THE DRAINAGE OF FENS AND LOW LANDS BY STEAM POWER.

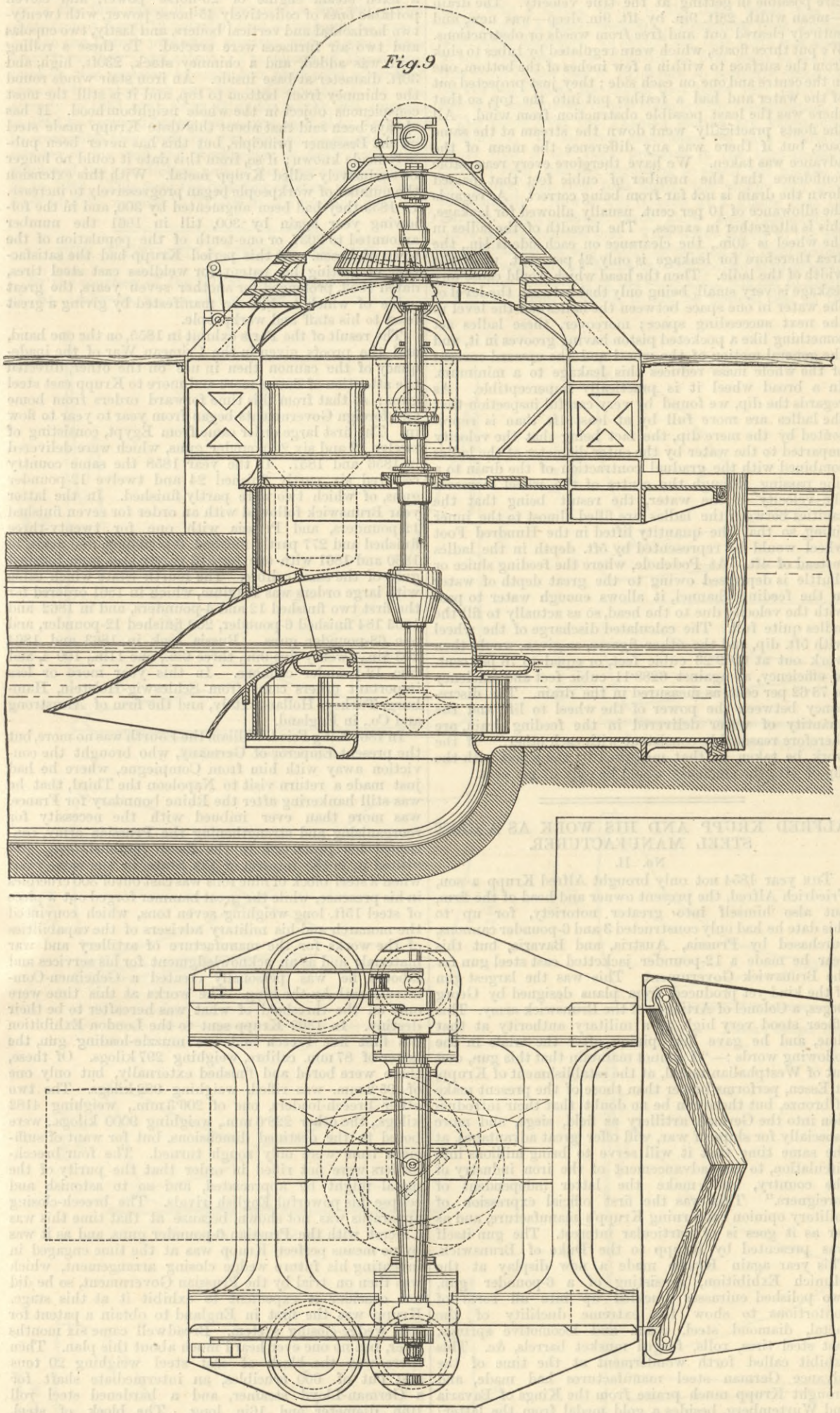
By W. H. Wheeler, M. Inst. C.E.

No. X.

Lade Bank, Lincolnshire.

This pumping station is for the drainage of a district known as the East Fen, forming part of the system of the Witham Drainage Trust. It was drained and brought into cultivation at the beginning of the present century, the principal drain being fourteen miles in length, and discharging into Boston Haven through a sluice with three openings of 15ft. each, the outlet doors being self-acting. Owing to the subsidence of the peat in the fen, the drainage of this district became imperfect, and in wet seasons it was frequently flooded, the proprietors in several cases using scoop wheels driven by portable engines to lift the water off their land, the aggregate power of these engines amounting to 80-horse power; and it was decided to provide pumping-machinery for more effectually draining the lowest parts of the district. In 1867 the pumping-machinery was erected, the site being fixed at Lade Bank, the pumps discharging into the main drain about nine miles above the outfall sluice. The area of land which is pumped is 35,000 acres. The average lift is about 4ft., the extreme being 5ft.; and it was assumed by Sir John Hawkshaw that pumping power should be provided equivalent to lifting a continuous rainfall of a quarter of an inch in twenty-four hours over the whole district. The machinery consists of two pairs of high-pressure condensing vertical and direct-acting steam engines of 240 aggregate nominal horse-power, of the A frame type. Two massive A frames span over either side of the pump well, and carry the crank-shaft, on which is fitted a large mortice bevel fly-wheel. The cylinders, which are 30in. diameter by 30in. stroke, are placed outside either A frame, being carried on a heavy base plate. Two small A frames fixed on the cylinder covers carry the parallel motion of a wrought iron grasshopper beam, one end of which is attached to the crosshead of the piston-rod, the other end being carried on a vibrating column.

Fig. 9



ENGINE AND PUMP, LADE BANK.

From this beam the air-pump and feed-pump are worked. The slide valves are worked by means of excentrics on the crank shaft, situate just inside the A frames. The arrangement of one of these engines is shown in the sketch, Fig. 9. The bevel mortice fly-wheel gears directly into a pinion on the pump spindle, which is suspended from a bracket, spanning across the engines, by means of an onion bolt bearing. By this arrangement, not only can the fan be readily withdrawn, but the bolt allows of any necessary adjustment in the level of the fan. Steam is supplied by six Lancashire boilers 23ft. by 6½ft., the furnaces being 5ft. long by 2½ft., the working pressure being 50 lb. to the inch, steam being cut off in the cylinder at quarter stroke. The base-plates of the engine are partly supported by the brickwork, and rest on and are bolted to the cast iron cylinder, which forms the lining of the pump well. There is one pump well to each pair of engines. The pump case consists of a cast iron cylinder, 12ft. in diameter, 9ft. 6in. deep, open throughout its whole depth on the delivery side, and furnished with self-acting gates, 12ft. wide. In each well is a double-inlet Appold centrifugal pump. The fan is placed horizontally, and is 7ft. in diameter and 2ft. 4½in. wide, the mouth of the lower suction pipe being 3ft. 6in. above the floor of the well, and 4ft. 6in. below the surface of the water at the ordinary drainage level. The upper suction pipe curves over, the mouth being about 1ft. 6in. above the other. Each pair of engines and pump works independently, and is capable of lifting 350 tons of water a minute 5ft. high, being the largest amount in volume for one pump which had been erected at the time. The engines are placed in a brick building 34ft. by 46ft., and 18ft. high. The boiler house is 69ft. by 38ft. The chimney shaft is square, 90ft. high, and 4ft. 9in. inside at bottom. The foundations rest on a bed of Portland cement concrete. Across the main drain are two sluices, each 12ft. wide, having doors to shut against the water on the lower side, and a lock 70ft. long by 12ft. wide, for the barges which navigate the main drain. The surface area of the main drains between the pumping station and the outfall sluice is about 100 acres. The machinery, buildings, and lock were erected by Messrs. Eastons, Amos, and Anderson, under the direction of Sir John Hawkshaw, and cost £17,000.

Taking the work done as 700 tons lifted 4ft. 6in. high per minute, this gives £80·37 as the cost per horse-power of water lifted.

The following account of the working of these pumps, a few years after their erection, was given by Mr. E. Welsh, the engineer to the Commissioners—"Trans." Inst. C.E., vol. xxxiii.—

	Years ending March 31st. 1871.		1872.
Weight of water discharged in tons	13,564,190	...	18,296,130
Average lift in inches	44·77	...	45·00
Average revolutions made by engines per minute	36·02	...	38·20
Sum of hours worked by both pumps	794·25	...	980·5
Coals consumed during working hours in tons	328·00	...	397·25
Engine oil used, gallons	25·75	...	20·25
Tallow used, lbs.	181·	...	135·
Waste used, lbs.	135·	...	85·
Wages paid first and second drivers yearly	£158 12 0	...	£158 12 0
Boy, yearly	15 12 0	...	18 14 0
Fireman, 2085½ hours at 3½d., and 2033 at 3½d.	30 8 0	...	29 13 0

Taking the above account of work done and coals consumed, the horse-power of water lifted for both engines is equal to 72·52-horse power for 1871, and 79·17 for 1872, the coals used equal to 11·37 lb. per horse-power of water lifted for the former year, and 11·46 lb. for the latter. This seems a very large consumption of coals for machinery of this class, but the correctness of the result is borne out by the quantity used by the engines and pumps for the North Sea Canal, in Holland, which are similar to these, and which are reported as using 11 lb. per horse-power of water lifted.

In 1875 there occurred a heavy flood in this district, the total quantity of rain registered for October and November was 9·49in. To cope with this, both pumps were running continuously from November 14th to the 20th, after which one pump only was used. The two pumps were running for 177 hours, and one pump for 562, during which time 300 tons of coal were used.

In the flood of 1876-77 the engines were running from December 27th to January 11th; the highest lift being 5ft. 2in., the lowest 3ft. 3in., and the average during that period 4·20ft.

For the three years ending 1881-83 the average working charges were £1089, equal to 7·46d. per acre, taking the average lift at 4ft., equal to 1·86d. per acre per foot of lift.

Littleport and Downham.

This district consists of 28,000 acres of peaty fen land, situated in the South Level of the Bedford Level in the county of Norfolk. In addition to the fen land some of the adjacent higher land also discharges its water into the drains of this district, so that the total area drained is about 35,000 acres. There are fifty-three miles of main drains which collect and convey the water to the engines, and twenty-three miles of catchwater drains. The drain which leads direct to the engine has a 22ft. bottom with slopes of 1½ to 1. There are two pumping stations seven miles apart; one on the Hundred Foot River and one on the Ten Mile River—part of the Ouse—near Hilgay. The drains communicate with both, so that the water can flow to either station. The machinery at both stations consists of scoop wheels driven by beam engines, and was put up by the Butterley Company in 1830, under the direction of Mr. Glynn.

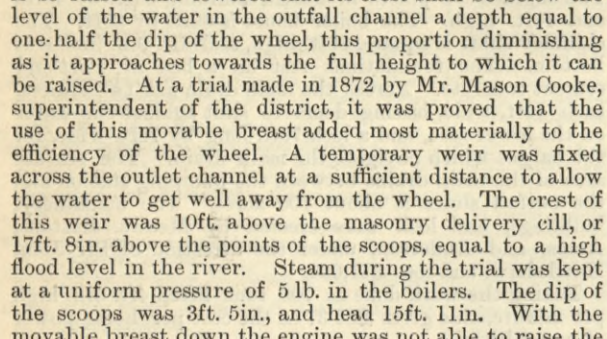
The Hundred Foot Station.—The scoop wheel at this station pumps into a tidal stream, and is now the largest in diameter that the author knows of. The wheel as originally constructed was 37ft. in diameter. It was subsequently altered to 41ft. 8in. diameter, with scoops 2ft. 8in. wide. This was removed and replaced by the present wheel, which has sixty scoops and a diameter of 50ft., with an internal spur wheel of 36ft. diameter, gearing into a pinion on the crank shaft. The scoops at the same time were widened and the radial length increased to 6ft. 6in. and width of 3ft. 4in. The start posts are of oak, 7in. by 4in., diminishing at the outer end to 4in. by 4in. The average dip of the scoops is 3ft. 3in.; the greatest, 5ft. 6in.; the average head, 13ft. 9in., the maximum being 17ft. The scoops drop from the radial line at an angle of 42 deg., being tangents to a circle 25ft. diameter. At average flood level they

enter the water at an angle of 31 deg., and leave it at 50 deg. With the maximum dip of 5ft. 6in., they enter at 22 deg., and at the maximum lift of 17ft. leave the water at 42 deg. The wheel makes three revolutions a minute to 21 of the engine. This wheel has been very accurately hung on its bearings, the clearance on the delivery side between the wheel and the masonry at the sides and the bottom being only about ⅛in. On the inlet side the walls diverge from the wheel, the idea being to allow the inflowing water to get freely to the wheel to feed it. It is questionable whether the effect of this, by diminishing the velocity with which the water approaches the wheel, does not do harm. When working to its full extent the wheel discharges 197 tons per minute. A movable breast struck to the radius of the wheel, with curved top, worked by a shaft, and gearing from the engine-house has been added to the original structure on the delivery side of the wheel. This can be raised at pleasure 8ft. above the masonry delivery cill, which is 12ft. above the tips of the scoops. No portion of the floor is raised with the breast as at Podehole. This breast is so raised and lowered that its crest shall be below the level of the water in the outfall channel a depth equal to one-half the dip of the wheel, this proportion diminishing as it approaches towards the full height to which it can be raised. At a trial made in 1872 by Mr. Mason Cooke, superintendent of the district, it was proved that the use of this movable breast added most materially to the efficiency of the wheel. A temporary weir was fixed across the outlet channel at a sufficient distance to allow the water to get well away from the wheel. The crest of this weir was 10ft. above the masonry delivery cill, or 17ft. 8in. above the points of the scoops, equal to a high flood level in the river. Steam during the trial was kept at a uniform pressure of 5 lb. in the boilers. The dip of the scoops was 3ft. 5in., and head 15ft. 11in. With the movable breast down the engine was not able to raise the water over the dam, but came to a standstill. The movable breast was then raised 4ft., when the engine made 10 revolutions a minute; when raised to 5ft. the number increased to 12; at 6ft., to 13; at 7ft., to 13½; and at 8ft., or 18ft. above the tops of the scoops, the engine made nearly 14 revolutions per minute, and discharged over the dam a stream of water 7ft. 6in. wide by 1ft. 8in. deep. A vertical door is fixed on the inlet, which can be raised or lowered by gearing, but this is not used to regulate the inflow of the water, and the wheel is not provided with any adjustable shuttle. The wheel takes up and discharges its water quietly and efficiently, and although necessarily a portion of the water is lifted above the level in the outlet channel, there is no dashing about of the water, but it leaves the scoops freely and in a solid mass. The wheel is driven by a condensing beam engine having cylinders 3ft. 6in. diameter and 8ft. stroke; the steam pressure in the boiler being now 20 lb., the pressure before the recent alterations being 5 lb. This engine was overhauled and refitted by Messrs. Watt and Co., of Birmingham, in 1881, and adapted to the increased size of wheel. The old cast iron crank shaft was replaced with a wrought iron crank with 4ft. throw, a circular slide valve to work from the parallel motion was substituted for the D valve, and an internal expansion valve added to cut off at from one-tenth to one-half of the stroke, as regulated by a hand wheel and screw. When pumping at an average level, the engine is well above its work, and advantage is taken of the expansion gear, the steam being frequently cut-off at from one-sixteenth to one-tenth of the stroke. Steam is generated in three Lancashire boilers, 24ft. long by 7ft. diameter, the safety valves of which are adjusted to blow off at 20 lb. The enormous weight of this machinery compared to the work done may be judged from the following:—The wheel alone weighs 75 tons; the beam of the engine is 3ft. 8in. deep, and weighs 15 tons; the fly-wheel is 25ft. diameter and weighs 30 tons.

The improvements in the engine and wheel resulted in a very considerable saving of coals, the consumption for 1881, before the improvements were made, being 1411 tons for a running of 2988 hours, and an average dip of the scoops of 2·66ft. as against 691 tons for 1883 for 2288 hours' running, and an average dip of 3·30, or, after allowing for the difference in the number of hours' run, this shows a clear saving of 369 tons of coals in one season, while the average extra head pumped against was increased 1·54ft., or an increase of work of 31 per cent. and a decrease of coals of 35 per cent.

A series of trials were made by Messrs. Watt and Co., Birmingham, on January 13th, 1882, after the improvements to the engine and wheel had been completed by

Fig. 9A



100-FEET ENGINE.

them. The following figures give the results of the last of these trials. The diagram, Fig. 9A, is the mean of those taken for this trial:—

Mean dip of scoop	4·0ft.
Mean lift of scoop	14·79ft.
Mean revolutions of engine	18·66ft.
Mean revolutions of wheel	2·75ft.
Mean velocity of water flowing down engine drain	45·766ft.
Area	137·397ft.
Quantity per minute	6288·11 cub. ft.
Horse-power, gross indicated	224·05
Horse-power, water lifted	176·158
Ratio per cent. $\frac{\text{W.H.P.}}{\text{I.H.P.}}$ =	78·62
Mean circumference of immersed portion of wheel	144·5ft.
Cubic contents of immersed portion, each revolution less space occupied by scoops	1782·11 cub. ft.
Ditto ditto per minute	4900·80 cub. ft.

From this it will be seen that the quantity delivered, as measured by the water passing down the drain, instead of being less than that due to the theoretical discharge as measured by the wheel, was about 21 per cent. greater. Messrs. Watt observe as regards this:—"We took every care possible in getting at the true velocity. The drain—mean width, 28ft. 9in. by 4ft. 9in. deep—was new, and entirely cleared out and free from weeds or obstructions. We put three floats, which were regulated by tubes to sink from the surface to within a few inches of the bottom, one in the centre and one on each side; they just projected out of the water and had a feather put into the top, so that there was the least possible obstruction from wind. All the floats practically went down the stream at the same pace, but if there was any difference the mean of the advance was taken. We have therefore every reasonable confidence that the number of cubic feet that passed down the drain is not far from being correct. As regards the allowance of 10 per cent. usually allowed for leakage, this is altogether in excess. The breadth of the ladles in the wheel is 40in., the clearance on each side is ⅛in., the area therefore for leakage is only 2½ per cent. upon the width of the ladle. Then the head which would cause any leakage is very small, being only that between the level of the water in one space between the ladles and the level in the next succeeding space; moreover, these ladles act something like a pocketed piston having grooves in it, and the general motion of the wheel and the upward current of the whole mass reduces this leakage to a minimum. In a broad wheel it is practically imperceptible. As regards the dip, we found by very careful inspection that the ladles are more full by at least 1ft. than is represented by the mere dip, the fact being that the velocity imparted to the water by the outer diameter of the ladles combined with the gradual contraction of the drain to a line passing through the centre of the wheel increases the velocity of the water, the result being that the cavities between the ladles are filled almost to the inner lining, so that the quantity lifted in the Hundred Foot wheel would be represented by 5ft. depth in the ladles instead of 4ft. At Podehole, where the feeding sluice or shuttle is depressed owing to the great depth of water in the feeding channel, it allows enough water to pass with the velocity due to the head, so as actually to fill the ladles quite full. The calculated discharge of the wheel with 5ft. dip, and the other figures, as given, would then work out at 6089·23 cubic feet, or equal to 76 per cent. of efficiency, as against 6288·11 cubic feet and efficiency of 78·62 per cent. as measured in the drain. The discrepancy between the power of the wheel to lift, and the quantity of water delivered in the feeding drain, are therefore reasonably consistent with each other." If the work be taken as that measured by the wheel with the dip of 4ft., the efficiency would be only 61 per cent.

ALFRED KRUPP AND HIS WORK AS A CAST STEEL MANUFACTURER.

No. II.

The year 1854 not only brought Alfred Krupp a son, Friedrich Alfred, the present owner and head of the firm, but also himself into greater notoriety, for up to this date he had only constructed 3 and 6-pounder cannons, purchased by Prussia, Austria, and Bavaria, but this year he made a 12-pounder jacketted cast steel gun for the Brunswick Government. This was the largest gun of the kind yet produced, from plans designed by Georg Orges, a Colonel of Artillery of the Brunswick army. This officer stood very high as a military authority at that time, and he gave his opinion after the trials in the following words:—"I cannot maintain that this gun, cast out of Westphalian metal, at the establishment of Krupp, at Essen, performs better than those of the present make of bronze, but there can be no doubt that their introduction into the German artillery as field, siege, and more especially for ships of war, will offer great advantages, at the same time that it will serve to bring millions into circulation, to the advancement of the iron industry of the country, and make the latter independent of foreigners." This was the first official expression of military opinion concerning Krupp's manufacture, and as far as it goes is of particular interest. The gun itself was presented by Krupp to the Duke of Brunswick. This year again Krupp made a new display at the Munich Exhibition, consisting of a 6-pounder gun, two polished cuirasses buckled up into all sorts of contortions to show the extreme ductility of the metal, diamond steel, coach and locomotive springs, cast steel tires, rolls, forged musket barrels, &c. This exhibit called forth wonderment at the time of the advance German steel manufactures had made, and brought Krupp much praise from the Kings of Bavaria and Wurtemberg, besides a gold medal from the latter; and as a result of the trials of the 6-pounder gun in Austria, the Emperor presented Krupp in 1855 with a valuable gold casket set with diamonds. As a matter of course, Krupp prepared an exhibit for the Paris Exposition of 1855. He sent a block of cast steel this time weighing five tons, and engaged to cast one up to 12 tons if demanded. A commission of French officers was appointed to make trials of the 12-pounder shell gun sent, which resulted in his receiving the great gold medal; but that was not all, for in 1855 a series of exhaustive trials were ordered to be carried out at Vincennes, at which Krupp personally attended. Still, up to this date Krupp had not gathered in any great harvest for his labours, as far as his guns were concerned, but, on the other hand, the other articles of his manufacture brought in their full reward. The number of workmen now employed gives the best proof of the gradual advance made, and from 360 in 1854 they had increased to 690 in 1855, or were nearly doubled, and two years later were greatly augmented again, till in 1858 the first thousand had been attained. This year Krupp was created a Commercienrath by the King of Prussia, and his works were visited by the venerable Archduke John of Austria. The year 1859 saw great extensions to the works. The existing ten steam hammers, of 370 cwt. collectively, were unequal to the growing needs, so a new one of 600 cwt., with a stroke of 10ft., was put down, together with a steam engine of 66-horse power to work it;* also a 20-cwt. steam hammer, a fixed steam engine of 20-horse power, and eleven portable ones of collectively 45-horse power, with twenty-two horizontal and vertical boilers, and lastly, two cupolas and two air furnaces were erected. To these a rolling mill was added, and a chimney stack, 230ft. high, and 30ft. diameter at base inside. An iron stair winds round the chimney from bottom to top, and it is still the most conspicuous object in the whole neighbourhood. It has always been said that about this date Krupp made steel on the Bessemer principle, but this has never been publicly made known; if so, from this date it could no longer be exclusively called Krupp metal. With this extension the number of workpeople began progressively to increase. In 1859 they had been augmented by 300, and in the following year again by 300, till in 1861 the number amounted to 2037, or one-tenth of the population of the town of Essen. At this period Krupp had the satisfaction of getting his patent for weldless cast steel tires, dated 1853, prolonged for another seven years, the great value of which to him he manifested by giving a great feast to his staff and workpeople.

The result of the Paris exhibit in 1855, on the one hand, and the proofs given in the Crimean War of the inadequacy of the cannon then in use on the other, directed the attention of States more and more to Krupp cast steel guns; so that from this time forward orders from home and foreign Governments began from year to year to flow in. The first large order came from Egypt, consisting of twelve 12 and six 24-pounder guns, which were delivered in 1856 and 1857. In the year 1858 the same country received six partly finished 24 and twelve 12-pounder guns, of which two were partly finished. In the latter year Brunswick followed with an order for seven finished 12-pounders, and Prussia with one for twenty-three finished and 277 partly finished 6-pounders, and again in 1860 and 1861 with one for 216 partly and nine finished guns of the same calibre. The fourth State which came with large orders was Belgium, which in 1861 ordered for the first two finished 12 and 4-pounders, and in 1862 and 1863 184 finished 6-pounder, 200 finished 12-pounder, and one 68-pounder guns. Russia took in 1863 and 1864 203 8in., twenty-five 9in., three 6in., one 11in., 100 4, and two 12-pounder cannons. In this year more or less important orders came from Schleswig-Holstein, Hamburg, Turkey, Holland, Italy, and the firm of Armstrong and Co., in England.

In 1861 King Fried. William the Fourth was no more, but the present Emperor of Germany, who brought the conviction away with him from Compiegne, where he had just made a return visit to Napoleon the Third, that he was still hankering after the Rhine boundary for France, was more than ever imbued with the necessity for reorganising and strengthening the Prussian army, continued his protection to the Essen establishment, and visited it, in the interest of the State, in the same year, when a steel block of nine tons was cast out of 300 crucibles in his presence, while the great hammer forged out a piece of steel 15ft. long weighing seven tons, which convinced the monarch and his military advisers of the capabilities of the works for the manufacture of artillery and war material; and as an acknowledgment for his services and labours he was personally created a Geheimen-Commerzienrath by the king. The works at this time were only on the threshold of what was hereafter to be their destiny. In 1862 Krupp sent to the London Exhibition his first five breech and one muzzle-loading gun, the latter of 87 mm. calibre, weighing 297 kilogs. Of these, three were bored and finished externally, but only one of 95·2 mm. was rifled, weighing 982 kilogs. The two other breech-loaders, one of 206·3 mm., weighing 4182 kilogs., the other 228·6 mm., weighing 9000 kilogs., were bored to the destined dimensions, but for want of sufficient time were only rough turned. The four breech-loaders were not rifled in order that the purity of the metal might be appreciated, and so to astonish and eclipse his powerful English rivals. The breech-closing apparatus was not shown, because at that time this was a secret with the Prussian 6-pounder guns, and as it was by no means perfect, Krupp was at the time engaged in inventing his future wedge closing arrangement, which was then on trial by the Prussian Government, so he did not consider it expedient to exhibit it at this stage. Krupp was the first in England to obtain a patent for this wedge-closing system. Broadwell came six months later, but no one ever heard much about this plan. Then there was the block of cast steel weighing 20 tons cast out of 600 crucibles, an intermediate shaft for a German-Lloyd steamer, and a hardened steel roll 10in. diameter and 16in. long. The block of steel, as will be remembered, certainly created a sensation; but it was a useless thing at that day, and could have been cast in England if there had been any demand for such pieces. As for the shafts, such were repeatedly tried in England and America, were found very expensive, and did not well fulfil their purpose; and as their run was not long, it must be presumed that Krupp's metal was not suitable for marine engine work; and as concerns the rolls, they were soon superseded by special cast iron chilled rolls, which answered the purpose equally well at a tithe of the price. This is all within our own knowledge, and it is perfectly astounding to read what at that time was paraded in the best journals and circles of Germany on this exhibit. Nevertheless, it set Sheffield men think-

* This hammer, as far as is publicly known, is different in construction and working to the ordinary steam hammer of the present day.

ing, and from that time, aided by the Bessemer process, dates a great advance in the steel manufacture of England. This exhibit having been considered a great triumph, Krupp gave another great feast on the occasion to 4000 people, consisting of his workmen and their families. This year the number of his workpeople had grown to 2464 from 2037 the year before.

In 1864 came the Danish war, when Krupp's cannons were to be tried in earnest, whereas till then all the trials had been of a peaceful character—in a word, theory was to give place to practice. It will be in the memory of many how completely the superiority of rifled breech-loading ordnance carried the day against the the old system at Eckernförde and Holniss, and again at Düppel, for in the first cases it only required a few well-aimed shots from a 6 and 12-pounder field Krupp gun to bore a hole in the Danish protected frigates, and to scare them away from their coast attack. The success of the Krupp guns on this occasion brought him more solid advantage than all the exhibition parades had done, for if he had already in 1863 sent away from his works 204 cannon, in 1864 he received orders for no less than 817. In order to accomplish this work, he was obliged to augment the number of his staff and workpeople to 6413, from 4031 employed the year before, and of his steam engines from 65 to 1083. This year the quantity of steel worked was 54,000,000 lb. against 25,000,000 lb. the previous year.

THE NEWCASTLE ENGINE TRIALS.

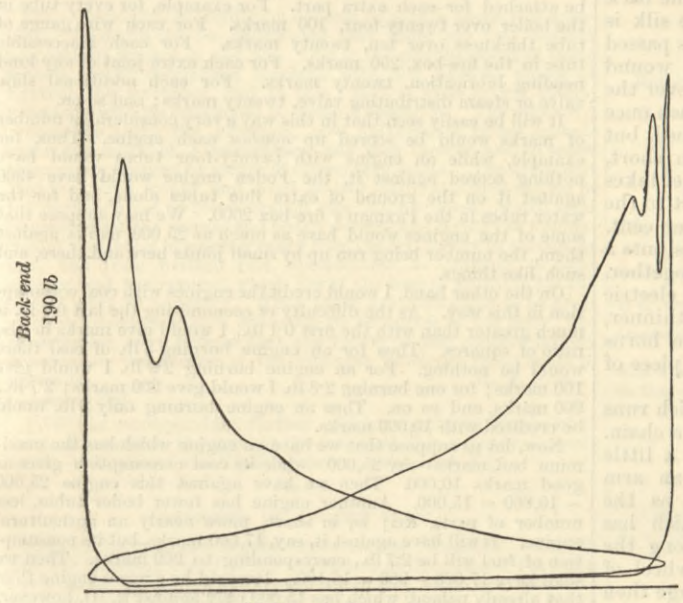
By the courtesy of the Royal Agricultural Society and of Mr. Anderson, we are able to place before our readers complete sets of diagrams, taken from the six most economical engines tested at Newcastle, namely, Messrs. Davey, Paxman, and Co.'s simple and compound engines, Messrs. J. and H. McLaren's simple and compound engines, and Messrs. E. Foden and Son's simple and compound engines. Our diagrams have, to suit our space, been reduced a little from tracings carefully made from the original diagrams. The reduction has been effected by photography, to avoid the chance of error, and is the same for all. With each diagram we have given the maximum pressure shown by the indicator, so that our readers can construct scales, and work out the cards for themselves.

It will be seen that none of the cards are remarkably good, and in more than one case there are peculiarities not easily explained. Thus, for instance, we have in the cards from McLaren's simple engine a pressure indicated far above that carried in the boiler. These cards were taken with a spring 48 lb. to the inch, which was too weak to give a steady diagram. Reasoning from analogy with other diagrams, we should say that there was water in the cylinders. It is difficult at first sight to see how this could be the case in cylinders so perfectly jacketted. On the other hand, the cut-off took place very early, and this it is well known causes considerable condensation.

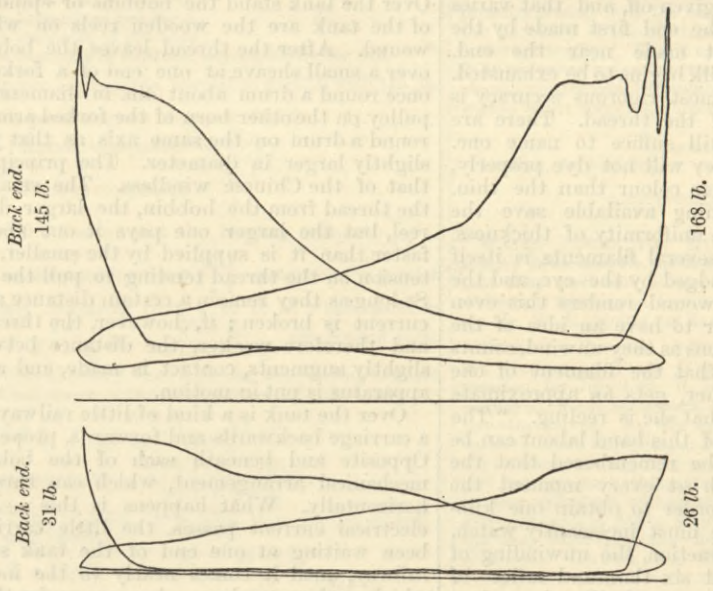
The cards from the Paxman engine are exceedingly instructive. In our own experience we have invariably found that if the back pressure in the high-pressure cylinder rises from the beginning to about the middle of the stroke, and then falls again, the engine will work economically. Now it will be seen at a glance that the Paxman high-pressure cards show this characteristic curve in the exhaust line. This is due partly to the setting of the valves, and partly to making the intermediate receiver very small. McLaren's compound high-pressure cards show something of the same kind, but not to nearly the same extent. Again, it will be noticed that in the Paxman cards the cut-off takes place much later in the stroke, and is much more clearly marked than in any of the other cards, from which it is safe to argue that nothing is gained by too early a cut off, and that the Paxman cut-off gear works better and more incisively than that used by the other competitors.

