business was reported on the Manchester iron market on Tuesday, either in pig or manufactured iron, and with the exception that outside brands, such as Scotch and Middlesbrough, still maintain a tolerably firm tone, prices if anything were generally rather easier. Lancashire pig iron makers still ask 43s., less $2\frac{1}{2}$ per cent., for forge and foundry qualities, delivered equal to Manchester; but the few offers that do come forward are, as a rule, at under this figure, which practically keeps local brands out of the market, in face of the lower prices at which district brands can now be bought. The brands which at present are competing the most keenly in this market are those from Lincolnshire, which are being offered at about 42s. to 42s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities, delivered here, and in some cases they could be got at even a little under these figures. Derbyshire brands are also coming into this market at very low figures, and in some cases can be bought at about 43s. to 44s., less $2\frac{1}{2}$, delivered here.

The question of blowing out some of the Lincolnshire furnaces is under consideration, and, although it has not yet been definitely decided to take this step, it is more than probable that the present depressed state of trade will before long necessitate a reduction of the output.

Hematites still meet with very little inquiry; nominally quoted rates remain unchanged, but prices are weak.

The finished iron trade is extremely quiet, and one large maker told me he had not known it in a more depressed condition for years past. Not only is the home trade exceptionally dull, but the shipping season has brought forward none of the usual activity at this time of the year, and what trade there has been doing appears to have gone largely to Scotland. Nominally £5 15s. is still the quoted price for good local and North Staffordshire bars delivered into this district, but for good specifications makers are in many cases open to entertain offers, and common bars can be got readily at about £5 12s. 6d. per ton; hoops average about £6 2s. 6d. per ton delivered into this district.

An announcement, which illustrates the present condition of the finished iron trade, is made to the effect that the ironworkers employed at the Ince Works of the Wigan and Ince Hall Rolling Mills have received seven days' notice to terminate all contracts, and it is believed to be the intention of the company to close the works for the present owing to the severe depression prevailing in the iron trade. This will affect a large number of workmen, and unless trade speedily revives it is added that the proprietors will be reluctantly compelled also to close their works in Woodhouse-lane. I may add that in other large finished ironworks in Lancashire a resort to short time has been necessary owing to the scarcity of orders.

The attempt to float a company for the purchase of the Gidlow Coal and Ironworks at Wigan, to which I referred a week or two back, appears to have fallen through, a result which was only to be expected in the present state of trade, and the works are to be offered next month for sale by auction.

The reports which I receive from well-informed quarters as to the condition of the engineering trades are to the effect that although there is still a fair amount of activity generally, there is a decided, if not serious falling off in the weight of new work coming forward. Locomotive builders in this district who have had a long run of activity, and have indeed been pressed with an accumulation of orders, are now practically busy only finishing old contracts, with very little new work coming in, and the reports which have recently appeared of large orders having been booked in other districts are very much exaggerated. With regard to tool makers, those firms engaged on heavy marine work are getting quiet, but there is still a good deal in hand amongst the established well-known makers, and in special work activity is being well maintained, so that this branch of trade can scarcely be said to be in really unsatisfactory condition, except so far at the prices at which work has to be taken are concerned. Machinists are still kept tolerably well employed on the large foreign orders recently booked in this district, but I do not hear that these are being followed by any further large weight of new work.

The fact that Government have recently been placing out contracts abroad for iron and steel required in the construction of Indian railways has naturally given rise to a good deal of severe comment in the North of England, and the replies given to the questions put by Mr. W. H. Houldsworth a short time back, and to Mr. Fowler this week, are not looked upon as by any means satisfactory. The general feeling is that, although an apparently plausible justification may be given for the course of action taken, the Administration of the Indian Railways is carrying work out of the country when every branch of the iron trade throughout the kingdom is languishing and suffering for want of employment. It is also further urged that it is scarcely fair that English capital should be embarked in the extension of Indian railways if the result of this activity is simply to carry work into the hands of Belgian manufacturers—orders which might be placed with the English makers, and I may add that the difference in the contract prices is not regarded as the only point at issue.

The coal trade all through Lancashire is extremely quiet. All classes of round coal are bad to sell, and engine fuel, notwithstanding the lessened production of slack, is still fairly plentiful. The demand generally is not more than sufficient to keep pits working three or four days a week, and where they are kept running more than this, stocks are being put down. Pit prices are now so low that there is not much margin for further reduction; and in the ordinary quoted rates there is no material change, but for quantities to clear away stocks under load very low prices are taken, and there is a downward tendency in the market. It is, however, only in a few exceptional cases that any actually announced reductions in the quoted pit prices are being made with the close of the month; but in the Manchester district the delivered rates on all classes of round coal are being reduced 10d. per ton, and on engine fuel 5d. per ton.

The shipping trade continues quiet, with very low prices ruling both at Liverpool and Garston, Lancashire steam coal being delivered at the above port at 7s. per ton.

The question of a reduction in wages in the South West Lancashire district, to which I referred last week, is now taking more definite shape. A special meeting to consider the matter was held in Liverpool on Monday, and although one important section of the district was not represented, a sufficiently unanimous feeling was expressed to enable definite action to be taken, and at some of the collieries notices for a reduction of 10 per cent. will be posted next week.

Barrow.—I have no change to report this week in the condition of the hematite pig iron trade of this district. Business remains very quiet all round. The market has remained firm, however, throughout the week, and the prices last quoted have been well maintained by makers, viz., No. 1 Bessemer samples, 48s. per ton net at works; No. 2, 47s. 6d.; and No. 3, 47s. per ton. The demand has not improved on home account, but pig iron is selling a little better to Russian consumers, and the shipments are now larger than they have been for some time past. Buyers are not placing much confidence in makers, and appear to be waiting for a further drop in prices. The weight of metal now on hand is considerable, the output having been well maintained, although it is nothing like what it was a few months ago. Stocks are not diminishing. The steel trade continues briskly employed, and some good orders are being received from both home and foreign consumers. Rails are selling at about 90s. per ton net at works, prompt delivery. Merchant qualities are also asked for, and wire is in good demand. There is no change in the shipbuilding industry of the district, works continuing almost at a standstill. Engineers and boiler-makers quiet. Iron ore in rather increased demand at last week's rates. Coal and coke easier. Shipping freights low.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE officials of the Yorkshire Miners' Association are bestirring themselves in view of Mr. Burt's action on mining legislation. The member for Morpeth is to move a resolution on July 4th to the following effect:—"That, considering the great development of the mining industry of Great Britain in recent years, the number and extent of the mines, their increase in depth, and the large number of persons employed therein, this House is of opinion that the time has come when there should be a considerable addition to the staff of inspectors of mines." The Home Secretary has consented to receive a deputation from the members of trades unions on July 2nd, in reference to the question. The last increase in the number of inspectors of mines was made in 1872, when the output of coal was 123,000,000 tons, while the output last year was 163,000,000 tons. The Yorkshire Miners' Association have appointed their president—Mr. E. Cowly—Mr. B. Pickard and Mr. John Frith—secretaries—with Mr. W. Parrott, treasurer, and three other delegates to attend the deputation to the Home Secretary.

After nine weeks' strike, the Elsecar ironworkers, pressed by the distress which prevails in the district, have returned to their employment.

The proposed amalgamation of the Chesterfield and Barnsley Institute of Engineers, and the removal of the headquarters to Sheffield, is being vigorously opposed at Chesterfield.

The proposal to found a technical school, in connection with Firth College, is making rapid progress. At a meeting of the Firth College Council, held on Tuesday, it was reported that the funds at the disposal of the Technical Committee, including the donations lately promised by the Duke of Norfolk of £3000, and the Duke of Devonshire of £500, now amount to a capital sum of £10,300, and a yearly income of £845 for five years. It has been decided to advertise for professors of metallurgy and mechanical engineering at salaries of not less than £300 per annum.

The annual meeting of the Ebbw Vale Steel, Coal, and Iron Company was held at Manchester on the 25th inst. The chairman—Mr. Edward Coward—stated that during the year the company had rolled a much larger quantity of steel rails than they had rolled before—116,000 tons against 113,000 tons in 1883, and 90,000 tons in 1882. But the prices were unremunerative, and the company had also been obliged to work short time during a portion of the year, the fact being that the productive power of the rail mills was greater than the consumptive power. Mr. Coward incidentally confirmed my statement that a confederation of English and foreign rail makers had been formed. "Prices had been forced so low," he said, "at the end of last year, that the steel rail makers of England and Scotland, with one exception, and most of the makers in Belgium, Germany, and Austria, had agreed together to decrease the production *pro rata*, according to what they had before rolled, with the result that during the last few months they had got an improved price for the manufactured article."

Messrs. John Brown and Co., Limited, Atlas Steel and Ironworks, also held their annual meeting on the 25th inst. It being the twentieth year of the company's existence, the chairman—Mr. J. D. Ellis—reviewed its history. Mr. Burridge, managing director, gave encouraging accounts of the state of the company's business and position, and the report recommending the payment of a dividend of £5 per share for the year—£6 13s. 4d. per cent.—and carrying forward £15,193 to reserve—now increased to £100,000—was adopted.

The first sod of the new sewage works of the Sheffield Corporation at Blackburn Meadows was turned on the 25th inst. Messrs. Wm. Bissett and Son, Sheffield, have the contract for this section, which will cost about £24,000, the total expense of the complete scheme being £150,000. The system adopted is that of precipitate, and the works will be erected under the superintendence of Mr. Alsing, C.E.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE improved tone in the Cleveland pig iron trade, which began to be noticeable about three weeks ago, has been steadily maintained during the past week, and considerable quantities of iron have been sold. At the market held at Middlesbrough on Tuesday last a brisk business was done, and as there was practically no iron in second hands, the makers obtained without difficulty the prices they asked. Consumers seeing that there was nothing to be gained by holding back purchased freely, but only for prompt delivery. The lowest price at which No. 3 g.m.b. can now be bought is 37s. per ton, but there are several makers who will not accept less than 37s. 6d., and that price is obtainable for picked brands. The demand for forge iron is somewhat easier, but the price remains steady at 35s. 6d. per ton.

Warrants are nominally 37s. per ton, but sales are few and far between.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s store at Middlesbrough continues slowly to decrease. On Monday last the quantity held was 58,207 tons, being a reduction of 92 tons for the week. At Glasgow their stock on Monday was 589,387 tons, or a decrease of 600 tons.

The monthly quantity of pig iron shipped from the Tees up to Monday last was 60,469 tons, being about 4000 less than during the same number of days in May, and about 14,000 tons less than during a similar portion of June last year.

The manufactured iron trade continues quiet, very few mills being now in operation. Those manufacturers who are still able to supply stand firmly to the prices which have been quoted during the last few weeks. Ship-plates are £5 to £5 2s. 6d. per ton; angles, £4 15s. to £4 17s. 6d.; and common bars, £5 2s. 6d. to £5 5s.; all free on rails at works, less $2\frac{1}{2}$ per cent.

The Hartlepool Malleable Ironworks, which were laid idle last week, are at work again this week.

About 150 workmen were paid off by Messrs. Doxford and Sons at their shipyard at Sunderland last Saturday.

The Wheatley Hill and Thornley Collieries were offered for sale by auction at Newcastle on Saturday last. There was a large attendance, but no bid was made. These collieries comprise an area of 2080 acres, and it is estimated that with an output of 250,000 tons of coal per annum, they would not be exhausted in fifty years.

It is reported that a new company is being formed at Middlesbrough to erect blast furnaces for the production of iron of a superior quality from ores to be obtained from Devonshire and elsewhere.