Mr. Foden's diagrams deserve particular attention, because of the peculiar conditions under which the engine worked. The pressure, although high, it will be seen, was considerably below that in the boiler, viz., 250 lb. The cut-off nominally took place when the high-pressure piston had made one-twentieth of its stroke, or half an inch; but the diagrams do not seem to bear this statement out, or else the clearance must have been comparatively enormous. The exhaust lines of the high-pressure cards are nearly straight, and fall continuously. This is no doubt due in part to the circumstance that the cranks are not set quite at right angles. Those who were present when the engine was running noticed that there was a comparatively heavy exhaust beat. The reason for this is apparent. The card from the front end of the low-pressure cylinder shows a back pressure of over 6 lb. per square inch above the atmosphere. This represents a dead loss of 1·75-horse power indicated at the speed at which the engine ran. To what cause the back pressure is to be attributed we are unable to say. That it existed was a very unfortunate circumstance for Mr. Foden.

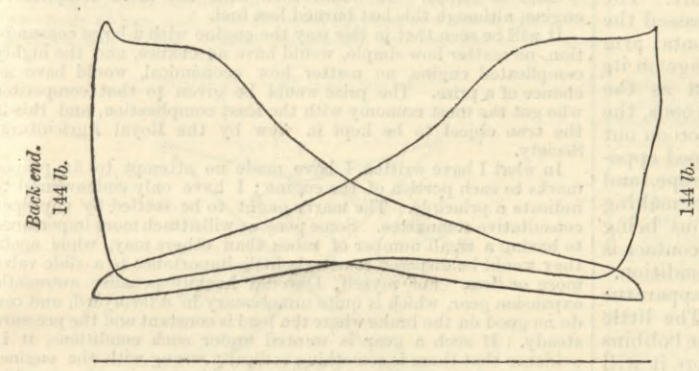
It is almost impossible to work out either the steam used per horse per hour or the water evaporated; because the boiler no doubt did a great deal of work twice over. It is, however, worth considering whether in the case of such engines as those of Messrs. McLaren, in which the cylinders are virtually placed in the steam space of the boiler—the opening to the jackets being very large and the jacketting thorough—any water of condensation is ever produced. It appears to us probable that the steam which comes in contact with the sides of the cylinders may be brought to the vesicular or cloudy state, but that true water is produced and runs down the sides of the cylinders and back into the boiler must remain an open question. Much would depend on whether the steam in the boiler were fully saturated or not. When steam is led into jackets by small pipes, circulates round them and passes away, water will certainly be produced, but the conditions are not the same in all cases. Again, as regards the heaters. It is erroneous to suppose that the whole of the exhaust steam condensed in the act of heating the feed-water returns as water to the feed-water tub to be pumped thence into the boiler. On the contrary, the quantity of water produced may be small, while the quantity of vesicular vapour or cloud carried up the chimney is large. This was shown very clearly by the heavy white cloud of steam which escaped from the chimneys of both Paxman's and McLaren's engines, the exhaust being cooled down by the water passing through the tubular heater.

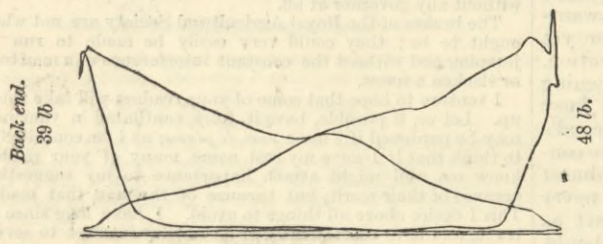


McLaren's Simple Engine.

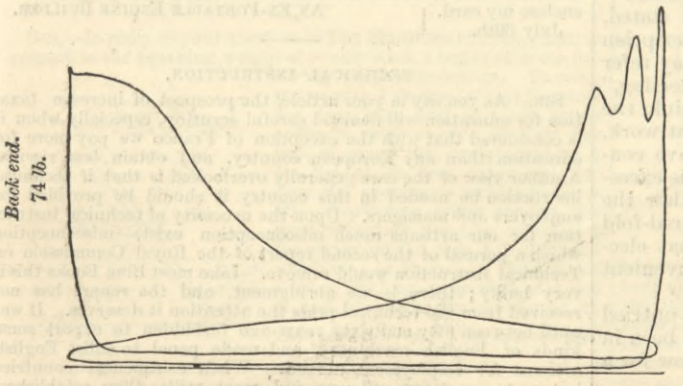


McLaren's Compound Engine

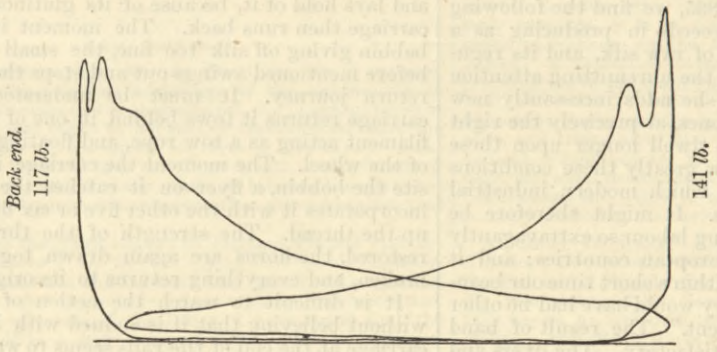




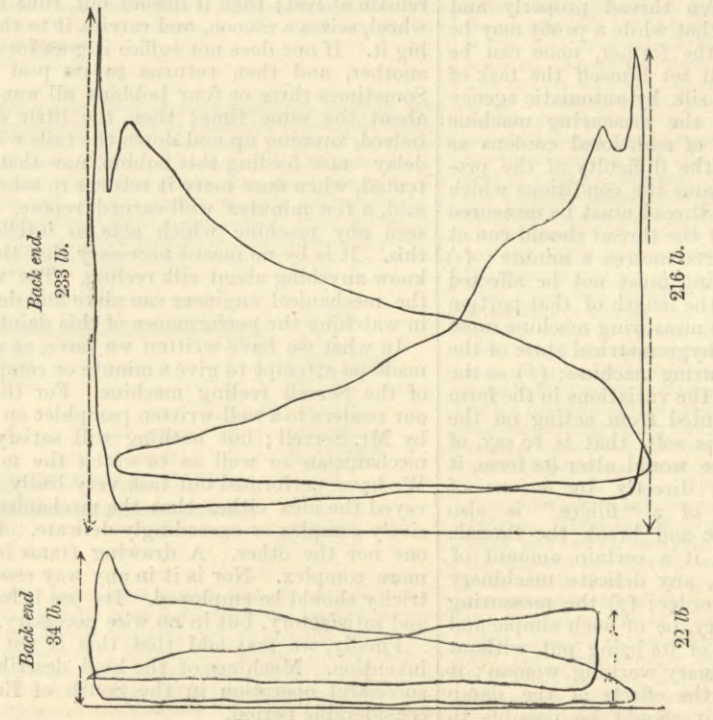
Paxman's Compound Engine.



Paxman's Simple Engine.



Foden's Simple Engine.



Foden's Compound Engine.

A NEW DEPARTURE IN SILK REELING.

One of the most ingenious machines ever used in textile industries may now be seen at work in Queen Victoria-street. It is the invention of Mr. Edward W. Serrell, and has for its object the production by automatic means of a silk thread of predetermined thickness with perfect accuracy. As an adjunct to this machine there are certain improvements in the method of winding silk from the cocoon. In order that our readers may understand what follows, it is necessary to explain a little in detail the process of silk reeling, as ordinarily pursued.

Most of our readers have seen silk cocoons—little yellow masses about as large as the first two joints of the forefinger. These apparently consist of a network of threads. In reality, there is but one thread in each, wound over and over by the silkworm into a compact case, in which it lies concealed until the time comes for its escape in the form of a large moth. In the entrance gallery of the Manchester Exhibition may be seen certain glass cases containing a very interesting collection of moths and pupæ, in all stages and many varieties. In order to get the silk, a number of cocoons are thrown into a large vessel containing nearly-boiling water, which acts on the glutinous matter with which the

silk is coated. The thread is extremely fine; not very much thicker, indeed, than a spider's web—but much denser, heavier, and having a strength not much short of that of iron wire of similar thickness. The attendant, after the cocoons have lain for a couple of minutes in the water, commences to stir them about with a species of small broom, with a handle a foot long. The outer surface of the cocoon breaks up into numerous loose ends which adhere to the broom, and the attendant goes on skilfully working the broom among the cocoons until at last all the loose ends come away, and each cocoon is left hanging to the broom by the end of the true length of thread. Five or six or more of these threads are then joined to make one strand, which is passed up through a bobbin put in rapid rotation, which accordingly spins the silk thread together. The spinning is, however, very slight compared to that employed with cotton. The end of the thread is then led to a reel, which continually revolving, winds up the silk. The cocoons float in hot water during the whole process, several bobbins or "spindles," as they would be called in a cotton mill, standing over each hot-water tank. In this way raw silk thread is produced, its thickness depending on the number of cocoons, and consequently of single threads, used. Of course the raw silk can be subsequently spun up to any thickness required; but with this we have nothing to do. Mr. Serrell has devised very simple means for steeping the cocoons and collecting the ends, which, while not dispensing with manual labour, greatly aid it; but into the details of this part of the process we shall not enter. We have said that the thickness of the thread depends on the number of cocoons being wound off at one time to form each thread, but this is only a general truth. The thickness of the thread also depends on that of the fibre given off, and that varies continually. That is to say, the end first made by the "worm" is stouter than that made near the end, apparently because the store of silk begins to be exhausted. Now it so happens that the most rigorous accuracy is demanded in the thickness of the thread. There are several reasons for this. It will suffice to name one. Unless the threads are even they will not dye properly, the thicker portions taking less colour than the thin. Hitherto there has been nothing available save the skill of the silk reeler to secure uniformity of thickness. The thread produced by the several filaments is itself so fine that its size cannot be judged by the eye, and the speed with which it is being wound renders this even more impossible. But in order to have an idea of the size, the reeler watches the cocoons as they unwind, counts them, and, on the hypothesis that the filament of one cocoon is as big as that of another, gets an approximate idea of the size of the thread that she is reeling. "The difficulty," says Mr. Serrell, "of this hand labour can be still better understood if it be remembered that the reeler, being obliged to watch at every moment the unwinding of each cocoon, in order to obtain one kilogramme of well-reeled silk, she must incessantly watch, and without a moment of distraction, the unwinding of ten thousand kilometres—about six thousand miles—of silk filaments; for four kilogrammes of silk, she reels a length of filament sufficient to girdle the earth." In the *Génie Civil*, No. 4, Nov. 28th, 1885, we find the following passage: "A skilful reeler succeeds in producing as a day's work about 250 grammes of raw silk, and its regularity absolutely depends upon the unremitting attention and the exactitude with which she adds incessantly new filaments to replace exhausted ones, at precisely the right instant. It is not necessary to dwell longer upon these facts in order to make clear how greatly these conditions of labour differ from those to which modern industrial organisation has habituated us. It might therefore be expected that a process employing labour so extravagantly would soon disappear from European countries; and it could have been foreseen that within a short time our beautiful silk manufacturing industry would have had no other source of supply than the Orient." The result of hand labour has by no means been satisfactory. The dyers and silk weavers have become more and more exacting, and the difference in value between thread properly and improperly reeled is so great, that while a profit may be made by the silk grower on the former, none can be had on the latter. Mr. Serrell set himself the task of measuring the thickness of the silk by automatic agency continuously, and of making the measuring machine supply just the right number of additional cocoons as needed. To give some idea of the difficulty of the problem he had to solve, we may name the conditions which have to be fulfilled:—(*a*) The thread must be measured constantly while running; (*b*) the thread should run at a rate of from 130 metres to 230 metres a minute; (*c*) the system adopted for measuring must not be affected by the speed of winding; (*d*) the length of that portion of the thread which is in the measuring machine must not exceed one metre; (*e*) the hygrometrical state of the thread must not affect the measuring machine; (*f*) as the thread is never perfectly round, the variations in the form of its section must be prevented from acting on the apparatus; (*g*) as the thread is soft, that is to say, of such a nature that any pressure would alter its form, it is impossible to measure it directly by means of a gauge; (*h*) the employment of a "filière" is also impossible, as it would bruise and break the thread; (*i*) as the thread carries with it a certain amount of greasy and gummy substances, any delicate machinery would quickly be put out of order; (*j*) the measuring apparatus should, on the contrary, be of such simple and strong construction as to admit of its being put, without risk, into the hands of an ordinary working woman; it should also be able to resist the effects of the damp atmosphere of a filature; (*k*) it should be possible to regulate the apparatus so as to admit of its use in the production of all sizes; (*l*) such is the accuracy required of the apparatus that it must be able to mark a difference in weight of more than one-tenth of a milligramme in the thread, and a difference of more than one one-thousandth of a square millimetre, or, supposing the thread to be perfectly round, the differences in diameter must not attain three-ten-thousanths of a millimetre; (*m*) accidental inequalities of the silk must not derange the apparatus; (*n*) the starting of the apparatus must be prompt and easy; (*o*) the thread must in no wise be deteriorated in passing through the apparatus; (*p*) the apparatus must be unaffected by draughts, by the vibration inseparable from machinery in motion, by changes in temperature, and, generally, by anything hurtful to the proper working of an apparatus of precision.

Mr. Serrell solved the problem after many experiments by availing himself of the facts that the stretch of a silk thread depends on its thickness, the load being constant, and that a moderate stretching does the thread no harm so long as it does not exceed its elastic limit. Without drawings it would be impossible to make the precise construction of the Serrell reeling apparatus intelligible. With drawings it would take up much space, and demand much patience on the part of our readers to understand them; not that the apparatus is complex, but that it is so original that it is difficult to understand from a printed description. We shall content ourselves, therefore, with giving an accurate idea of the way in which Mr. Serrell has solved his problem, without going into details.

The spinning bobbins are arranged over a long, narrow tank, in which float the cocoons. Into this tank dips the lower edge of a wheel about 1ft. in diameter, its axis standing at an angle of about 45 deg. with the surface of the hot water in the tank. A number of cells are made round this wheel, and in these are placed cocoons. The filaments from the cocoons are brought over pegs, so that they stand nearly vertical at the dipping side of the wheel. The cocoons are put into the wheel by an attendant after they have been treated with a broom as before described. Over the tank stand the bobbins or spindles, at the back of the tank are the wooden reels on which the silk is wound. After the thread leaves the bobbin it is passed over a small sheave at one end of a forked arm, wound once round a drum about 4in. in diameter, then over the pulley on the other horn of the forked arm, and then once round a drum on the same axis as that just named, but slightly larger in diameter. The principle is, in short, that of the Chinese windlass. The smaller wheel takes the thread from the bobbin, the larger delivers it to the reel, but the larger one pays it out about 2 per cent. faster than it is supplied by the smaller, and this puts a tension on the thread tending to pull the horns together. So long as they remain a certain distance apart an electric current is broken; if, however, the thread gets thinner, and therefore weaker, the distance between the horns slightly augments, contact is made, and another piece of apparatus is put in motion.

Over the tank is a kind of little railway, on which runs a carriage backwards and forwards, propelled by a chain. Opposite and beneath each of the bobbins is a little mechanical arrangement, which can throw out an arm horizontally. What happens is this:—As soon as the electrical current passes, the little carriage which has been waiting at one end of the tank starts along the railway, until it comes nearly to the inclined wheel of which we have spoken. An arm under the carriage then moves, and engages with one of the vertical filaments, and lays hold of it, because of its glutinous nature. The carriage then runs back. The moment it has passed the bobbin giving off silk too fine, the small horizontal arm before mentioned swings out and stops the carriage on its return journey. It must be understood that as the carriage returns it tows behind it one of the cocoons, the filament acting as a tow rope, and floating the cocoon out of the wheel. The moment the carriage is stopped opposite the bobbin, a flyer on it catches the tow rope, and incorporates it with the other five or six filaments making up the thread. The strength of the thread thus being restored, the horns are again drawn together, contact is broken, and everything returns to its original condition.

It is difficult to watch the action of this apparatus without believing that it is endued with life. The little carriage at the end of the rails seems to watch the bobbins as a cat does a mouse. For a minute or more it will remain at rest; then it dashes out, runs to the magazine wheel, seizes a cocoon, and carries it to the bobbin wanting it. If one does not suffice it goes for another, or yet another, and then returns to its post of observation. Sometimes three or four bobbins all want strengthening about the same time; then the little carriage is busy indeed, running up and down the rails without a second's delay—now feeding this bobbin, now that, till all are contented, when once more it returns to take, we had almost said, a few minutes' well-earned repose. We have never seen any machine which acts so intelligent a part as this. It is by no means necessary that the visitor should know anything about silk reeling. The mechanician and the mechanical engineer can alike find delight, we think, in watching the performance of this dainty mechanism.

In what we have written we have, as we have stated, made no attempt to give a minute or complete description of the Serrell reeling machine. For that we may refer our readers to a well-written pamphlet on "Silk Reeling," by Mr. Serrell; but nothing will satisfy, we think, the mechanician so well as to watch the machine at work. We have performed our task very badly if we have conveyed the idea either that the mechanism used is excessively complex or exceedingly delicate. It is neither the one nor the other. A drawing frame is a hundred-fold more complex. Nor is it in any way essential that electricity should be employed. Its use is found convenient and satisfactory, but in no wise necessary.

Finally, we may add that this is not a new, untried invention. Machines of the kind described have been in successful operation in the South of Europe now for a considerable period.

A tunnel in Colorado 2000ft. in length through solid rock has been completed by the aid of machinery dragged over the snows of a hitherto trackless wilderness, and this month trains will run daily between Leadville and Colorado Springs.

LETTERS TO THE EDITOR.

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

THE ENGINE TRIALS AT NEWCASTLE.

Sir,—I am surprised that no criticism of the engine trials at Newcastle-on-Tyne has appeared in your correspondence columns. Perhaps the weather has been too hot. Will you permit me to say something on the subject? As an old builder of portable engines, although no longer in the trade, I can write with some knowledge of the questions I am going to discuss.

In the first place, it seems to me that the Royal Agricultural Society has not gone far enough. The prizes have been awarded solely on the basis of consumption of fuel. To this I take no exception. It is a very good standard in its way, but I submit that it is not the only standard; nor is it the best standard for an agricultural society to adopt. Such a society should bear in mind the uses to which portable engines are put by its members, and judge them accordingly. I am not going to find fault with the competitors. They acted according to the instructions, or no instructions, given them by the society. It is, however, tolerably clear that another trial must take place, possibly next year, and if I explain how this trial ought to be conducted, my objections to the past trial will be easily deduced from the explanation.

I submit at the outset that the proper test would be to go to the stands of exhibitors and take ordinary engines such as they sell and put these on the brake. This, I suppose, will not be done. As an alternative, I suggest that the awards should be made on a basis of marks prepared thus:—For single cylinder engines of 8-horse power a typical engine should be taken and regarded as zero. This engine to have twenty-four tubes, 6ft. 6in. long and 2¾in. diameter. Its moving parts will be a crank shaft; piston and piston-rod, crosshead, and connecting-rod; an excentric ring, a valve rod, and one slide rod; a governor with six joints, and a throttle valve; a feed pump and excentric, and three valves. These things are the least that will suffice in the simplest engine that can be made. The standard of coal consumption I take at 3 lb. per horse per hour.

Now every competing engine is to be compared with this standard or ideal engine, and a certain number of marks are to be attached for each extra part. For example, for every tube in the boiler over twenty-four, 100 marks. For each wire gauge of tube thickness over ten, twenty marks. For each inaccessible tube in the fire-box, 250 marks. For each extra joint of any kind needing lubrication, twenty marks. For each additional slide valve or steam distributing valve, twenty marks; and so on.

It will be easily seen that in this way a very considerable number of marks would be scored up *against* each engine. Thus, for example, while an engine with twenty-four tubes would have nothing scored against it, the Foden engine would have 4900 against it on the ground of extra flue tubes alone, and for the water tubes in the Paxman's fire-box 2000. We may suppose that some of the engines would have as much as 25,000 marks against them, the number being run up by small joints here and there, and such like things.

On the other hand, I would credit the engines with coal consumption in this way. As the difficulty of economising the last 0·1 lb. is much greater than with the first 0·1 lb., I would give marks in the ratio of squares. Thus for an engine burning 3 lb. of coal there would be nothing. For an engine burning 2·9 lb. I would give 100 marks; for one burning 2·8 lb. I would give 200 marks; 2·7 lb., 900 marks, and so on. Thus an engine burning only 2 lb. would be credited with 10,000 marks.

Now, let us suppose that we have an engine which has the maximum bad marks—say 25,000—while its coal consumption gives as good marks 10,000. Then we have against this engine 25,000 − 10,000 = 15,000. Another engine has fewer boiler tubes, less number of parts, &c.; is, in short, more nearly an agricultural engine. It will have against it, say, 17,000 marks, but its consumption of fuel will be 2·7 lb., corresponding to 900 marks. Then we shall have 17,000 − 900 = 16,100. It would be a worse engine than that already named, which has 15,000 only against it. If, however, the consumption of fuel were 2·5 lb., the figures would stand 17,000 − 2500 = 14,500. It would then beat the more complicated engine, although this last burned less fuel.

It will be seen that in this way the engine with a large consumption, no matter how simple, would have no chance, and the highly complicated engine, no matter how economical, would have no chance of a prize. The prize would be given to that competitor who got the most economy with the least complication, and this is the true object to be kept in view by the Royal Agricultural Society.

In what I have written I have made no attempt to fix proper marks to each portion of the engine; I have only endeavoured to indicate a principle. The marks ought to be settled by a proper consultative committee. Some persons will attach more importance to having a small number of tubes than others may, while again they would be disposed to attach little importance to a slide valve more or less. For myself, I would heavily penalise automatic expansion gear, which is quite unnecessary in a farmyard, and can do no good on the brake where the load is constant and the pressure steady. If such a gear is wanted under such conditions, it i evidence that there is something radically wrong with the engine. Under such conditions the engine ought to run quite steadily without any governor at all.

The brakes of the Royal Agricultural Society are not what they ought to be; they could very easily be made to run without jumping and without the constant interference of a man to tighten or slacken a screw.

I venture to hope that some of your readers will take the subject up. Let us, if possible, have it fully ventilated in your pages. I may be pardoned if I use a *nom de plume*, as I am conceited enough to think that if I gave my real name, many of your readers who know me well might attach importance to my suggestions, not because of their merit, but because of the man that made them. This I desire above all things to avoid. I have long since left the trade, and have consequently no pecuniary interest to serve. My trade in portables lay principally with contractors, not farmers; but for the latter I did repairs, and I know where agricultural engines give out first, always in the boiler, whereas, with contractors' work, as a rule, the engines fail long before the boilers. I enclose my card.

An Ex-Portable Engine Builder.

July 30th.

TECHNICAL INSTRUCTION.

Sir,—As you say in your article, the prospect of increase taxation for education will demand careful scrutiny, especially when it is considered that with the exception of France we pay more for education than any European country, and obtain less results. Another view of the case generally overlooked is that if technical instruction be needed in this country it should be provided for employers and managers. Upon the necessity of technical instruction for our artisans much misconception exists—misconception which a perusal of the second report of the Royal Commission on Technical Instruction would remove. Like most Blue Books this is very bulky; there is no abridgment, and the report has not received from the technical press the attention it deserves. It was until between fifty and sixty years ago forbidden to export some kinds of English machinery, and made penal to enlist English artisans for employment abroad. When continental countries began to construct railways and erect mills, they established technical schools and sent engineers and men of science to Englan to prepare themselves for becoming teachers in the institutions which now are to be found in every continental State for the purpose of instructing those who are to become the directors of industrial establishments. Palatial buildings are erected, furnished with the best appliances and teachers at very low fees by the State but these institutions are used for educational purposes by those

who in this country are expected to provide similar advantages for themselves. For the technical instruction of artisans and foremen literally nothing is done beyond by a few societies who afford means for evening instruction. There are in some countries technical schools for workmen, but as they are held in the daytime, and can only be attended by those who can afford to give up their employment for the time, complaints are made that they are used by those for whom they were not intended. The advantage possessed by the continental workman is in the excellent system of primary education, and in some countries in his being obliged to attend a continuation school during his apprenticeship. To this may be added the care taken by the various guilds that the apprentice is properly instructed in his trade, and his being obliged to show proof of his competency before being allowed to become a journeyman. It is not so much technical instruction for the workmen as greater energy on the part of employers that our trade requires.

The following extracts from the second report of the Commission on Technical Education are worth perusing:—"Great as has been the progress of foreign countries, we have no hesitation in stating our conviction, which we believe to be shared by continental manufacturers themselves, that taking the state of the arts of construction and the staple manufactures as a whole, our people still maintain their position at the head of the industrial world. We cannot repeat too often that we have been impressed with the general intelligence and technical knowledge of the masters and managers of industrial establishments on the Continent. Up to the present time, though a few foremen have received some technical instruction in schools provided for them, foreign foremen have not generally been technically instructed, but have, as in England, raised themselves from the position of ordinary workmen. In the technical education of workmen outside the workshop the resources of continental countries have hitherto been, and are still, very much more limited than has been supposed in this country to be the case. Though there are numerous societies for the purpose, their sphere is very limited, and the facilities they offer for evening instruction in science and technology are inferior to those at the disposal of our own workmen, the absence of which means has been lamented by many competent persons with whom we came in contact abroad." C.

Westminster, August 3rd.

Sir,—Considerable confusion appears to prevail about this question. It ought to be understood that there are two distinct proposals at present in the air. One is the establishment of trade schools, giving specialised teaching with the avowed object of fighting the foreigner, and to this I take it your article refers, especially with its references to South Kensington. The other is a proposal to carry the principle, now universal in infant schools under the name of Kindergarten, one step further, and to teach elementary sciences by means of elementary crafts. The argument that the pupil would find what he had learnt at school useless in the workshop has no force against this latter proposal, which aims at quickening the mental and bodily powers, and laying the foundation of that habit of passing easily from general theory to particular fact, and from written rule, specification, or drawing, to solid objects, and the reverse, which lies at the base of aptitude for the higher work of industry. That there are difficulties to be overcome in introducing such education its advocates do not deny; but nevertheless they believe that the future of this country largely depends on the success of the attempts which are being made to realise it. W. A. S. B.

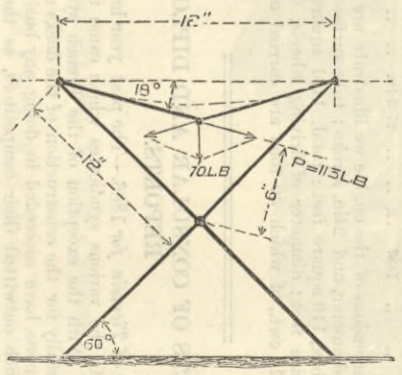
August 2nd.

[Will our correspondent further enlighten us by saying on what facts is based the theory that the future of this country depends on the extension of the Kindergarten system?—Ed. E.]

STRESSES IN A CAMP STOOL.

Sir,—With reference to the letter signed "Puzzled," I beg to give the following result of my calculation of the stress of the camp stool, which shows that the portable seat can carry nearly double the load; the experiment I ask "Puzzled" to try, and to verify the calculation:—

Assuming that the load of 140 lb. is equally distributed over the two pairs of legs, and that the span between two legs is 12in., *i.e.*, an incline of 60 deg. against the ground, and the dip of the seat



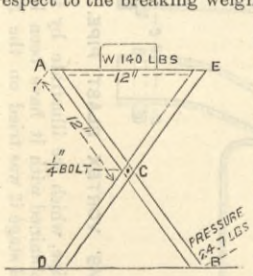
about 2in. We find in an approximate way, by means of the parallelogram of forces, the force P acting on each leg to be

$$P = \tfrac{1}{2}\,\frac{140}{\cos.\ 72\ \text{deg.}} = 113\ \text{lb.}$$

which form an angle of tang. $\alpha = \frac{2}{3}$, $\alpha = 18$ deg. with the horizontal line. This force tries to bend the leg round the screw-hole on a lever of 12 sin. 48 deg. = 8·9 to 9in. The ultimate strength of ash is, according to Molesworth, 7½ tons, which gives a breaking strain of $\frac{1}{2}\,\frac{(\frac{5}{4})^3 - (\frac{1}{4})^3}{12}\,\frac{4}{5} \times 2 \times 7{\cdot}5 \times 2000 \times \frac{1}{3} = 215$ lb. to the leg, therefore a safety against fracture of $\frac{215}{113} = 1{\cdot}9$ nearly 2. E. K.

Woolwich, July 30th.

Sir,—In reply to your question in The Engineer of Friday last, in respect to the breaking weight of a camp stool, I beg to offer the following rough calculations. To commence with, I assume (α) that the stool has four legs, and is made as an ordinary camp stool. (β) That the legs, of sound ash, are pierced by a ¼in. hole at 1ft. from either end. (γ) That the opening or width of seat is 1ft. Neglecting minor strains, the most important point to consider is the strain on the legs A B D E, and which may be viewed in the light of a beam 2ft. long, supported at A and B and loaded in the middle at C. The pressure of $\frac{140}{4}$ lb. exerts a pull of 24·7 lb. at right angles to A B on each leg—35 lb. force resolved into two others at angle of 45 deg. Now this pull is the same as that of a weight of 49·4 lb. at centre of beam 2ft. long, and the moment of the strain at centre of beam = 296·4 lb.

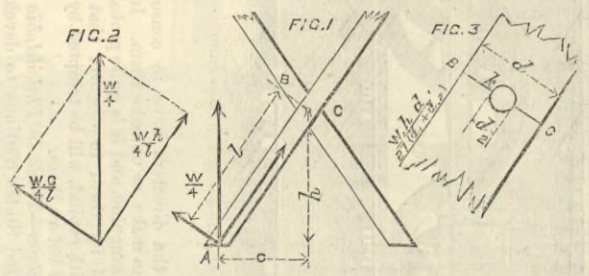


A section of sound ash 1in. square will yield under a breaking moment of 2250 lb. The section of these legs is, deducting the ¼in. bolt, ½in. square, yielding under breaking moment of 1125 lb., and requiring a weight of 187·5 lb. at C to produce it, or a pressure of 93·7 lb. at each end A and B. Resolving these forces of 93·7 lb., we arrive at the result that the stool should not break under a less pressure than 484 lb. equally distributed.

The accuracy of this calculation will be much impaired by bad material and workmanship. The shearing strain which would break a ¼in. bolt is about 2450 lb., so that if of good iron, of an even section, and properly fitted, there would be little to fear from that quarter. Trusting these hasty calculations will be of use to you.

Milton Cottage, Brixham, Devon, B. J. Hall.
August 2nd.

Sir,—Your correspondent "Puzzled" does not give the data necessary for the solution of the problem he suggests. The following, however, appears to me to be a correct solution, neglecting the friction between the legs and the ground. Fig. 1 shows sketch of lower part of stool, Fig. 2 diagram of forces, and Fig. 3 enlarged



sketch of leg of stool at pin-hole. I have assumed that the ash is of first-rate quality, dry, straight-grained, and free from knots, as the wood used for such stools usually is. If such is not the case, the modulus of rupture f must be reduced.

Let W = weight on stool;
$\frac{W}{4}$ = vertical reaction at foot of one leg;
l = length of one leg;
c = half distance between feet of stool;
h = height of pin above ground;
b = thickness of one leg;
d_1 = breadth of one leg;
d_2 = diameter of pin-hole;
f = modulus of rupture, say 12,000 lb. for ash.

Resolve $\frac{W}{4}$ into two components, normal to parallel with the leg A B C as shown on parallelogram of forces, Fig. 2.

$$\text{Normal component} = \frac{W\,c}{4\,l};$$

$$\text{Parallel component} = \frac{W\,h}{4\,l}.$$

The cross section B C has to resist the bending moment $\frac{W\,c}{4\,l}\,l = \frac{W\,c}{4}$, and also the crushing force $\frac{W\,h}{4\,l}$, acting on the portion B k, and uniformly increasing from k to B, at which point it amounts to $\frac{W\,h}{4\,l} \times \frac{2\,d_1}{d_1 + d_2} = \frac{W\,h\,d_1}{l\,b\,(d^2_1 - d^2_2)}$ per square inch, which must be deducted from f when equating the bending moment to the moment of resistance of the cross section B C, thus:—

$$\frac{W\,c}{4\,l}\,l = \tfrac{1}{6}\left(f - \frac{W\,h\,d_1}{l\,b\,(d^2_1 - d^2_2)}\right) b\,(d^2_1 - d^2_2);$$

$$\text{from which } W = \frac{2\,f\,b\,l\,(d^2_1 - d^2_2)}{3\,c\,l + 2\,h\,d_1}.$$

Assuming l = 12in., c = 6in., h = 10in., b = ½in., d_1 = 1¼in., d_2 = ¼in., and f = 12,000 lb.—

$$W = \frac{2 \times 12{,}000 \times \frac{1}{2} \times 12 \times \frac{25 - 1}{16}}{3 \times 6 \times 12 + 2 \times 10 \times 1\frac{1}{4}} = 896\ \text{lb.}$$

Scarbro', August 2nd. R. W. M. M.

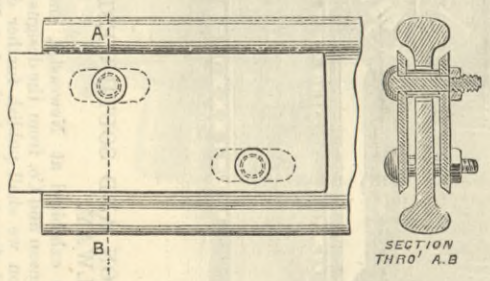
RAIL JOINTS.

Sir,—Your correspondent Mr. A. M. Clark has, I suppose, rightly guessed the principal advantage of the outside key in railway chairs—it cushions the chair against the incessant blows of the wheel flange, and ought to aid smooth travelling and save the chairs. But as it is not uncommon for three or four keys to be out of their places at the same time in a single length of rail, leaving it unsupported for a length of some yards, it behoves the advocates of the outside key to defend it on some other ground besides that of easy travelling.

For many years the oldest railway in England was laid with the inside key. I believe I am right in saying that the old engineers began with it; and some railway men who have been long accustomed to it, look upon the outside key as a dangerous innovation. Although not an advocate of the latter, I have found that the system lends itself to a more comprehensive design of chair-jaw and key than the other, in which the keying jaw has to be kept low, in order to clear the wheel flanges, and the key has to be correspondingly reduced in depth. This is all I positively know in its favour, but Mr. Clark is quite welcome to this small contribution towards his enlightenment. S.

Darlington, July 25th.

Sir,—I have seen a good deal of correspondence lately in your paper about the expansion of rails by heat and consequent distortion of the line. Would it not be practicable to adopt the following plan upon inclines where the rails creep if the fishbolts are not screwed up tight, and where they bulge when the contrary is the case? Secure one end, or the centre, of each rail rigidly to a special chair, or otherwise. Enlarge the fishbolt holes in the rail sufficiently to allow of the free passage of a short piece of iron or steel piping through which the fishbolt would in turn pass. The



length of this pipe or collar must be such that the fishplate would bear upon it when the bolts were tightly screwed up, and not upon the rail, and consequently the free end of the rail would have room to expand or contract. Should the bearing for the fishplate be insufficient, the holes could be punched diagonally and as near as possible to the top and bottom, as in accompanying sketch. In the sketch the distance of the fishplate from the rail, and consequently the length of the collar, is exaggerated for clearness.

Mateur, near Tunis, July 25th. T. L. Smith.

CROYDON WATER SUPPLY.

Sir,—My attention has been directed to a statement in your issue of the 22nd July, page 67, where it is stated that the new Addington reservoir of the Croydon Corporation will be carried out under my instructions.

I desire to state that I have nothing whatever to do, and have not had for many years past, with any of the works prosecuted by the late Local Board or the present Corporation of Croydon. I deem it is expedient that I should make this contradiction as it will be clear to any person of discernment that no engineer of repute who was desirous of economically constructing a reservoir would make one of the proportions stated by you, when, as in this case, he has ample space at command to adopt more economical proportions for the construction of such a work. Baldwin Latham.

7, Westminster-chambers, Victoria-street,
Westminster, S.W., August 2nd, 1887.

THE CLARK PROCESS.

Sir,—In reference to Mr. Howatson's letter of the 25th ult., respecting his patent apparatus for softening and purifying water, of which we have acquired the English right, we may mention we have been able in England to achieve even a better result than that given by him, a machine erected at Messrs. Bolton's, in Birmingham, treating water having a varying hardness of from 60 deg. to 90 deg., which is reduced to 5 deg. by this process. The hardness in this case is all permanent and contains:—

Sulphate of lime	43·26
Chloride of calcium	54·98
,, ,, magnesium	10·78
,, ,, sodium	41·82
Soluble silica	0·28
Oxide of iron and alumina	0·28
Alkaline carbonates	25·98
	177·38

Surely, if it be possible to successfully treat a water of this nature, there can be no difficulty in the case of that of the Severn Tunnel, and your contention in this respect is undoubtedly correct.

London, August 4th. J. W. Gray and Son.

SOUTHWICK TRAMWAYS.

Sir,—With reference to your very careful notice of our work at Southwick, in last week's issue, I wish to correct a little false impression arising from the very last paragraph, that is, concerning the necessity of two electro-motives complete, to work a line with a storage engine. This is not at all requisite, as I have very carefully prepared an arrangement by which the accumulators on the electro-motive can be replaced, when discharged, by charged ones within eight minutes, thus economising rolling stock.

Will. D. Gooch,
Consulting Engineer to the E. T. Syndicate.

London, August 3rd.

Water Power for Mills.—We are requested by Messrs. Bodley Bros. and Co., of the Old Quay Foundry, Exeter, to state that they were not in any way concerned with the water wheel which was mentioned in our impression of the 15th ult. as erected for Mr. W. R. Mallet, of Exwich.

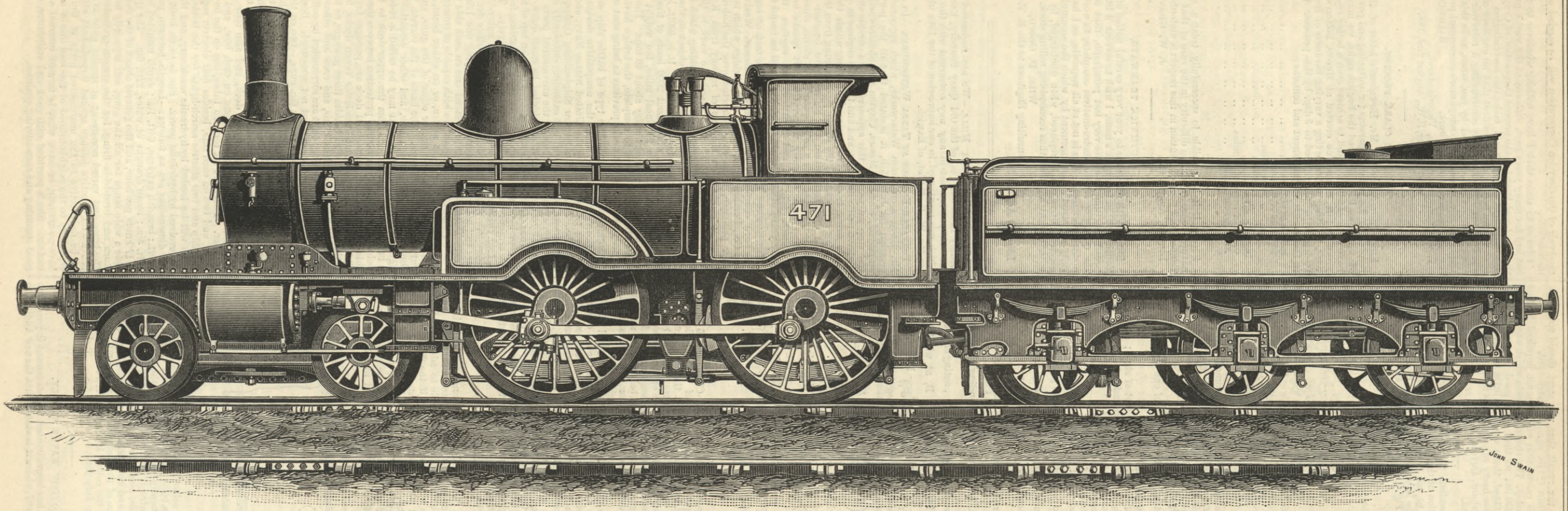
Portable Engines at Tanza Waterworks.—In an article by Mr. Hedges on Tanza Waterworks, which appeared in our impression for July 15th, it is stated that all the portable engines employed, made by Messrs. Clayton and Shuttleworth, had defective stop valves. As this appeared to be a curious state of affairs, we have made inquiries, and find that the engines in question were made some twenty-four years ago, during which time they have had few repairs, and the steam pipes leading from the stop valves to the cylinders within the boilers have become more or less corroded, and so pass a small quantity of steam, enough to render the stop valve partially inoperative. It speaks in high terms of Messrs. Clayton and Shuttleworth's engines that, after so many years of hard work, they should still be found fit for duty.

The Sukkur Bridge.—This remarkable feat of engineering has just been completed at the works of Messrs. Westwood, Baillie, and Co., London Yard, Poplar. The bridge, which is on the cantilever principle, is to be constructed over the Kohri Pass of the Indus at Sukkur, on the line of railway from Kurrachee and Attock. A noticeable feature about the work is the erection of probably one of the finest pieces of scaffolding which has ever been built, and which has been a conspicuous object on the banks of the Thames at Poplar and for miles round. It is 400ft. long by 120ft. wide, and 180ft. high, with about 2600 loads of timber, which, if laid out, would measure 24 lineal miles, the weight of the bolts, nails, and other ironworks being about 40 tons. The contract has taken about two years to complete, the bridge having to be temporarily erected at the works previous to being sent out to India.

American Ironclad.—The type of battle ship selected by the American Government from the competitive designs, and recommended to be built by the United States Navy, and designed by Mr. Wm. John, of the Barrow Shipbuilding Company, will have twin screws, an armoured belt extending sufficiently long to ensure stability, even if the whole of the unarmoured parts of the water-line before and abaft it are riddled by small quick-firing guns or large ones, and there is an armoured deck on top of this water-line armour-belt, and also an armoured deck extending from the top of the armour belt to the bow and stern respectively. The belt itself is 12in. thick, and extends from 2ft. above the water-line to 4ft. 6in. below it. Above this deck there are two other decks, extending fore and aft with two turrets, each carrying one 12in. gun. above this. These two turrets are placed one on each side of the ship *en échelon*, and the heavy guns are both capable of concentrating their fire right ahead or right astern, or on either beam, and covering the whole horizon with one or other of the guns, and the greater part of it with both guns. The bases of the turrets, together with the funnels, ammunition lifts, and other essential elements in fighting, are enclosed in what may be called a redoubt, forming a breastwork, as it extends from the upper deck to the deck next below it. The only armoured protection between the lower part of this redoubt and the armoured deck are passages for ammunition. This, which may be termed the lower 'tween decks, has nothing in it that can be termed vital besides these passages, as they are taken up with stores of various kinds, and crew and other accommodation, but all the openings on it are surrounded by coffer dams and such other available means, but not armoured. Besides the 12in. guns in the turrets there are six 6in. guns,—two on the upper deck with a fore-and-aft fire, and two on each side, on the main deck, capable of firing nearly fore and aft. These are protected by shields. Besides these there are four 6-pounder Hotchkiss rapid-firing guns and six 3-pounders distributed on the maindeck, and two 1-pounder Hotchkiss guns on the flying deck, and also four 37-millimetre Hotchkiss revolving cannons, one on each bow, and one on each quarter. There are six torpedo tubes, one on the bow, one on the stern, and two on each side, besides four electric search-lights for the ship and two electric search-lights for the boats. The heavy guns will be loaded by hydraulic machinery, and the turrets will be revolved by hydraulic power. She is to be built of steel, and the dimensions are as follows:—Length between perpendiculars, 290ft.; breadth extreme, 64ft. 1in.; depth moulded to upper deck, 39ft. 8in.; mean draught of water, 22ft. 6in. The speed intended is 17 knots per hour, and the general object of the design is to provide a wide range for all the guns, and especially heavy bow and stern and broadside firing for the armour-protected 12in. guns. The large and varied armament of smaller guns is calculated to provide an effective defence against torpedo-boat attack, and also to be destructive to the unarmoured parts of the enemy, and especially to the neighbourhood of the load line of such vessels as have no armour, or have what is termed internal armoured protection. She is provided with good coal endurance, and will have good steaming and manœuvring qualities.

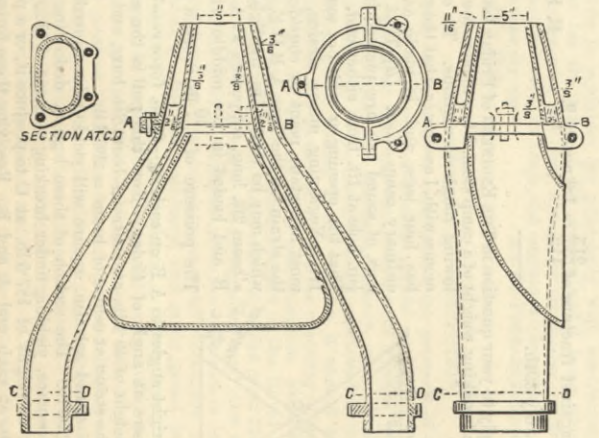
THE NEWCASTLE EXHIBITION.—EXPRESS ENGINE, LONDON AND SOUTH-WESTERN RAILWAY.

MR. W. ADAMS, M.I.C.E., ENGINEER.



EXPRESS ENGINE, LONDON AND SOUTH-WESTERN RAILWAY.

We illustrate above an engine exhibited at Newcastle, and constructed by Messrs. Robert Stephenson and Co. from the designs of Mr. W. Adams. In another impression we shall publish further details. The engine above mentioned was designed to work the fast West of England passenger trains, with an average load of 150 tons, exclusive of passengers' luggage, at a speed of about forty-five miles an hour, making the journey from London to Exeter. The engine is fitted with



ADAMS' VORTEX BLAST PIPE.

Adams' vortex blast pipe, which we illustrate by the accompanying diagram. The results obtained with it have been highly satisfactory. During its experimental stage it was tried on the Nine Elms, Yeovil, and Exeter express goods engine link, six engines of which were fitted with the vortex pipe, and the remaining engines—five—with the plain pipe, the result being a saving of 2·73 lb. of coal per mile in favour of the patent pipe, the engines so fitted hauling an average load of 29·93 vehicles at an average consumption of 27·21 lb. of fuel per mile, as against 28·48 vehicles, the load of the engines fitted with the plain pipes, the average consumption of fuel being 29·94 lb. per mile. Since the introduction of the vortex blast pipe on the South-Western Railway, fuel consumption has steadily decreased, as will be seen by the statement below, viz.:—

	Fuel per engine mile.	Fuel per train mile.
January 1st to 30th June, 1885	29·9 lb.	40·3 lb.
January 1st ,, ,, 1886	28·8 lb.	39·0 lb.
January 1st ,, ,, 1887	27·3 lb.	37·9 lb.

The principal dimensions of the engine we illustrate are as follows:—Cylinders, 18in. diameter, and 24in. stroke; tube surface, 1051 square feet; ditto fire-box, 110 square feet; total, 1161 square feet; area of grate, 17·7 square feet; diameter of driving wheels, 6ft. 7in.; total weight, 46 tons 15 cwt., of which 30 tons are carried on the driving wheels.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

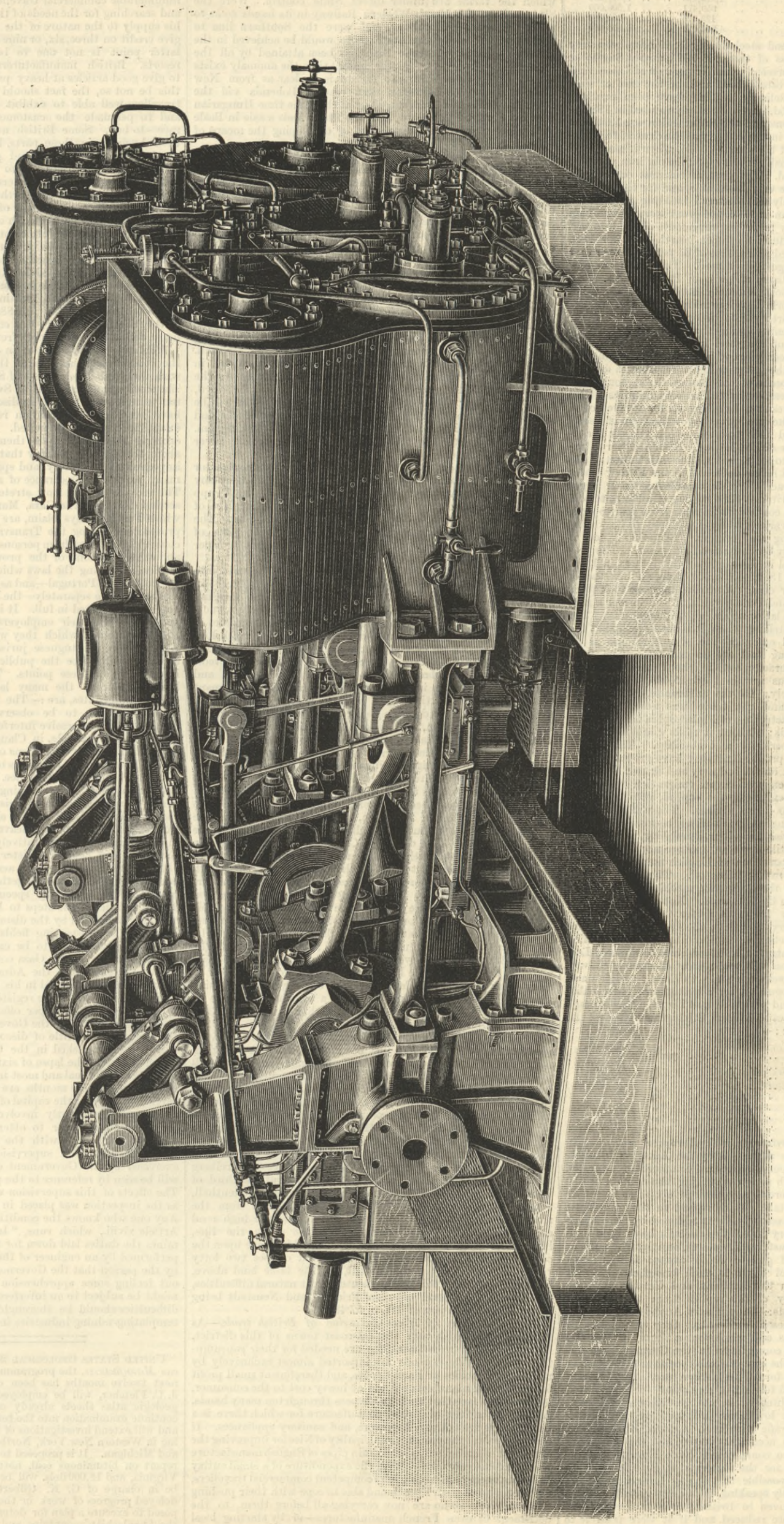
China—Trade of Tientsin for 1886.—The past year has been one of disappointment to the various syndicates which came to Tientsin so full of hopes. With the exception of the French syndicate which tendered successfully for the construction of the docks and workshops at Port Arthur, none have succeeded in doing any business. In this matter the French outwitted their competitors, as they understood better how to deal with the officials with whom the decision lay. The Chinese have shown themselves very ready to take advantage of the keen competition existing between foreigners, and not always a very fair advantage. They will encourage different persons—at considerable expense to themselves—to make preliminary surveys, to obtain information from Europe by telegraph, to give specifications, and to make tenders, and then place all this information in the hands of some rival, and ask him if he will undersell the others. Towards the end of the year a couple of miles of the narrow gauge Decauville Railway was laid down near the British Concession. Since the opening day the small railway has been running every afternoon to afford the people of Tientsin an opportunity of judging of the advantages of railway travelling. There is a general belief that when railways come, Tientsin will develope into a very important place. Land in and about the foreign concession has almost doubled in value. Some new buildings have been erected, among which is an imposing edifice put up by the agent of the French Syndicate, to serve as a sort of museum or show-room for the exhibition of machinery, models of ironclads, torpedo boats, &c. During the past year the first railway officially recognised has been under construction. It is intended to connect the Kâi-ping coal mines with the river Peh-fang, at the town of Lu-fai, which vessels drawing 14ft. of water can reach. The railway company has taken over from the coal mine company the seven miles of line already existing at Kâi-ping, and an addition of twenty-four miles will bring it down to the river bank. The capital has been provided by half-a-dozen local officials, and the undertaking appears at present to be in the nature of a private company. It is stated that this line is to be extended from Lu-fai, round by Peh-fang and Taku to Tientsin, and that its utility for military purposes has influenced the Chinese Government in giving its consent. The control of the railways will be in official hands, and the public, who may be invited to subscribe, will have no voice in the direction. The result can only too surely be forecast, from the fate of the China Merchants Steam Navigation Company, which, after starting with every advantage, after a few years became hopelessly involved through the incompetency and venality of the officially appointed directors. This is a most unfortunate beginning. The Chinese Government has resolved that railways shall be made with Chinese capital. Chinese shareholders, with an official board of directors at their head, are helpless; they have to acquiesce in whatever the directors choose to do, while the directors have to consult the wishes of the higher officials, who make or unmake them. In any new venture the Chinese are always sanguine, and it is quite probable that until sufficient time has elapsed for them to discover that they have been victimised, Chinese, with capital, will be tempted by any railway prospectus which may be put before them.

United States—Trade in Philadelphia in 1886.—The vast resources of the United States continue to develope, and this consular district, comprising the States of Indiana, Michigan, Ohio, and Pennsylvania, has had its full share of increased prosperity in internal commerce, manufactures, and shipping. The British commercial marine has steadily increased with slight variations from year to year. The American merchant marine continues to decline, and for the past two years propositions have from time to time been made to Congress for subsidies in various forms, but have met with little encouragement. As a rule, iron shipbuilding on the Delaware has been prosperous. The Harlan and Hollingsworth Shipbuilding Company have just launched a steamer for the Albany Day Line from New York, 300ft. long, 40ft. beam, and 12½ft. deep. Other yards at Camden, Chester, Kensington, and Wilmington, have all been engaged on iron and steel vessels of various dimensions. There is one good basin dock at Philadelphia, belonging to Messrs. Cramp, capable of receiving the largest ships, and it is in almost constant use for repairs of crafts of all sizes. Messrs. Cramp and Sons are about to lay the keel of a Government steel cruiser of 1700 tons, to be armed with six 6in. rifles, five Hotchkiss cannon, and one Gatling gun; and to have a speed of 16 knots an hour. Two other steamers are being constructed—one for the trade between Tampa and Havana, and the other for the Metropolitan Line plying between New York and Boston. Both vessels are near 3000 tons burthen and 2000-horse power. The pig iron production of the United States continues to increase, showing an increase in 1886 of 1,836,819 tons, or 40 per cent.—283,859 tons of which were in Pennsylvania. The iron and steel industries have been especially active throughout 1886, and the production of pig iron, Bessemer steel, and steel rails, open hearth steel, structural steel and iron, and other products, has largely exceeded that of any pre-

TRIPLE EXPANSION ENGINES OF THE DOGALI.

MESSRS. R. AND W. HAWTHORN, LESLIE, AND CO., NEWCASTLE-ON-TYNE, ENGINEERS.

(For description see page 116.)



vious year. For the whole country the production has been as follows :—

Product.	1885. Tons.	1886. Tons.
Bessemer steel ingots	1,519,430	2,000,000
,, ,, rails	959,471	1,500,000
Open hearth steel	133,375	200,000
Pig iron	4,044,526	5,600,000

The importations of iron and steel during 1886 have been very heavy, and much in excess of those of 1885, amounting to at least 1,000,000 tons. The present prices for pig iron and steel rails have only recently been established, and in the case of steel rails large contracts for delivery in 1887 have been made at from £7 0s. 6d. to £7 5s. 5d. Iron ore was produced in 1886 to the extent of 10,000,000 tons, and the importation was 1,000,000 tons. The stock of pig iron in this country at the close of 1886 was probably no larger than at the close of 1885, when it amounted to 371,885 tons, a very small surplus when the pig iron wants of the country are considered. The general business outlook for 1887 is at the present time very favourable, and for the iron and steel industries is especially so. Railroad building promises to be more active in 1887 than in 1886, the great increase in which year contributed so largely to the improvements of the iron and steel industries. The production of open hearth steel for 1886 in the United States showed an increase of 64 per cent. over that of 1885, and was the largest on record. There was one new plant in Ohio, two in Indiana, and six in Pennsylvania. The States of California, Illinois, Massachusetts, New Hampshire, New Jersey, and New York, have open-hearth plants, and the total number of open-hearth plants in operation in the whole country is thirty-nine ; Pennsylvania's share being twenty-seven. The open-hearth branch of the steel industry has made slow progress during the eighteen years which have elapsed since its introduction, but during the last year it has received a decided impetus, which has prospects of continuing throughout 1887. A drill made by this process penetrated in forty minutes a steel safe plate warranted to resist a burglar drill for twelve hours. A penknife tempered by the same process cut the stem of a steel key readily. It is claimed that the tempering process is conducted without expense or skilled labour. Several other extraordinary claims have yet to be proved to the satisfaction of the public. The production of bituminous coal in the United States is double that of anthracite, but is distributed in a larger number of States and territories. The mining of anthracite coal maintains a moderate but continuous increase from year to year, while that of bituminous varies greatly due chiefly to the different methods of marketing and mining. Bituminous coal is mined as wanted, generally for industrial purposes. The production of bituminous coal in this consular district was, in 1885, 34,200,000 tons, and in 1886 41,150,000 tons, an increase of 7,950,000 tons, or 23·3 per cent. A marked increase took place in the States of Indiana and Pennsylvania, in the former a gain of 1,700,000 tons, and the latter a gain of 4,000,000 tons. The gain in Pennsylvania is striking when it is considered that the increased production and extended use of natural gas as an industrial and illuminating fuel are so marked. The total annual production of anthracite coal in the United States as compared with bituminous was, in 1886 35,466,843 tons and 67,449,057 tons respectively. Of the anthracite, Pennsylvania produced 92 per cent., and the trade was never so brisk. The one question in the metropolis of Philadelphia is Protection. With it prosperity abounds; without it mills would necessarily succumb to English superiority and stability. The cloths, tapestries, and woollens—productions that have grown to fabulous dimensions—are built on the industry and skill of Bradford, Leeds, and Manchester emigration, an emigration which has developed the factories, enhanced the capital, and flooded the market with cheap and good productions. The wealthy classes of this country like the English productions, because the higher grades of them are superior in colour, durability, and texture. Hence those grades of textile manufactures are not so materially interfered with. The importation of English machinery for all textile manufactures has rather fallen off. The best English machines are imitated by the American machinists and sold at a slightly lower price than the imported. Notwithstanding the millowners would in many instances prefer to pay the higher price for English machinery, they, as upholders of a protective tariff for their own products, must reciprocate with the machine manufacturers of the country. The Inter-State Commerce Law recently passed by Congress will make great changes in railway traffic and passenger travel from State to State; freights and passenger fares will be regulated on a permanent and equable basis, and combinations and pools declared illegal. The average rates of wages in the States of Indiana, Michigan, Ohio, and the other Western States, are :—

		£	s.	d.
Bricklayers	per week	3	15	0
Carpenters	,,	3	2	6
Masons	,,	3	2	6
Blacksmiths	,,	2	16	3
Miners	,,	2	6	3
Labourers	,,	2	1	3
Tinsmiths	,,	2	16	3
Wheelwrights	,,	2	16	3

Austria—Commercial relations with European nations.—In July, 1886, a circular was addressed by the Austrian Minister of Commerce to the various chambers of commerce, commercial and industrial bodies, with a view of taking the opinion of the country as to the commercial negotiations about to be set on foot with Germany and Italy. With regard to the complaints brought forward, and the considerations adduced by the various authorities consulted, very interesting details have been supplied by the Union of Austrian Exporters, and by the various trading corporations and guilds, which cannot fail in many instances to afford useful hints to such branches of British trade as may compete in the Austrian and German markets, Here follows a summary of the replies from the different branches of Austrian trade:—In carriages Austria can compete with Germany, at the present duties, but they should not be increased. In iron goods and machines an almost unanimous opinion prevails that all competition in the German market is impossible, excepting in the case of some special articles, such as tin or metal moulds and forms for kitchen use. Any increase of duty here is deprecated for fear of reprisals.

British trade with Hungary is not so inconsiderable as would appear from the low place indicated by the British Customs returns. Our trade with both Austria, Hungary and Switzerland can never be accurately stated, and the number of commercial travellers who come direct from England to this country is, unfortunately for the interests of British trade, so restricted that it is impossible to get any information from private sources. Generally speaking, it is quite possible that a great impetus might be given to British trade if the tariffs of the Southern Railway were reduced, and if it were possible to develope the trade with Great Britain *viâ* Fiume and Trieste. Both in regard to the general commercial relations of Austria, as well as to British trade, fixed Customs tariffs do not suffice to create stable commercial intercourse, for railway tariffs are an important factor. Tariffs which react unfavourably suffice to destroy any impetus that may be given by Customs measures. The three streams of Austrian export flow—eastwards along the Danube, northwards to the Elbe, and seawards to Trieste. In none of these three directions is there an Austrian line on which the tariffs are under direct State control. Were the State to have the North-Western Railway in its hands so as to reach the sea *viâ* Hamburg, and were the Southern line to Trieste purchased by the State, more would be achieved in the interests of Austrian trade than has been attained by all the existing State railways. At the present time the anomaly exists that transport from Vienna to Trieste is as dear as from New York to Liverpool. Russian corn reaches Bohemia *viâ* the Black Sea Ports and Hamburg, but at the same time Hungarian corn *viâ* Fiume, Rotterdam, and the Rhine finds a sale in Basle facts which proves the importance of developing the means of water transit in the interests of Austrian trade.

Denmark—Licences for commercial travellers.—Frequently commercial travellers or members of foreign firms arrive here ignorant of the fact that they must take out a licence before they are allowed to undertake any business. In consequence of this ignorance they are often summoned, and have to take out a licence as well as be fined for having traded without one. The law is that a trading licence shall be issued by the Custom-house of the town in which the individual wishes to do business, which before being used must be exhibited to the proper police authority, who without a fee will certify the same. The licence will be valid for one year from the date of issue, and on its expiration will be exchanged for a new one, good for another year, by the Customs or Excise authorities of the district where the holder resides. For each licence and for each renewal of the same the holder has to pay £8 18s., and if he shall be travelling on behalf of several houses, an additional sum of £4 9s. for each. Any infraction of the above provisions is punished by, in addition to the obligation to take out a licence, a fine of for the first offence, £3 11s.; for the second, £5 3s. 6d.; for the third, £7 2s. 3d. After a third offence, any infraction of the law will be punished by a fine of £7 2s. 3d., the confiscation of effects and samples, and the interdiction to reside or trade in the kingdom. The law is strictly enforced, and a plea of ignorance never admitted as an excuse.

Ecuador—German railway iron in.—The English contractor for the Quito Railroad has been obliged to transfer to Germany his orders for railway iron, as the quotation from the Krupp Manufacturing Company for rails is £4 18s. per ton in place of the price of £5 quoted for the same rails in England. The freight was also much cheaper, being 23s. per ton in place of 27s. 6d., and there is also a saving of from 4 per cent. to 5 per cent. in the exchange.

Egypt—Trade of Alexandria in 1886.—British imports into Alexandria decreased from £3,486,388 in 1885 to £2,953,168 in 1886, or 15 per cent. This decrease is in a great measure accounted for by the low prices obtained for Egyptian products exported abroad. There have been fluctuations in the values of the different imports, but, on the whole, prices have ruled low. Of the iron imported, 50 per cent. is from the United Kingdom, but iron rafters for building come mostly from Antwerp ; tools are imported to a large extent from Belgium, France, and Germany. The trade in ironmongery is in an almost stagnant condition, though at times the want of a store well supplied with better and more durable goods, and of a greater variety, is felt by the European, and especially by the English, colony. The quantity of machinery imported has again shown a tendency to decrease. This is due in great part to its having been found that the system of irrigation by small ridged canals does not allow the use of agricultural machinery on a very large scale, and the quantity in stock is almost sufficient to meet present wants. The demand for coal has very considerably decreased, owing to the improved system of irrigation, and the consequent decrease of many of the steam pumps by which the water is raised to the level of the lands. The efforts of Colonel Moncrieff to raise the barrage, and so enable the fellaheen to dispense with many of the steam pumps in that part of the country, have met with great success, and are more appreciated as they are better understood by the cultivators. The raising of the barrage has caused the salt water from the sea to force itself for a considerable distance up the Rosetta branch of the Nile; but this was remedied last year by the construction of a dam above Rosetta, and a canal connecting the Mahmoudieh Canal at Alexandria with the river a little distance above the dam. An English commercial traveller, acquainted with French and Italian, would probably be able, after a short residence in the country, to determine whether English capital might, with a reasonable chance of ultimate profit, be more largely invested than it is at present in any of the branches of commerce.