It will be remembered that the proposition to reduce puddlers' wages 3d. per ton, and other forge and mill wages $2\frac{1}{2}$ per cent., was subject to confirmation by the subscribers to the Board of Arbitration. The result of the balloting at seventeen works has now been made known. Twelve of the works with 6325 subscribers were in favour of the reduction, and five works with 2245 subscribers were against. The arrangement is therefore confirmed.

A town's meeting was held in Middlesbrough on Tuesday evening under the presidency of the Mayor, to consider what means should be taken to provide work for the unemployed, and sustenance for those who cannot work. From statements made by various persons conversant with the condition of the working population, it seems that great destitution and distress already prevails, and immediate relief is necessary. Fortunately a balance of nearly a thousand pounds remains from a fund collected in 1879, the complete distribution of which became unnecessary because of the sudden advent of the American boom. This sum has been handed over to a Relief Committee already organised. Whilst disbursing it they will endeavour at the same time to substantially maintain it by fresh contributions, and so make it last out till better times.

Now that the East Coast operatives are idle in thousands, and pig iron, coal, and other raw materials are leaving the country as freely as ever, in order to be worked up into higher products where that can be done more economically than here, it behoves those operatives to turn their thoughts to their habits, and rectify whatever therein is found wasteful and mischievous. Drunkenness and gambling are their two besetting sins. The former vice is already energetically denounced both from the pulpit and the platform, and many organisations exist having for their object its suppression. But gambling is seldom decried, and indeed few are aware of the terrible extent to which it is practised by the northern operative. Middlesbrough, North Stockton, and South Stockton, each have their place of resort for gambling in the open, and every day during the dinner hour hundreds may be seen, mainly workmen, but sometimes including boys and women, all busily engaged in betting with professional bookmakers. These latter individuals, parasites as they are, live lives of ease and luxury on their ill-gotten gains. Their dupes are kept impecunious in good times, and in periods of depression have, of course, nothing to fall back on. Attempts of a more or less feeble character have been from time to time made to put down this miserable system, to keep the fools apart from the knaves, to separate the blindfold yet self-confident victims from the vampires who feed upon them; but these attempts have so far been only half-hearted, and naturally unsuccessful. Possibly idle works with active store yards, streets of empty houses with full workhouses, disease, want, and starvation stalking rampant through the land, may open the eyes of local authorities and of bookmakers' victims to the utter unwisdom of such practices, even though all other means may have heretofore failed.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

AFTER being very firm till near the close of last week, the Glasgow pig iron market became quieter, and the quotations of warrants have since been slowly declining. The causes that led to large purchases last week have passed, and the likelihood is that the market will now assume a quieter position. The shipments of pigs, which amounted to 12,731 tons, compared favourably with those of the preceding week, but are considerably short of the quantity despatched in the corresponding week of 1883. There is no change in the amount of the current production, but there is a likelihood that one or two furnaces may go out soon. The week's decrease in the stock of Scotch pig iron in Messrs. Connal and Co.'s Glasgow stores amounts to fully 500 tons.

Business was done in the warrant market on Friday at 41s. $6\frac{1}{2}$d. cash. On Monday forenoon transactions occurred at 41s. $5\frac{1}{2}$d., 41s. 7d., and 41s. 6d. cash, the afternoon quotations being 41s. 6d. to 41s. $4\frac{1}{2}$d. cash. The market prices on Tuesday morning were 41s. 4d. to 41s. 5d. cash, and in the afternoon the market was steadier at 41s. 6d., with, however, very little doing. Business was done on Wednesday at 41s. $5\frac{1}{2}$d. to 41s. $3\frac{1}{2}$d. cash. To-day—Thursday—the market was quiet at 41s. 3d. to 41s. 4d. cash.

The market prices of makers' iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 6d.; No. 3, 50s.; Coltness, 57s. and 50s. 6d.; Langloan, 53s. 6d. and 51s.; Summerlee, 50s. 6d. and 47s.; Calder, 52s. and 46s. 6d.; Carnbroe, 50s. 6d. and 47s.; Clyde, 47s. 6d. and 45s.; Monkland, 43s. 6d. and 40s. 3d.; Quarter, 42s. 6d. and 40s. 3d.; Govan, at Broomielaw, 42s. 6d. and 40s. 3d.; Shotts, at Leith, 51s. 6d. and 51s.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 50s. and 43s. 6d.; Eglinton, 44s. 6d. and 41s.; Dalmellington, 46s. 6d. and 42s. 6d.

The inquiry for hematite pig iron is not so good, and the stocks are on the increase.

The total imports of Cleveland pig iron into Scotland up to Saturday last were 121,680 tons, being a decrease of 6562 tons for the year to date.

In the manufactured iron trade there is no improvement, and prices remain nominally unaltered since the reduction of last week. The week's exports of iron and steel goods from Glasgow are valued at £63,000.

Coals are in rather less demand both for home use and shipment. The shipments from Glasgow in the past week embraced 2900 tons to Montreal, 3000 tons to Rio de Janeiro, 850 to Bordeaux, and smaller quantities to other places. At Grangemouth 8600 tons were despatched, and considerable cargoes at the other Forth and the Ayrshire ports. Prices are nominally unchanged in most districts. Quotations at Burntisland are 6s. 6d., 6s. 9d., and 7s. per ton f.o.b. Home orders are scarce all over. In the Lanarkshire colliery districts the miners are not now keeping so closely to their policy of restricted labour. The annual summer holidays are at hand, and the men are working longer in order to have a little more money for holiday purposes. Coalmasters have full supplies at present, and they state that unless trade improves they will be obliged to reduce wages. On the East Coast there have been some pressing shipping orders for Russia, but these are now all but met.

A seam of Dunnet shale 5ft. 10in. in thickness has been discovered by boring in the Crosswoodhill property of the Lanark Oil

Company. The shale is of good quality, and the deposit is believed to be extensive.

A strike of six weeks' duration at the Allanshaw Colliery, near Hamilton, has now terminated, the colliers having gone to work on the masters' terms.

In reply to a letter from Mr. Weir, the miners' representative, the Secretary of the Fife and Clackmannan Colliery Owners' Association has stated that in the present condition of trade and prices it is impossible to give an advance of wages. At the same time the colliery owners express their willingness to meet with the men and arrange a sliding scale for the regulation of wages.

Several fresh shipbuilding contracts have been received on the Clyde since my last report, but they are quite insufficient to supply the places of vessels that are being launched. Messrs. D. J. Dunlop and Co., engineers and shipbuilders, Port Glasgow, having completed all their orders, discharged the whole of their workmen last Friday evening. At Greenock the engineering firms have given notice that at the termination of the Fair holidays, which begin next week and generally extend over about ten days, the wages of artisans will be reduced ½d. per hour, and those of labourers half that amount.

Messrs. Denny and Co., Dumbarton, have intimated a reduction of 7½ per cent. on the wages of the workmen in their engineering and boiler-making shops.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

When the line from the Rhondda to Newport was but half completed I was speaking one day to a director of the Taff Vale Railway, and hazarded a surmise that his company would want the line when finished. "There are many things more unlikely," he rejoined, with a significant look. So I am not at all surprised at the statement made by Sir George Elliot that it is wanted. It will be a good thing all round; the Taff organisation is perfect, and its extension to the new line will free the early life of the Newport, Caerphilly, and Pontypridd line from the usual results of want of experience.

The Barry inquiry in the House of Commons is now almost at an end, and the whole of the district is awaiting impatiently the result. When the decision is given I may refer to some important points that have been raised as to the probable duration of the coalfield of South Wales. One party was not represented in the House—the people; and the voice of the people is emphatically against any more outlets than those now existing, or in course of formation. The voice of the people says: "We do not want to hurry off our best coals at highest pressure. It may enrich a few; but what shall we do in twenty years hence when our best coals are gone, and we have only the lower coals, which cannot be worked so cheaply as the best, and must of necessity place us second in the market of the country?"

The output in every valley has been well sustained this week, and Cardiff, Newport, and Swansea keep up their averages capitally. On the railways the briskness of the coal trade is well shown, and enormous quantities are being run on the Taff Vale, Great Western, Midland, London and North-Western, and Brecon. In fact travelling on the Taff line is an excellent way of seeing the enormous quantity grappled with, and this week no congestion was to be met with, and the flow down seawards was uninterrupted.

Several good coal finds have come to light of late, one in the direction of Ogmore; the other, Blackwood; and an excellent quality of coal has been won.

Apart from the coal, the other industries are not flourishing. Iron and steel rails are in slight request; bars fairly good at low prices, and tin-plate flagging again. Patent fuel is in tolerably free demand, particularly at Cardiff and Swansea. From the latter place the shipments last week amounted to 10,000 tons, quality all that could be desired.

The organisation of the engineers and stokers of South Wales is becoming more settled and perfect, and it is evident that the intention of promoters is to make essays in matters of time and wages. The eight hours' movement is strongly advocated, and at a meeting held this week at Aberdare it was shown that there was an urgent need for equalisation of wages. From Treharris to Hirwain at present the wages vary from 3s. 2d. to 3s. 7d., and from Nantyglo to Blaina, 3s. to 3s. 6d.

The Caerphilly district of colliers recommend that the men of Coedcefn colliery work out their notice, but do not continue, as the coal of that colliery is to be worked by contract. They have also recommended the men at Rudry to refrain from "pushing the trams to and from several parts" of the colliery, such not being their labour. In other parts of the coal valley the colliers are working with a good deal of earnest cordiality, the grave questions of wages and doctors being effectually at rest.

The Newport Chamber of Commerce has had the amended Shipping Bill before it, and having warmly discussed it, rejected it by a majority of 15. The prominent members did not deny but that a measure of some sort was called for, but with respect to the Board of Trade, they maintained "that all should unite in the agitation for its reconstruction, as at present the name was a misnomer. There was no Board of Trade, and the legislation for shipping during the last twenty years had been a failure." It is clear that, as far as Newport is concerned, a Minister of Marine is regarded as a necessity.

One man has been killed, and six injured, by a fall in one of the Abercarne coal pits this week.

The new dry dock has been opened at Cardiff this week. Now that the Tyne steamers come here to coal, dry docks are increasing, and so far pay well—some as much as from 10 to 15 per cent.

Another grievance has occurred at the various ironworks. They are getting into straits for want of water. If they worked full time instead of half a week only, a still greater mischief would be caused. Times are emphatically dull, and most of the works are accumulating financial burdens. I hear of one which paid away last year £15,000 sterling to the bad.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

17th June, 1884.