Germany—New railway in the Black Forest.—A short but very peculiar line of railway has just been opened from Freiberg, on the main line from Frankfort to Basle, through the Höllenthall to Neustadt, a village about 21¾ miles to the south-east. The main idea of this line is to open up the great timber industry of the higher districts of the Black Forest, and ensure a better means of transport for the products of the forest than can be attained by road. It is hoped that the line will be extended to join the railway system of the east of the forest of Donaueschingen, and thus form another possible means of communication from Austria and Germany to France. On leaving Freiberg the line runs through level meadow land for about one-third of its entire length, and then enters the defile of the Höllenthall, a pass through which the River Wutach descends from the mountains, and which barely admits of room for the high road skirting its banks. Half-way through the defile the line, hitherto working on ordinary rails, is changed into one upon the cog system and runs in steep gradients and crosses two lofty viaducts until it reaches Neustadt, on the table land above. The construction of this line presented great natural difficulties, the difference of level between Frieberg and Neustadt being about 2000ft., or a rise of 1ft. in 57·4ft.

France—District of Nice—Extension of British trade.—As thousands of British visit the sea-coast towns of this district, British goods in large quantities are needed for their consumption and use. These goods are imported almost exclusively by rail from Marseilles or Paris depôts, and therefore at small profit for the British manufacturer and at heavy cost to the consumer, owing to the fact that such goods pass through too many hands. Among the articles of British manufacture for which there is a market here are cutlery, hardware, and sanitary appliances. If the proposals of the present municipality of Nice for improving the drainage are carried out, glazed drain pipes of English manufacture will be extensively used. With the expenditure of a small outlay and some energy by sending here competent commercial travellers, well acquainted with French and able to cope with their pushing German rivals—who are now carrying all before them, to the detriment of even French manufactures—or by starting local agencies, these English goods would find a ready market, being supplied by direct importation from England at less cost than heretofore. German manufacturers have long since appreciated these facts; the innumerable shops in the district are stocked with German goods which, in spite of the heavy protective tariff, can be sold cheaper and with greater profit to the local tradesmen than Paris goods. The success of the German manufacturer may, in a great measure, be ascribed to his indomitable energy and initiative, the linguistic capabilities of his innumerable commercial travellers, his capacity for recognising and searching for the needs of the buyer, his willingness to adapt his supply to the nature of the demand, and his readiness to give credit on three, six, or nine months' bills of exchange, which latter point is not one to be disregarded in these winter resorts. British manufacturers are generally supposed here to give good articles at heavy prices, and with scant credit. If this be not so, the fact should be made known by competent travellers well able to exhibit their samples in the best light and to persuade the customers—a peculiarly impressionable race—to buy. Some British manufacturers, wishing to extend their business in these parts, have lately adopted the plan of posting printed circulars and price lists to British consular officers; many have applied to this office for assistance in the difficult task of seeking customers, and rest satisfied that they have thus done their utmost to further their own interests. This is a complete fallacy. Consular officers, however willing they may be to further and push British enterprise, cannot be expected to transform themselves into commercial agents. With the enormous competition of the present day so lax a mode of advertising is ridiculously insufficient. Consuls are only too ready to help on the spot with advice and information agents who will come here ready to help themselves. The only article of direct importation from Great Britain into Nice is coal, the value of which fell from £27,484 in 1885 to £19,700 in 1886, delivered at the following prices :—Gas coal, from £1 0s. 8d. to £1 1s. 5d.; house coal, £1 4s.; steam coal, from £1 1s. 5d. to £1 2s. 3d. per ton.

Mozambique—Mining laws in South Africa.—The attention of the commercial public is at the present time much engaged with the great development of South African mining industries. The steady prospecting of the Swazieland and Transvaal for over ten years has resulted in the discovery of auriferous tracts which have been found to contain reefs from which gold in payable quantities may be extracted. Capitalists and companies are erecting machinery upon them, townships are springing up about them, and a country that two years ago possessed but an impecunious, migratory, and sparse population, presents now in many parts the appearance of a progressive and thriving State. The prospectors are now stretching beyond the confines of the settled district. The Gaza, Manica, and Mashona countries, to which Portugal lays claim, are the first that lie in the path of prospectors passing the Transvaal borders. Applications being constantly received from persons looking towards these countries and other portions of the province of Mozambique for information respecting the laws which regulate mining industries in the colonies of Portugal—and as these inquiries are too numerous to be replied to separately—the law which governs these matters has been translated in full. It is of the utmost importance that prospectors and their employers should be made aware of the conditions under which they will have to work in all parts of Africa where Portuguese jurisdiction exists. The translation appended will place the public in possession of all necessary information on these points. The chief points in which the law differs from the many laws of all other South African colonies and States, are :—The number of steps to be taken and legal formalities to be observed before a concession can be obtained. The excessive interference of Government in private enterprise, for example, in Clause 12 of Article xxviii, Section iv., relating to the obligations of the concessionaire, which prohibits the engineer of the works to be changed without the consent of the governor of the province. The unusually large area that may be included within a single concession is 6184 acres. A single syndicate has just registered five claims of 6184 acres each, or nearly 31,000 acres in all, or 48·28 square miles. Such concessions will eventually leave the richest part of the country in the hands of comparatively few. No one person in the Transvaal can hold or register a claim of more than 300ft. by 150ft., or little more than an acre, and though a number may be bought up and blocked together, a seasonable check is kept upon the eye of purely speculative and protective holdings. The difficulties in the steps to be taken to obtain a concession are much increased by the distance and want of communication between the prospecting fields and the centres at which the legal formalities have to be carried out. Any one wishing to prospect in the North Gaza country must first obtain his prospecting licence from the Administrador de Concilio at Chilwan ; if he is successful in his searches he must return to the coast at Sofala and there register his discovery. He must then apply through the proper official channels, and according to certain legal forms, to the Governor-General at Mozambique for the recognition of title of discovery. Notice of his application will then be published in the Government *Gazette* of the province, and after the lapse of sixty days the title may be granted to him. For the final and most important step—the gaining of the concession—twelve months are allowed, and this must also be carried through at the capital of the province. These successive stages are sufficiently involved in technicalities of law to compel a man either to attend himself or to employ those who are conversant with the law to carry them successfully through. The close supervision exercised or which may be exercised by the Government over the working of the mines will be seen by reference to the provisions of Article xxvii. *et seq.* The effects of this supervision would be mainly salutary as long as the inspection was placed in competent and judicious hands. Any one who knows the condition of this province cannot read Article xlviii., which runs, "In the absence of an engineer of mines the duties laid down for that officer in this decree will be performed by an engineer of the province, and if there be none, by the person that the Governor judges to be the fittest," without feeling some apprehension that those in charge of mines might be subject to an interference difficult to bear. All these difficulties should be thoroughly understood by foreigners contemplating mining industries in Mozambique.

United States Geological Survey.—According to the *American Manufacturer*, the programme for the geological survey for the next twelve months has been completed. A party, headed by J. C. Fletcher, will be employed in West Virginia to finish the geologic atlas sheets already commenced. Various parties will continue examination into the terrace system of the Atlantic slope, and will extend investigations of the basin of the great lakes, working in Western New York, Northern Pennsylvania, Northern Ohio, and Michigan. It is proposed to complete and publish a projected report on bituminous coal, natural gas, and petroleum in West Virginia, and 18,000 dols. will be devoted to this work, which will be in charge of G. K. Gilbert. Circumstances have hitherto delayed progress of work in the division of iron. It is now proposed to execute a plan for determining the extent of iron ore in the Appalachian mountains and the Cumberland plateau, with a view to presenting the results on the geologic map of the United States. Investigation of the forest resources of the country will be continued, and 55,000 dols. will be devoted to the work of the survey on the eastern slope and 125,000 dols. altogether to geologic work.

RAILWAY MATTERS.

IN recently changing the gauge of the Toledo, St. Louis, and Kansas City Railroad, the prize offered for fastest work was won by Owen McSweeney. With thirty men he changed 5 miles 84ft. between 5 a.m. and 12.10 p.m., or in 7h. 10m., if the report is correct.

A STEAM omnibus is described by *Kuhlow's Trade Review*. It is in use in Dresden. The motive power is applied to the hind wheels, and is supplied by an upright boiler and compound engine. Is is used in the streets for carrying passengers, and will seat twenty.

THE Dutch Government contemplates the construction of a railway on the Island of Sumatra, for the purpose of utilising some coalfields discovered about twenty years ago. The coal is stated to be superior in quality to the best English coal, and the yield is estimated at 200,000,000 tons. The work on the railway is to extend over six years, and the cost will be about 16,000,000 fl.

MESSRS. NEILSON AND CO., of Hydepark Locomotive Works, Glasgow, have contracted to build twenty-one engines for the Southern Mahratta Railway. Added to recent contracts, this order will bring up the engines that have been placed with this firm during the last two months to about seventy. Other locomotive builders in the district have not been nearly so fortunate.

THE Baldwin Locomotive Works have decided to abandon the use of gas and arc lights altogether in their works, and have contracted with the Westinghouse Electric Company for a plant consisting of about 1700 16-candle power lamps distributed throughout the various offices and machine shops, and 200 150-candle power lamps in their erecting shop and boiler shop, yards, &c.

THE Railroad Commissioners of Massachusetts have sent circulars to the presidents of all railroads in the State, asking them to send in for all railroad bridges complete plans of structures with dimensions, stress diagrams, date of erection, name of designer, and a mass of general information in tabular form. This is good work as far as it goes, but it yet remains to be seen whether the recommendations of the Commission will be better heeded in the future than in the past.

THE first experiment of lighting the Hoosac tunnel by the electric light has been so successful that the Westinghouse Electric Light Company is about to illuminate a half-mile section in a similar manner with the intent of finally lighting up the whole tunnel. Incandescent lamps are used, suspended from horizontal iron bars in the side of the tunnel. The positive wire is carried in at the eastern portal, and along the ends of the ties, so as to avoid the damp sides of the tunnel.

THE Lachine Bridge over the St. Lawrence, on the Canadian Pacific Railway, was completed on Saturday last. The bridge spans the St. Lawrence about twelve miles from Montreal, and is nearly 3500ft. long. It is not yet stated at what date traffic will begin to be moved over it. The bridge is regarded as an important feature in the Canadian Pacific system, as it affords an independent connection with the lines south of the St. Lawrence, and gives the railway access at every season of the year to all ports on the Atlantic from New York and Halifax.

THE new Illinois central bridge across the Ohio river at Cairo will contain two spans of 525ft. each, and seven spans of 400ft. each, with ten piers. The lumber and other material for the construction of the caissons has arrived, and work on them will begin at once. The first caisson built will be placed on the Illinois side, and will be 70ft. long, and 30ft. in diameter. The foundation for the piers will be 75ft. below the zero of the water gauge, and about 45ft. below the bed of the river. Three hundred and fifty men will be employed on the superstructure.

THE Midland Railway Company has a difficulty with its drivers on the question whether these men are to be paid six days' wages, as heretofore, whether they work or not. The men are determined to resist the new order, which, they say, will seriously affect them in the summer months, when the coal trade is slack. Should the directors refuse to reconsider their decision, the men have resolved to discontinue work. The directors have named the 12th inst. for an interview, but the men say they ought not to start under the new proposals, and unless the circular be withdrawn before the 5th a general strike is threatened.

ON Thursday, near Hazlehead station, on the main line between Sheffield and Manchester, the 12.25 goods train from Ardwick, laden with quarry stones, was partly wrecked. It had passed Dunford-bridge, when the axle of a wagon gave way. One truck went over the embankment, several others were thrown off the rails, and the permanent way torn up for a distance of 200 yards. On August 2nd a Midland excursion train from Bristol to Bradford came into collision with a North-Eastern Company's engine at Normanton, which was on the point of crossing for the turntable. Several passengers were injured, the two engines damaged, and the down line blocked for nine hours.

COMPARING the cost of electrical traffic with that of horses, Herr Huber states that to operate the usual one-horse car, which, including driver and conductor, carries twenty-six persons, seven horses are required on the same line for one day of 100 kilometres run. So that, as the electric car carries thirty-one persons, $8\frac{8}{100}$ horses would be necessary. The cost of maintenance for one horse during the last year, according to the *Jahresbericht der Strassenn Eisenbahn Gesellschaft*, Hamburg, amounted to 1·96 marks—two shillings—per day per horse; so that the cost per car kilometre amounts to 16·04 pfennigs per car per mile. It follows therefore that even to-day electricity is more economical than horse flesh, and the cost of the former can be considerably reduced by improvements.

THE *Electrical Review* thinks many will be surprised by the statement that more than 3,500,000 passengers are carried annually in the United States in street cars moved by electric motors. In Montgomery, Ala., electricity is used on eleven miles of road, and the cost is reported by the general manager to be only one-half the cost of horse-power. Roads on which electricity takes the place of horses are found in Baltimore, Los Angelos, Port Huron, Detroit, Scranton, Appleton, Wis., and Denver. Electric railways are either in course of construction or under contract in twelve other cities, and in thirty-seven companies have been formed or other steps taken for the building of such roads. Upon none of the roads now in operation, however, is force supplied by storage batteries attached to the cars. In most cases power is communicated by an overhead conductor.

THE conveyance of heavy goods traffic by tramways is, under the management of the South Staffordshire and Birmingham District Steam Tramways Company, proving a remarkable success. Some time ago we described the wagon, somewhat similar to a railway lorry, which Mr. A. Dickinson, the general manager of the company, had just then patented, and the special feature of which is two sets of wheels, the one set being of the ordinary wagon type, for use on the roads, and the other being tramway wheels, for use on the company's lines. The scheme of goods conveyance has been worked out in the Black Country towns through which the company runs, and has proved a most satisfactory enterprise; and now the scheme has been extended to Birmingham, a regular service which has been commenced this week, connecting Birmingham with all the surrounding townships. Some manufacturers have discarded their teams, and intend relying in future wholly upon the company for conveyance.

NOTES AND MEMORANDA.

M. LIPPMANN has recently proposed to the French Academy of Sciences the introduction of a new unit of time to replace the arbitrary and variable second. He suggests a unit based upon some ascertained electrical resistance which can be shown to represent an interval of time, such as the resistance of a cube of mercury.

IN the *Revue Photographique*, M. Eliel gives the following formula for a mixture which can be used for firmly attaching paper and other materials to metal, glass, or wood:—Gum tragacanth, 30 grammes; acacia gum, 120 grammes; water, 500 c.c. Dissolve, filter, and add 2½ grammes of thymol suspended in 120 c.c. of glycerine; then add enough water to make up the bulk to 1 litre. This bath will keep a long time.

MICA, so named from its being easily divided into glistening scales, consists of silica and alumina, associated with magnesia, soda, and lime, in varying proportions. Thus we have potash mica, consisting of silica, alumina, and potash; and magnesia mica, in which the alumina is partially replaced by magnesia, passing—as the proportion of magnesia increases—into soft talc, which is chiefly composed of silica and magnesia.

STATISTICS show that 53,000 wells have been drilled in Pennsylvania and New York since the discovery of petroleum, at a cost of 200,000,000 dols. These wells have produced 310,000,000 barrels of oil, which were sold at the wells for 500,000,000 dols. This represented a profit to the producer of 300,000,000 dols. The amount of oil exported is placed at 6,231,102,924 gallons. In the pool in Washington County alone 3,200,009 dols. has been expended in machinery and drilling. This does not include the many millions that are represented there in the natural gas industry. Independent of the oil business there is about 50,000,000 dols. invested in natural gas plants in Pennsylvania.

FLUORIDE of nitrogen has been formed by passing an electric current from seven ferric chloride batteries through a concentrated solution of ammonium fluoride. After the lapse of a short time, several drops, of oily consistence were observed attached to the negative plate. On becoming connected with the positive, a thin gold wire, these drops exploded with violence. The compound is undoubtedly highly unstable, being at once decomposed in contact with glass, silica, or organic matter, thus rendering the analysis of the same one of considerable risk. Its explosive violence is even greater than the chloride of nitrogen, and it is also prone to spontaneous decomposition.

SOME instructive experiments on atmospheric electricity are described by Herr Nahrwold in *Wiedemann's Annalen*, No. 7; one being a suitable lecture experiment, showing the action of electricity from points on finely divided matter in the air. *Nature* says:—"He thinks it established that such a stream of electricity does not electrify the air itself statically—indeed, that air and other gases probably cannot be statically electrified—but only dust particles in it. Further, a glowing platinum wire sends out particles which diffuse in air that has been electrically freed from dust, making a fresh charge possible. Here, too, the electricity streaming from such wire does not statically electrify the air, but the charges which are observed as atmospheric electricity belong to fine non-gaseous particles given out by the wire, or already present in the air. An experiment is also adduced to show that at ordinary temperature negative electricity of high potential streams more readily from solid conductors into atmospheric air than positive."

MR. DENT, lecturing at the Society of Arts, points out that the solubility of carbonate of lime in water charged with carbonic acid not only gives rise to very remarkable and curious incrustations, but exerts a very considerable influence upon geological limestone formations, the insoluble carbonate of lime being deposited as a sedimentary rock. The white concretionary limestone known as travertin, of which both ancient and modern Rome are largely built, is an example of such a deposit which is taking place in some parts of Tuscany at the rate of 6in. a year. Carbonate of lime being deposited from its solution in carbonic acid, serves to bind together other materials with which it comes in contact in the course of such deposition. It thus serves as the binding material of several varieties of building stone, and becomes an important agent in the formation of rocks. An excellent example of such formation is to be seen at Bermuda. The islands are surrounded by immense beds of calcareous sand, to the extent of twenty miles, resulting from the disintegration and breaking up of the coral reefs which abound in that part of the world. This sand is washed up by the sea, caught by the prevailing winds, and blown up into hills 40ft. or 50ft. in height. The rain falling upon these calcareous deposits dissolves out from the upper portions carbonate of lime, which is again deposited as the water percolates the drift, and binds together the particles of sand, as well as the other *débris*, into a coherent mass, which gradually hardens into a rock.

AN abstract of a paper on "Latent Heat of Vaporisation of Certain Volatile Substances," by J. Chappuis, is given in the *Journal of the Chemical Society*. The apparatus consists of a cylindrical glass reservoir closed at the bottom, and containing the liquid to be evaporated. This receiver terminates in a serpentine capillary tube united to an ordinary delivery tube, and to the free end of this a steel stop-cock with a lateral tubulus is cemented. The receiver containing the liquid under examination is weighed and placed in a Bunsen's ice-calorimeter, in which both it and the serpentine tube are completely surrounded by mercury. The stop-cock is then opened, and the vapour is allowed to escape very slowly, so that the reduction of pressure which is essential to vaporisation may be kept as small as possible. After the usual readings have been made, the apparatus is again weighed. The loss of weight gives the difference between the weight of the liquid which has been volatilised and the weight of its saturated vapour which occupies the same volume; from this, the weight of the liquid evaporated is readily calculated. The following results were obtained:—Methyl chloride, 96·9; sulphurous anhydride, 91·7; cyanogen, 103·7. Further experiments, which will be described in a subsequent paper, show that the rate of vaporisation exerts considerable influence on the results, but if it does not exceed 8 to 16 mgrms. per minute, the latent heat of vaporisation is constant. Within the same limits, the temperature of the apparatus in which evaporation takes place is not reduced below 0·3 deg.

THE phenomena which occurs in an electrolysing cell during the decomposition of water in the immediate neighbourhood of the electrodes during the passage of the currents of electrolytic convection formed the subject of a recent communication to the Berlin Physical Society by Dr. Richarz. As is well known, an electromotive force of 1·5 Daniell is necessary in order that the current may pass electrolytically and the water be decomposed; if the electromotive force is less than the above, the water is not decomposed, but at the same time it can be shown that the electricity does traverse the fluid. According to Von Helmholtz's views on electrolysis, when the electromotive force is small, currents of electrolytic convection pass through the fluid, which are kept up by the occlusion of the positively charged hydrogen atoms at the kathode and by the neutral oxygen in solution. Starting from the work of Moritz Traube, who has proved the formation of hydrogen peroxide at the kathode in the electrolysing cell, Dr. Richarz has been able to prove, both qualitatively and quantitatively, the formation of hydrogen peroxide at the kathode during the passage of convection currents. This formation of the peroxide takes place, according to the views of the speaker, by the union of two atoms of the occluded hydrogen with the neutral molecule of the dissolved oxygen, which has given up its positive charge to the kathode. As the result of this separation of the occluded hydrogen, fresh portions of hydrogen can be occluded by the metal of the electrode, and in this way a renewal of the electric current can take place.

MISCELLANEA.

THE electric light is now being used in certain London omnibuses; a 5-candle incandescent lamp is fitted in the focus of a hexagonal reflector. The current is supplied by a battery under the driver's seat, enclosed in a wooden box about 7in. by 7in. by 2ft. long.

AT a shipyard in Newburg there is being constructed the first vessel to be propelled by electricity ever built in the United States. It is a yacht 37ft. long, 7ft. wide, and 5ft. deep. It is to be run by stored electricity. It is building for a Newark, N.J., electric company, and will be run between that city and New York.

THE Wolverhampton Corporation, impelled to that action by the inconveniences suffered during the recent drought, have under consideration a scheme for enlarging the water supply of the town. They propose to sink another well, put down another powerful pump, and lay an additioual 18in. main. The aggregate cost of £23,000, upon which the annual charge will be about £1225, is likely to be covered by the profits from the waterworks.

THE French Government is said to have concluded an arrangement with the Edison Company whereby the latter will have possession of the extensive vaults of the Palais Royal free. The vaults will be turned into a central storehouse for electricity, and the company is to undertake the lighting up of the whole of the Palais Royal, the Conseil d'Etat, the Cour des Comptes, and the Théâtre Français. The Edison Company is also under contract to fit up the electric light at the Menus Plaisirs Theatre.

THE existence of the only organisation in South Staffordshire which provides for the arrangement of wages disputes in the iron trade is, it would appear, seriously threatened. The authorities of the South Staffordshire Mill and Forge Wages Board have issued a circular in which they point out that, owing to the cessation of subscriptions from outside districts, and to the considerable decrease of those from South Staffordshire, it is necessary to appeal for further urgent contributions as the only means of maintaining the existence of the Board, Its disappearance would result, they believe, in a recurrence of the disastrous strikes which often took place before its formation in 1876.

IN the monthly report by Mr. William Crookes, F.R.S., Dr. William Odling, F.R.S., and Dr. C. Meymott Tidy, it is stated that the condition of the water supplied to the metropolis during the month of June did not differ substantially from that which has prevailed now for some months past; although, indeed, the proportion of organic matter present in the Thames-derived water, identical with that in the supply for April, slightly exceeded that met in the supply for the immediately preceding month of May. As for some months past, several samples of the East London Company's water were not wholly free from turbidity, and consequent colour, but the proportion of organic matter present in this company's water was exceedingly low, showing the turbidity to be entirely of a mineral and, apparently, an ochrey nature.

MESSRS. KNIGHT have now completed their new works at Brierley Hill, which have supplanted the historic works at Cookley, in East Worcestershire, which have been in existence for 200 years. The new works are on the premises formerly occupied by the Blackmoor Iron and Tin plate Works. Messrs. Knight have put down extensive new plant in addition to that removed from Cookley, and the change has entailed an outlay of £14,000. The works are laid out in complete fashion, and allow of a larger and more rapid production than the Cookley establishment, while fuel and pigs are secured at a cheaper rate through the saving of conveyance. The tin-plates and black sheets manufactured find their way chiefly to the United States, Australia, France, Germany, Russia, and Denmark, in addition to the home trade. Terne plates for roofing, of which the firm make a speciality, go to America.

AMONGST the reforms proposed by a select commission, appointed by the German Reichstag to investigate the question of factory labour, are the following:—(1) From April 1st, 1890, no children to be employed in factories who have not completed their thirteenth year, and have satisfied the requirements of their local educational laws; (2) women not to resume factory work until four weeks after their confinement; (3) women not to be employed in quarries, mines, and wharves, or in carrying burdens in connection with building operations; (4) women not to be employed on Sundays and holidays, nor between the hours of 8.30 p.m. and 5.30 a.m., and the occupation of women and children to cease at 6 p.m. on Saturdays and on the eves of holidays; (5) women who have households to look after, not to be employed in factories longer than ten hours daily; (6) measures to be adopted for male and female operatives being separated as far as practicable in establishments where both sexes are employed.

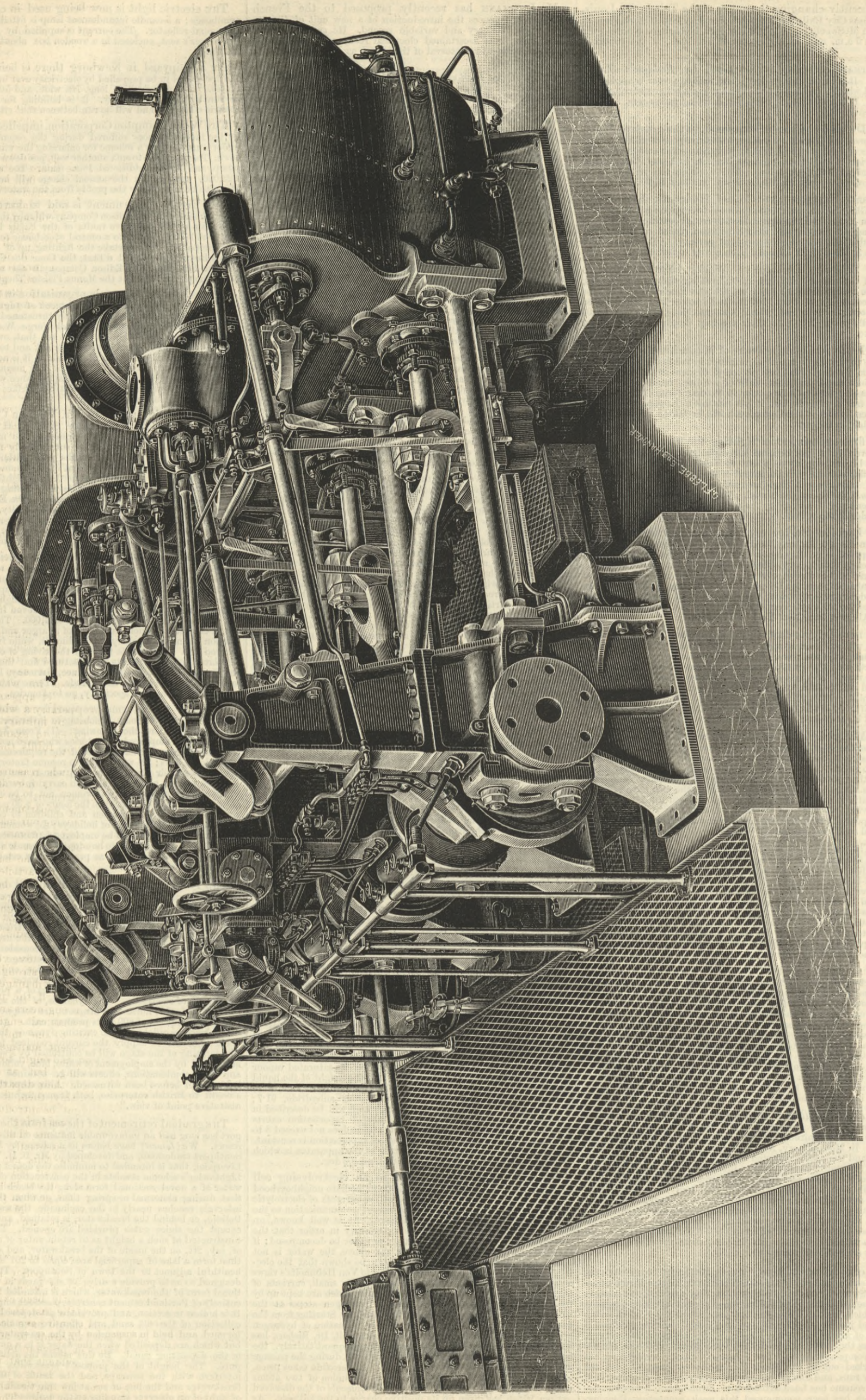
THE *Times* correspondent, telegraphing on Sunday, says:—"To-morrow the Imperial Opera will be re-opened after the usual summer vacation. The day will mark an epoch in the history of Vienna theatres, as the Opera will for the first time be lighted with electricity. The installation has been entrusted to the British Continental Gas Association. It comprises the use of large direct-driven steam dynamos, giving currents of considerable, though not excessive, pressure, and several sets of storage batteries, placed conveniently near the points of consumption, and coupled in series on the five-wire system. The steam and water connections are in duplicate, so that the accidental bursting of a pipe will not affect the supply of electricity. The dynamos, of the vertical Crompton type, with double horse-shoe magnets, are designed to give an output of 120 ampères of 600 volts pressure each. Accumulators have been placed parallel with the exciting dynamos, these accumulators being sufficient to supply the current required for several hours. The lighting of the stage will be controlled by a special stage regulator; and by the employment of white, blue, yellow, and red lamps, and their combinations, effects will be obtained which have probably never before been witnessed. Altogether the installation is a credit to British enterprise, both from a technical and an administrative point of view."

THE gradual retirement of the sea from the town of Southport has long had an unfavourable influence on this pleasant seaside resort. We (*Lancet*) have before us a scheme by Mr. Lightowler, a Southport tradesman, and developed by Mr. B. H. Thwaite, C.E., of Liverpool, that is intended to minimise the defect mentioned. Mr. Lightowler's scheme consists in the construction of a dwarf breakwater of a novel sectional form along the beach in such a position that during abnormal or spring tides, or when the water at rare intervals reaches nearly to the esplanade, the water accumulated therein, or behind the breakwater, is retained, and cannot escape, except the sluice gates provided are opened. The breakwater is constructed of such a height as to retain water of an average depth of, say, 2ft. on the inside of the breakwater, and such water would then form a lake of superficial area equal to 201 acres, and form a healthful adjunct to the town of Southport. The breakwater is designed so as to provide a drive of six yards in width. The sectional form of the breakwater, which is intended to be constructed entirely of Portland cement concrete, possesses some novel features. It is hollow in section, and provides a silt depositing canal for the collection of the silt sand and offensive organic matter brought forward and held in suspension by the sea-water when in motion, but which are deposited when the water is in a quiescent condition in the depositing canal. By this means the artificial lake is kept pure. The height of the proposed breakwater is such as not to interfere with the seascape, and the reach of sand between the breakwater and the line of sea at low tide would be lost in the line of sight of an observer standing on the esplanade. The advantages of what is practically the bringing of the sea back to Southport will be obvious to any one, and its applicability to seaside resorts similarly situated to Southport need not be dilated upon.

TRIPLE EXPANSION ENGINES OF THE DOGALI.

MESSRS. R. AND W. HAWTHORN, LESLIE, AND CO., NEWCASTLE-ON-TYNE, ENGINEERS.

(For description see page 116.)



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CONTENTS.

TO CORRESPONDENTS.

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

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

J. T. C.—*It has been proposed over and over again to utilise the power of the tides for various purposes. The enormous cost of the necessary works is always fatal to such schemes.*

S. J. (Edinburgh).—*The pressure will be the same on each square inch of both pistons.*

PULP BOILERS.

(To the Editor of The Engineer.)

Sir,—Can any reader give us the name and address of makers of wood pulp boilers? A.

Walbrook, August 1st.

COMPRESSED YEAST.

(To the Editor of The Engineer.)

Sir,—Can any reader kindly oblige me with the cost, and also the names of the best makers of machines for making compressed yeast?

Hammersmith, 29th July. H. G. B.

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THE ENGINEER.

AUGUST 5, 1887.

THE STATE OF THE THAMES.

A letter from Dr. Dupré has been read at a meeting of the Metropolitan Board, calling attention to the unsatisfactory condition of the Thames, the writer expressing his disapproval of the manner in which the sewage is now being treated at the outfalls. Dr. Dupré describes the state of the river as foul and offensive, and possessing the character of a sewage stream. Of course this refers more expressly to that part of the Thames which lies between Greenwich and Erith. Should an epidemic of cholera break out while the river is in this condition, Dr. Dupré declares that the Board will incur a very serious responsibility. It may be asked—What has Dr. Dupré to do with the matter, and why should he write to the Board? Those who have read our statements with regard to this subject from time to time will doubtless be prepared for the answer. In that part of his letter which has not found general publicity, Dr. Dupré stated in effect that as his name has long been associated with a certain plan for treating the London sewage, which plan the Board was understood to have adopted, it is naturally supposed by most persons that it is this process which has failed to keep the river pure. Comparatively few persons are aware that the original plan has been departed from and another substituted, and hence Dr. Dupré is held to a large extent responsible for the present untoward results. From that responsibility he wishes to escape, and accordingly he has written to the Board, in order to put himself right with the public. It is quite possible Dr. Dupré also feels that the Board has failed to show him that consideration which he had a right to expect under the circumstances. He had been their chemical adviser during the whole period of the sewage experiments which had resulted in the determination to build extensive sewage works at Barking and Crossness. Yet suddenly, without any consultation with himself, and without any obvious reason, the Board has called in another chemist, namely, Sir Henry Roscoe, and given the whole affair into his hands, including the adoption of a process differing essentially from that previously agreed upon. However, the main question is that which immediately relates to the state of the river. If Sir H. Roscoe is successful in preventing the sewage from polluting the river, and can do this at less cost than by the plan on which Dr. Dupré, Sir F. Abel, Dr. Odling, and Dr. A. W. Williamson had previously agreed, together with Mr. Dibdin and Sir Joseph Bazalgette, then it may be held that the end justifies the means. But when it appears that the river is in a dangerously polluted state under the new system, anything like a practical justification appears to be wanting. Such is the condition of the Thames that Dr. Dupré does not hesitate to pronounce the new system "a failure."

The Board being thus confronted with a protest from one of the highest chemical authorities of the day, and the foul state of the river in the vicinity of the Isle of Dogs having also been named in Parliament, what is going to be done? The letter from Dr. Dupré has been laid before Sir H. Roscoe, and the latter has admitted that the river is as Dr. Dupré has described it. This point, therefore, is beyond dispute. As to the cause, Sir H. Roscoe says it is the want of rain. If the rain would come, and continue for a week, the river would be clean. Sir H. Roscoe has been pouring in chloride of lime for a month, but the river is *not* clean. Doubtless the meteorology of 1887 has thus far been very unfavourable for all rivers that receive sewage. In respect to the Thames, there is a deficiency of fresh water, owing to the long-continued drought, and as there is less water than usual coming down the stream, the tide flows upward with greater force. Hence the sewage has less chance to get away seaward, and undergoes diminished dilution. The hot weather also hastens and intensifies the putrefactive action, and, altogether, the present is a very crucial time for testing the merits of any scheme intended to produce sewage effluent which shall not damage the river into which it flows. But the question still remains to be decided whether the conduct of the Metropolitan Board has been wise. A process which has been tested and tried, and which has the approval of competent scientific authorities, has been superseded by another of which the Board has had no experience. Supposing the new process to be a good one, its application was delayed until the difficulties of the case had become serious. The policy of the Board was to wait until the river was in an obviously bad condition, and then in some way to face the inevitable. It is only just about a month ago that the plan proposed by Sir H. Roscoe was put into operation One error on the part of the Board has been that of changing front in the presence of the enemy. The peril was obvious, and we pointed it out some weeks ago. That which we then feared has now come to pass. The history of this affair is important as indicating the policy which governs the Board. The principle embodied in that policy is one of finance. The neglect with which the Board has treated the Canvey Island scheme is simply due to the fact that the project appeared to be a costly one. Its promoters say it will prove cheaper than any other plan. But the Board held the opinion that the plan prepared by Sir J. Bazalgette and Mr. Dibdin would be less expensive than that which had been proposed by Mr. Bailey-Denton and Lieut.-Colonel Jones. Right or wrong, this was the conviction obviously entertained by the Board. Aided by these financial considerations, Mr. Dibdin's star rose in the ascendant. But now there comes another project, promising to cost only half as much as that prepared by Mr. Dibdin, and the Board's chemist speedily finds himself in the same situation as Mr. Bailey-Denton and Lieut.-Colonel Jones. In like manner Sir H. Roscoe would find himself shelved if anyone could persuade the Board that something else would be cheaper than chloride of lime. All other things being equal, or nearly so, the Board would undoubtedly be justified in adopting the cheaper method. But other things do not look as if they were equal in this instance. When Mr. Childers was in office as Home Secretary, he expressed — in somewhat sarcastic terms—his doubts as to the prospect of success in using manganate of soda. We wonder what he would have said if bleaching powder had been proposed!

With regard to the sewage question, the Metropolitan Board appears to be simply drifting. It has taken fright at the heavy expense incurred last summer in applying Mr. Dibdin's method. An expenditure of £100,000 is certainly a serious amount. But Mr. Dibdin worked under disadvantages which need not have been repeated. The river was foul from previous neglect, and the requisite plant for the perfect treatment of the sewage had not been provided. It was necessary to use chemicals lavishly, and the cost was consequently high, though even then the cost was only half the amount estimated by the Royal Commissioners. Chloride of lime is now being used, and while the cost is reduced, there is the assured fact, as admitted by Sir H. Roscoe, that the river is not foul. In plain English, the chemical question is being "muddled." If the rainfall continues deficient and the Thames becomes unbearable, public opinion will agree with Dr. Dupré that Sir H. Roscoe's plan has failed, and there will be a prevalent suspicion with regard to all chemical processes. The Canvey Island scheme will then come to the front, costing £200,000 per annum. It is in this direction that we now find the Board to be drifting. If chemistry fails, or if it only seems to fail, nothing less than Canvey Island will be the alternative. Without really intending it, the Board is now playing into the hands of Mr. Bailey-Denton and his colleague. Perhaps it is well to have something to fall back upon, and certain it is that no merely cheap method will suffice for the treatment of the London sewage. The undertaking is vast, and must be dealt with in a broad and liberal spirit. The drainage of London is the great work originally committed to the Metropolitan Board, and the reputation of that body depends on the completeness with which the task is accomplished.

WAR-OFFICE ORGANISATION.

It is rumoured that Lord Morley's Committee have recommended fundamental changes in our War Departments. The Surveyor-General is to have under him three heads of main branches—(1) The Director of Artillery; (2) the Inspector-General of Ordnance; (3) the Director of Contracts. Of these the first and third departments will be chiefly composed of civilians. The second will consist wholly of military officers. Under the Director of Artillery will be (1) the Ordnance Committee, (2) the Finance Department, (3) the Supply Department, (4) the Manufacturing Departments, all under one head, who is to be designated the Superintendent of Ordnance Manufacture. He is to be an Artillery officer, but under him the whole of the manufacturing departments will be in civilian hands. The drawing offices for the whole of the departments will be in one under a separate head. Waltham Abbey will be under a civilian head. The three manufacturing departments in the Royal Arsenal—that is, the Gun Factories, the Royal Laboratory, and the Royal Carriage Department, as well as the Small Arms Factory at Enfield—are to be under one mechanical engineer, directly responsible to the Superintendent of Ordnance manufactures. The notion appears to be to have an inspection department, consisting of Artillery officers, under the Inspector-General of Ordnance. We have not seen the report, and can only surmise the reasons for what is stated to be the system recommended. It appears as if the idea was that manufacturing operations would be best performed by civilians unchecked by military officers, but that the latter are very proper men to examine what is made, and to see that everything fulfils the conditions required for service.

As a leading principle this sounds reasonable, but we much question the working of it as here shown. The examination by a separate department can never be as efficient as that conducted by the department where the article is made. It amounts to putting our manufacturing establishments on the same footing as private firms working by contract, with the exception that what a private firm now makes is examined by those who have practical experience in the manufacture of the articles submitted to them, whereas now the inspection will be conducted by officers who will be little more than gangers. The Inspector-General of such a department might be termed the "head military ganger." On this system we may act for some years before real disgrace and scandal arises, but it will be only a question of time.

No one has probably attacked the five year appointment system of military officers more strongly than ourselves, and we have urged that our managers were not in a fair position; but we question if the plan here set forth is a good one. Mechanical engineers are to conduct the departments with one mechanical engineer placed over them, who is responsible to one military officer. Who are these to be? The present managers, we have urged, are not in a fair position, and ought to have higher salaries and a better standing, but at the present moment the principal clerks and their departments could not be put under them. Probably, then, it means that four mechanical engineers might be introduced into the manufacturing departments. Considering the nature of the correspondence, and the questions that come before the superintendents, which is essentially on military questions, we must question how this can be worked. However, it may be better to wait till we have full information and the report itself in our hands to decide. In the meantime, we indicate the general principle that is reported to be at the bottom of it. Mechanical engineers are to manufacture, officers are to check and examine.

COLONIAL LAND SALES AND PUBLIC WORKS.

It is significant of a change of policy in regard to colonial procedure in the method of accounting for land sales, that the regret has recently been expressed by a leading colonial journal that, in the past, the funds derived from the sale of Crown lands should have been treated as revenue. It has long been apparent to ourselves that such a method must, in the end, prove to be productive of much embarrassment. It is evident that the time has arrived when our conviction is being justified. We do not propose to instance the particular Colony the regrets of which have arrived too late. They may well serve, however, as the text upon which to discuss the con-

sequences of an error, long persevered in, which are now showing themselves obstructive to desired future progress with public works. It is not in the one Colony alone that such a regret is felt, and in many it has received more or less expression. We see the result of the impolicy of the course indicated in an apparent reduction of revenue, which is alarming to those whose duty it is to hold a check over the too free expenditure in which many of our Colonies have hitherto indulged. It is common to hear complaints of the lavish way in which applications are made for loans for public works by our Colonies generally. The answer to these has almost always been to direct reference to the proportion between public debt and annual revenue. Such a reference would be justifiable and conclusive were the revenue returns based upon an actual instead of a fictitious basis. The fact is that, almost since their establishment, most of our Colonies have been parting annually with their capital and calling it revenue. But, as was foreseen, the end to such a system has come—or is close approaching—in many of our Colonies, and the money-subscribing public at home is rapidly becoming alive to the real truth of the matter.

Year by year the Governments of our Colonies have alienated vast tracts of the lands which formed their substantial capital. The money derived from such sales figured in the annual accounts as income, and this was justified on the assumed basis of the permanent character of such a source of income. The system had, apart from considerations for the future, some current inconvenience. It tempted the home authorities to impose burdens in the way of military contribution, &c., which the true and actual revenue was unfitted to bear; and now that the land capital is becoming narrowed almost to the vanishing point, the comptrollers alarmed at the different aspect which recent balance-sheets have presented to those to which they have been accustomed in the past, have said in respect of contemplated public works that they are beyond the resources of the Colony. It is not matter for wonder that the Colonists begin to acknowledge with regret that they "have killed the goose that laid the golden eggs." Not alone to their apparently abounding revenue have Colonists pointed when challenged to justify their requisitions for loans. They have also insisted—and probably with some justice—that the works to the execution of which such loans were to be applied were of a reproductive character, that they were essential to the opening out or improvement of lands, free access to which could alone induce settlement upon them, and so on. But if the only result to such a course has been, as it has most undoubtedly been in very many cases, to permit the sale of such lands in perpetuity to a few favoured individuals, of what use to the community generally have the said works been? We know that in several of the most important of our Colonies this vicious system has been most strongly condemned, and at length abrogated; but the door has only been shut after the steed has been stolen, and at this present moment millions of acres have been altogether alienated from public possession, with the sole result of having enriched a few individuals only.

Now, we hold that if public works are to receive further development in our Colonies, if railways are to spread and carry with them the benefits of settlement and civilisation, it behoves those who from Downing-street control the colonial purse to see that a course which has brought in many cases public improvements to a dead standstill should no longer be permitted. We find the journal to which we have referred sighing its regrets that the monies derived from past land sales had not been funded, and that they have been swallowed up by an extravagance of expenditure incommensurate with what has been actual as apart from fictitious revenue. The writer of such regrets alludes to constant augmentations of establishments, to the building of palatial public offices, asylums, residences for governors, &c., all of which might well have been done without, and which were only permitted because year by year the balance-sheets which represented income and expenditure were fictitious. Sooner or later the land available for Crown sales in any Colony must come to an end, or at least materially and sensibly diminish. Yet the establishments, the interest on the cost of unnecessary buildings, &c., remain as they were, and cannot be got rid of. As the consequence, an economy most galling to those Colonies which have hitherto been allowed almost entire freedom as to their expenditure, has been imposed upon them, and works most necessary to their development are now rigidly withheld. We do not say that in every case the restrictions now enforced are wise or really economical. Many instances are known to us where a further expenditure would prove to be infallibly the truest economy; but if in these cases there is good ground for complaining of the tight hand exercised by the Colonial Office, it is more to the past policy of the Colonists themselves in dealing with the realisation of their capital in land than to the shifting authority of Downing-street that its imposition is due. One by one the same regretful cry is uttered by all the Colonies as they find themselves approaching to the end of that tether which once seemed to them to be so far off. They will now have to contract their expenditure while their populations submit to personal burdens which have hitherto been cast upon posterity. If they will not consent to this they cannot expect that British capitalists will meet their demands with confidence and freedom.

RAILWAY WORKING.

The first of the great railways to issue its accounts is the North-Eastern, and its statement for the half-year is on which is of some interest. In the past half-year the North Eastern Railway has added to its capital expenditure some £180,339, an additional sum being paid for out of the premiums received on stock and shares. Out of the total £153,388 have been expended on lines and works open for work and traffic; but in this sum there is included the expenditure of £48,164 on the additional lines between Heaton and Newcastle-on-Tyne and £8112 also expended in the half-year on a line just opened—that from Darlington to Fighting Cocks. On the lines and works in course of construction the expenditure for the half-year has been:—Alnwick and Cornhill branch, £56,361; on the extension and the dock at Middlesbrough, £16,869; and on the Denston extension line—a little line for which powers were obtained last session—£15,500 have been already expended. It is a fact which is well worthy of notice that in the past half-year the North-Eastern Railway Company expended £18,261 on land, and the cost of the law, parliamentary, and conveyancing charges amounted to £3043—a very considerable sum indeed. It is anticipated that in the next half-year the amount to be spent on capital account will be less than it was, £185,585 being set down in the original estimate as the expected amount. Out of this sum there are £95,580 expected to be spent on lines and works open for traffic, one of the prominent items in the report showing that there is included in that sum £13,000 on the additions to lines between Heaton and Newcastle. On lines and works in course of construction £58,005 are to be spent—£25,000 on the Alnwick and Cornhill branch, and £33,005 on the Middlesbrough Dock extension. The other items of expenditure include £10,000 on additional rolling stock. It thus appears that in the half-year which is now running its course the expenditure on the Alnwick and Cornhill branch, which is now expected to be opened in about a month, will be practically completed. The capital expenditure, after the end of the current half-year, is put at £428,852, of which more than half is for the railways authorised by the Act of the present session, and thus it will be seen that the North-Eastern expenditure down to the Act is brought to a limited amount. In the abstracts of the accounts for the past half-year one of the most noticeable features is that of locomotive power. The cost of the coal and coke consumed was for the six months £84,380, which is £9000 less than in the same period of the past year, although 100,000 more miles have been run by trains. Altogether the running expenses are £12,000 less than a year ago, but in repairs and renewals this sum is spent, the materials having cost more by £11,000. This change is one which may have explanation by the chairman, but it is one which is rather curious as it stands. The half-year has been on the whole a better one to the North-Eastern Railway than its corresponding predecessor, and the indications of the improvement in the receipts are continued into the present year, though it is certain that a considerable part of the increase in the traffic receipts in the first part of the current period is due to the holding of the Royal Agricultural show in the North. The great company of the north-east ought to have passed the worst, for it is well-known that in the last six months it had to bear the loss of a considerable part of its revenue by the strike in the coal trade of Northumberland. That trade is now flowing back into its old channels, and in the current half-year the company should recoup itself for the loss. Trade seems to be on the whole growing in that quarter; too much should not be expected from any recovery in the iron trade, but the tendency is on the whole to increase, and the North-Eastern, as the carrier, must have its proportion of the cost of carriage. It is noticeable, too, that the economies in the working have continued during the past year, many departments showing a falling off in the gross amount of their expenditure for the first six months of the present year, though not so great as might have been anticipated, when the cost of the great storm of last year was borne in mind, and though the increased cost of locomotive power, and especially of the cost of carriage and wagon repairs, have swallowed up all the savings. Probably it may be found that in the half-year now begun there may be other savings attainable, for the higher cost of the working in the last half-year should bring in review by the heads of departments some of the sums that need reduction, and the general conclusion is that the North-Eastern Railway comes creditably out of the past half-year, but this is chiefly due to the large growth in the passenger and goods traffic, and to the fall in some of the expenses, such as rates and taxes.

A SENSATIONAL STORY ABOUT GAS.

There is a story told of a man who, living in the States, wanted "to be patted with a shingle to keep him from being *too* happy." Blessed with natural gas and petroleum, certain States of the Union were in danger of being too happy, when a man has come along with a shingle. In other words, a correspondent of the Cincinnati *Commercial* predicts an overwhelming disaster to the sections of country occupied by the natural gas wells, and is so positive in his assertions that he urges the calling of an extra session of Congress to take some action in the matter. "Boring for natural gas should be prohibited by stringent laws. The good people of Ohio and Indiana, while trying to develope the gas magazines, do not take time to consider that they are toying with a force that may destroy this country and themselves. The danger that impends is well known to scientists." As it happens that about 50,000,000 dols., or £10,000,000 sterling, are invested in natural gas wells in Pennsylvania alone, it is not likely that the advice of the correspondent of the Cincinnati *Commercial* will be taken. Therefore he backs it up with a sensational story:—"Two hundred years ago in China there was just such a craze about natural gas as there is now in America. Gas wells were sunk with as much vigour as the Celestials were capable of, but owing to a gas explosion that killed several millions of people and tore up and destroyed a large district of country, leaving a large inland sea, known on the maps as Lake Foo Chang, the boring of any more gas wells was then and there prohibited by law." It seems, according to the Chinese history, as told by the correspondent of our contemporary, that many large and heavy pressure gas wells were struck, and in some districts wells were sunk quite near to each other. Gas was lighted as soon as struck, as is done in America. It is stated that one well with its unusual pressure, by induction or back draught, pulled down into the earth the burning gas of a smaller well, resulting in a dreadful explosion of a large district, destroying the inhabitants thereof. Lake Foo Chang rests on this district. Having told his tale, he adds the moral. "The same catastrophe is imminent in this country unless the laws restrict further developments in boring so many wells. Should a similar explosion occur there will be such an upheaval as will dwarf the most terrible of earthquakes ever known. The country along the gas belt from Toledo, through Ohio, Indiana, and Kentucky will be ripped up to the depth of 1200ft. to 1500ft., and turned over like a pancake, leaving a chasm through which the waters of Lake Erie will come howling down, filling the Ohio and Mississippi valleys, and blotting them out for ever." The correspondent of the Cincinnati *Commercial*, whose name we regret we cannot rescue from oblivion, simply because we do not know it, not unnaturally concludes with the statement that some prompt action should be taken at once to prevent this catastrophe.

ENGINEERING TRADE PROSPECTS.

The report of the General Committee of Management which was adopted at the annual meeting of the Iron Trades Employers' Association, held at Manchester last week, contains a most discouraging outlook of the present condition and prospects of the mechanical engineering and other kindred trades of the United Kingdom. Every report presented to the members of the Association since 1883 has recorded the gradual decay of trade, with increasing severity in the competition for work in every department of the engineering industries of the country, and the Committee responsible for the present report have to repeat the same facts, and to record a deepening depression in trade, coupled with competition for orders more severe than has hitherto been felt, and attended by a fall in prices, which has made business all but profitless to the employer. Nor at the end of so long a period of bad trade do the Committee see any signs of revival, the immediate outlook being of the most cheerless nature, and pointing to difficulties which will affect alike the workmen and their employers, unless some new field is opened up by which to find employment for the industrial and commercial energies of the country. The Committee very naturally add that it is with sincere regret they have to make this statement, but the facts are patent to every employer and commercial man, and the sooner they are realised and understood by the public the better it will be for all classes concerned. Capital employed in the engineering trade, the report goes on to say, is now unremunerative to its owners, and is shrinking in value. This process has been going on so long that its influence is reaching the wage-earner, and all who depend upon the industrial life of the nation. The strike in the Bolton engineering trade has necessarily to be dealt with at some length, as bearing upon the serious conclusions come to in the report, and it is pointed out that the movement is twofold in its character—it is not simply a wages question, but the men have made no secret of their ulterior intentions in regard to the eight hours movement—piecework, the entire suppression of overtime, &c.—and these questions lying behind the movement, the interests of the employers all over the country were involved in the issue of the strike upon which the trade-unionists had entered. The matter had therefore become of general, as well as of local, importance, as the final issue of the dispute would affect other districts, and might involve questions compared to which the wages aspect of the case became of secondary importance. In closing their report the Committee feel conscious that they are ending their year of office under circumstances which claim and should have from every member of the Association, and from every employer in the iron and engineering trades, the most serious attention. The falling and almost collapsed condition of trade, the absence of profit to the employer, and the attitude taken by the men and their leaders, are such as point to further troubles, and indicate more than at any previous time the pressing importance of union amongst employers. The Iron Trades Employers' Association is in a position to speak with authority on the condition and prospects of the important branches of industry that it represents, and the gloomy outlook which is presented in the report from which we have quoted, without comment, is therefore all the more discouraging and deserving of serious attention.

THE REGISTRATION OF WORKMEN.

We have before alluded to the beneficial results which we know to have followed the course taken by the Plumbers' Company in granting certificates of competency to the workmen of the plumbing trade, and are glad to observe that the example set by it is being followed by the Carpenters' Company. We by no means attach the same importance to competency among our carpenters and joiners that we have always assigned to our plumbers. The work of the former is almost always open to inspection, and, if of faulty character, the results of imperfection are not so serious as in the case of the plumbing trade. But nevertheless we hold that very much good may be attained by establishing standards of excellence in all our building trades, and by stimulating their workmen to the acquisition of acknowledged proficiency. The agitation now proceeding for the wider diffusion of technical education seeks to secure that end by Government aid and direction. It may be that, after all, our great City companies, by fulfilling the functions imposed upon them as guilds in ancient days, may render very great assistance in that direction without adding to the burdens of the public. We cordially hope the example set by the Plumbers' Company, and now followed by the Carpenters' Company, will be adopted by the other kindred associations of our capital city.

LITERATURE.

The Theory and Practice of Surveying. By J. B. Johnson, Professor of Civil Engineering in Washington University, St. Louis, Mo. J. Wiley and Sons. 1886.

The appearance of this book ought to be taken by English civil engineers as one more in a rapidly increasing series of warnings that we on this side of the water have received of late years, that we have no easy task before us if we mean to maintain our right to the first place of merit in engineering science. It is not suggested that American surveying theory or practice has reached a higher pitch of excellence than our own, although the United States Government surveys have been acknowledged very generously all over the world to be of an extremely high order of accuracy, and probably the organisation of their Surveying Department is unequalled elsewhere. A text-book cannot be taken as an index of the degree of perfection to which the practice of the art it treats of has reached in the country where the book is published. So far as this book indicates the state of American survey practice, it leads us to suppose that in the States there are some methods still commonly practised which are out of date here, while in other directions—namely, the free use of telemetric methods—they appear to have advanced further than we have. The warning we suggest has reference not so much to any comparison of our present respective standards of accuracy, but to the progress being made on the two sides of the Atlantic, and the scientific methods adopted to ensure the continuance of progress along the safest and best lines.

No doubt the science and art of surveying has advanced immensely in England, as well as in France and Germany, during the last twenty or thirty years. But this advance has been made, not with the assistance of any rational method of securing progress, but in spite of nothing having been done outside particular surveying offices to advance the art and to train the profession to an ever-increasing knowledge of its principles and the means it can employ in its work. There are but few text-books on the subject, and these are, with perhaps one exception, thoroughly antiquated, and of such mean quality that they are not really fit to put into the hands

of any intelligent student who wishes earnestly to master his subject. There are sections on surveying in Rankine's "Civil Engineering," and in the "Roorkee Treatise," but they are meagre to such a degree that it would be little else than a cruel mockery to refer the student to them. The best systems of recording field notes of various kinds are described to a very small degree. The result is that among English surveyors there exist, probably, as many systems of keeping field notes for one and the same purpose as there are counties in the country. Another result is that the construction of surveying instruments receives very little intelligent criticism from the men who use them; it is left wholly to the instrument makers, who either blindly follow long established patterns, or else design by the light of an unchastened and undisciplined imagination. The development of any class of instruments towards perfection of construction depends upon constant cross-criticism between user and maker.

If one may judge from the illustrations in the book under review, the American is behind the English in many points of design. For instance, it would appear from those illustrations that the old four-levelling-screw arrangement is still in vogue in the States, except for instruments used in geodetic work. On the other hand, they show the upper parts of the levelling screws invariably covered by small tube caps to keep dust, &c., away. This is decidedly good. There is no point where greater inconsistency is shown by makers than in the construction of tangent screws, it being not infrequent to find even in the same instrument some of the tangent screws fitted with springs to take up slack—as all should be—and others with common collars. In this respect the Americans seem to be on a par with our own makers.

English surveyors will find Professor Johnson's book interesting as giving a description of the methods used in the States. These, as is well known, are very different to ours in many respects, and the causes that have led to these differences are also pretty well understood. The book is quite up to date. In fact, it contains frequent suggestions for further improvement on present practice. It covers the whole ground of surveying as thoroughly as is practicable in a text-book of over 600 pages. For instance, the Construction and Use of Instruments occupies 170 pages; Land Surveying, 150 pages; Topographical Surveying, 40 pages; Railroad Surveying, 12 pages; Hydrographic Surveying, 57 pages; Mine Surveying, 20 pages; City Surveying, 40 pages; Geodetic Surveying, 140 pages; the rest of the book being occupied by chapters on "volume measurement," "map making," tables, and appendices giving legal and professional information of a technical kind. The adjustments of the instruments are described in a very thorough and intelligent fashion, and great pains are taken to insist that no one deserves the title of surveyor who is unable to dispense with the assistance of the instrument maker in keeping his instruments in good order, and in putting them in good order when they have got out of it.

The most interesting American instrument is the solar compass, which can either be mounted on an ordinary magnetic compass or, for more accurate work, upon a theodolite. In the States the land is parcelled out by lines due south-north and east-west; and, although magnetic surveys may have been used in the earlier stages and for unimportant work, evidently something more trustworthy and accurate is needed for the great bulk of surveyors' work. The solar attachment enables one to get the true meridian from a single observation of the sun at any time of day, the best time of day being distant both from noon, from sunrise, and from sunset. If either the true local solar time be known by help of a good watch, or the true latitude of the station be known, then a single observation suffices; if neither of these be known, a second observation is required to determine the latitude. This second observation does not need, however, to be at noon. If the latitude be known approximately to within a few minutes of arc—and this is always the case in ordinary surveying—the error in obtaining the meridian by a single observation is very small. The use of this instrument, which is in reality very simple, is the best possible introduction a student can have to geodetic surveying, because the instrument solves mechanically for him all his solar problems in solid trigonometry, and he sees without difficulty how they are solved.

What the Americans call stadia, and what we call more commonly telemetric, measurements, are now used much more by them than by us. The length of a rod held at the distant station is taken as the base of a small triangle whose angle is measured by the theodolite or other instrument. The angle is really fixed and determined by two parallel hairs in the telescope, and the base on the rod is read off as one reads a level rod. The method was, we understand, first introduced by an Englishman, Mr. Wells. Chaining is capable of greater accuracy in the measurement of a line, but ordinary chaining by unskilled chainmen, or with a chain not carefully and frequently tested, is considerably more inaccurate than stadia measurements made in fairly good weather. We are surprised that more extended use of this method is not made in England. It has many evident advantages, the chief, perhaps, of which lies in the surveyor not having to depend nearly so much on the carefulness and accuracy of his assistants. It is also a very great deal more rapid, more cleanly and generally convenient. One can take lines across a river or pond as easily as on terra firma, and across brushwood, tall grass, or growing crops, without doing damage to the ground. Considering that taking accuracy and trustworthiness—freedom from gross error—together, it is really superior to the use of the chain with the theodolite, these advantages are surely sufficient to recommend it to any unprejudiced surveyor.

But although the principle of stadia measurements is excellent, the above is not the best way of carrying it out. In triangulation in aiming at accuracy we take as long a base line as we can conveniently get accurately measured. Instead, therefore, of using a fixed angle and a variable base which is always less than the full length of the rod and often only a small fraction of it, we should use the whole length of the rod as a constant base and measure the angle subtended by it. If the angle be measured and read off by means of its tangent—or difference of tangents to top and bottom of staff—the calculation of the distance is as simple as with the stadia observation, a division being substituted for a multiplication, and no reduction being necessary for difference of level nor any additive correction to be made. The division is facilitated by carrying in one's pocket a good table of reciprocals. This is the method of Eckhold's omnimeter, an instrument which deserves to be used far more than it is. It also gives at once the difference of level. Unfortunately, as made in England by Elliot Bros., the omnimeter is not stiff and steady enough in its framing, and is incapable of more than one-eighth or one-tenth of the accuracy its micrometer pretends to. Possibly its sale is also hindered by the occurrence of a prodigious error in the pamphlet sold with the instrument to explain its use, which error has been copied bodily into D'A. Jackson's "Practice of Surveying," and into Spon's "Engineering Dictionary." In both omnimeter and stadia methods the rod is supposed to be held vertically. A considerable error in holding it so influences the result only in a small degree, and usually no means are provided for accurately erecting the rod. This is a mistake. A plumb-line or a small level should be attached to the rod, and should be used to test its verticality. With the stadia method it would be still better to hold the rod not vertical, but perpendicular to the line from rod to instrument. This can easily be arranged for by fixing to the rod a simple pair of sights, the sighting from rod to instrument not requiring to be minutely accurate.

In both these telemetric methods a practical mistake is made in holding the rod vertical. In this position the rod cannot be held steady if there be the slightest breeze on, and the reading to its top is vitiated in a small degree by this unsteadiness, while that to the bottom is vitiated still more ordinarily by the unsteadiness of the atmosphere close to the ground. A much superior instrument would be one for which the base-rod, say, 10ft. long, as with Eckhold's omnimeter, would be held horizontally. It would have other advantages than those indicated here which we have not space to mention.

While giving high praise to Professor Johnson's work as a complete and scientific text-book of surveying, we by no means imply that it is not liable to fair criticism in many minor respects. We suppose it was necessary to explain fully the use of "protractors," but it is hardly needful to recommend their use. The use of a table of chords is much preferable. Parallel rulers again should not be preferred to the use of a good straight-edge and set-square. Again, what is said on "scales" is not at all to be commended. There is surely a confusion in the formula, page 176, for the convergence of two neighbouring township lines. Some wrong lettering occurs in the diagram on page 185. On page 193, Rule 3 is given as applicable when it is known that the angles have been taken accurately, and that the errors lie in the measurements of distances alone; but the rule for the adjustment of the errors affects the angles as well as the distances. In the chapter on railroad surveying the student is told to use the stadia instead of the chain in surveying, but in staking out the line he must—page 275—use the "transit and chain." There seems no good reason for this; if the stadia is suitable for one operation, it must be so for the other. This chapter on railroads is far too short in comparison with the space devoted to other subjects; but perhaps the author considers that railroad surveying is so important that it needs a volume to itself, or should be treated separately in a text-book on general railway construction. The chapter on Hydrographic Surveying is one of the best, and is sufficiently complete. That on Mining Surveys is incomplete, and does not attack the peculiar difficulties of this class of work.