9040. Holdfast, H. G. Norrington, Exeter.

9041. Self-signalling Target, G. Edwards, Rainbow Hill.

9042. Combined Convertible Safety Lamp, R. E. Astley, Croxdale.

9043. Tent Pegs, H. M. Goodman, Birmingham.

9044. Seed-sowing Machine, D. Jones, Warborne.

9045. Sewing Machines, J. H. Johnson.—(*J. L. Follett, New York, U.S.*)

9046. Appliances for Toasting Bread, &c., J. Leiper, Bryn Efa.

9047. Casting Metal Articles, T. Withers, West Bromwich.

9048. Stenographic Printing, W. P. Thompson.—(*J. A. Mathieu, Detroit, U.S.*)

9049. Carbonising Apparatus, W. P. Thompson.—(*J. A. Mathieu, Detroit, U.S.*)

9050. Mechanical Telephone, W. P. Thompson.—(*A. A. Knudson, Brooklyn, U.S.*)

9051. Bicycles, &c., A. J. Tonkin, Bristol.

9052. Fishing-rod Joints, R. Heaton, Birmingham.

9053. Loose Paper Clip, C. H. Brampton, Birmingham.

9054. Screw Stocks, J. E. Walsh.—(*C. C. Flamme, Hof, Bavaria.*)

9055. Cementing Leather Fabrics, &c., T. Carter, London.

9056. Propelling Tricycles, &c., J. Wheatley, Abergavenny.

9057. Dabbing Brushes, W. Robertshaw and E. Cockcroft, Allerton.

9058. Brushes, J. Danks, London.

9059. Drying Moist Sheets of Paper-board, &c., J. H. Johnson.—(*F. Flinsch, Germany.*)

9060. Wire Fencing, A. Shepherd, Meigle.

9061. Ventilating Tunnels, &c., W. Clutterbuck, London.

9062. Chairs, C. A. Day.—(*J. S. MacKaye, U.S.*)

9063. Non-conducting Composition for Protection against Heat, S. P. Wilding.—(*Wirth and Co., Germany.*)

9064. Automatic Swimming-bait for Angling, M. C. Campbell, Walthamstow.

9065. Gas, S. C. Salisbury, New York, U.S.

9066. Anti-friction Bearings, P. Brownley, St. John's, Canada.

9067. Refrigerators, H. C. Goodell, Atchison, U.S.

9068. Steam Engine Slide Valve, M. C. Baker, New York, U.S.

9069. Toy Air Gun, &c., H. J. Allison.—(*E. J. B. Whitaker, New York, U.S.*)

9070. Cork Strips for Covering Pipes, &c., J. Bourdon, Paris.

9071. Preventing Smoke in Domestic Fire-grates, R. H. Hepburn, London.

9072. Gas or Oil Stove, R. W. Boyd, London.

9073. Stove for Introducing Fresh Warmed Air into Rooms, R. W. Boyd, London.

9074. Sewing Machines, J. Thomas, Bristol.

9075. Horse-rakes, W. F. Walker, Norfolk.

9076. Taps or Valves, G. Chisholm, Stirling.

9077. Crushing Quartz, H. Moon, Leicester.

9078. Ventilating Belt Corset, W. Rushton, Landport.

9079. Knitting Machinery, J. Berton, Paris.

9080. Reeling Silk, &c., H. E. Newton.—(*O. Atwood, New London, Connecticut, U.S.*)

9081. Formation of the Holes for Separators, &c., F. J. Drechsler, London.

9082. Water-cooled Valve, A. J. Boult.—(*J. Hanlon, New York, U.S.*)

9083. Railway Chairs, F. Keeling and R. Rigley, Bulwell.

9084. Illuminating, &c., Gas, A. J. Boult.—(*J. Hanlon, New York, U.S.*)

9085. Water Meters, L. H. Nash, Brooklyn, U.S.

9086. Water Meters, L. H. Nash, Brooklyn, U.S.

9087. Mechanical Movements, A. J. Boult.—(*L. E. Wallermann, Milwaukee, U.S.*)

9088. Water Meters, L. H. Nash, Brooklyn, U.S.

9089. Water Meters, L. H. Nash, Brooklyn, U.S.

9090. Hose Reel, A. J. Boult.—(*H. L. Gardner, Springfield, U.S.*)

9091. Producing Wall-paper, &c., H. W. Johns, New York, U.S.

9092. Recovery of Exhaust Steam, A. J. Boult.—(*D. Renshaw, Braintree, U.S.*)

9093. Automatic Sky Battery, E. de Pass.—(*F. A. Gower, Paris.*)

9094. Directed Sky Battery, E. de Pass.—(*F. A. Gower, Paris.*)

9095. Envelopes, &c., D. Greig, jun., and J. W. Thackery, Leeds.

9096. Explosives, W. A. Barlow.—(*A. Gacon, Paris.*)

9097. Bracelet, A. S. Openshaw, London.

9098. Brushes, H. H. Lake.—(*F. L. Fenerty, Halifax.*)

9099. Electrical Wires, &c., H. H. Lake.—(*J. J. Williamson, Boston, U.S.*)

9100. Setting for Jewellery, H. H. Lake.—(*C. A. Fowler, New York, U.S.*)

9101. Letter Files, &c., H. H. Lake.—(*W. H. Gilman, U.S.*)

9102. Carbon, J. W. Gatehouse, Bath.

9103. Gas Producers, C. D. Abel.—(*F. Siemens, Dresden.*)

9104. Metal-cased Insulated Electric Conductors, J. S. Raworth and R. A. Smith, Manchester.

9105. Protecting Iron Surfaces from Damp, J. Brydson, Kingston-upon-Hull.

9106. Fastening Devices for Gloves, &c., H. H. Lake.—(*W. S. Richardson, Boston, U.S.*)

9107. Producing Carbonate of Strontium, &c., E. F. Trachsel, London.

9108. Cultivation of Oysters, A. P. Price, London.

9109. Metallic Packing for Piston, &c., Rods, C. T. Sleeper, Chicago, U.S.

9110. Locks for Fire-arms, J. Victor, Perry, Illinois, U.S.

9111. Hot-air Engines, W. Schmidt, Germany.

9112. Gas or Oil Motors, L. A. Groth.—(*G. Daimler, Germany.*)

9113. Electrodes, J. S. Beeman, London.

9114. Castor for Chairs, H. B. and H. R. F. Bourne, London.

9115. Operating Electrical Switches, H. B. and H. R. F. Bourne, London.

9116. Electrically Measuring Distances, &c., H. B. and H. R. F. Bourne, London.

9117. Tram Rails, E. Edwards.—(*E. Willmann, Dortmund, Germany.*)

18th June, 1884.

9118. Cutting Fabrics, G. H. Smith and B. Cooper, Manchester.

9119. Ventilating Rooms, &c., W. Potts, Edinburgh.

9120. Grippers for Rotary Cylinders, G. A. Wilson, Liverpool.

9121. Rifled Torpedo, W. J. Murphy and J. R. Foster, Richmond, Cork.

9122. Revolving Carriages, J. H. Potter, Poole.

9123. Carriage Springs, &c., G. Simmons, Liverpool.

9124. Pencils, J. F. Williams, Derby.

9125. Machine for Working Sides of Nuts, A. von Babo, Baden.

9126. Hinges, J. Thomas, jun., Wrenbury.

9127. Driving Bands, G. Perrott and G. Perrott, jun., Cork.

9128. Securing Wire to Frames, G. L. Scott and I. Chorlton, Manchester.

9129. Coupling, &c., Vehicles, T. Veitch and S. Hanna, Edinburgh

9130. Securing Concrete Slabs to Framing, J. S. Haslip, Maidstone.

9131. Hose Reel, &c., J. W. Duncan and W. Tennant, Sunderland.

9132. Raising, &c., Covers of Boxes, J. N. Favell, Sheffield, and E. Fletcher, Heeley.

9133. Weighting Stoppers for Bottles, R. Walton, Colne.

9134. Handles for Cutlery, W. Binks, Sheffield.

9135. Filtering Fluids, W. A. Hepburn, Ramsbottom.

9136. Looms for Weaving, G. H. Hodgson and W. Tetley, Bradford.

9137. Roasted Coffee, J. S. Richardson, London.

9138. Saddle-bars, S. Davis, London.

9139. Fire-bars, R. and W. Welford, Sunderland.

9140. Gas Lamps, J. D. Ready and C. Mason, Staffordshire.

9141. Accumulators for Batteries, W. B. Brain, London.

9142. Multiple Cylinder Engines, F. Wynne, London.

9143. Neck-ties, &c., R. Latham, and H. W. Wickins, London.

9144. Nuts, A. Johnson, Hampden, U.S.

9145. Bread, H. Shaw, London.

9146. Garden Edgings, A. Smith, Goudhurst.

9147. Perambulators, A. Brochelbank, London.

9148. Applying Bronze to Printed Surfaces, P. Lawrence.—(*Lawrence and Baxter, New York, U.S.*)

9149. Marking Ink Pencils, J. Hickisson, London.

9150. Ventilating Railway Carriages, A. Miller, London.

9151. Amalgamating Apparatus, A. Miller, London.

9152. Furnaces, C. D. Abel.—(*J. and C. J. Haswell, Vienna.*)

9153. Shawl Straps, J. H. Johnson.—(*E. Marx, New York, U.S.*)

9154. Hoisting Bales, L. H. Brock, Alexandria.

9155. Driving Velocipedes, D. Jones, London.

9156. Knife-cleaning Apparatus, W. Fabian and A. Teller, Hamburg.

9157. Jointing Chains, W. R. Lake.—(*J. L. Robert, Paris.*)

9158. Signalling Apparatus, W. R. Lake.—(*B. Schneider, Germany.*)

9159. Silos, J. Howard and E. T. Bousfield, Bedford.

9160. Clocks, W. R. Lake.—(*A. Vanoli, Germany.*)

9161. Valve Gear, R. de Palacios, Berlin.

9162. Producing Yellow Colouring Matter, J. Erskine.—(*Farbenfabriken vormals F. Bayer and Co., Elberfeld.*)

19th June, 1884.

9163. Transmitting Currents, M. H. Smith, Halifax.

9164. Cooking Ranges, G. Birkitt, Derby.

9165. Compressing Ensilage in Silos, A. Seward and H. G. Walton, Liverpool.

9166. Corsets, W. P. Thompson.—(*M. Borsarelli, Marseilles, France.*)

9167. Gas Motor Engines, T. M. Williamson, J. Malam, and W. A. Ireland, Southport.

9168. Double Spiral Springs, G. Lumb, Halifax.

9169. Suction Hose, J. Jones, Dublin.

9170. Tires, H. C. Birley, Manchester.

9171. Bookshelves, A. Cotgreave, Richmond, and W. Morgan, Birmingham.

9172. Latches, W. Morgan, Birmingham.

9173. Manhole Frames, W. Lord, Bury.

9174. Checking Restive Horses, H. G. Thiriet, Rancourt, France.—*20th May*, 1884.

9175. Propelling, &c., Steam Vessels, J. Jopling, Sunderland.

9176. Regulating the Feed of Carbons in Arc Lamps, W. Oswald and W. Foster, London.—*8th May*, 1884.

9177. Tipping and Screening Apparatus, E. Jones, Cawthorne.

9178. Drilling Apparatus, J. P. Adams, Liverpool.

9179. Salt, J. E. and T. H. Higgin, Liverpool.

9180. Domestic Cinder Rakes, T. McGrah, Sheffield.

9181. Chimney Cowl, E. and J. M. Verity, Leeds.

9182. Incandescent Electric Lamp Holders, A. Swan, Gateshead-on-Tyne.

9183. Chin Holder for Violins, &c., L. Löwenthal, Saxony.

9184. Combined Anvil and Vice, T. D. Richardson, North Greenwich.

9185. Incandescent Electric Lamp Holders, A. Swan, Gateshead-on-Tyne.

9186. Drawing the Form of the Foot on Paper, &c., L. A. Groth.—(*J. Stern, Berlin.*)

9187. Vessels for Annealing Iron, &c., J. Thompson, near Wolverhampton.

9188. Garden Trowels, M. E. Rochfort, London.

9189. Chemical Fire-engines, J. Gibbs, Glasgow.

9190. Mixing Tea, A. Carson, Stirling.

9191. Music, &c., Cases, A. Tuck, London, and C. G. Noakes, Sydenham.

9192. Printing Machines, W. S. Hope, London.

9193. Hose Couplings, J. C. Hudson, London.

9194. Cuisine, A. Parkes, Wolverhampton.

9195. Electrodes for Secondary Batteries, H. J. Haddan.—(*L. Epstein, Saxony.*)

9196. Sighting Fire-arms at Night, W. Winans, Brighton.

9197. Attaching Handles to Coffins, C. E. Clive, Birmingham.

9198. Piston Meters, A. Goodwin, jun., and C. H. Brain, London.

9199. Igniting Matches, &c., R. Mayes, Redland.

9200. Fire-proof Structures, C. D. Abel.—(*P. Franquin, Paris.*)

9201. Exercising the Lungs, H. H. Lake.—(*Wirth and Co., Frankfort-on-the-Main.*)

9202. Mirror, W. R. Lake.—(*H. Grunbaum, Paris.*)

9203. Reaping Machines, J. Howard and G. Gibbs, Bedford.

9204. Removing Tin Foil from the Necks of Bottles, A. Chapman, London.

9205. Plastic Compositions, J. J. Varley, Merton.

9206. Crucibles, &c., A. M. Clark.—(*Wirth and Co., Frankfort-on-the-Main.*)

9207. Mats, &c., J. Whiteley, Salford.

20th June, 1884.

9208. Wheel Tires, J. Needham, Manchester.

9209. Two-wheeled Velocipede, J. E. Dixon, Nottingham.

9210. Attachments to Brace, &c., Buckles, C. N. Eyland, Walsall.

9211. Telephonic Apparatus, S. P. Thompson, Bristol.

9212. Valves and Cocks, J. S. Borlase, Coed Poeth.

9213. Saving Waste in Candles, G. J. Harcourt, Clifton.

9214. Water Motor, &c., W. Freakley, Endon.

9215. Warping Mills, H. Stott, West Vale, near Halifax.

9216. Stone-breaking, &c., Machines, S. Mason, Leicester.

9217. Automatic Friction Brakes, H. W. Jones, Plumstead.

9218. Self-lubricating Roller Wheel Nave, G. Parkington and J. Chew, Blackburn.

9219. Waterproof Fabrics, H. H. Waddington, Manchester.

9220. Consolidating Leather, H. A. Gibbs, Edgbaston.

9221. Winding Drums, G. H. Daglish, St. Helens.

9222. Line-throwing and Fire-extinguishing Apparatus, W. Miller, Glasgow.

9223. Tricycles, T. Shakespear, Smallheath.

9224. Advertising, F. J. Piper, Stoke.

9225. Animal Engine, A. Tietz, London.

9226. Flues for Steam Boilers, J. H. Smith, Salford, and D. Smith, Burnley.

9227. Bread Vans, &c., T. and W. Rodgers, Pendleton.

9228. Self-supplying Apparatus for Filters, F. C. Bliss, Swansea.

9229. Safety Loop or Catch, W. Fletcher, Dover.

9230. Combining the Posting of Telegraphic, &c., Intelligence with Advertisements, C. J. Chubb, Clifton.

9231. Spindles for Spinning Machinery, J. de Hemptinne, Ghent.

9232. Protection for Suspended Wires, E. Tomlinson, London.

9233. Permanent Way of Railways, J. H. Johnson.—(*C. Séguin, A. Odé, J. E. Filassier, and G. P. E. Bruneau, Paris.*)

9234. Chlorine and Bleaching Powder, T. Macfarlane, Montreal.

9235. Couplings for Vehicles, N. S. Russell, London.

9236. Presses for Stamping Sheet Metals, W. Rhodes, Wakefield.

9237. Self-acting Filtering Apparatus, J. Walsh, London.

9238. Foot-warmers, W. R. Lake.—(*J. T. Scholte, Paris.*)

9239. Extinguishing Fire, W. B. Dick and J. Sinclair, London.

9240. Handles of Cricket Bats, &c., W. R. Lake.—(*E. Cady, Hertford, U.S.*)

9241. Projectiles for Ordnance, W. A. F. Blakeney, Dublin.

9242. Printing Machines, C. D. Abel.—(*La S. P. Laffitte et Cie., Paris.*)

9243. Osmose Apparatus, C. D. Abel.—(*H. Leplay, Paris.*)

9244. Stencil Holding and Printing Frames, F. T. Ball, London.

9245. Hektographic Copying or Transfer Sheets, F. T. Ball, London.

9246. Engraving Marble and Granite, F. W. Coons, St. Louis, U.S.

9247. Car Couplings, F. F. A. Brandt, St. Clair, U.S.

9248. Pulverisers, G. J. Fritz, St Louis, U.S.

9249. Supports for Lawn Tennis Nets, T. W. Goddard, Bitteswell.

9250. Land Rollers, S. W. Blyth, Ongar.

9251. Obtaining Motive Power, &c., C. P. Johnson, London.

9252. Chloroiodoc Bases, E. Ostermayer and M. Dittmar, Germany.

9253. Moulds for Making Cigars, J. F. Berndes, sen.,—(*F. Hachnel, New Orleans.*)

21st June, 1884.

9254. Wicker Hampers for Carboys, C. J. Schofield, Clayton.

9255. Waterproof Garments, H. Markus, Fleetwood.

9256. Tricycles, J. Appleby, Dunham.

9257. Locking Railway Points, W. Thompson, near Blyth.

2958. Wire Rope and Automatic Railway Couplings, R. C. Sayer, Newport.

9259. Spouts of Watering Cans, P. Garton, Liverpool.

9260. Effective Washer, S. Woodall, Dudley.

9261. Chimney Caps or Wind Guards, J. Hobbs, Bristol.

9262. Button Fasteners, O. G. Goodman and T. Westwood, Birmingham.

9263. Dyeing and Padding Cloth, T. Briggs and E. Webb, Salford.

9264. Pianoforte Sounding Boards, W. H. Dreaper, Liverpool.

9265. Obtaining Motive Power by Electricity, R. B. Gant, Woolwich.

9266. Rivetting Machines, R. H. Tweddel, London, J. Platt and J. Fielding, Gloucester.

9267. Horse Gears, R. Burns, Rugeley.

9268. Steering Carriages, H. C. Tucker, Banbury.

9269. Producing Gases of High-heating Powers, A. T. D. Berrington, Abergavenny, and J. Parry, Ebbw Vale.

9270. Utilising Furnace Gases, A. T. Bearington, Abergavenny, and J. Parry, Ebbw Vale.

9271. Making Biscuits, A. Grant, London.

9272. Ornamental Clamp Window Blind, A. Kelvie, London.

9273. Carbonising and Drying Woollen Pieces, &c., D. Fox, Dewsbury.

9274. Baking Oatcake, J. Wright, Shipley.

9275. Rolls for Rolling Flats, W. Leonard, Coatbridge.

9276. Life Buoy and Rope Sender, A. Oppenheimer, London.

9277. Punch for Cutting Leather, A. T. Perrins, Birmingham.

9278. Preparation of Food, C. Becker, Berlin.

9279. Convertible Double Tricycles, W. H. Benson, Bristol.

9280. Opener for Internally Stoppered Bottles, J. Allen, Bolton.

9281. Fishing Rods, T. Hemming, Redditch, and R. Hill, Ipsley.

9282. Hat Boxes, G. Downs, Hooley Hill.

9283. Gas Engines, J. McGillivray, Glasgow.

9284. Pumps, G. Murray and R. Turnley, London.

9285. Retorts for Distilling Shale, &c., R. Bell, Broxburn.

9286. Velocipedes, A. J. Boult.—(*J. de Bornier, France.*)

9287. Separating Cream from Milk, H. J. Allison.—(*N. Jacobsen and H. P. Jensen, Denmark.*)

9288. Treating Flexible Catheters, J. Mitchell, London.

9289. Expansion Gear for Steam Engines, W. W. Horn.—(*C. W. F. Falkenberg, Holland.*)

9290. Bessemer Converters, A. Tiappen, Germany.

9291. Locomotive Engines, A. M. Clark.—(*G. Bretel, Brazil.*)

9292. Marker for Lawn Tennis, &c., A. C. Bluett, Watford, and A. Remington, Kent.

9293. Canals, &c., W. N. Hutchinson, Wellesbourne.

9294. Machine for Ploughing, &c., J. and J. Broad, Ashford, Kent.

23rd June, 1884.

9295. Bands and Ropes, C. Gill, Admalton.

9296. Compressing Green Crops in Silos, T. Potter, Alresford, Hampshire.

9297. Wiring Corks in Bottles, H. J. Allison.—(*O. C. Carpenter, Brooklyn, U.S.*)

9298. Chisels, &c., C. Willey, Sheffield.

9299. Coupling Chains of Railway Wagons, T. H. Heard, Sheffield.

9300. Sliding Rings for Parasols, &c., A. Altschül, Vienna.

9301. Washing Hanks of Yarn, F. Bosshardt.—(*J. B. Straub, Germany.*)

9302. Cricket Stumps, H. G. Thompson, Lancashire.

9303. Cart, W. Blackshaw, Birmingham.

9304. Furnaces, W. Weldon.—(*Messrs. Pechiney et Compagnie, France.*)

9305. Chlorine, W. Weldon.—(*Messrs. A. R. Pechiney, et Cie., France.*)

9306. Obtaining Hydrochloric Acid, &c., W. Weldon.—(*Messrs. A. R. Pechiney et Cie., France.*)

9307. Chlorine, &c., W. Weldon.—(*Messrs. A. R. Pechiney et Cie., France.*)

9308. Stove Grates, G. W. Chambers, Rotherham.

9309. Cells for Galvanic Batteries, J. B. Spence and H. A. Fergusson, London.

9310. Portable Electric Alarm, H. C. Newton, London.

9311. Journal Bearings, H. J. Allison.—(*W. R. Austin and J. F. de Navarro, New York.*)

9312. Bleaching, J. B. Thompson, New Cross.

9313. Gas-motor Engines, H. Campbell, Leeds.

9314. Anglo-German Concertinas, G. Jones, London.

9315. Preventing Draughts under Doors, J. Wilson, Wandsworth.

9316. Valves, &c., for Controlling the Supply of Water, W. Till, New Cross.

9317. Sulphuric Acid, W. Spence.—(*J. J. Thyss, Russia.*)

9318. Wrapper for Cigarette Papers, &c., A. Jezzi, London.

9319. Pruning Shears, A. C. Henderson.—(*A. Lemeunier and G. Branchu, Paris.*)

9320. Lock Ribs, &c., of Umbrellas, H. Young, London.
9321. Heating Water, L. Jardin, Paris.
9322. Striking Moulds for Hand Rails, A. M. Clark. —(*F. R. Bodley, Denver, U.S.*)
9323. Letter-box Alarm, G. J. Harcourt, Clifton.
9324. Treating Iron and Steel, P. H. Baily, London.
9325. Stop Action in Twisting, &c., Machines, H. Tee, Tipperary.
9326. Electric Regulating Apparatus for Clocks, H. J. Haddan.—(*P. Guisol, Paris.*)

ABSTRACTS OF SPECIFICATIONS.

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

4575. Printing Presses, *W. R. Lake, London.—25th September*, 1883.—(*A communication from B. Huber and W. K. Hodgman, Taunton, Mass.*) 6*d*.

Consists partly in the combination in a printing press of an impression cylinder having two or more faces, each fitted with a set of grippers and one or more series of wheels, or one or more cylinders fitted with sets of grippers, all arranged to take up a sheet from one printing surface of the impression cylinder and transfer it on to another face of the same cylinder.

4755. Apparatus for Raising Water, &c., *C. Burnett, Hartlepool.—6th October*, 1883. 1*s*. 2*d*.

Consists partly in the employment of a piston or diaphragm in combination with a steam admission valve or valves—double beat or otherwise—whereby the steam is admitted in such quantity that at any desired point before or on the completion of the stroke the pressure of the steam will fall to or below the pressure of the column of water in the rising main, when a portion or jet of same will return through the injection port, the said jet being controlled when desired either by the piston or otherwise, and so effect the condensation.