The treatment of geodetic surveying is very full and extensive. The most interesting portion of this part of the book is that on the measurement of base lines. The author strongly recommends the use of steel tapes for this purpose, and we altogether agree with him in this, having come to the same conclusion some time ago. We also agree with him in advocating the use of a long tape of very small section. Wire would really be best but for the difficulty of keeping it from kinking. We experimented with phosphor bronze wire, and found it to be an excellent material for measurement of lines, except for its tendency to kink. In the form of a very thin tape $\frac{1}{8}$in. wide it would probably be found very suitable. Professor Johnson gives a most interesting account of the use of steel tapes for base-line measurement by Mr. O. B. Wheeler on Missouri River Survey—Report, 1886—and by Professor Ed. Jäderin, of Stockholm. We would like to describe these methods here but space forbids. The tape must be suspended in mid-air to attain accuracy, and to keep it approximately straight without friction. Mr. Wheeler suspended it at regular intervals by hooks from nails driven into stakes. We might suggest that suspension by silk threads would be much more frictionless and more readily adjustable as regards level. Very detailed calculations of the corrections for sag, tension, and temperature, are given. The method of correcting for temperature used by Professor Jäderin seems the best, and leaves nothing to be desired. He stretches two wires, one of steel and the other of brass, in the same place and under exactly the same conditions in every respect. The difference of their readings gives a perfectly good measurement of the temperature. Probably two small tapes of steel and phosphor bronze, stretched side by side and linked together at their ends so as to ensure both being stretched by exactly the same force, would form a very satisfactory arrangement. Looking back a generation, it is difficult to imagine what advantage was expected to be gained in the measurement of the bases for the great triangulation of England by the use of the ponderous chains made of bar $\frac{1}{2}$ square inch in section.

In conclusion, we heartily congratulate Professor Johnson and his publishers on having supplied a text-book which will be extremely useful to the rising generation of surveyors in the United States and elsewhere. We hope a second edition may be soon required, and that in it the book may be improved in several details.

BOOKS RECEIVED.

The Pocket Technical Guide, Measurer, and Estimator for Builders and Surveyors. B. A. C. Beaton. Fourth edition. London: Crosby Lockwood and Co. 1887.

The Economic Theory of the Location of Railways. An analysis of the conditions controlling the laying out of Railways to effect the most judicious expenditure of capital. By Arthur Mellen Wellington, M. Am. Soc. C.E. Revised and enlarged edition. London: E. and F. N. Spon.

Journal of the Society of Telegraph Engineers. No. 67, vol. xvi. Edited by F. H. Webb, secretary. London: E. and F. N. Spon. 1887.

Picturesque Wales: A handbook of the scenery accessible from the Cambrian Railways. By Godfrey Turner. London: W. J. Adams and Sons, and Simpkin, Marshall, and Co.

Annual Report of the Board of Regents of the Smithsonian Institution; showing the operations, expenditure, and conditions of the Institution to July, 1885. Part I. Washington. The Smithsonian Institute. 1886.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Honduras North Coast Railroad and Improvement Company.—A meeting of the company and representatives of the several exchanges was held recently at New Orleans to consider the question of developing the resources of Honduras. Within the last few years there has been an important growth of trade between that State and New Orleans, notably in the fruit trade. The traffic, however, is hampered by the fact that the steamers to Truxillo have to stop at various points on the coast and leave orders for fruit, and on the return trip take in the cargo in small quantities. By steam to Truxillo is three days, and if the cargo could be obtained there the round trip would be made in eight days, instead of fifteen or eighteen. There is further delay owing to the fruit being brought out to the ships in dories or small boats, so that in rough weather either the ship will not touch at certain points or there is danger of loss of fruit in transit. The same process obtains with all cargoes. The company has a concession from the Government of Spanish Honduras for a railroad along the north coast, which would develope vast natural resources and would enable fruit and other freight to be put on the cars and sent direct to the port. The line has been surveyed and some grading done. The cost of construction and equipment is estimated at 1,500,000 dols., but it is not proposed to build the entire road at once. The road is to be 110 miles long, but seventy-five, or even fifty miles, would be profitable. Bonds are now to be issued for the construction. The meeting was favourably disposed to the enterprise, and a resolution was adopted to appoint a committee composed of two members of each commercial body in the city to bring the matter to the attention of their respective bodies and facilitate the speedy accomplishment of the enterprise.

Death of Mr. Parry.—Mr. Chas. T. Parry, the senior member of Burnham, Parry, Williams, and Co., of world-wide renown as the "Baldwin Locomotive Works," died at Beach Haven, N.J., July 18th, at the age of sixty-two. He entered the works as an apprentice when a lad, passed through the pattern-room and drawing-office, and in a few years became superintendent. Together with Geo. Burnham he purchased the Baldwin interest in 1867, and after the death of Mr. Baird the firm was known as Burnham, Parry, and Co. About ten years ago Mr. Parry spent considerable time in Russia, supervising the building of locomotives for the Government. The last of his many trips to Europe was made in August, 1886. He was a member of the Franklin Institute, and a frequent contributor to its *Journal*. In October last the semi-centenary of his connection with the works was celebrated. Mr. Parry was a man of great executive ability, and by his energy brought to the present state of perfection and reliability for which they have a reputation. He was the designer of many labour-saving tools.

Export of breadstuffs.—The Bureau of Statistics has issued the following statement of the exports of domestic breadstuffs for the month of June:—Barley, 66,255 bushels—36,437 dols.; corn, 2,714,060 bushels—1,294,542 dols.; corn meal, 22,304 bushels—58,947 dols.; oats, 17,475 bushels—8029 dols.; oatmeal, 291,840 bushels—8712 dols.; rye, 43,216 bushels—27,205 dols.; wheat, 12,148,459 bushels—11,466,495 dols.; wheat flour, 882,649 bushels—4,125,473 dols. The total export for the month was valued at 17,025,840 dols., as against 13,702,993 dols. for June, 1886. The value of the exports for the year ending June 30th, 1887, was 162,426,194 dols., as against 122,810,379 dols. for the year ending June 30th, 1886. This statement includes about 98 per cent. of the entire exports of the articles named from all ports of the country.

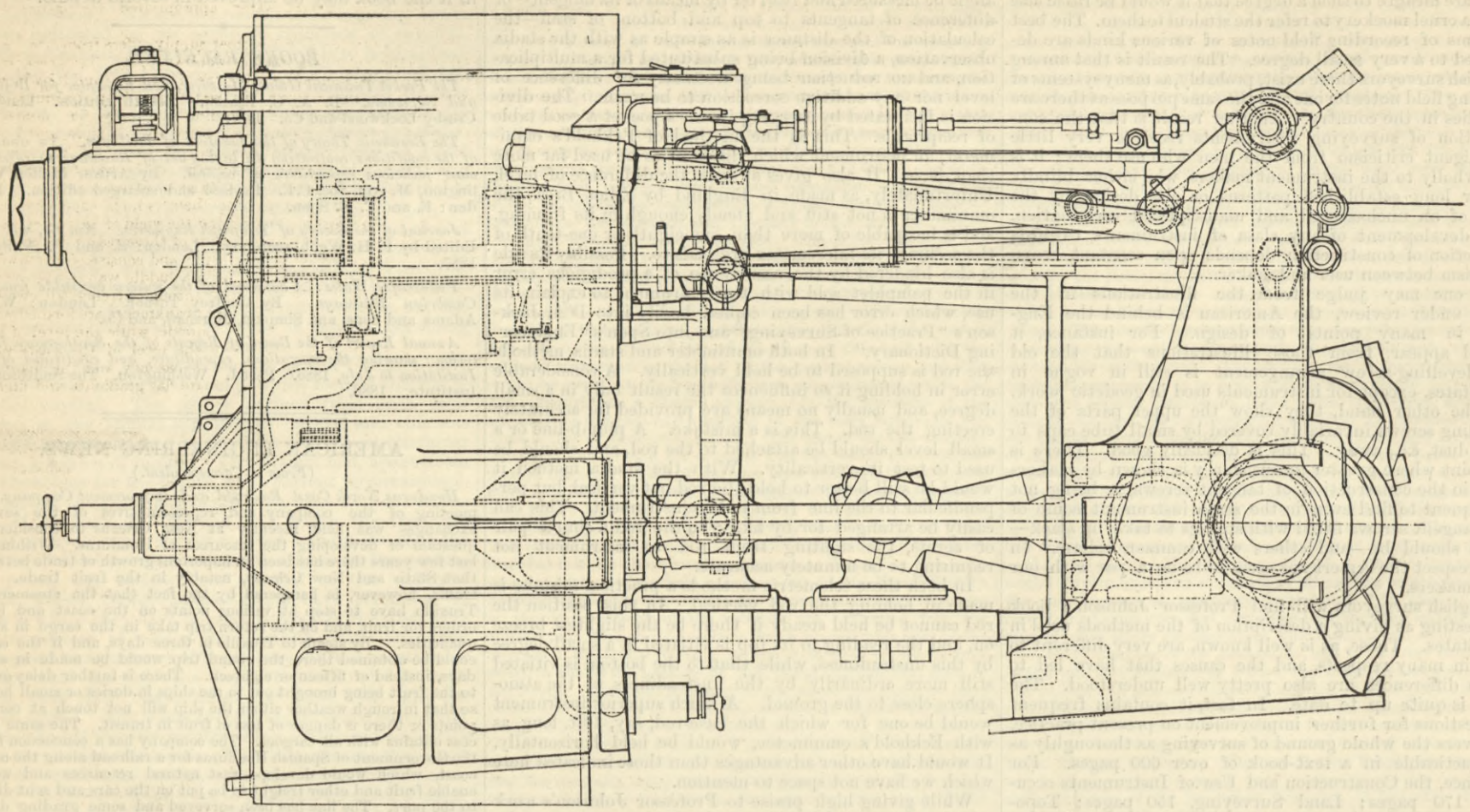
Water supply for San Francisco.—A project, with solid backing, is in hand to bring water from the Sierra to the city. The scheme is put forward by the Trolumne Ditch Company and the Amador Ditch Company, the latter owning a large lake, twenty miles from Sonora, supplied by large ditches. This company has submitted plans. The proposition is to convey the water from the lake to the city through a 48in. main. The length of the pipe line is about 120 miles. It will run down the foothills to Stockton, and follow the railroad to Niles, crossing the bay to Redwood. Branches will be laid to several cities and towns, including Oakland, Stockton, and San Jose, all of which are in need of a better supply. Oakland has deferred the consideration of its water supply until more is learned about this project, and it is proposed that the city shall bond itself to the new company for a considerable amount.

New Steamers.—The Day Line of steamers, running on the Hudson from New York to Albany has put on the new steamer, New York, which, it is claimed, will be the fastest boat on the river, beating even the famous Mary Powell. She is a side-wheel boat of the usual river type, and is guaranteed to make twenty-three miles per hour. The Now Then steam yacht, built by Herreshoff, has caused great excitement by her great speed on the experimental trips. She made the 170 miles between Newport, R.I., and New York in 7 h. 4 m., averaging approximately twenty-four miles per hour; and its owner declares he will beat this record. The yacht is 85ft. long over all, 81ft. long on the water line, 10ft. beam, draught 3ft. 3in. Cramp Bros., of Philadelphia, have the contract for the machinery and boilers of a fine new passenger boat for the Providence and Stonington Steamship Company. The engines will be compound, and of the oscillating system, a novel departure from the standard beam engine. The cylinders will be in a line fore and aft; their diameters will be high-pressure, 56in.; low-pressure, 104in.; stroke, 11ft. The Wheelock valve gear will be fitted. The engine was designed by Mr. Geo. B. Mallony, and is estimated for 4500 indicated horse-power, at twenty-five revolutions per minute. The side wheels will be 29ft. diameter, with feathering buckets 14ft. by 4½ft.

Pennsylvania Railroad.—The following particulars have been collated from the company's records:—Mileage, east of Pittsburg, 4154; west of Pittsburg, 3250; total, 7404; total mileage including double track, sidings, &c., 11,250. The company owns 2567 locomotives, and 92,204 freight cars. From the president down the company employs 43,800 persons, and it is estimated that 219,000 persons are directly or indirectly dependent on the company for a living. The average pay roll is 68,193·23 dols. per day, and the total for last year was 24,892,355·44 dols.

TRIPLE EXPANSION ENGINES OF THE ITALIAN CRUISER DOGALI.

MESSRS. R. AND W. HAWTHORN, LESLIE, AND CO., NEWCASTLE-ON-TYNE, ENGINEERS.



ENGINES OF THE DOGALI.

In our impression for June 10th we illustrated the cruiser Dogali, constructed by Sir William Armstrong, Mitchell, and Co., Newcastleon-Tyne. Through the courtesy of the makers we are now enabled to illustrate the engines of the Dogali. Above we give a sectional elevation, and perspective views on pages 109 and 112 of the engines as they stood in the erecting shop.

This vessel is the first warship fitted with triple-expansion engines. They were made by Messrs. R. and W. Hawthorn, Leslie, and Co., of Newcastle-on-Tyne, and are of the twin-screw horizontal type. Each set of main engines has three cylinders, 30in., 45in., and 73in. diameter, with a stroke of 2ft. 9in. The piston valves are worked on Marshall's system, which admits of a very large range of expansion being adopted, and gives as equable a distribution of steam when working at low speeds as when working at full power. The propellers are three-bladed. The whole of the engine pumps are driven by separate independent engines. The condensers are of brass. Steam is supplied from four boilers, each having six furnaces, capable of being worked either with natural or with forced draught. The air for the forced draught is supplied by eight fans, each driven by a separate Brotherhood engine. The whole of the auxiliary engines may be made to exhaust either into the main condensers, auxiliary condenser, or into the atmosphere. The engines are situated in two separate water-tight engine rooms, the communication between which may be closed at any time by water-tight doors moving horizontally worked from the deck. The boilers also are placed in two water-tight stokeholes. This subdivision of the vessel, and the fact that the whole of the auxiliary engines, as well as the main engines, are in duplicate, renders the chances of a complete breakdown very remote. During the trial the engines worked well, running at a speed of 155 revolutions per minute, and developing a power of over 7600-horses, the vessel attaining a speed of 19·66 knots per hour.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The autumn meeting of the Institution of Mechanical Engineers commenced on Tuesday morning, in the University of Edinburgh, with a reception of the President, Mr. E. H. Carbutt, and the council and members, by the Marquess of Tweeddale, chairman of the local committee, by the Lord Provost, the Chancellor, the Principal, and others of the University. A very large number of members was in attendance, and the weather was everything that could be desired to enable the members to enjoy and to do full justice to every part of the programme and well-organised arrangements. A number of papers for reading was placed on the programme, giving it a business appearance and sufficient inducement to members who prefer to feel that they are taking a week chiefly on business rather than to acknowledge to themselves that the holiday aspect of the promised excursions to works is the real incentive. The papers are all short, and several of them briefly descriptive of the works visited. Only the mornings of two days were appropriated to these papers, the excursion arrangements being very extensive and occupying two half days and two whole days. A very large and influential local reception committee was formed, with an executive including the Right Hon. Sir T. Clark, Professor Armstrong, Professor Kirkpatrick, Colonel Malcolm, Mr. D. M. Westland, M.I.C.E., Mr. Alan Brebner, M.I.C.E., Mr. Robert C. Reid, M.I.C.E., Mr. James Mc Laren, General Superintendent North British Railway, and Mr. St. John V. Day, F.R.S.E.

Arrangements were made for the members to visit several works in Edinburgh, but as the business of the meeting commenced each day at 9.30 a.m. and the excursions to places more or less distant from Edinburgh started as soon after the reading and discussion of papers as a hurried lunch would allow, there was no time to visit the town works except by neglecting the meeting-room. The programme thus contains features which must tend to spoil the attendance during the reading of papers. The attendance was small on Wednesday as compared with Tuesday for this reason, and for the further reason that three papers were read on Tuesday and a discussion hurried through. When three papers are read and discussed in about two and a-half hours, there is very little time to weigh what is said; and, with the exception of the inveterate talkers, every one feels that there is only time to touch on the surface of any matter. Such discussions are quite useless, and it still appears—as it has done for some time—that a programme of one paper per sitting would be far more useful and far more creditable to the Institution. This is especially the case when the meeting is held in a place like Edinburgh, and in splendid weather. The attractions are so very numerous that men who feel that the papers can be read at home very wisely take the opportunities the occasion affords for seeing the places of great natural beauty, of historic and antiquarian interest, of evidence of modern development, or where methods, processes, and engineering works may be seen in operation. Amongst the works open for inspection in Edinburgh were those of Messrs. George and William Bertram, of the St. Katherine's Paper Machinery Works, Sciennes; Messrs. Nelson and Sons' Printing Works, W. and A. K. Johnston's Edina map printing works, the new cable tramway under construction by Messrs. Dick, Kerr, and Co., under the superintendence of Mr. W. N. Colam, Assoc. M. Inst.C.E., and the Edinburgh Gasworks. After the reception and formal business on Tuesday morning, a paper by Mr. Malcolm Wood, "On the Forth Bridge," which was read, and another "On the Machinery Employed at the Forth Bridge Works," was read by Mr. W. Arrol. These papers contain nothing that has not already appeared in our pages, so we do not reproduce them. In the discussions upon them there was little said that added materially to the papers themselves, but to some of the few noticeable points mentioned we shall refer later. The president next called upon the secretary to read a paper "On Electro-Magnetic Machine Tools," by Mr. Frederick John Rowan. Most of the machines described we have very recently described and illustrated in The Engineer.

At one o'clock the members were entertained at luncheon in the student's reading-room of the University, at the invitation of the Local Committee. They then proceeded by special free train to Newalls station, adjoining the Forth Bridge works.

About two hundred members accepted the invitation. The three great cantilever piers, now nearly complete, were the special attraction. These structures are of such magnitude, and so perfectly unique in this respect as works of art, that it is difficult to convey any adequate impression to one who has not seen them, except by saying that they make the mighty Forth look small. Towering up to 350ft. in height, and with a base that is almost sufficient to carry one of the 600ft. cantilevers, if the opposite one were carried away, their proportions seem from the distance to reduce all to the ordinary relations of bridge and river or high-level bridge over a stream. It is not, however, until the upper part of the pier towers are reached that one feels the grandness of the structure, for then the Forth looks what it is, and the great steel structure seems a dominant giant, of which the perception of bigness is at the same time awakened and awe-struck, just as it is when in the presence of some of the isolated grandeurs of some of the Alpine peaks. When standing on the upper works and looking down over one side, the great vertical tubes, four yards in diameter, seem to descend in size, at their feet, to mere masts standing on boulders far down in the water below; but after a time the movements of the insect men help the eye to receive impressions for comparison, and help to the recollection that those boulders are about 60ft. in diameter where seen. Some of the visitors were carried to the top staging by means of a cage and winding engine, and some walked up the step ladder gangways, some of which had been made specially suitable for people not much accustomed to the great heights. Several of those who tried this rise to the 350ft. level by step ladders were sorry, and some of those who descended by the ladders were not less so, for legs grow very shaky at the end of such a descent. A good idea of the cost of erecting such a structure as this may be gathered from such a visit. Every piece that is elevated into position now costs a good deal for this alone, when the time of the men as well as of the machinery is taken into account. A piece is lifted from the lowest staging and is seen fading away in the far height, where men await and seize it. Watching this one can easily understand the objection that the men have to work in the intermediate heights. The men, especially in very windy weather, much prefer to be at the top, for the wind has much less effect there than at mid-height, and the top is free from the danger of falling pieces. Protection is possible, and is provided for the men on the lower and more finished work, but in the intermediate parts, where the space is so much occupied with the cross bracing, with moving staging and scaffolding, this cannot be done. About a fortnight ago one of the thinner plates slipped, and in slipping cut the rope with which the men were placing it. It fell, and in its fall cut through a 3in. plank upon which two men were engaged, hurling them about 150ft. below and of course killing them. The plate itself doubled up and buckled like a sheet of crumpled writing-paper. It will thus be admitted that there is reason in the reluctance to stand under what may be the path of any object that has started on an unchecked downward career, and it will be further comprehended when it is learned that a drift or a spanner, if falling from the top end-on, will pass clean through a 3in. plank and leave a hole hardly large enough to push the spanner through afterwards.

The great cantilevers are beginning to show themselves now, and the suspension links of the old Hammersmith Bridge are doing duty as suspenders of the lower members of the cantilevers from the great vertical piers. They are used in conjunction with and as a means of building up a strong plate suspending guy ending in a great plate-sling under the tube. In another impression we must return to this subject.

After their return to Edinburgh, the members met at the annual dinner, Mr. Carbutt being in the chair. On Wednesday the proceedings commenced with the reading of a paper, which we cannot give this week, by Mr. D. A. Stevenson, M. Inst. C.E., descriptive of the electric lighthouse on the Isle of May, which is being visited to-day—Friday. Another paper read was on the "Tay Viaduct," by Mr. Fletcher F. S. Kelsey, M. Inst. C.E., resident engineer of the viaduct. The Tay Viaduct was visited yesterday—Thursday.

Among the places of interest visited are the Carron Works, the Edinburgh Waterworks, and two paper mills.

The Carron Ironworks.

The Carron Ironworks were founded by Dr. Roebuck, of Sheffield, in 1759, and the company was incorporated by Royal Charter in 1773. The works are situated on the banks of the river Carron, in Stirlingshire, about a mile from the Larbert Station of the Caledonian Railway, and the same distance from the Grahamstown Station of the North British Railway, and are connected with both systems and with the Forth and Clyde Canal by a branch railway; there is also a canal connecting with the port of Grangemouth on the Firth of Forth. The coalfields, which have a total area of about 3500 acres, are in the vicinity of the works. The several seams belong to the lower portion of the upper series of coal measures. With the exception of the Main coal, all the seams differ very much in thickness in various parts of the field. The Craw coal, which is of excellent quality as a house coal, is chiefly used in the steamers belonging to the company. The Main and Coxrod seams are worked wholly for blast furnace purposes, for which they are well suited. The ironstone supplies are drawn entirely from the Cadder estate, near Glasgow, having an area of about 5 miles in length by 1½ mile in breadth. There are six mineral seams, lying immediately below the carboniferous limestone, and locally known as the Possil strata. The most important seams are the blackband and clayband ironstones, which are worked on an extensive scale. The ore chiefly used in the blast furnaces is blackband, with a slight admixture of clayband and hematite; the pig iron produced is so soft that thin castings made from it can be punched and sheared.

The Carron Works,[1] which occupy a space of 28 acres within the walls, are on two different levels. On the higher level are the blast furnaces, heavy foundry, and stove brick works; the lower level is occupied by the light foundry, together with the various fitting shops, offices, &c. The blast furnaces are four in number, about 50ft. in height by 16ft. diameter at the boshes, each supported on eight cast iron columns and enclosed in plate-iron casings. Two of the furnaces have closed tops, and are fitted with Cowper's regenerative hot-blast stoves, one to each

1 "Proceedings" Institution of Civil Engineers, vol. lxxxvii., 1886 p. 373.

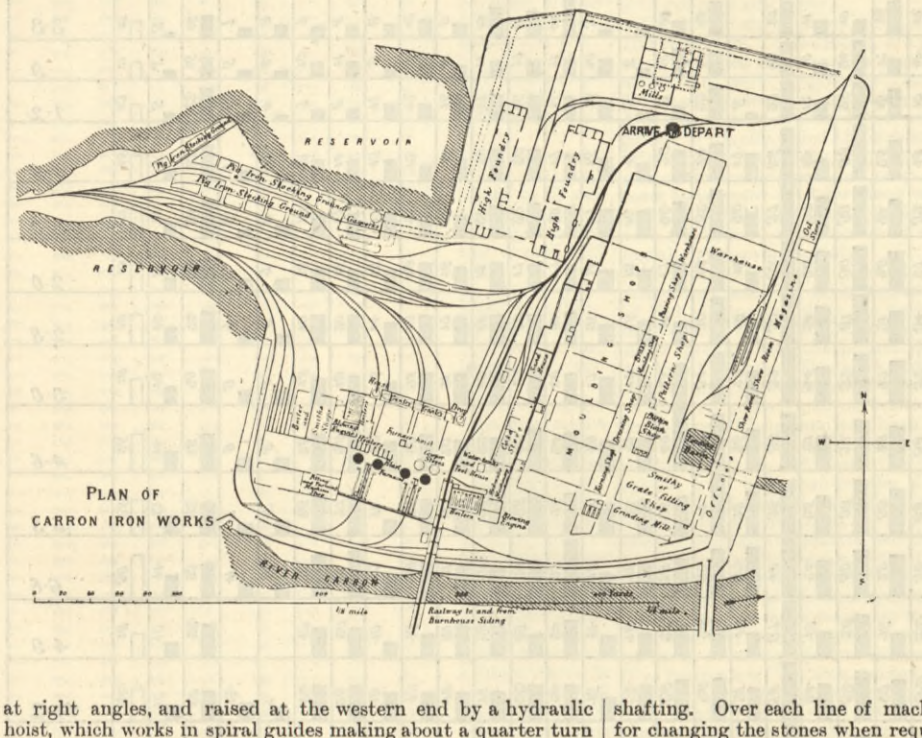
furnace. Each stove is 54ft. high to the springing of the dome, and 24ft. diameter; these were the first regenerative fire-brick stoves erected in Scotland. The two furnaces with the regenerative stoves have each a weekly output of 220 tons, as against 180 tons from the two open-topped furnaces worked with pipe stoves. The blast is heated to a temperature of from 1400 deg. to 1500 deg. Fah. As the furnaces work on raw coal, the large surplus of gas in excess of that required for heating the blast and raising steam for the blowing engines is being utilised as fuel in other departments; and ultimately no raw coal will be used in the works except that put into the blast furnaces. With this object it is proposed shortly to blow in another furnace; but before doing so certain improvements are being carried out, which it is hoped will still further reduce the cost of production, in addition to yielding a full supply of gas for all the departments of the works. These consist principally in increasing the total height of the furnaces to 68ft., so as to give a working height of about 60ft., which is the greatest height that a column of raw coal can stand without crushing; and also closing the top and fitting an additional regenerative hot-blast stove and dust-catcher. At present, as gas is being collected from two furnaces only, the supply is supplemented from special gas producers, consisting of plain plate-iron cylinders, charged by means of a bell and hopper, and provided with suitable tuyeres, into which air is forced by the blowing engines at such a pressure as to balance that of the gases given off by the blast furnaces. An independent supply of gas is thus available for the other departments of the works in case the furnaces should be damped down at any time.

A gantry is to be provided for storing minerals on the furnace bank. Wagons can neither be run direct on to the top of the gantry, nor even in a line parallel to it, but are delivered below flues underneath, through which the waste products from the kilns circulate. There is an overhead tramway for distributing the ground clay to the several moulding-tables.

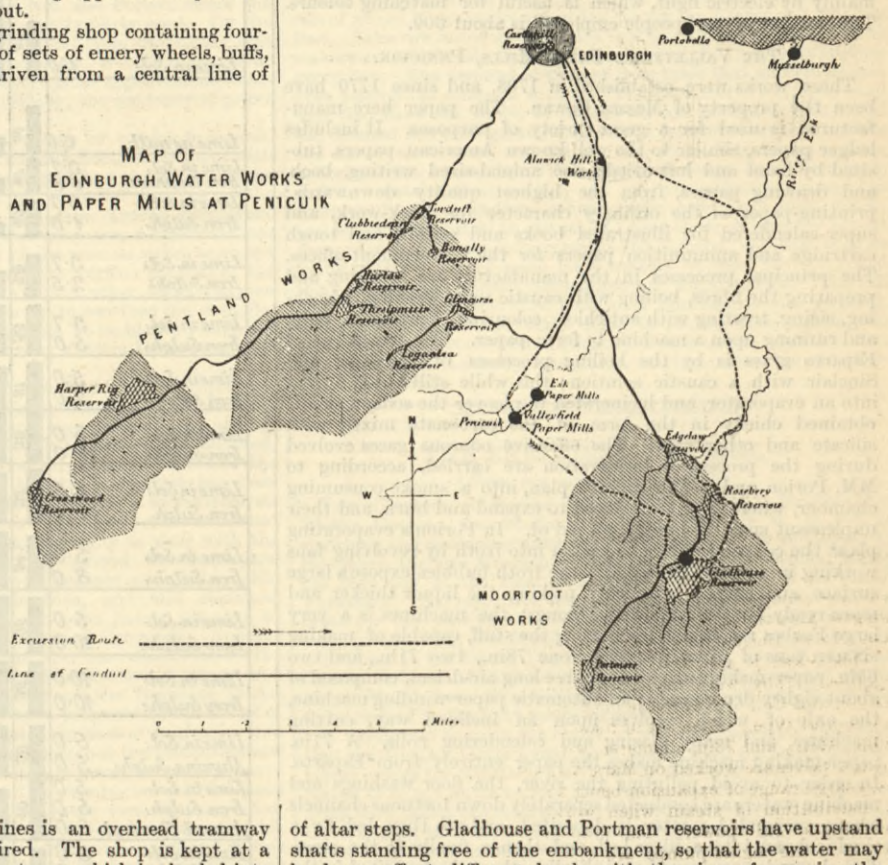
The light foundry occupies the whole of the low-level area of the works. The goods here manufactured consist of ships' and steamers' cooking apparatus and ship fittings, stable and cattle-house fittings, cooking ranges and stoves, register stoves, rain-water and sanitary goods, smithy and general workshop fittings, garden furnishings, cart bushes, and pots and pans. The peculiarly soft quality of the Carron iron enables it to be run into the finest moulds, and renders it specially suitable for castings in which lightness and strength and finish are required. The foundry forms a quadrangle round an open space, in which are the loading platform for the despatch of goods by rail, and a commodious basin for despatch by canal. The moulding shops have an area of 10,044 square yards, with ample provision for future extension; and are laid with tramways throughout, on which in many cases the molten metal, even for the finest castings, is conveyed to a distance of 200 yards before pouring. The blast-furnace gas is utilised for drying ladles, heating core-stoves, sand kilns, &c., lighting up cupolas, and for almost every purpose for which coal is usually required in a foundry. The dressing shops are provided with the ordinary rumbling and emery-wheel appliances. On the south side of the quadrangle are the fitting shops, with a floor area of 3442 square yards. Here cooking apparatus of all kinds for sea and land, fittings for builders' use or for stables and cattle houses, are put together. Every special piece of cooking apparatus is put to a practical test before being turned out.

Adjoining the fitting shops is a grinding shop containing fourteen stones, and the same number of sets of emery wheels, buffs, &c., arranged in two rows and driven from a central line of shafting. Over each line of machines is an overhead tramway for changing the stones when required. The shop is kept at a uniform temperature by the waste steam, which is also led into the grindstone troughs for tempering the water during cold weather. Another adjunct to the fitting shops is a sheet iron workshop and Berlin blacking shops. For the best Berlin blackwork as many as four coats of enamel are required. The various articles are dried in kilns and stoves, and the several coats of enamel ground down with pumice stone, much in the same way as in coach painting. These kilns are fired during the night with blast-furnace gas, which is shut off during the day; but owing to the mass of brickwork, a practically uniform temperature is maintained.

From 2000 to 3000 tons of castings are usually kept on hand in the extensive warehouses, which occupy a considerable part of the range of two-storey buildings forming the eastern



PLAN OF CARRON IRON WORKS



MAP OF EDINBURGH WATER WORKS AND PAPER MILLS AT PENICUIK

at right angles, and raised at the western end by a hydraulic hoist, which works in spiral guides making about a quarter turn during the ascent, so as to deliver the loaded wagon upon one or other of two roads running along the length of the gantry. Along these they are hauled by a hydraulic capstan, and descend empty at the eastern end by a spiral drop similar to the hoist. On reaching the ground they run by gravity into sidings.

There are two vertical blowing-engines with blowing cylinders 78in. diameter by 48in. stroke, and one beam-engine with blowing-cylinder 102in. diameter by 120in. stroke. Steam is supplied from eleven double-flued Lancashire boilers. Near the beam-engine are the pumping-engines for raising water for the blast-furnace tuyeres, &c.; and the hydraulic engines, accumulators, &c., for supplying hydraulic power throughout the works.

The heavy foundry is one of the most modern of the structures of the old works, and is being worked in with the new in order chiefly to preserve it as a memorial of the past. Here many of the old "carronades" were cast; but latterly the work done has consisted chiefly of sugar pans, dyers' pans, stills, &c. When remodelled and completed, the building will be 154ft. long by 80ft. wide, and will be fitted with two overhead travellers capable of lifting from 25 to 30 tons, while the whole floor-space is commanded by light hydraulic cranes fixed either to the walls or to the line of pillars running down the centre of the building. For the better class of castings reverberatory gas-furnaces will be used, but for ordinary purposes the iron will be melted in cupolas. Two of these cupolas are erected at present, and space has been provided for two more. They consist of wrought-iron shells lined with fire-brick, with an internal diameter of 4ft. throughout. The tuyeres, connected outside with an air-belt, are rectangular, each 6in. high by 1in. wide; and are so arranged that the direction of the blast is not towards the centre, but tangential to a circle of 12in. diameter. On the top are a number of baffle-plates for catching the dust and preventing it from lodging on the roofs of the buildings. Similar cupolas are in use in the Low Foundry, where they have proved very successful. Each is capable of melting from 12 tons to 15 tons per hour, according to requirements. They are worked with a blast pressure of 2 lb. per square inch, and the consumption of Scotch coke—Gartshore—is under 200 lb. per ton of iron melted. There are two large moulding pits, one 30ft. diameter and 18ft. deep; and the other elliptical, 50ft. by 30ft. and 12ft. deep. As they are only 33ft. above mean sea-level, special precautions have to be taken to guard against water. An 18in. tramway is being laid down, to be worked by locomotives. When complete, the foundry will be partially supplied with molten iron direct from the blast-furnaces.