4858. Valves, *M. Williams and A. Schottler, Cardiff.—12th October*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in manufacturing the valves of air and circulating pumps of woven cotton, hemp, jute, manilla, or other analogous and suitable fibrous substance.

4944. Heating Stove, *A. C. Kenard, Falkirk.—17th October*, 1883. 6*d*.

Relates to the construction and use of a heating stove, wherein a fire-box is arranged in combination with sets of vertical partitioned chambers, through which the products of combustion are caused to descend and ascend, these chambers having covers and doors giving access to them.

4966. Machine for Filling and Syruping Internally-stoppered Bottles for Containing Aerated Liquids, *F. Foster, London.—18th October*, 1883. 6*d*.

Relates to means for regulating the charge of syrup delivered at each stroke of the pump.

5009. Hydraulic Lifts, &c., *J. S. Stevens and C. J. Major, London.—20th October*, 1883. 10*d*.

Consists partly in connecting by a lever or levers with an hydraulic ram, or system of rams, a counterpoise, so that the counterpoise moves with the ram, but at a rate in relation to the movement of the ram, which changes with the position of the ram, and in such manner as to compensate, or partially to compensate, variations in the efficiency of the ram or in the load dependent on the position of the ram in its stroke.

5031. Electric Motors, &c., *A. Reckenzaun, London.—23rd October*, 1883. 6*d*.

The armature coil is made up of a number of links connected together like a pitch chain. The coils are wound on the links. The armature revolves between outer fixed field magnets and an internal, which may either revolve or be stationary.

5110. Generation, Storage, Regulation, Distribution, &c., of Electricity, *J. S. Williams, Riverton, N.J., U.S.—27th October*, 1883. 1*s*. 2*d*.

It is proposed to utilise any surplus of electrical power by extracting metals from their ores, or recovering them from their compounds. Various methods of connecting the depositing cells, together with their automatic cut-outs, meters, pressure regulators, &c., into the circuit are described, as is also the construction of the cells and various combinations of apparatus for utilising natural forces or regulating the consumption of fuel.

5119. Apparatus for the Treatment of Wool and Mixed Fabrics, &c., *J. Woodcock, Huddersfield, and H. Webster, Dewsbury.—29th October*, 1883. 6*d*.

Consists, First, in the employment of a machine where the fibre or fibrous materials undergoing carbonisation, neutralisation, bleaching, or disinfecting is carried backward and forward by lattice sheets or rollers, and dropped from sheet to sheet to the bottom sheet, and then thrown from the bottom to the top lattice sheet or row of rollers, and thus exposing every portion of the material to the action of the gases; Secondly, the employment of a machine in combination with a retort or other chemical apparatus necessary for making any of the gases required.

5167. Portable Buildings, *E. E. Allen, London.—31st October*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of portable buildings formed of corrugated or other sheet or plate iron or zinc.

5173. Pianos, &c., *J. H. Johnson, London.—31st October*, 1883.—(*A communication from W. R. Elmenhorst, Montreal.*) 6*d*.

The object is to supply mechanical means, whereby an air or melody played upon a piano or organ or analogous instrument may be transposed from the original to a higher or lower key without difficulty, the air being played in such higher or lower key while the player strikes apparently the notes set down in the original music.

5204. Producing Surfaces for Printing, *H. Garside, Manchester.—2nd November*, 1883. 4*d*.

The object is the production, by mechanical and chemical means, of surfaces for mechanical or ink printing, and its leading feature is the breaking up of the varying tints of the photographs or object to be represented into the dots or lines of varying dimensions which are needed for ink printing.

5208. Purification of Petroleum, &c., *R. Baynes and J. Fearenside, Liverpool.—2nd November*, 1883. 4*d*.

Relates to the purification or bleaching of distillable oils by mixing with them to the consistency of mud, or thereabouts, animal charcoal or other thoroughly dried granular indifferent porous material, and distilling preferably through more thoroughly dried hot granular indifferent porous material.

5227. Treating Zinc Ores, &c., in Blast Furnaces, *L. Von Neuendahl, Breslau.—3rd November*, 1883.—(*Void.*) 6*d*.

Relates to the process of subjecting zinc ore, other materials containing zinc, zinkiferous furnace waste, and other products of a similar class to a distilling process and a smelting process in a blast or other similar furnace, for the purpose of producing or extracting both the zinc and the lead; in other words, treating zinkiferous and plumbiferous ore, and other materials, in a direct manner (in opposition to the extraction of the zinc in muffles, tubes, crucibles, and such like), in a blast or high furnace, in such manner that not only all the zinc, but also the entire lead contained in the ores or other materials is won, and whereby the zinc in the furnace fumes and the zinc dust are collected in suitable receptacles.

5262. Disintegrators, *C. Schütze, Charlottenburg.—6th November*, 1883.—(*Not proceeded with.*) 2*d*.

The machine is open all round and at the bottom, so that the material in being thrown out is projected against a movable and flexible mantle made of leather, rubber, or the like, and then falls to the bottom.

5275. Counterpoise Brake for Mining Purposes, *W. Teague, jun., Carn Brea, Cornwall.—7th November*, 1883. 6*d*.

Consists in the application of a balance or endless rope, attached to the top and bottom of a pit cage or skip, and passing over guide pulleys, in combination with a brake strap and levers.

5276. Winding Machinery, *J. C. Jefferson, Leeds.—7th November*, 1883.—(*A communication from C. Meinicke, Hanover.*) 6*d*.

Consists in the use of a balance rope, attached at its ends to lighter auxiliary ropes, by which it is so connected to the winding engine that the winding ropes are balanced.

5277. Mules for Spinning, *T. Rawsthorne, Preston.—7th November*, 1883. 6*d*.

Consists in imparting a varying speed to the carriage, spindles, rollers, and attendant mechanism during the outward stretch or traverse, in such manner that the traverse being commenced at an ordinary speed, such speed may be increased at any desired point, and may be subsequently reduced to the original or other required speed as the carriage approaches the end of its outward movement.

5278. Corset Clasps, *W. R. Lake, London.—7th November*, 1883.—(*A communication from J. M. Cohn, New York.*) 6*d*.

The inventor claims the eye piece for a corset clasp, constructed with an opening for the passage of the head, and with a narrower slot leading therefrom, the said slot having an upwardly projecting flange or flanges at its side or sides, to form a stop for the stud.

5279. Grooving Metal Rolls, *D. Burr, Croydon.—7th November*, 1883. 6*d*.

Consists in imparting rotary motion alternately in contrary directions to the rolls, by means of a toothed wheel loose on a shaft driving the roll, which wheel carries two pawls, gearing with two ratchet wheels fixed on the said shaft, and so arranged that the rotation of the toothed wheel in one direction causes the one ratchet wheel to rotate the roll through a somewhat less angle in the backward motion than the angle through which the other ratchet wheel is made to rotate the roll in the forward motion, when the toothed wheel is rotated in the other direction.

5280. Pencil Cases, *O. Bussler, London.—7th November*, 1883. 6*d*.

Relates partly to forcing the lead forward by an elastic tube.

5281. Spring Hinges for Doors, *J. S. Stevens and C. G. Major, London.—8th November*, 1883. 10*d*.

Relates to the construction of spring hinges in which the check is given by liquid pressure.

5283. Shifting, Stowing, Trimming, and Cooling Grain, *J. H. Johnson, London.—8th November*, 1883.—(*A communication from H. Stubbendorff, Montreal.*)—(*Not proceeded with.*) 2*d*.

The grain is impelled forward in the required direction by a blast of air.

5284. Frames for Bed Bottoms, &c., *E. Hoskins, Birmingham.—8th November*, 1883. 4*d*.

Consists in forming or attaching to both the head and foot rail a bar or bars of angle or other iron having blocks upon them, with an arrangement of dovetails, by means of which longitudinal bars can be attached.

5285. Blinds, *E. and B. Barber, Tring.—8th November*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in so constructing Venetian and other blinds that when partly raised the closed laths, instead of being at the bottom of the blind, may be adjusted so as to close at the top, or to a position in any part of the height of the same, the whole of the remaining or lower portion being unclosed to admit light.

5286. Manufacture of Glass-ware, *L. J. Murray, Birmingham.—8th November*, 1883. 2*d*.

Relates to the mode of decorating the glass.

5287. Wheels for Tramway and other Vehicles, *R. A. and J. B. Hansell, Sheffield.—8th November*, 1883. 6*d*.

Relates to the peculiar construction of cast metal wheels cast in two interchangeable (inner and outer) parts, in which the inner part of the complete wheel consists of an internal rim or drum formed with lugs and recesses, and having two sets of alternately disposed arms and a boss all cast in one piece; and the outer part consists of a tire having lugs cast therein corresponding to the lugs and recesses in the internal rim or drum of the inner part, the two parts being fitted and secured together to form a complete wheel.

5288. Mounts for Tobacco Pipes, &c., *R. W. King, London.—8th November*, 1883. 6*d*.

The object is to enable the pipe to be readily cleaned.

5289. Compositions for Heating and Illuminating, *H. J. Haddan, London.—8th November*, 1883.—(*A communication from U. K. Mayo, Massachusetts.*)—(*Not proceeded with.*) 2*d*.

Consists of 20 lb. benzine, 1 lb. resin, 1 lb. gum camphor, 2 lb. blue vitriol, and 1 lb. beeswax, mixed together. The solution is placed in receivers, and evaporated by air forced therein, and from thence into a gasometer.

5290. Railways and Tramways, *H. J. Haddan, London.—8th November*, 1883.—(*A communication from A. Count Dienhem-Sczawinski-Brochocki, Rome, and B. Vogdt, Vienna.*)—(*Not proceeded with.*) 2*d*.

Relates to several improvements in the permanent way.

5291. Governing Steam and other Motors, *W. P. Willans, London.—8th November*, 1883. 8*d*.

The throttle valve is actuated directly by a pair of "motor" solenoids controlled by a "governor" solenoid. The latter works a lever which, by means of two insulated contact pieces, brings into play either one or the other of the two motor solenoids, and so tends to open or close the throttle valve. An auxiliary valve is used in connection with the throttle valve to control the pressure on the two sides—engine and boiler—of the latter.

5292. Breech-loading Fire-arms, *D. Bentley, Birmingham, and W. Baker, Handsworth.—8th November*, 1883. 6*d*.

Relates to means for cocking drop-down guns, and to making hammerless guns easier to open.

5294. Grinding Mills, *A. J. Boult, London.—8th November*, 1883.—(*A communication from J. Boultier, fils, Viriville, France.*)—(*Not proceeded with.*) 2*d*.

Relates to the arrangement of a mill with vertical stones, one of which is fixed and the other rotates.

5295. Cages of Lace Machines, *J. Chapman, Nottingham.—8th November*, 1883.—(*Not proceeded with.*) 2*d*.

The central rod or bar which has hitherto been commonly slotted is formed with a rack or teeth along its sides, and suitable catches are provided on the cross piece, which bears on the top bobbins when placed in position, and these catches are capable of sliding into and engaging with the teeth or notches on the central bar when required, on the necessary pressure being reached that is desirable to be applied to the bobbins.

5296. Manufacture of Iron, *P. L. T. Von Schöning, Vienna.—8th November*, 1883.—(*Not proceeded with.*) 2*d*.

The inventor brings the ores in a heated state into contact with substances capable of forming chemical compounds with phosphorus, which compounds are removed either in the form of gases or of slag.

5298. Instrument for Measuring Distances, *A. M. Clark, London.—8th November*, 1883.—(*A communication from Messrs. Davey and Lepage, Paris.*)—(*Not proceeded with.*) 2*d*.

Relates to an instrument whereby the indication of the distance of the object observed from the station is obtained immediately by a single motion of the alidades without measuring a base line, or the angles made by the relative displacement of the sights or telescopes.

5297. Petroleum Motors, *F. Wirth, Frankfort.—8th November*, 1883.—(*A communication from J. Löhnlein, Schierstein.*)—(*Not proceeded with.*) 4*d*.

Relates to a petroleum engine wherein finely-divided petroleum in the form of a conically-diverging spray, like jet is injected into a chamber filled with compressed air, and is fired electrically at the point of its greatest density and during the time of its formation.

5299. Electric Arc Lamps, *H. Springman, Berlin.—9th November*, 1883.—(*A communication from H. A. Earle, London, and E. Goltstein, Hanover.*—(*Not proceeded with.*) 2*d*.

This relates to a lamp in which the feed of the carbons is regulated by the flow of a liquid.

5300. Drying Wool, &c., *J. and W. McNaught, Rochdale.—9th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to an apparatus for drying wool, &c., by means of air.

5302. Fastenings for Gloves, Boots, &c., *G. and C. Ball, Birmingham.—9th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of a snap fastener.

5303. Coupling and Uncoupling Railway Wagons, *W. Dean, J. Holden, and W. H. Stanier, Swindon.—9th November*, 1883.—(*Not proceeded with.*) 2*d*.

The operations of coupling and uncoupling are effected by means of a lever actuated from outside the wagons, one of the buffers forming the fulcrum.

5304. Ligneous Materials for the Manufacture of Cigar Boxes, *J. M. Webster, Bootle.—9th November*, 1883.—(*Not proceeded with.*) 2*d*.

The boxes are formed of ordinary white wood covered with a veneer of cedar.

5305. Revolving Chairs, *R. Cruikshank, jun., Denney, N.B—9th November*, 1883. 6*d*.

Refers to a mode and means of, and construction or arrangement of mechanism for, the excentric swiveling of the upper seat part of chairs on their under or frame stool part.

5307. Chairs for Theatres, &c., *P. Jensen, London.—9th November*, 1883.—(*A communication from the MacKaye Manufacturing Company, New York.*)—(*Not proceeded with.*) 2*d*.

Relates to the construction of folding-up chairs.

5308. Mathematical Measuring and Dividing Instruments, *P. S. Marks, London.—9th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of proportional compasses.

5310. Filters, *G. F. Marshall, London.—9th November*, 1883. 6*d*.

Relates to forming part of the filtering medium solid or non-porous.

5311. Making Extract from the Bark of the Mangrove Tree, &c., for Tanning Leather, &c., *J. Fisher, Matlock.—9th November*, 1883.—(*Partly a communication from C. M. Allen, Singapore.*) 4*d*.

Relates to the method of soaking in water and treating the bark of Mangrove trees, and other plants of an analogous kind, for the purpose of obtaining from them an extract containing tannin.

5312. Lifeboats, *H. Critten, Great Yarmouth.—9th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the construction of the mid-ship air tanks.

5313. Perambulators, *L. L'Hollier, Birmingham.—10th November*, 1883.—(*Provisional protection not allowed.*) 2*d*.

Consists principally in the use and application of bamboo cane.

5314. Pocket Razors, *A. B. Ball, Sheffield.—10th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the mode of securing the blade.

5315. Gas Engines, *J. H. Johnson, London.—10th November*, 1883.—(*A communication from J. J. E. Lenoir, Paris.*) 8*d*.

Relates partly to the employment of an apparatus for superheating the explosive mixture before ignition, thus admitting of the use of extremely poor explosive mixtures.

5316. Saving Life at Sea, *J. H. Johnson, London.—10th November*, 1883.—(*A communication from P. T. Ramakers and F. X. Nyer, Paris.*)—(*Not proceeded with.*) 2*d*.

Consists essentially of a float or buoyant sphere of cork or other equivalent material containing an air chamber or chambers, and combined with a belt or girdle or with an annular float.

5317. Hot Air Engines, &c., *W. Schmidt, Germany.—10th November*, 1883. 6*d*.

Relates partly to a double-acting air pump adapted to act both as a compression pump proper, and as a pump for replacing the escaped air, this effect being obtained by completely shutting off the air contained in the waste space at the reversal of the stroke, so that the air may expand to a pressure below that of the atmosphere. Any loss of air may be replaced through a suction valve, operated by the excess of pressure of the atmosphere. Several other improvements are described.

5319. Preparing, Spinning, Doubling, and Winding Cotton, Wool, &c., *R. Tatham, Rochdale, and T. Bentley, Oldham.—10th November*, 1883. 6*d*.

Relates partly to preventing the formation of what are called "singles" in machinery or apparatus for preparing spinning, doubling, and winding cotton, wool, silk, and other fibrous materials by breaking or severing the remaining sliver, yarn or thread or slivers, yarns, or threads of a set upon one of such slivers, yarns, or threads becoming broken or severed.

5320. Domestic Fireplaces, &c., *J. N. Moerath, London.—10th November*, 1883. 1*s*.

Relates partly to the employment of automatic air suckers, tubes, tuyeres, or passages for the sucking in or admission of air to air mixing chambers, which by pipes distribute same through silicious material.

5321. Fire-arms, *E. G. Brewer, London.—10th November*, 1883.—(*A communication from E. Sèches, Paris.*)—(*Not proceeded with.*) 2*d*.

The butt end plate of the stock is made double, and is composed of two halves, one of which is secured to the butt end of the stock, while the other is connected to it by a hinge; and when opened into the vertical position above becomes a prolongation of the other, in order to take accuracy of aim at long distances.

5322. Braces, *H. J. Bellman, London.—10th November*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to form braces so that they may adjust themselves to the various motions of the body without strain upon the buttons.

5323. Steam Engines, *S. Lake, Milford Haven.—10th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates specially to the arrangement of the cylinders and pistons of compound engines.

5324. Production of Surfaces for Printing, &c., *J. J. Sachs, London.—10th November*, 1883. 4*d*.

Relates to the production of rollers or surfaces for printing or embossing purposes by means of a sand blast.

5325. Carbons for Incandescent Electric Lamps, *J. Wavish, J. Warner, and M. Bailey, London.—10th November*, 1883. 4*d*.

The "carbon" consists of two end pieces having a flat helix or ribbon piece between them. The ends are connected together by flattened sockets or clips.

5326. Antiseptic, *W. R. Lake, London.—10th November*, 1883.—(*A communication from T. A. Breithaupt, Strasbourg.*) 4*d*.

Relates to a combination of glycerine, crystallised boric acid, water, and alcohol.

5328. Valves for Motors, *G. Temple, Sheffield.—12th November*, 1883.—(*Not proceeded with.*) 2*d*.

Consists in the construction of so-called "balance slide valves" in which the said valves are relieved of the pressure over and above that which is absolutely necessary to make them steam-tight.

5329. Miners' Safety Lamps, *J. M. Wilkinson, Sheffield.—12th November*, 1883.—(*Not proceeded with.*) 2*d*.

The oil vessel screws into the base of the lamp frame and carries the wickholder and extinguisher and a picker to trim the lamp. Tubes pass through this vessel and are arranged around the wickholder, their bottoms being open to admit air, while the tops are closed and perforated on the side facing the burner. Pure air is thus admitted to the lamp, while inflammable gases entering the tubes will burn at the perforations without danger. On top of the oil vessel is a cam-shaped catch connected by a crank lever to an extinguisher, which is lowered over the burner as the oil vessel is unscrewed.

5330. Anti-fouling Composition, *W. F. McIntosh and W. S. Croudace, Dundee.—12th November*, 1883. 4*d*.

Consists in boiling together Venice turpentine, Palma Christi oil, tallow, and colcothar with another mixture composed of barium sulphate, calcium carbonate and alumina.

5331. Gas Engines, *J. Robson, Shipley.—12th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to the general construction of the engine.

5332. Screw Propeller, &c., *O. Wartmann, London.—12th November*, 1883.—(*Not proceeded with.*) 2*d*.

This consists principally in forming screw propellers hollow, so that they may provide additional buoyancy to the vessel to which they are applied, as well as serving to propel the same.

5334. Braces, *F. Tew, London.—12th November*, 1883.—(*Not proceeded with.*) 2*d*.

A cord encircling the body, and having its ends fastened together, passes through loops upon shoulder straps of the braces.

5335. Cocks and Valves, *J. B. Fenby, Sutton Coldfield.—12th November*, 1883. 6*d*.

The objects are to prevent continuous waste of liquids when cocks are left fully or partly open, the means provided being so arranged that they cannot be reached from the outside of the cock; to enable the valve seats to be renewed without cutting off the supply; to construct ball-cocks and other water-cocks with self-closing valves moving with little friction, and without liability to stick; and to construct water-cocks which will deliver fixed quantities of water.

5336. Breakwaters, &c., *L. W. Leeds, London.—12th November*, 1883. 6*d*.

The breakwater is of peculiar form and construction, and is so arranged with irregular angles made expressly to destroy the continuous motion of the waves, that the breakwater remains comparatively motionless even in a rough sea.

5337. Steam Vessels for Carrying Live Fish, &c., *L. W. Leeds, London.—12th November*, 1883. 6*d*.

Consists in the construction of steam or other vessels, by means of which the air for ventilation is taken from above deck, separated from its moisture by means of baffle plates, and then conducted to and through the below deck portion of the vessel, and finds its outlet preferably through an air funnel, which in steam vessels is in close proximity to the smoke stack, and of equal height therewith.

5338. Copying and Engraving Machines, *J. Wetter, London.—12th November*, 1883.—(*A communication from A. Schmid, Zurich.*) 6*d*.

Relates to that class of copying machines which are provided with a pattern plate carrying the original in metallic ink on a non-conducting base, a copying plate, a contact pin movable on the pattern, a tracer movable on the copying plate, and mechanism for imparting to the contact pin and the tracer a motion parallel to the surfaces of the discs. An electric circuit passing through the contact pin and pattern plate sets the tracer by means of an electro-magnet as the pin passes over the metallic ink lines forming the pattern.

5339. Obtaining Motive Power, *C. Barker, Thetford.—2nd November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to obtaining motion by means of balls, rollers, or weights falling through a cylinder.

5340. Refining and Deodorising Oils and Fats, *E. S. Wilson, London.—12th November*, 1883. 4*d*.

Consists principally in the employment of chlorinated alkaline leys or free chlorine gas, or an emulsion of or saponified crude or discoloured fats or oils, and transforming them by destroying the colouring matters contained therein, and odours arising therefrom.

5341. Heat Regulating Apparatus for Steam Engines, &c., *H. H. Lake, London.—12th November*, 1883.—(*A communication from J. Garadot, France.*)—(*Not proceeded with.*) 2*d*.

This relates to the use of a pipe situated within one of two cylinders and through which the gases from the fire-box pass, such cylinder having radiating wings to offer a large heating surface to the steam in the chamber. A piston is caused by a screw, actuated by a governor, to rise or fall, and so increase or decrease the capacity of one of the chambers. A slide valve alternately places the heat-regulating apparatus in communication with the generator and the cylinder of the motor.

5342. Screw-bolt and Nut for Bedsteads, &c., *A. J. Boult, London.—12th November*, 1883.—(*A communication from Boitiat-Bernot and Fils, France.*)—(*Not proceeded with.*) 2*d*.