The stove-brick works are adjacent to the heavy foundry, and are specially designed for the manufacture of bricks required for the stoves, ranges, and register grates produced in the light foundry. Fire-clay of the finest quality is procured from the colliery adjoining, and is suitable for making the best fire-bricks, especially those used for the combustion chambers of regenerative hot-blast stoves, reverberatory furnaces, &c. The three kilns are small, as the demand for stove bricks is limited; they are not regenerative, but whenever they require to be rebuilt they will be made so. The only fuel used is blast-furnace gas. The drying-shed has a floor-space of 90ft. by 66ft., with a series of

Edinburgh Waterworks Reservoir.

Works.	Name of reservoir.	Distance from Edinburgh.*		Size of reservoir.			Embankment.		Drainage area.	Cost.	
		By road.	By pipe.	Surface area.	Greatest depth.	Storage capacity.	Greatest height.	Total content.		Approximate total.	Per million cub. feet of storage.
		miles.	miles.	acres.	feet.	gallons.	feet.	cub. yards.	acres.	£.	£.
Pentland.	Castlehill	0·30	—	—	30	1,715,625	30	—	—	10,153	—
	Torduff	5·60	4·90	11¾	80	112,500,000	85	177,600	758	13,467	748
	Clubbiedean	6·20	5·50	12¾	44	65,625,000	55	69,052	250	6,021	573
	Bonally	6·60	—	14½	25	53,125,000	32	37,074	110	3,500	411
	Harlaw	8·00	—	30½	64	168,750,000	67	72,968	3934	7,778	288
	Threipmuir	8·50	—	112	23	206,250,000	29	34,552	3613	10,000	303
	Glencorse	8·30	9·50	52	62	359,373,000	77	86,335	3964	43,000	747
	Loganlea	10·30	—	18½	55	121,875,000	59	102,000	1426	11,364	582
	Harper Rig	12·20	—	173½	38	562,500,000	36	54,587	4217	11,548	128
	Crosswood	16·00	—	62	40	175,000,000	48	88,061	2113	20,686	738
Moorfoot.	Alnwick Hill	3·60	3·30	5	24	19,904,263	33	107,521	—	18,800	—
	Edgelaw	13·16	—	37	80	275,000,000	93	93,050	6363	35,000	795
	Rosebery	13·68	—	52⅓	75	381,250,000	84	175,403	7751	33,000	541
	Gladhouse	15·86	13·42	399	68½	1,713,356,000	79	152,349	6131	63,400	231
	Portmore	17·37	16·95	102½	12½	250,000,000	16	16,068	610	12,500	312

* The distance by road is from the Mound in Princes-street; that by pipe is from Castlehill Reservoir.

boundary of the works. The central portion of the upper flat is taken up by the general offices, in which is conducted the whole of the business, comprising besides the ironworks the management of large hematite ore mines in Cumberland, and of other estates, and the independent business of public carriers.

The Edinburgh Waterworks.

The following particulars have been kindly furnished by Mr. Alexander Leslie, F.R.S.E., one of the engineers of the works. The city of Edinburgh and the adjacent district derive their present supply of water from two main sources, namely, the Pentland Hills and the Moorfoot Hills.

Pentland supply.—The Pentland supply consists chiefly of spring water, most of which is conveyed direct to the city in pipes; and the yield of the springs being subject to very little fluctuation in quantity, a comparatively small amount of storage is all that is required to equalise the available discharge throughout the year. There are, however, several small reservoirs which are used for this purpose, and they also serve to store the water of the adjacent district naturally draining into them. In connection with the supply of spring water, several compensation reservoirs have been constructed, the water of which being of a peaty nature is not suitable for drinking, but is now used to afford compensation in water-power to the mills on the streams into which the spring water appropriated for Edinburgh naturally flowed.

Moorfoot supply.—The Moorfoot supply differs from the Pentland in being entirely a surface-water supply. Two reservoirs have been constructed, namely, the Portmore and Gladhouse reservoirs, for impounding the water naturally draining into them, for the purpose of affording a supply for domestic purposes; and two compensation reservoirs, Edgelaw and Rosebery, have been constructed for the purpose of affording compensation to the streams on account of the water abstracted. The capacity of the reservoirs is fixed as equal to six months' yield of the district draining into them, which experience has proved to be sufficient for equalising the yield of three dry years consecutively. All the embankments of these reservoirs are constructed upon much the same principle, and consist of earthwork formed in thin horizontal layers, with a puddle wall in the centre of the bank, which is continued down through a trench till a water-tight foundation is reached. These embankments are formed with slopes of 3 to 1 inside and 2½ to 1 outside, while the level of the bank is generally 5ft. or 6ft. above the level of the waste-weir crest. The waste weirs are formed of masonry, and the channels leading from them consist of alternate flat gradients and flights of altar steps. Gladhouse and Portman reservoirs have upstand shafts standing free of the embankment, so that the water may be drawn off at different levels, with the view of securing the purest water nearest the surface; while the compensation reservoirs have the sluice shaft in the centre of the embankment where the water is always drawn off at the bottom level, as its quality is of no importance. The water is conveyed towards Edinburgh partly by a built aqueduct and partly by a pipe; of the latter a portion is 24in. diameter and the rest 22in. The water is subjected to a process of filtration at Alnwick Hill, where the works consist of a service reservoir, four filter-beds, and a clear-water reservoir, from which last the water is led to Edinburgh and the adjacent district of supply. There are seven separate pipes leading the water into Edinburgh, and at present the district of supply is being divided up, so that it may be arranged for each pipe to serve its proper district. On the map are shown the drainage areas and the positions of the various reservoirs; and the accompanying table gives details as to their capacity and cost, &c.

The Esk Paper Mills, Penicuik.

These mills, belonging to Messrs. James Brown and Co., are situated in the valley of the North Esk, within eight miles of Edinburgh, and close to the Eskbridge station of the North British Railway. When established in 1790 they turned out probably not more than one ton of paper per week. About 1815, new buildings were erected and new machinery was introduced, including a Fourdrinier machine and powerful steam-engines. New machinery has since been gradually introduced to the present time, and the mills now, as described by Mr. John Jardine, produce 100 tons of paper per week. The raw materials consist chiefly of esparto grass and rags; and the processes through which they pass before becoming finished paper are dusting, boiling, bathing, bleaching, pressing, beating, making, calendering, cutting, sorting, and baling. The raw material,

run by a siding from the railway direct into the mills, is first thrown into the dusting machine, where it is shaken about, and the dust extracted by a powerful exhaust fan. It is then conveyed by a series of endless felts to the boiler, where it is at once violently beaten down by a continuous shower of boiling alkali. After the boiling, which occupies about eight hours, the grass is forked loosely into open vats, and is bathed with tepid water and drained of alkali. In the bleaching cisterns, which have semicircular ends and are fitted with revolving knives, the grass is then pulped and partially opened out, and slightly rinsed with pure water, and then bleached; after which the pulp is treated in the "presse pâte" machine to remove all remaining sand or grit, and knots, roots, heather, &c., and is delivered in rolls into boxes, having thus been thoroughly prepared without any hand labour. In the beating engine the fibres of the pulp are drawn out into a finely divided condition, and the colouring and sizing materials are added. The beating engines are driven by a compound engine working up to nearly 600 I.H.P. There are four paper-making machines, one of which is 120ft. long, and delivers paper 76in. wide at any speed from 20ft. to 150ft. per minute, according to the thickness or quality required. The calendering machines are fitted with cotton and chilled iron rolls, and by means of compound levers great pressure is exerted upon the paper sheet. In the cutting machines six or eight sheets can be cut at a time. The plant and general machinery are of the newest and most approved kind; while the arrangements for using waste liquors over again and for preventing pollution of the river are very complete. At night the works are lighted up mainly by electric light, which is useful for matching colours. The number of workpeople employed is about 300.

The Valleyfield Paper Mills, Penicuik.

These works were established in 1708, and since 1770 have been the property of Messrs. Cowan. The paper here manufactured is used for a great variety of purposes. It includes ledger papers, similar to the well-known American papers, tub-sized by hand and loft-dried; also animal-sized writing, book, and drawing papers, from the highest quality downwards; printing-paper of the ordinary character for book-work, and super-calendered for illustrated books and serials, and tough cartridge and ammunition papers for the Government offices. The principal processes in the manufacture are selecting and preparing the fibres, boiling with caustic soda, washing, bleaching, sizing, treating with antichlor, colouring, beating to pulp, and running upon a machine to form paper. The treatment of Esparto grass is by the boiling processes of Roeckner and Sinclair with a caustic solution; this while still hot is floated into an evaporator, and incinerated to recover the soda, which is obtained chiefly in the form of the carbonate mixed with silicate and other salts. The offensive odorous gases evolved during the process of incineration are carried, according to MM. Porion and L'Espermont's plan, into a smoke-consuming chamber, where they are allowed to expand and burn, and their unpleasant smell is thereby got rid of. In Porion's evaporating plant the caustic solution is beaten into froth by revolving fans working in a tunnel of hot air; the froth bubbles expose a large surface and evaporate quickly, making the liquor thicker and more ready for the furnace. Amongst the machines is a very large Forbes rag engine for beating the stuff, capable of making sixteen tons of paper per week; one 78in., two 71in., and two 68in. paper-making machines; three long air-driers, composed of about eighty drums each; an automatic paper-winding machine, the axle of which revolves upon an inclined way, cutting machines, and many glazing and calendering rolls. A 71in. paper-making machine makes the paper entirely from Esparto. In order to avoid polluting the river, the floor washings and machine waters are conducted separately down tortuous channels where suspended matter is deposited, and are then led by a single channel to a filter bed, and thence finally to the river. The channels are cleaned periodically; the pulp deposited in the machine-water channel is flushed into a tank through sluices at the bottom of every two lengths of channel, and is dried and sold to packing-paper makers. The boiler waters are purified in a similar manner, assisted, however, by chemical precipitation. The deposit on the filter beds is cut out and wheeled away. The process of preparing gelatine size from hide pieces and cuttings is also carried on at these works. The mills are supplied with the finest spring water, conducted in pipes from about three miles distance. On the top of a hill there is a chimney shaft communicating with the boilers through a bricked archway running up the steep hill-side. The seventeen steam boilers are fed with dross coal by self-acting feeders; economisers raise the feed-water to a temperature of 220 deg. Fah. The motive-power is supplied by numerous steam engines, ranging from 6 indicated horse-power to 200 indicated horse-power, and amounting to about 1200-horse power in all.

AN EXAMINATION OF SOME RECENT EXPERIMENTS ON SEWAGE TREATMENT MADE, BY MR. W. J. DIBDIN, F.C.S., FOR THE METROPOLITAN BOARD OF WORKS.[1]

By R. W. Peregrine Birch, M.I.C.E., F.G.S.

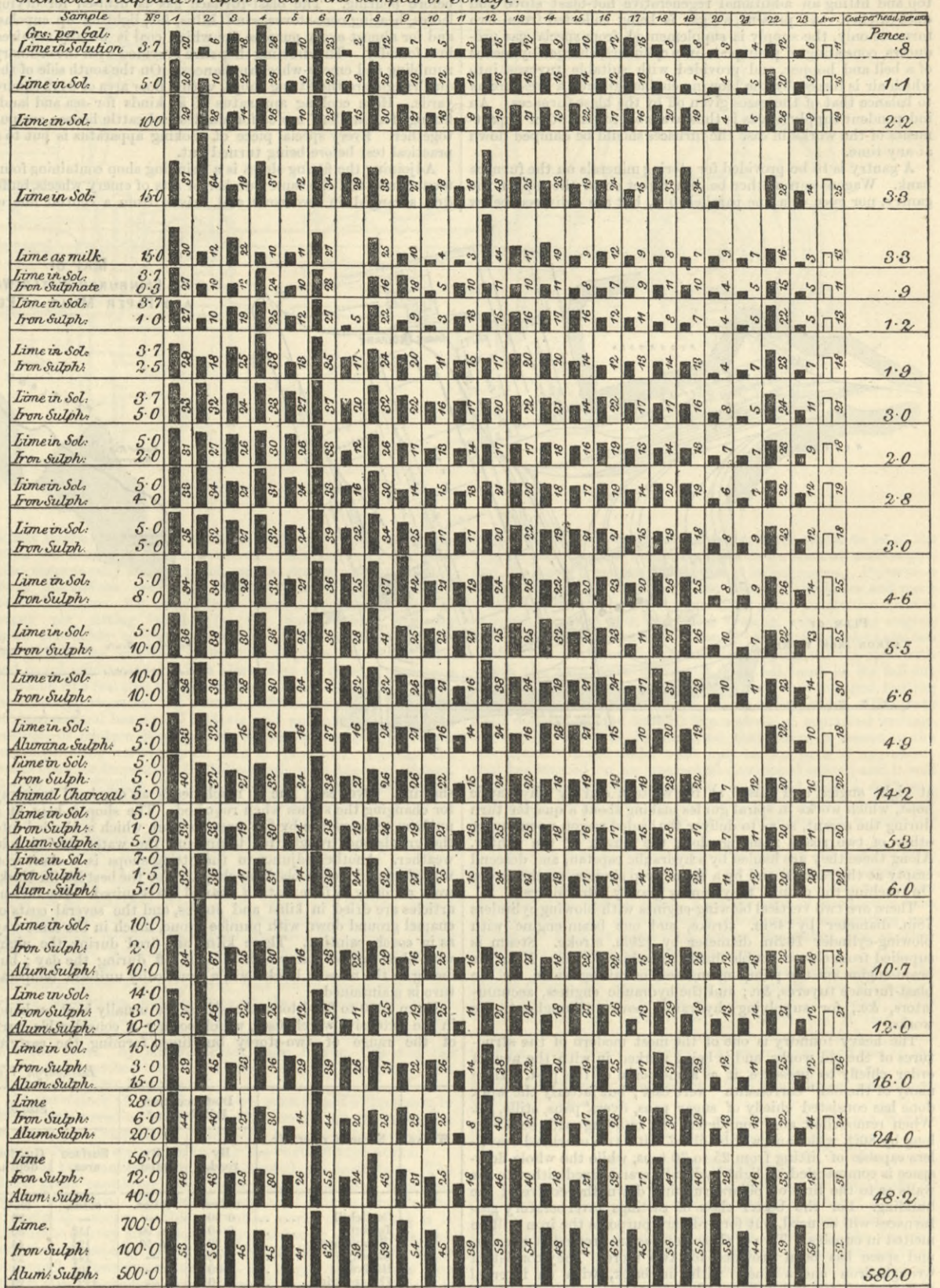
At the Institution of Civil Engineers at the beginning of the year an admirable paper was read by Mr. Dibdin, Chemist to the Metropolitan Board of Works, upon "Sewage Sludge and its Disposal," in which he sets forth the process about to be put into operation by the Board for the treatment of the sewage of London. The metropolitan sewage is to be treated with 3·7 grains of lime and 1 grain of sulphate of iron per gallon, and Mr. Dibdin produced the results of a large number of experiments to show that although greater purification might have been effected by a greater expenditure of chemicals, the improvement would not have been worth its cost. Great difference of opinion was expressed in the discussion as to the capability of such homœopathic treatment, and it is not proposed here to say anything about the relative merits of different precipitants; but the 500 odd analyses made by Mr. Dibdin besides showing the relative merits of different agents also show the relative susceptibilities of the samples tested, and it is to call attention to the importance of this difference that the author has ventured on this occasion to address the society. In this communication there is nothing but what could be extracted from Mr. Dibdin's paper; but the object in the two cases not being the same, it has been thought worth while to utilise the large mass of well-authenticated facts obtained by the Metropolitan Board of Works to teach a lesson which on the former occasion was not emphasised as the present author considers it might have been with great advantage. Mr. Dibdin took twenty-three samples of sewage from the Metropolitan Outfall at Crossness, and having extracted from them the matter in suspension, treated each in twenty-five different ways. He used lime alone in quantities varying from 3·7 to 15 grains per gallon, sometimes in solution, sometimes as milk of lime. He used lime in conjunction with sulphate of iron in various proportions, lime together with sulphate of alumina, lime supplemented by both sulphates, and also lime, sulphate of iron and animal charcoal together. As will be seen from the diagram, the chemicals necessary for these treatments were estimated to cost from ·81 of a penny per head per annum to 48s. per head per annum, and it is obvious from Mr. Dibdin's figures that the use of the larger quantity of chemicals would, independently of the expense of dealing with the increased quantity of sludge, have cost a great deal more than their worth. It is to be learnt from Mr. Dibdin's figures that whether he added 4·7 grains of chemicals or 108 grains to the gallon at costs respectively of 1¼d. per head and 4s. per head, it did not make more than 20 per cent. difference in the amount of organic matter removed. This is very strong if not conclusive evidence in support of the opinion arrived at by the Board of Works, namely, that it was best to limit the amount of chemicals used as proposed by Mr. Dibdin. But although the difference between the effect of one precipitant and another precipitant upon any one of the samples tested is small compared with the cost, the difference in the extent to which two samples have been found to yield the dissolved organic matter contained in them is very striking, and this brings the author to the point he wishes to impress upon the members of this Association having the management of sewage precipitation works, viz., that more is to be expected from experiment and research into the question of what are the influences affecting the susceptibility of sewage to chemical precipitation than from trials of different chemical agents. The diagram shows what percentage of the dissolved organic matter was removed from each sample by every one of the different precipitants. The horizontal rows of ordinates represent the results of one treatment upon twenty-three different samples; the vertical columns the results obtained from treating one sample in twenty-five different ways.

Upon examining the diagram it will be seen that there is a much greater uniformity in the latter set of results than in the former ones, showing that the results arrived at depend more upon some quality or condition of the sewage at the moment of treatment than upon the character or quantity of the precipitant used. For example, compare the behaviour of samples Nos. 1 and 6 with that of Nos. 20 and 21. The two first under the twenty-four different treatments—the twenty-fifth treatment is excepted because of its prohibitory expense—yielded from 20 per cent. and 23 per cent. respectively to 49 and 55 per cent., or an average of 33 per cent. and 35 per cent. respectively, while 20 and 21 only yielded from 0 per cent. to 29 per cent. and 16 per cent., or an average of 8 per cent. and 9 per cent., showing that where the greatest success attended the treatment the result was due more to the sewage than to the precipitant used. It will be seen that certain samples have yielded up their impurities far more generously to all of the treatments than other samples have to any, and that certain samples yielded more dissolved organic matter to 15 grains of lime than they did even to a greater quantity of lime, together with a considerable addition of sulphate of iron and alumina. Columns Nos. 1, 6, and 22 show that a sample of London sewage may be in such a condition that it will yield its dissolved organic matter practically equally as well to any of the twenty-five treatments. The few weak places in columns No. 2 and No. 4, and the one weak place in No. 22, suggest that their occasional stubbornness is due rather to the temporary condition of the sewage when treated than to the class or quantity of filth which they contained, and that the inefficiency of all the reagents alike to touch samples 20 and 21 may be due rather to the conditions under which they were treated than to the elements of which they were composed.

It is obvious when certain samples of sewage yield generously to twenty out of twenty-five different treatments, but in the other cases resist reagents which have been effective with other samples of the same sewage, that the strength of sewage is not the only factor to be considered, and that the variety of result must be due to some varying physical condition, possibly age or temperature, or degree of decomposition of the sewage when treated, or maybe to the temperature of the atmosphere or the barometric or photological conditions prevailing at the time.

The author knows that Mr. Dibdin has not at present satisfied himself as to the meaning of the facts collated on the diagram further than was necessary for the question he had in hand at the time he made the experiments; but the author believes that if the science of sewage precipitation is to be advanced it must be through investigations, by gentlemen in this Association, of the nature and extent of the outside influences which affect the action of precipitating agents upon sewage

Diagram showing the Percentage Reduction of Oxidizable Organic Matter in Solution by various methods of Chemical Precipitation upon 23 different samples of Sewage.



[1] Paper read before the Society of Municipal Engineers and Surveyors.

The Manchester Exhibition.—In our notice of the exhibits in the Irish section of the Manchester Exhibition, in our impression of the 22nd ult., we stated that the cylinders for the Great Southern and Western locomotives were cast by Messrs. Grendon, of Drogheda. This is a mistake. The cylinders in question were cast at Inchicore. All the cylinders on the Great Southern and Western Railway have been cast for the last five or six years at the Inchicore works of the company. Previously they were cast by Messrs. Grendon.

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

(*From our own Correspondent.*)

Specifications for sheets are more plentiful this week than last, and makers have no sort of difficulty in keeping the works going full time. They might indeed place many more orders on their books if they were less determined to accept no business except at the 5s. to 7s. 6d. per ton advance which has recently prevailed. The time, however, of low prices has continued so long that producers are resolved to make the most of the revival, which has now occurred, and some of them quote as much as 10s. per ton advance. This full rise, however, they hardly expect to obtain in any case, and the figure is quoted more as an indication that order books are closed for the present against the receipt of further business. £6 2s. 6d. was this afternoon again named as the figure for galvanising singles, £6 5s. to £6 7s. 6d. for doubles, and £7 5s. to £7 7s. 6d. for lattens. A few firms would, however, not have refused £7 2s. 6d. for lattens. Merchant singles were £5 17s. 6d. upwards, the strengthening in the market upon merchant sheets having been much less than upon galvanising sorts. Indian inquiries for galvanised corrugated sheets are on the market this week in increased numbers, while the South American demand keeps good. Cable advices from Melbourne indicate a continued expectation by the market of an improvement in demand and prices, without, however, at present any very palpable reason for such anticipations. Staffordshire galvanisers' prices are strengthened by the information of an advance of £1 per ton, just announced by the Scotch galvanisers. The Clyde is coming into increasing prominence as a galvanising centre. £10 5s. to £10 10s. per ton, f.o.b. Mersey, is again quoted this week for Staffordshire brands. Thin sheets for staying and working-up purposes remain in good sale on home, continental, colonial, and American account. Prices are well maintained.

Messrs. John Knight and Co. quote Dilldale singles, £8; K.B.C. singles, £9; Crown, £10 10s.; plough sheets, £12; C.S.S. charcoal sheets, £14 10s.; and Knight's charcoal, £12. Steel sheets are £11; Crown bars are £7; plough bars, £9; and charcoal bars, £15. Tin-plates the firm quote:—Cookley K. charcoal, 22s. I.C.; C.S.S. charcoal, 20s.; and Woolverley, 18s. per box. Cokes they quote 17s. for I.C. Large tin sheets of the Cookley K. charcoal brand are 25s. 6d. per cwt. for singles; C.S.S. charcoal, 23s. 6d.; and Cookley coke, 21s. 6d. Doubles are 1s. 6d. per cwt. extra, and lattens 3s. per cwt. extra.

Messrs. Hatton, Sons, and Co. quote thin iron sheets for working up purposes of single gauge at £10 to £12 per ton; charcoal, black sheets, £15 to £18 per ton; steel boiler plates, £7 to £8 per ton; soft steel sheets, heavy singles, £9 to £10 for deep stamping purposes and tinning; and doubles, 20s. to 30s. extra, with a yet further 20s. to 30s. per ton for lattens. Soft steel blooms and billets the firm quote about £5 15s. to £6.

Current prices of ordinary qualities of finished iron may be gathered from the revised rates of the Pelsall Coal and Iron Company, which are this week as follows:—P.C. bars, £5; P.C. hoops, £5 5s.; Crown bars, £5 10s.; Crown hoops, £5 15s.; Crown sheets, £6; charcoal sheets, £13; hinge strip, £6; gas strip, £5; nail strip, 24in. wide to 13 gauge, £5, all at makers' works.

Business in the pig iron trade remains tame; 37s. was again quoted for good Derbyshires, but less excellent qualities might have been had for 36s. 6d. Northamptons were something under 36s., and Derbyshires about 39s. 6d. to 40s. at stations. Hematites keep firm at 52s. 6d. for Welsh, and 53s. 6d. to 54s. for West coast; forge sorts without much doing. Native pigs are 28s. 6d. to 30s. for common sorts, 37s. 6d. to 40s. for part-mines, and 50s. for hot-blast all-mines.

The prices which are now being paid for Bessomer plating bars delivered into this district from the Welsh steel works are £4 15s. to £5 per ton, and from Sheffield, for metal of guaranteed temper, £5 10s. to £6. Superior quality bars of Sheffield make are £9 to £10, and Swedish Bessemer ditto, £14. Edge-tool makers state that in doing a large amount of work they would prefer to employ the cheap Sheffield bars to the cheaper Welsh bars, since there is less waste, and the work produced is more satisfactory. Cast steel prices vary from a minimum of £20 to a maximum of £60 per ton delivered here, and the qualities employed in the largest quantities by the edge-tool makers range between £26 and £35 per ton.

The quantity of steel offering upon the local market will be early increased by the starting of the extensive new steel works of the Aireside Steel and Iron Company, Leeds. It is announced in this district that the works are now rapidly approaching completion, and in six weeks' or two months' time orders will be being executed. The works will have, it is asserted, a capacity of some 2000 tons of steel a week. The Bessemer process has been adopted, and Spanish ores are the material to be employed. The company has for some time past owned three blast furnaces, which will produce some 700 tons of pigs each per week. The ores can be brought straight from Spain right to the furnaces by means of the Aire and Calder Canal navigation. Blooms and billets are the chief classes of steel for which a market is anticipated in this district, and Mr. Jno. E. Perry, of Wolverhampton, has been appointed the new company's representative. The new steel will be offered at the lowest possible price, and excellent quality is promised.

The railway wheel and axle makers continue fully occupied. Orders recently received for India and South America are for some thousands of pairs in a line. The material employed in their manufacture is steel.

There has been a considerable resumption of work on the part of the nailmakers and chainmakers who have been on strike. Some fifty employers, distributed over both industries, have conceded substantial advances. On Wednesday, however, a rattening outrage was executed upon the premises of Messrs. H. and F. Shaw, Birmingham, one of the malleable nail firms who have persisted in the demand for a reduction of 10 per cent. An attack was made by gangs of men, who broke the windows and attempted to unroof the shops. The police, however, made a timely rescue.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is no specially new feature to report in connection with the iron trade of this district. Business all through, with the exception of perhaps a moderate demand for hoops and sheets, continues very slow, but prices maintain a generally steady tone, and in this respect the market may be said to be in a fairly healthy condition. Pig iron makers not only show no anxiety to press sales, but where business might be done at a little under current rates, it is only in exceptional cases that there is any disposition to entertain the offers that buyers put forward. Hematites are being kept steady in price by the activity which prevails generally in the large steel-making centres, and although supplies are plentiful, and the business doing in this market only small, very little concession upon late rates is obtainable. Finished iron is scarcely maintaining the improvement which seemed to have set in recently; for sheets and hoops better prices are still being got than were taken a short time back; but bar iron is easier to buy, and some very low figures are reported to have been taken by merchants.

The Manchester iron market on Tuesday was only moderately attended, and business was very slow. For pig iron there was but a limited inquiry, and business seemed to be held in check by the firmness with which makers generally adhered to their prices. For Lancashire pig iron, quotations remain at the practically unobtainable figure, so far as this market is concerned, of 38s. 6d. for forge, and 39s. 6d. for foundry qualities delivered equal to Manchester, and local makers seem to be firm in holding for these prices. District makers, who have mostly pretty well filled their books for the present by the sales recently made at a little under the prices they are now asking, are holding for 36s. 6d. for forge, and 37s. to 37s. 6d. for foundry, less 2½, as their minimum for delivery equal to Manchester. In outside brands offering here Scotch and Middlesbrough makers are generally holding pretty firmly to late rates, but in some instances there is a disposition to entertain special offers at 3d. to 6d. per ton under the quoted list rates. For hematites the current market prices are about 52s. to 52s. 6d., less 2½, for good No. 3 foundry qualities, delivered into the Manchester district, with makers in some instances asking a little above these figures. In finished iron, sheets are quoted at £6 5s. to £6 7s. 6d. for local, and £6 10s. to £6 12s. 6d. for good Staffordshire qualities delivered into the Manchester district, but the top figures are not very readily obtainable. Hoops are firm at about £5 5s., and good qualities of bars are quoted at £4 17s. 6d. per ton, but under this figure is being taken to secure orders.

Taking the engineering branches of industry all through, there seems to be a fair amount of work in hand. Boilermakers generally are being kept fully employed, toolmakers are moderately well supplied with orders, stationary engine builders and millwrights are better supplied with work, and machinists, although the new orders coming forward just now are not of any great weight, are in a better position than they were a short time back. Locomotive builders are kept moderately employed with orders in hand, but have comparatively little new work in prospect. The returns of the trades union organisations continue to show a lessened number of members out of employment, and the report of the Steam Engine Makers' Society for the present month shows a fair improvement all round, with a reduction of 1 per cent. in the unemployed list. The reports sent in to this society from the various districts throughout the country are to the effect that, with the exception of London, which is still returned as bad, and Bolton, where the strike is still in progress, trade is generally fairly good. On the other hand, there is still the general report from employers that work, unless it is of some special character, is only to be got at excessively low cut prices, and that there is no improvement whatever in this direction, but that, if anything, the tendency of prices is to get even still lower.

The Bolton strike shows no sign whatever of coming to an end. The employers, I understand, are gradually filling their shops with men, obtained from various districts, sufficient to carry on the work they have in progress; and at a special meeting of the National Executive Committee of the Iron Trades Employers' Association, held in Manchester on Thursday last, a resolution was passed to the effect that the refusal of the men on strike to accept arbitration entitled the employers to the further support of the Association, which will be given. On the other hand, the men seem to be quite as determined as ever to continue the struggle, and the Bolton Strike Committee continue to be liberally supplied with funds, the last balance-sheet showing £900 in hand, after paying all expenses up to date.

The fifteenth annual meeting of the Iron Trades Employers' Association was held in Manchester last week, Mr. C. D. Holmes, of Hull, the president, in the chair, and there was a large attendance of members. The report, which was presented and adopted, dealt specially with the present depressed state of trade and the strike at Bolton. The work done by this committee has been varied, and, the report adds, it is hoped, conducive to the interests of the iron and engineering trades, as well as of other important industries. The committee have had specially to deal with the Rating of Machinery Bill, the Bill to amend the Employers' Liability Act of 1880, and the Steam Engines and Boilers Bill, which had been before the Legislature, and still remained in an undetermined condition owing to the heavy pressure of other imperial questions upon the House of Commons. Another matter partially legislative, which has also been dealt with by the committee, has reference to the proposed collection of labour and wages statistics by the Labour Bureau of the Board of Trade. Very elaborate blank schedules had been prepared by the Board of Trade, and specially drawn up to meet the case of engineers, iron shipbuilders, machinists, and ironfounders; but the committee saw nothing in this project which could in any way be made to serve the interests of the iron trades of the country or could be made useful to the public generally, whilst there were features introduced into the inquiry of a singularly inquisitorial character, which far exceeded the functions of any Government department in this country, and for these and other equally grave reasons they instructed the secretary to issue a circular to all their members suggesting that none of the blank schedules should be filled up or any replies given to the officers of the Board of Trade except through the officers of the Association. In this respect the view entertained by the committee was adopted by their members and endorsed by employers in other industries apart from the iron and engineering trades, as was shown by the recent statement in the House of Commons that out of 46,000 inquiry forms sent out only 6000 replies had been received from employers. After the report the usual formal business of the annual meeting was transacted, and Mr. J. H. Kitson, of Leeds, was elected president of the Association for the ensuing year.