The head of the bolt has holes in it by which it can be turned, and the thread on the body is square and coarse pitched. The nut is secured in position on the bed and can be removed by slackening the screw.

5343. Soap and Soap Powder, *A. J. Boult, London.—12th November*, 1883.—(*A communication from Tisserant and Martin, St. Die, Vosges, France.*—(*Not proceeded with.*) 2*d*.

One hundred kilos. of fatty acid is placed in a heated boiler, and saponified with 100 kilos. of caustic lye of 20 deg.; then 50 kilos. of resin, 20 kilos. of caustic lye of 25 deg. and 50 kilos. of silicate of soda or potash are added. When this mixture has been so far made and has become pasty, 100 to 120 kilos. of carbonate of soda of about 90 to 92 deg. are gradually added, and the whole thoroughly mixed till cold, when it is moulded.

5344. Brooms, &c., *A. J. Boult, London.—12th November*, 1883.—(*A communication from St. J. Lacam, Tours, France.*)—(*Not proceeded with.*) 2*d*.

Relates to the means of fastening the tufts.

5345. Fire, Heating, and other Pipes or Tubes, *E. A. Brydges, London.—12th November*, 1883.—(*A communication from G. Sokoff, Russia.*)—(*Not proceeded with.*) 2*d*.

The object is to increase the heating surface of the pipes or tubes without increasing the diameter of same.

5346. Dummies, Stands, &c., for Displaying Articles of Dress, *J. H. Johnson, London.—12th November*, 1883.—(*A communication from E. and A. Merle, Paris.*) 6*d*.

Relates to a means for adjusting the dummies to various sizes.

5347. Hats, &c., *J. H. Johnson, London.—13th November*, 1883.—(*A communication from C. H. Wilcox, New York.*) 8*d*.

Relates partly to improvements in attaching covered wire or its equivalent, as cord for example, to the brims of hats or bonnets.

5352. Pneumatic Power Hammers, *W. D. Player Birmingham.—13th November*, 1883. 8*d*.

Relates principally to the construction of the air cushioning arrangement of the hammer head, and the parts by which the hammer head is connected to the rocking bar of the hammer.

5353. Generators for Producing Gaseous Fuel, *J. Lones, C. Vernon, E. Holden, and R. Bennett, Smethwick.—13th November*, 1883. 6*d*.

A chamber, built partly of brick and partly of cast iron, is divided horizontally into two chambers, the upper containing the fuel and the lower forming the ash-pit, the opening for removing ashes from which is ordinarily tightly closed by a door. Jets of steam are introduced into small openings in the ash-pit and force air into the combustion chamber, such openings being regulated by valves. Horizontal fluted rollers separate the chambers, and the projections of one are arranged opposite the recesses of the others, and are perforated so that when oscillated or revolved the ashes will be allowed to pass, but the solid fuel will be prevented from doing so.

5354. Umbrellas for Carriages, &c., *C. H. Butlin, Camborne.—13th November*, 1883. 8*d*.

Relates to an umbrella to be fitted on an arched support in any desired position.

5356. Manumotive Velocipedes, *W. P. Thompson, Liverpool.—13th November*, 1883.—(*A communication from S. Krnka, Prague.*)—(*Not proceeded with.*) 2*d*.

The velocipede is driven by two cranks turned by hand.

5358. Wool-oiling Machines, *J. L. Mattthews, West Troy, U.S.—13th November*, 1883.—(*Complete.*) 6*d*.

The object is to provide an even and well-equalised distribution of oil into the stock, and to regulate the supply according to the nature of the stock; and it consists of mechanism to automatically regulate the supply to and discharge of oil from a tank. A number of springs bear upon an oiling feed roller, and convey the oil to the stock travelling along an endless feed apron. A float in the oiling chamber regulates the passage of oil to and from the tank.

5359. Extracting Cobalt, Nickel, and Manganese from their Ores, *J. B. Readman, Glasgow.—13th November*, 1883. 2*d*.

Relates to the treatment of ores containing cobalt, nickel, and manganese with chloride of iron or other suitable chloride.

5364. Cutting and Making-up Trousers, &c., *A. Macture, jun., London.—13th November*, 1883.—(*Not proceeded with.*) 2*d*.

The object is to permit of the backbody portion being loosened from the front and band portion with ease and facility when desired.

5365. Automatic Expansion Gear for Controlling Steam Engines, &c., *F. J. Burrell, Thetford.—13th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to improvements in automatic expansion gear for controlling steam and other motive power engines where an expansion link is used in connection with a high-speed governor to vary the cut-off.

5366. Registering and Indicating Mechanism for Lace and other Machines, *H. B. Payne, Nottingham.—13th November*, 1883.—(*Not proceeded with.*) 4*d*.

The apparatus combines the self-regulation of the work, the number of yards or other lengths, the number of racks, the number of inches to the rack, or whatever mode or modes of reckoning may be used.

5367. Manufacture of Steel, *W. Beardmore and J. McC. Cherrie, Glasgow.—14th November*, 1883. 6*d*.

Consists in the casting of steel into ingots of a shallow or flat shape, so that there is in the said ingots a thin or shallow, as distinguished from a thick, depth or length of liquid steel, through which the gases have to escape, and whereby the escape or elimination of the said gases is much facilitated.

5368. Ropes, *G. E. Vaughan, London.—14th November*, 1883.—(*A communication from S. Trott and F. A. Hamilton, Halifax, Canada.*) 4*d*.

Consists in the combination of yarns of right-hand and left-hand twist or lay, arranged respectively in left-hand and right-hand layers or sewings.

5369. Automatic Fog Signalling on Railways, *O. W. White and W. Sinclair, London.—14th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to an apparatus for automatically discharging a detonating mixture, or for striking a gong, bell, or other apparatus.

5370. Boring Taper Holes, *R. Letherby, Barnstaple.—14th November*, 1883. 6*d*.

Consists in the employment of a cam acting upon a counterbalanced jaw, and thereby upon the boring bitts or augers in such manner that the said bitts or augers are intermittently presented to and withdrawn from the articles operated upon to clear the holes or borings of chips.

5371. Batteries for Electric Lighting, &c., *J. Noad and R. Matthews, London.—14th November*, 1883. 6*d*.

This battery may be used either as a primary or secondary, and is constructed with outer cells of glass containing iron plates which form the positive elements. Within these are porous cells provided with carbon plates and charged with a solution composed of nitric acid, sulphuric acid, nitre crystals, and water. The outer cell is charged with a solution of nitro hydrochloric acid and water.

5372. Car Couplings, *H. J. Haddan, London.—14th November*, 1883.—(*A communication from J. W. Snyder, Pennsylvania, U.S.*)—(*Not proceeded with.*) 2*d*.

Relates to devices which are readily applied to most ordinary draw-heads of a car, and are adapted to be used in connection with the usual coupling pin and link, and by means of which the coupling of the cars can be effected with the greatest facility and safety.

5374. Pumps, *G. Murray and R. Turnley, Elvaston.—14th November*, 1883.—(*Not proceeded with.*) 2*d*.

Refers to the construction of a pump or apparatus for raising and forcing liquids, and is more especially applicable for purposes where water and other fluid has to be projected some distance, and with more or less pressure, as, for example, a fire engine.

5375. Protecting Submerged Structures from Corrosion and Fouling, *F. M. Lyte, London.—14th November*, 1883. 4*d*.

The iron or steel to be protected is first coated with a paint, having for its basis a metallic oxide electro-positive to iron or steel, and is, secondly, painted with a paint having anti-fouling qualities.

5376. Paring the Edges of the Soles of Boots and Shoes, *F. Cutlau, Cardiff.—14th November*, 1883. 6*d*.

Relates to the construction of apparatus for holding the last, and to the knife, and means of keeping the knife to its work.

5377. Lamp "Globes" and Shades, *F. J. and H. A. Biertumpfel, London.—14th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to a framework for receiving "fields," panes, or slides of glass or other transparent or partly transparent material.

5378. Wire Fences, *W. R. Lake, London.—14th November*, 1883.—(*A communication from J. B. Oliver, Pittsburgh, U.S.*)—(*Not proceeded with.*) 2*d*.

Consists in the combination with two or more twisted strands of wire of a tablet or warning plate interposed at intervals between the strands.

5379. Deodorising Foul Air, *J. F. Johnstone, Belvedere.—14th November*, 1883. 6*d*.

The foul air is caused by a fan to be driven into a chamber, into which a deodorising liquid is admitted gradually.

5380. "Bessemer" Converters, &c., *W. M. Murdock, Gilwern, Breckon.—14th November*, 1883. 6*d*.

Consists partly in a "Bessemer" converter, of a receiver or spout for pouring out the metal, or rapidly clearing it from the tuyeres as the converter is tipped, in combination with blast tuyeres arranged around the circumference of the converter, or on opposite sides thereof.

5408. Magneto-electric and Dynamo-electric Machines, *G. Hookham, Birmingham.—16th November*, 1883.—(*Not proceeded with.*) 2*d*.

This relates to duplicating the series of permanent V-shaped magnets described in patent 2042 of 1883.

5417. Primary Voltaic Batteries, *D. G. Fitzgerald and T. J. Jones, London.—16th November*, 1883. 4*d*.

The negative element is of lead coated electrolytically with peroxide of lead, or of carbon surrounded with peroxide of lead, the positive electrode being of porous lead obtained by compressing lead electrolytically reduced from an oxide or salt; or the negative element may be of carbon immersed in a solution of chromic acid.

5419. Magnetic and Electrical Apparatus for the Treatment of the Nerves and Muscles Connected with the Human Eye and Ear, *S. Mason and C. R. Huxley, London.—16th November*, 1883.—(*Not proceeded with.*) 2*d*.

Relates to appliances for placing the nerves and muscles within the influence of a magnetic field.

5429. Lighting Trains by Electricity in Combination with Gas, *E. Edwards, London.—17th November*, 1883.—(*A communication from D. Tommasi, Brussels.*)—(*Not proceeded with.*) 2*d*.

Relates to an arrangement by which gas and electricity can be used simultaneously or alternately for lighting the train.

5451. Alarums, *A. M. Clark, London.—19th November*, 1883.—(*A communication from C. F. Luquer, New York.*) 6*d*.

The object is to provide an alarum that will sound once a day for eight days without being rewound, and it consists in the use of an alarum dial and a cam, rotating once every twelve hours, the cam acting upon a lever, which releases the alarm mechanism at a given hour, fixed by setting the cam, such alarum being prevented from sounding at each alternate revolution of the cam by means of a stop lever, which engages between stop pins attached to the pallet wheel.

5474. Tricycles, Bicyles, &c., *G. Illston, Birmingham.—21st November*, 1883. 10*d*.

This relates, First, to a double-driving mechanism applicable to tricycles, with driving or travelling wheels of different diameters; and Secondly, to the springs for supporting seats of velocipedes.

5644. Manufacture of Solid Non-deliquescent Phosphate of Lime Soluble in Water, *C. D. Abel, London.—4th December*, 1883.—(*A communication from F. Barbe, Paris.*) 4*d*.

The inventor claims, First, the method of solidifying phosphoric acid by means of lime for the production of a solid phosphate, all the constituents of which are assimilable, non-deliquescent, and completely soluble in water, containing as much anhydrous phosphoric acid as existed in the syrupy liquor employed in its production; Secondly, the manufacture of a solid non-deliquescent phosphate of lime, soluble in water by the addition of lime or its compounds to hydrated phosphoric acid; Thirdly, the use of the solid phosphoric acid above referred to, for the production of superphosphates of varying strengths.

5781. Compounds for Marking Surfaces or Blackboards, &c., *P. M. Justice, London.—18th December*, 1883.—(*A communication from N. F. Potter, Providence, U.S.*) 4*d*.

The compound for use as a marking surface consists of soapstone, alum, lime-putty, blacksand, silica, mortar black, and plaster of Paris.

5851. Electric Clock Regulators, *R. H. Brandon, Paris.—24th December*, 1883.—(*A communication from J. F. Kettell, Worcester, Mass., U.S.*) 6*d*.

This relates to means for "setting" one or more clocks, the main object being to enable the conducting wires to be used for telephonic or telegraphic purposes if desired.

5858. Driving Mechanism, *A. J. Boult, London.—24th December*, 1883.—(*A communication from J. C. Tennet, Maryland, U.S.*) 6*d*.

This relates to driving mechanism for velocipedes and other machines, and consists of an arrangement whereby the motion of the back in moving to and fro is caused to supplement the power of pedals worked by the feet of the operator.

5884. Greenhouses, *E. M. Wood, Massachusetts.—28th December*, 1883.—(*Complete.*) 6*d*.

This relates to means whereby the glass coverings or sashes of greenhouses can all be caused to turn simultaneously on pivots to any desired extent, so as to expose the plants to the action of the open air.

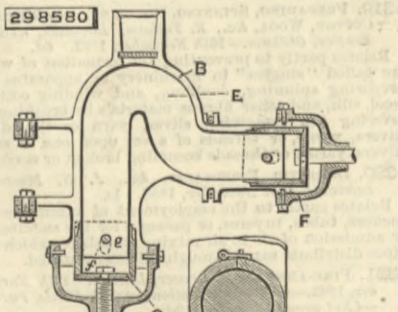
SELECTED AMERICAN PATENTS.

Frome United States' Patent Office Official Gazette.

298,580. Machine for Casting Plumbers' Blocks, *Charles E. Heiss, Chicago, Ill.—Filed February 28th*, 1884.

Claim.—(1) A mould for casting plumbers' traps, having an enlarged inner diameter at its ends, a core extending into the enlarged cavity at each end, a sleeve at each end, arranged to move back and forth on the core, and having an inner portion of thickness suitable to fit around the core in the smallest part of the mould, and an outer portion of thickness to fit in the enlarged part of the mould and support the core, and mechanism whereby pressure may be applied to the sleeves, to force them inward, all in combination,

298580



substantially as and for the purpose described. (2) The mould B, in combination with the core E, the sleeves F, provided with slots *f*, and the pins *e*, substantially as and for the purposes set forth. (3) The mould B, in combination with the core E, the sleeves F, the follower G, the screw H, and a suitable fixed bearing for the screw, substantially as and for the purposes set forth.

298,596. Steam Pumping Engine, *Joseph L. Lowry, Pittsburg, Pa.—Filed January 9th*, 1884.

Claim.—The method herein described for operating a pumping engine, which consists in weighing the pump plungers in excess of the weight required to discharge a column of water at a given level, and transferring said excess of weight of the descending plunger to the motive power cylinder, to assist in raising the ascending plunger, substantially as described. In a pumping engine, the combination of the motive power cylinder, beam, plungers, weighted as described, and connections between the beam, plungers and piston, arranged so that the changing leverages in the beam will cause a reduction of the work imposed on the engine in proportion to the reduction of the working pressure in the cylinder, due to the expansion of the steam after it is cut off, substantially as described. The combination of the two coacting weighted plungers, and an engine for operating the same, with a working beam of elliptic form, the connections of which are arranged in such manner that the beam pin of the piston-rod travels an equal distance above and below the centre of the beam shaft, and the beam pins to which the plunger rods are connected shall not travel below the centre of said beam shaft, substantially as described for the purpose specified. The combination of the hollow plungers, and an engine for operating the same, with a working beam of elliptical form, constructed with four arms differing in length and standing at different angles,

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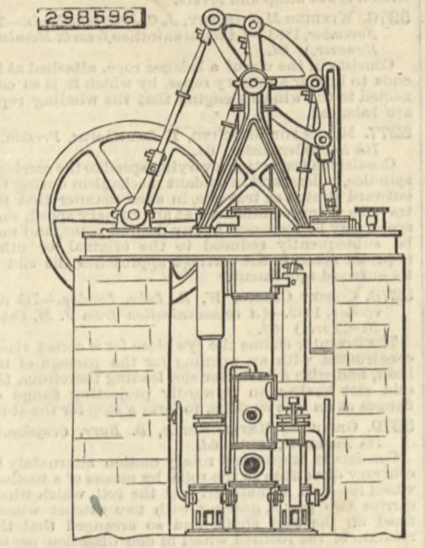

the piston, plunger, and crank connections, and the loading weights N[1] of the plungers, substantially as described, for the purpose specified. In combination, in a steam pumping engine, the loaded plungers J J, the engine L, the elliptic working beam A, having arms of different length, the working connections, and an air cushion T connected with the valve chamber S, all constructed for operation substantially as described.

298,649. Tack Hammer, *George S. Yingling, Albert L. Flack, and Henry T. Heller, Tiffin, Ohio.—Filed January 24th*, 1884.

Claim.—As an article of manufacture, a hammer having its head, shank, and handle all of one piece, the handle being hollow and open at its outer end,

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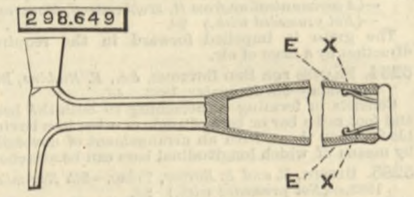

and there provided with the shoulders *x x* for retaining the springs *e e* of the stopper, thus forming a receptacle for holding tacks, all being arranged substantially as described.

298,679. Method of Treating Carbons for Electric Lights, *Thos. A. Edison, Menlo Park, N.J.—Filed July 3rd*, 1880.

Claim.—(1) The method of preparing carbons for incandescing electric lamps having broad or enlarged ends, consisting in first carbonising the filament, converting its body into carbon, and then subjecting the broad ends or enlarged portions to the action of heat

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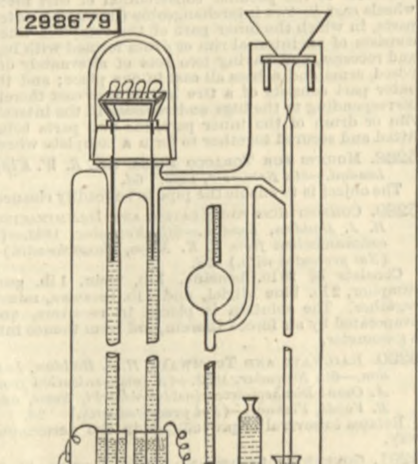
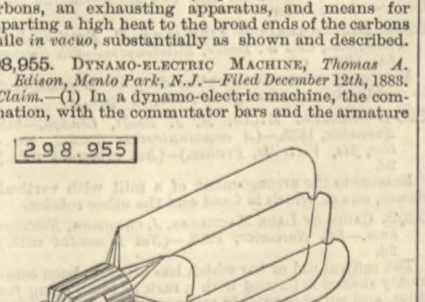


in vacuo, substantially as set forth. (2) The combination of a vacuum chamber, a platform therein for the carbons, an exhausting apparatus, and means for imparting a high heat to the broad ends of the carbons while *in vacuo*, substantially as shown and described.

298,955. Dynamo-electric Machine, *Thomas A. Edison, Menlo Park, N.J.—Filed December 12th*, 1883.

Claim.—(1) In a dynamo-electric machine, the combination, with the commutator bars and the armature

298.955

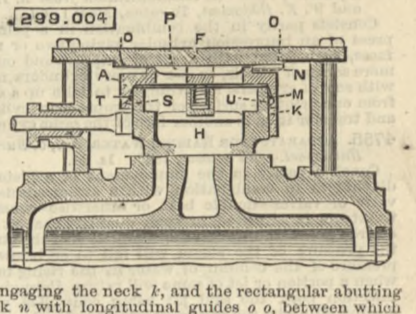


coils, of high resistance connections between them, substantially as set forth. (2) In a dynamo-electric machine, the combination, with the commutator bars and the armature coils, of connections between them of varying resistance, the highest resistance being in circuit when the current collector leaves a bar, substantially as set forth. (3) In a dynamo-electric machine, the divided commutator bars, all the divisions of a bar being connected at the same point to the armature coils, substantially as set forth. (4) In a dynamo-electric machine, the combination, with the armature coils and the commutator bars, of connecting strips of high resistance material between them substantially as set forth. (5) In a dynamo-electric machine, the combination of the divided commutator bars, the armature coils, and the connecting pieces of high resistance material, all the divisions of a bar being connected at the same point to the armature coils, substantially as set forth.

299,004. Balanced Slide Valve, *William A. Pearson, Scranton, Pa.—Filed December 21st*, 1883.

Claim.—(1) The combination, with a slide valve having a round neck, of a balance plate or cover A, interposed between the valve and the top of the chest, and having a round neck engaging steam tight with the neck of the valve, and having a square or rectangular abutting margin *n* to bear upon the top of the chest or its equivalent, and with means, substantially such as described, to prevent the rotation of the same, substantially as herein set forth. (2) The combination, with a slide valve having a cylindrical neck *k*, of the balance cover A interposed between the valve and the chest cover, having the circular neck

299.004



m engaging the neck *k*, and the rectangular abutting neck *n* with longitudinal guides *o o*, between which said neck fits, substantially as and for the purpose set forth. (3) The combination, with the steam chest and its slide valve, of a balance cover fitting between the top of the chest and the valve, and engaging together in the manner of a piston and cylinder, the top of the balance cover being rectangular, with the chest cover *f*, formed with the raised bearing surface *p* to receive said rectangular top, and with guides *o o* to embrace the same, substantially as and for the purpose set forth. (4) In combination with the slide valve *h* and balance cover A, engaging in the manne of a cylinder and piston, the oblique groove *s* in one of said engaging parts, with the split packing ring *t* of soft metallic wire fitted in said groove, and the springs *u*, placed beneath the ring and serving to press it out upon the other part, substantially as herein shown and described. (5) The combination, with a slide valve and a balance cover *h* A, having necks which engage in the manner of a cylinder and piston, of an oblique groove *s*, formed in one of the necks, and a packing ring *t*, placed in said groove, and means, substantially as described, for pressing said ring up in the oblique groove, and thereby wedging it against the opposite neck, substantially as herein shown and described.

299,025. Electric Arc Lamp, *Sidney Howe Short, Denver, Colo.—Filed October 26th*, 1883.

Claim.—In an arc lamp, a globe or chamber for the arc, closed air tight at the bottom and on all sides, a regulator above the globe or chamber, a tight tube

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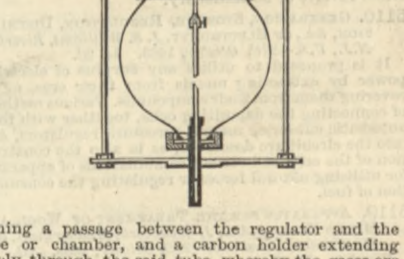

forming a passage between the regulator and the globe or chamber, and a carbon holder extending loosely through the said tube, whereby the gases are retained in the globe, undue pressure avoided, and free movement of the carbon secured, all substantially as described.

CONTENTS.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Charles F. Hulford, chief engineer, to the Ready; Thomas Hughes, chief engineer, to the Swift; Edward Norrington, chief engineer, to the Vigilant; Daniel Griffin, engineer, to the Alecto; Henry A. Evans, assistant engineer, to the Vigilant; and Walter J. Graham, assistant engineer, to the Alecto.