A circular has been received by the secretary of the Manchester Geological Society—and as it is a printed document, it has no doubt gone the round of the various scientific societies throughout the country—in which assistance is being solicited towards the cost of constructing an air ship, in which the inventor—Dr. A. De Bausset, of Chicago, U.S.—proposes to make a voyage of discovery to the North Pole. This air ship, which is to be capable of carrying 200 passengers, besides representatives of the press and accomplished observers and operators, is to be composed of a cylinder built of thin plates of steel, to which is attached a car for passengers, freight, and machinery. For his ascensional force the inventor departs from the old methods, and instead of gas uses a partial vacuum regulated by means of air valves and air pumps, by which the vacuum can be decreased or increased as required. Horizontal motion is to be secured by the use of eight compound exhausting air screws, displacing and throwing upon the surrounding atmospere 270,000 to 300,000 cubic feet of air per minute, which it is claimed will be sufficient to impart a velocity of seventy miles per hour. Dr. De Bausset is willing to admit that his project may appear to be the dream of a visionary, even to men of scientific attainments, but he seems to be satisfied that he has secured the endorsement of a professor of astronomy at Chicago, and a couple of electrical journals published at New York as to the effectiveness of his device for navigating the air by a vacuum instead of by inflation with hydrogen, and he has planned out a personally conducted excursionists' tour which puts into complete shade anything that the most enterprising of the tourist managers has ever even dreamed of. Dr. De Bausset estimates that a month's time will suffice for the journey to and from the North Pole, out of which ten days or two weeks will be available for scientific observations of arctic phenomena, and the journey is to be commenced on June 1st next year, starting from New York, and calling on the way at Philadelphia, Washington Toledo, Chicago, Omaha, San Francisco, Jeddo, Canton, or Pekin, Constantinople, Rome, Paris, Berlin, St. Petersburg, and thence direct, *via* Greenland, to the arctic regions. Of course, to complete the building and equipment of this air ship, money is required, and the tempting offer is held out of a free passage either for himself or representative to every subscriber of 1000 dols.

The general condition of the coal trade of this district remains practically unchanged. For all descriptions of coal the demand continues extremely dull, and pits are kept working only very irregularly, some three and a few four days a week. All classes of round coal are very bad to sell, and with stocks accumulating, where sales can be effected to clear away quantities very low prices are taken. Supplies of engine fuel are rather scarce, so far as the best qualities of slack are concerned, but other sorts are plentiful enough to meet the very moderate requirements of consumers. The average current prices, which, however, do not represent the figures taken for special sales, remain at about 8s. to 8s. 6d. for best coals, 6s. 6d. to 7s. seconds, 5s. to 5s. 6d. common coals, 4s. 6d. to 5s. burgy, 3s. 6d. to 4s. best slack, and 2s. 9d. to 3s. per ton for ordinary qualities at the pit mouth.

The demand for shipment is only indifferent, and prices are very low, steam coal delivered at the high level, Liverpool, or the Garston Docks, not averaging more than 6s. 6d. to 7s. a ton.

Barrow.—The rumour I referred to last week of the probable acquisition of one of our largest shipbuilding and engineering concerns by a syndicate of gentlemen of the highest position in the shipbuilding and engineering world proves to be correct, but as nothing definite has been done, although I hear the project is making favourable headway, it is not prudent in the meantime to make further reference to it, except to say that the scheme if carried out, which there is every reason to believe it will be, will be of the greatest possible advantage and benefit to the town. Shipbuilding here has not for some considerable time past been well employed. It is evident now that steel plates, angles, slabs, and other material as produced by a new plant put down by the Barrow Steel Company being available, shipbuilding can be carried on at Barrow under favourable conditions for success, so soon as any demand springs up, and there are any prospects of securing new orders. The same quietude which characterises shipbuilding is also noticeable in the engineering trades, both marine and general. In the marine trade there are certainly satisfactory indications of improvement, and it is probable that more men will shortly be employed on the orders which are now held, while other important contracts are pending. In the pig iron trade no change can be quoted. The demand for hematite samples of pig iron is quieter than it has been, although it is known that buyers require the delivery of very large parcels, in addition to those already contracted for. But makers and dealers generally are well sold forward, and are busily employed on heavy contracts. There is no change to note in prices, which remain at 45s. 6d. per ton net, f.o.b., for parcels of mixed Bessemer iron, and 44s. 6d. for No. 3 forge and foundry iron. Sales are noted at about 44s. per ton for big parcels. Steel makers are very busily employed on rails, and the trade is improving every day. The demand at present is so brisk that makers cannot even attempt to compete with it. They are so fully sold forward that they have not much to dispose of for prompt delivery, and the demand has been greatly augmented from the fact that, on the one hand, some steel makers who in other districts have been suffering from a scarcity in the supply of water, have been compelled to restrict their output, and an extraordinary demand has therefore been put on those whose works have been kept going, and who had any steel to dispose of. But there is another potent reason for an immediate increase in the demand, and that is to be found in the fact that some large makers of steel have oversold their output, and cannot fulfil important engagements. The rail trade is, of course, the chief feature of business at the moment, but there is also a fair trade doing in plates, bars, angles, and other descriptions of steel. Finished iron is quiet. Iron ore firm and brisk for best descriptions at 11s. 6d., but raisers are not offering large parcels.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The directors of Messrs. Samuel Fox and Co., Stocksbridge Works, Deepcar, near Sheffield, have appointed Mr. W. H. Fox as chairman and managing director of the company, in succession to his father, the late Mr. Samuel Fox, founder of the business, which has been one of the most remarkable and successful in South Yorkshire. The report for the year ended 30th June last shows a profit for the year of £37,396, which, with the balance from last year, gives a total of £39,968. This enables them to recommend a dividend at the rate of 15 per cent. per annum, towards which an interim dividend at the rate of 10 per cent. annum was paid on the 1st of March last. The dividend absorbs £36,000, leaving £3968 to be carried to the next year's account.

A paragraph is going the round of the newspapers to the effect that the Turkish Government have placed with German manufacturers orders for 500,000 arms. This is the same order as was referred to in my letter to The Engineer a month ago. Two German firms have taken the contracts for 500,000 new rifles for the Turkish Government, and the steel for the barrels, &c., is now being produced by a Sheffield firm, who have undertaken to deliver at stated times within three years.

A newly-formed organisation of iron and steel workers, entitled the Associated Iron and Steel Workers of Great Britain, held a conference at Sheffield this week. The representatives of the press were excluded, and no official report of the proceedings could be obtained. Some time ago the National Association was split up over a proposal for a centralised fund, which was resented by the branches in the Midlands, and since then the operations of the National Association have been mainly confined to the North of England, the Midland districts being governed by the Conciliation Board. The formation of one body for the whole of the country, including the Scotch ironworkers, has led to the present movement. The Association was provisionally constituted at a conference held at Manchester in April, when draft rules were submitted. These have been circulated by the various branches for consideration, and were this week brought before the Conference for approval. The Association numbers over 7000 members, representing Wolverhampton, North Staffordshire, Manchester, Shropshire, West Bromwich, Warrington, Wigan, Bolton, Wishaw, Sheffield, Parkgate and Masbrough, Brierley Hill, Bilston, &c.

Mr. J. E. Bingham, ex-Master Cutler, has given notice of the following motion to be included in the programme of the autumnal meetings of the Associated Chambers of Commerce, to be held at Exeter in September:- "That in the opinion of the Associated Chambers of Commerce it is expedient that counsel should be paid for their services according to usual commercial laws, and be placed in a position to recover their fees by action at law from any solicitor who may employ them, and be made liable to pay damages for negligence in all cases in which, if such counsel were a solicitor, and was guilty of negligence, any client employing him would be entitled to recover damages against such solicitor."

The Cutlers' Company held their annual meeting on the 2nd inst., when Mr. James Dixon, of the firm of Messrs. James Dixon and Sons, silversmiths and electro-plate manufacturers, Cornish-place, Sheffield, was appointed master for the ensuing year. Mr. Dixon is among the youngest members of the company; but he has travelled extensively, has received a liberal education, and is one of our ablest rising men. His firm is the oldest and largest in the trade in this district, and the family of Dixon has long been to the front in social circles of Hallamshire and business relations in the leading markets of the world. The senior warden for the year is Mr. S. E. Howell, and the junior warden is Mr. S. G. Richardson. The Cutlers' Feast takes place on the 1st of September, when Mr. Dixon will be installed according to the quaint and picturesque ceremonial of this ancient corporation.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

A slight improvement has taken place in the Cleveland pig iron trade during the last three or four days. Buyers seem inclined to re-enter the market, but sellers are still somewhat wary. It is expected that the shipments will be good this month, and this tends to cause some hesitation in selling. At the market held at Middlesbrough on Tuesday last the attendance was but moderate. The tone was, however, decidedly cheerful, and prices were somewhat firmer than they were at the end of last week. No. 3 g.m.b. for prompt delivery could then easily be obtained at 34s. 3d. per ton, whereas now 34s. 4½d. is the lowest accepted by any merchants. Makers still refuse to quote lower than 35s., and manage to book a certain number of orders at that price from continental

consumers and such merchants as are absolutely forced to buy. The demand for forge iron is poor, and the price weak, purchases having been made at 32s. 6d. during the last few days, as against 32s. 9d. to 33s. a week ago.

Stevenson, Jaques, and Co.'s current quotations:—"Acklam hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire" (Cleveland), No. 3, 36s. per ton; "Acklam basic," 36s. per ton; refined iron, 48s. to 63s. per ton—net cash at furnaces.

Warrants have at Glasgow changed hands at 34s. 1d., or 3d. below last week's rate. At Middlesbrough holders will not take so low a price, and therefore no business is done.

The quantity of pig iron exported from the Tees during July was 64,516 tons, or about 8000 tons less than in June last, but 6000 more than in July, 1886. The principal items of the export list are as follows, viz.:—To Scotland, 19,295 tons; to Wales, 6235 tons; to Germany, 7440 tons; to the United States, 7225 tons; to Sweden, 4101 tons; to Holland, 3900 tons, and to Russia, 2850 tons. The shipments of manufactured iron and steel amounted to 29,787 tons, India taking, as usual, the largest quantity, viz., 11,787 tons.

The net average selling price of Durham coal during the three months ending June 30th is certificated to have been 4s. 5·21d. per ton. The wages of the miners will not be affected by this return.

The accountant to the North of England Board of Arbitration certifies that the net average selling price of manufactured iron for the two months ending June 30th was £4 12s. 5¾d. per ton, or 10d. less than that of the previous two months.

Great interest has been felt by all concerned in shipping at Stockton and Middlesbrough in the recently concluded action between the owners of the Castledale steamship and the Tees Conservancy Commissioners. The Castledale was an iron screw steamer of 2358 tons burden, built in 1882 by Messrs. Wigham, Richardson, and Co. She was about to proceed to India with rails for the Indian Government; when she had taken on board about 2200 tons of rails and 700 tons of bunker coals in the dock, she was taken out into the river and moored at high water alongside a new wharf belonging to Messrs. Walker, Maynard and Co. This was done at the suggestion of the pilot, and with the knowledge, if not by the consent of the harbour-master. When lying in her new berth, and the tide had fallen, she began to touch the ground; at the time of low water loud noises were heard in the engine-room, bolts began to give way, bulkheads to buckle, the boilers to move on their seatings, and the ship's floors to crack; the vessel had evidently settled amidships, while the ends were free, and she was apparently commencing to break her back. She was afterwards unladen, put in dry dock, and thoroughly repaired at a cost, according to plaintiff's statement, of about £8000. To recover this the action was brought, the plaintiffs asserting that the harbour-master should not have permitted the pilot to take the vessel to moorings which were untried, and afterwards proved to be unsafe. They attributed the accident to the presence in the bed of the river of the trunk of an ancient tree, which was found there later on, and which they held ought to have been previously discovered and removed by the Commissioners. The latter contended that the harbour-master did not give permission to the pilot to take so large and so heavily laden a vessel to the berth in question, and that what the latter did was upon his own responsibility, and that he alone was to blame. The result of the action was that judgment was given for the plaintiffs, the exact amount of damages to be left to be assessed by a jury.

Mr. T. Bell, her Majesty's inspector of mines for the county of Durham and the North Riding of Yorkshire, has issued a report wherein he alludes to the recent development of the salt industry of Teesside. It appears that last year four salt-producing firms were in operation, and that their joint output was within 2 per cent. of 100,000 tons. Several new wells had, however, then been sunk, or were in progress, and there was every prospect of a considerable increase in the supply. The salt bed had been proved to extend as far as the village of Greatham on the north, though the diminished depth at which it there exists seems to indicate that the edge of the basin is not far off. To the south, it has been proved at North Ormsby, where the depth is half as much again as at Greatham; and to the east at South Bank, where it is more than 200ft. deeper still. The deposit, as now known, is 4 miles in length by 2¾ miles in breadth, giving an area of nearly 12 square miles, the average thickness of the deposit being 100ft. The brine is being converted at some of the works into table salt of the finest quality. The total number of wells has now reached twenty-nine. The probable yield has been estimated at nearly 250,000 tons per acre, or 2,000,000,000 tons for the whole area of the deposit.

Mr. Bell's report deals not only with salt, but with all other minerals raised in his district. There has been, it appears, a considerable diminution of output in every case in 1886, as compared with 1885. Of coal, 277,460 tons less were raised to the surface; of ironstone 561,465, and of other metalliferous ores 9628 tons less. The number of miners employed diminished considerably, 786 fewer being needed at the collieries, and 795 fewer at the iron mines. In all the collieries and mines taken together the number of fatal accidents was 74, which is about the same as during the previous year. The total number of persons employed were as follows:—At Collieries 54,985, at ironstone mines 5918, at other mines 2845.

The weight of coal raised was 20,346,032 tons, the total ironstone 5,370,779 tons, and of other ores 88,673 tons. This gives 370 tons of coal per collier, 908 tons of ironstone, or 31 tons of other ores per miner employed per annum; or 7 tons per week as the average production of a collier, 18 tons per week as that of an ironstone miner, and 12 cwt. as that of one of those who raise other ores. The total number of mines of all kinds in work during the year was 338. Of these 191 were collieries, 35 iron mines, and 112 mines producing other metals.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been an improved feeling in the Glasgow pig-iron market this week, the general prospects of the trade being considered more promising. A succession of fairly good orders for pigs from the United States and Canada has been received in the course of the week. The shipments amounted to 8932 tons as compared with 7510 in the corresponding week of 1886. The prices of warrants have been rather better than last week. The only discouraging feature at the moment is that an increased amount of pig iron is being sent into the warrant stores. There are 82 furnaces in blast against 85 at the same date last year.

The current values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 48s. 6d.; No. 3, 44s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. and 45s. 6d.; Summerlee, 52s. 6d. and 43s.; Calder, 49s. and 42s. 6d.; Carnbroe, 44s. and 40s.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 43s. and 39s.; Govan at Broomielaw, 43s. and 39s.; Shotts at Leith, 49s. 6d. and 45s. 6d.; Carron at Grangemouth, 52s. and 44s. 6d.; Glengarnock at Ardrossan, 49s. and 41s. 6d.; Eglinton, 43s. and 39s.; Dalmellington, 44s. and 40s. 6d.

Merchants have of late advanced the prices of unbranded bars 1s. to 1s. 6d. per ton, and it is reported that offers from India are more satisfactory.

During the past week several good contracts have been booked by Clyde shipbuilders. The London and Glasgow Engineering and Iron Shipbuilding Company has engaged to construct two steel steamers of 2500 tons each for a Japanese company, and Messrs. A. and J. Inglis have obtained an order to build a screw steamer of over 2000 tons for the Tasmania Steam Navigation Company of Hobart Town.

Much satisfaction is felt in this district at the announcement made at the Naval Architects' meeting at Newcastle by Mr. White, Chief Constructor of the Admiralty, that after the fullest trials, basic steel had proved itself equal to the Admiralty requirements. Hitherto, this material, which is made by Messrs. Merry and Cuninghame and the Glasgow Iron Company from common Scotch clayband ores, has not been admissible for shipbuilding purposes because Lloyd's Committee refused to sanction its use; but there is now little doubt that the material will come into general use in our shipyards.

The iron and steel manufactured goods shipped from Glasgow in the past week embraced one locomotive, worth £900, for Colombo; three ditto, £5400, for Calcutta; a steel barge, £3700, for Calcutta; a small steel steamer, £1650, for Trieste; £19,750 worth of machinery, £2200 sewing machines, £9400 steel goods, and £27,000 general iron manufactures.

In the coal trade there is a marked revival here, chiefly to orders coming to hand that were held back during the holidays. Prices of main coals are, however, easier in consequence of the supplies being in excess of the current demand.

The coal miners are again adopting short time.

There is a serious dispute with the shale miners, who still refuse to accept the reductions of wages rendered essential by the very unprofitable condition of the mineral oil trade. Some of the oil works are being stopped, and the men are being ejected from their dwelling-houses. In the case of the Pumpherston Oil Company the men have accepted the reduction.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Cardiff Exchange has exhibited of late a slight increase of doubters—men who think that the improved prices were due to a spurt, and will not last much longer. Per contra, again, there are amongst the principal coalowners many who are firm in resisting any concession from late quotations, and who think that the little slackness of late is only temporary. For the good of all concerned, I hope that this view is the correct one. Any receding now in price will put an advance of wages to the colliers out of the question. Prices are 9s., 9s. 3d. to 9s. 6d. for best steam, but good coals are to be obtained at 8s. 6d. Rhondda coals are selling somewhat feebly at from 8s. to 8s. 3d. Monmouthshire coals also sluggish at 8s., and in some cases as low as 7s. 9d. Small steam is being turned out in greater quantity than the demand, and prices are at the best only 4s. 3d. Patent fuel has not attained the old average, and Swansea, which is still the headquarters of this industry, is only able to record a sale of about 6000 tons weekly.

Great interest continues to be centred on the Mines Regulation Bill which will come before the House in the course of a few days. There is now every reason for concluding that the objectionable clauses will be modified satisfactorily. A hard fight has been fought in the interests of the South Wales coal industry, and if the powerful objections of the coalowners of the district are accepted, there can be little fear but that the great industry will go on in its progressive ratio. The opinion of outsiders has been that the shot firing in the Welsh mines has been one great cause of the periodical explosions we have been subjected to; but, under proper direction, it has been proved satisfactorily that there is no danger. The great causes of explosions in the pits of South Wales have been, first, the fact that a steam colliery in its working condition evolves a certain amount of gas; and secondly, that the neglect, or carelessness, or recklessness of colliers, or of an individual collier, brings about a catastrophe. Taking the government of a mine under skilled mining engineers, with due observance of the local regulations, danger is placed at a minimum. Here, for example, are the Ocean Collieries, some literally teeming with gas, but explosions are unknown. The Government should thoroughly understand this fact, that it is the strongest policy of coalowners to avoid explosions. Apart from all questions of humanity, an explosion is always disastrous to a coalowner, in some cases ruinously so, and every effort is bent towards an avoidance. Accepting this, the plea of the coalowners, mining engineers, and skilled colliers, represented by the South Walian Committee, should be accepted unconditionally.

It is to be regretted that the drought still hampers the iron and steel works. Dowlais is practically at a standstill, and the pressing orders are being transferred to other works that are better favoured with water.

Swansea continues active in tin-plate, more so than Monmouthshire, which has scarcely made up its lost ground. Large shippings of tin-plates took place last week, and stocks are down to a week's consumption. For future business there is not much doing, buyers hanging back, but quotations remain very firm, and last week's price list is rigidly enforced.

In coke, Bessemer and Siemens prices remain unaltered, neither an advance nor a retrograde step; but this appears certain, that a change is imperative, and as makers are still unable to keep their works in full action, on account of the deficient water supply, next week may be expected to see an advance of from 3d. to 6d.

The Glamorgan Agricultural Show was held at Aberdare this week, under the presidency of Sir W. T. Lewis.

The Bute Dock extension will be inaugurated at the end of this month.

An amalgamation has been arranged between Messrs. F. H. Lloyd and Co., James Bridge Steelworks, near Wednesbury, and Messrs. H. White and Co., Pontymister Steel and Ironfoundry, Newport, Mon., and a limited company under the style of Lloyd, White, and Co., has been formed to carry it into effect. Both firms are engaged in the manufacture of steel castings. The board consists of the present proprietors of the two works, and Mr. P. C. Gilchrist, a name well known in the steel trade. The extensions deemed necessary have been in progress for some months at the James Bridge Works, and will shortly be completed.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The Rhenish-Westphalian iron market has lately assumed a more decidedly cheerful tone, and in almost all branches more confidence is perceptible, which has also been reflected in the speculations in industrial shares on the Exchanges. In Silesia the tone is also friendly for everything but pig iron, but, however, the smelting masters have come to an agreement to fix the minimum price of common forge at M. 47·40 and foundry at 52, which is a small rise and in harmony with the price of the raw materials. The wrought iron trade is in a very buoyant condition, and many branches of it have sold their output for the whole current quarter. There is most call for sectional iron, for plates and smooth and corrugated sheets, and the quotations are for bars M. 127·50; sectional iron, 140·00; plates, 150 to 160; while rails have receded 4·00 to 5·00 p.t. The Austrian market shows an unaltered, firm front, which has led to slightly enhanced prices all round, but especially in black sheets.

Returning to Rheinland-Westphalia, the better outlook for iron ores lately hinted at has been realised, and iron ores in Siegerland now fetch 2d. to 3d. per ton more than a fortnight ago, and cost M. 8·20 to 12 p.t. at mine stations. Crude iron is just now quite firm, and there is an active demand, in some cases a very active one indeed, which is the case with forge pig in particular, which is on the rise. This is mainly caused by the action of the wrought iron convention, and because buyers begin to feel pretty certain that there will be no receding of prices for some time to come, at all events, so they come forward well, and many have contracted for their requirements for months to come. Besides this, the raw materials and finished products stand now in equitable proportion to one another, so with the good current demand prices are more likely to go up than come down or even retain their present level. Such at least is their horoscope. The firm attitude of the Sieger works has encouraged the Rhenish-Westphalian Convention to raise the price of forge pig already M. 2 p.t., so that best sorts will now cost M. 45·50, instead of 43·50 as last noted. Basic pig has also gone up M. 1·50 p.t. Other sorts remain pretty much as they were, though the good demand for foundry iron continues. In June, 320,760 t. of crude iron were produced, including Luxemburg, distributed into 151,025 t. of forge pig and spiegel, 39,270 Bessemer, 87,372 basic, and 43,093 t. of foundry iron. Last June only 275,596 t. were made. The buoyant character of the wrought iron trade still keeps up, and for bars the call has been very active of late. This is fortunate, for it has helped to carry off all the old unremunerative contracts, and now a small profit is obtainable on the transactions. Just before the syndicates were positively achieved large contracts were entered into, so that under all the circumstances prices were bound to rise, and on the 28th ult. the syndicate announced a rise of M. 3, making the basic price now M. 115 p.t. Some works still require two to three months' time for delivery, so the rise was justified. To this may be added the fact that last June only 22,923 t. were on the order books of the twenty-one mills it concerns, whereas, this June there were 44,021 t. at a higher price by M. 20 p.t. There seems a good chance of a union of all the wrought iron syndicates being accomplished, and if so, it would be supposed that the mills and forges would once more become lucrative investments. How long it will last is another question. The plate mills keep very busy, and the prices can be well maintained. The same can be said of the sheet mills, with the difference that there is even greater demand for them, and the prices have a more upward tendency. Prices of wire rods are still depressed, as the works are insufficiently supplied with orders. However, American and English export houses are again making inquiries, and it is reported that in the former country rods have gone up M. 14 p.t. It is therefore hoped that this will soon lead to business. For drawn wire and wire nails, on the other hand, the demand is good, and orders are in hand for some months to come, which it were to be hoped would lead to better prices, for the latter article has been sold for months at a dead loss. In the steel trade there is nothing worth mentioning. At the last tendering for rails at Strasburg, Cockerill and Co. offered at M. 111, and the Ougré Company at 109½ p.t., delivered at Ulfingen. Such prices must keep the German ones down very low, according to their view of prices. The factory and mechanical workshops are at last satisfactorily busy, but it is the old story as to keenness of competition for the orders and unpaying prices.

The coal and coke prices at present are—lumps, M. 7·40 to 8·40; furnace quality, 5·40 to 6·00; coke for blast furnaces, 7·20 to 8·00; foundry coke, 7·80 to 9·00; and briquettes, 6·60 to 8·00.

The Bilbao ore market has been active, and a good many contracts, at different prices according to quality, have been signed. For best current sorts of red ore the price was 6s. 6d. to 6s. 9d., and 6s. 9d. to 7s., and 7s. 2d. for Campanil, but the latter is below the demand in quantity, a rare circumstance at this time of year. The export of ingots is not so active as it was. Last week 79,147 t. of ore were shipped, against 95,600 t. in the corresponding week of last year. From January 1st to July 16th, 2,430,300 had been exported against 1,818,103 t. last year.

In France great efforts are being made on the part of the works to improve the extremely unsatisfactory condition of the iron trade. It is not uncommon to meet with stacks of 10,000 tons of wrought iron in bars, &c.

The Belgian iron trade continues firm as ever, and sheets are to be, and plates probably will be, raised 5f. p.t. The coal proprietors are being exercised by the project, which is almost sure to be sanctioned at Berlin, for making a canal to form a continuation of existing canals on Prussian soil to others on Belgian in order to establish a direct water communication between the Westphalian coal-basin and Antwerp. The Belgians are agitating for a prohibitive duty on coal importation at the same time that they are petitioning for reductions on railway freights in the direction of Antwerp.

At Balachana, north of Baku, a petroleum well is on fire, and had, on the 24th ult., extended to other wells and burnt down a storehouse containing about a million puds of oil.

A tremendous accident overtook the Friedenshütte, belonging to the Eisenbahnbedorfs—railway requisites—Company, in Upper Silesia, on the 25th ult., namely, a battery of twenty-two steam boilers exploded; but as these were elephant ones with one and two fire-tubes, as it would appear, seven to eight actual boilers would evidently be nearer the mark. Be that as it may, the explosion completely pulverised the blowing machines, setting fire to the engine-house as well, and hurling the parts in all directions. The boilers and pieces of them flew about, entirely demolishing the workmen's dwellings—setting forty families adrift—store, and many neighbouring houses, cut the chimney stack in two, besides dismantling the whole works, with the exception of the coke ovens and the steel department, which can still be worked. The devastation is far more complete than that caused by a heavy bombardment of a close town. One man made an aeronautic expedition in one of the boilers. He was cleaning inside at the time, coming down in a wood, uninjured, it is said, 300 metres distant from the point of departure. People around the works were thrown out of their beds, and at Königshütte, many miles distant, the panes of glass clattered as if it had been caused by an earthquake. Nine hundred men will be put out of employment some months, till the works are rebuilt. Ten persons were killed and four injured, and three are missing, but this is the first account only. At present the cause of the explosion has not been ascertained. The damage, it need hardly be said, is enormous, but both boilers and buildings were insured.

LAUNCHES AND TRIAL TRIPS.

On Monday, the 25th ult., Messrs. Earle's Shipbuilding and Engineering Company launched from their yard at Hull the s.s. Colorado, which they have built for Messrs. Thomas Wilson, Sons, and Co., for their Atlantic trade, her dimensions being 370ft. by 44ft. 6in. by 28ft. 6in. She has a long full poop and a long topgallant forecastle extending abaft the foremast, the bulwark between them being carried up to the same height, and is built to Lloyd's highest class in steel, with a double bottom all fore and aft on the cellular system, divided into five watertight compartments. for water ballast. She has a compound steel and iron stern frame and a steel rudder made by Messrs. W. Jessop and Sons, Sheffield, Accommodation for twenty-six first-class passengers is provided under the poop deck at the fore end of it in large state rooms, where will be built a spacious saloon in hardwoods, polished and handsomely finished. The captain and officers' quarters, with cabin entrance, are in a deckhouse over the cabins, and the engineers and firemen are berthed at the sides of the engine-room. It is intended to rig her as a barque with three masts, and for steering one of Amos and Smith's steam steering engines and gear have been fitted. The machinery, also made by the builders, is of 400 nominal horse-power, and has cylinders 31in., 50in., and 82in. diameter, and 57in. stroke, these being arranged on the triple expansion, three-crank system, and steam is supplied from three steel boilers, two double-ended and one single-ended, made for a working pressure of 160 lb. per square inch.

On Saturday, 30th July, the new steel screw steamer Linda, built by the Tyne Iron Shipbuilding Company, of Wellington Quay-on-Tyne, was taken to sea for her trial trip. The vessel is of the following dimensions, viz.: Length, 290ft.; breadth, 40ft.; depth moulded, 27ft.; and is fitted with triple expansion engines by Messrs. Wigham, Richardson, and Co., of Newcastle-on-Tyne. Cylinders 24in., 37in., and 62in. by 42in. stroke; with two large boilers 150 lb. pressure. She has been built to the order of Messrs. Hunting and Pattison, of London and Newcastle, under special survey for Lloyd's 100 A1 class, is strengthened in excess of Lloyd's requirements, and is fitted with water ballast in cellular double-bottom extending right fore and aft. Her speed, as ascertained by the trial runs, nearly averaged 12 knots.

AMERICAN NOTES.

(From our own Correspondent.)

New York, July 21st.

Indications point to large importations of iron and steel from abroad. The distribution of tin and tin-plate is improving. The sales of copper for the past week foot up 600 000 lb., of which 25 per cent. was for export. The consumption of tin-plate in America will be larger than usual this year to all appearances. Reports from the mining districts in the West show that a great increase in activ ty is in progress. Combinations of capital ranging from ten millions down to a-half million dollars have been recently formed to develope new mining regions in the North-west. The experiments or prospecting that has been done is of a most encouraging nature. Several prospecting parties have just returned from the old mining sections in the South-west, where the Spaniards mined in a primitive way some three centuries ago. The sites of the seven famous mines have been determined. Chicago, St. Louis, and New York capital have schemes under consideration which may result in the development of these regions, provided the Apache Indians can be driven out. Western capital is greatly encouraged to prosecute mining enterprises, on account of the liberal returns that have been realised in numerous instances. The iron trade is strong and active, and mills are booking orders faster than work can be delivered. The railway requirements are the heaviest and consist of steel rails, locomotives, cars, bridge iron, lumber, &c. The bridge builders have contracts for from two to three months ahead, and their best facilities will be kept busy all season. The building requirements of the country are running from 20 to 50 per cent. ahead of last year. In this city expenditures for the first six months of this year foot up 47,000,000 dols., as against 37,000,000 dols. for the same time last year. The locomotive works are generally supplied with three months' work. The car builders will not be able to execute all the business offered them. The distribution of lumber is about 10 per cent. ahead of last year, and all supplies are in heavier demand, and mainly at higher prices than were realised last year. Every manufacturing interest is in a prosperous condition. Competition is still keeping prices at a point where enterprise is willing to assume the risk of heavy investments. Iron quotations are 21·50 dols. for No. 1 foundry; 19·50 dols. for No. 2; 17·50 dols. for forge, and 20 dols. for Bessemer. Steel rails are 38 dols. to 40 dols.; old rails, 23·50 dols. to 25 dols.; rail blooms, 30 dols.; slabs, 30·50 dols. The interior requirements for foreign material must sooner or later crowd consumers into the market. Advices from all interior points show that production has been retarded considerably by oppressive weather, but the requirements of the country are fully up to the present producing capacity, and there will be no idleness or dulness, and very little weakness in quotations.

NEW COMPANIES.

The following companies have just been registered:—

Anglo-Deutsche Mechanische Spitzenfabrik, Leipzig, Limited.

This company was registered on the 25th inst., with a capital of £50,000, in £10 shares, to carry on business as lace makers and finishers, and to take over the undertaking carried on at Leipzig as the Mechanische Spitzenfabrik Leipzig Marx and Co. The subscribers are:—

	Shares.
J. A. Marx, Nottingham, merchant	1
J. B. Willkes, Nottingham, lace manufacturer	1
J. W. M'Craith, Nottingham, solicitor	1
R. Vogel, Nottingham, cashier	1
H. Sands, Nottingham, mechanical engineer	1
F. Jennison, Nottingham, cashier	1
W. F. Grundy, Nottingham, clerk	1

The number of directors is not to be less than three, nor more than six; the subscribers are to appoint the first; qualification, £100 in shares or stock; the company in general meeting will determine remuneration.

Cairo Sewage Transport Company, Limited.

For the sum of £12,000, this company proposes to purchase the rights of Messrs. Perry, Beisner, and Co., of Alexandria, and others interested in contracts and concessions granted by the Egyptian Government for the transport of sewage in Cairo; together with a piece of land at Abbasseih, near Cairo, and the plant and material thereon. It was registered on the 22nd inst., with a capital of £12,000, in £50 shares, with power to increase. The subscribers are:—

	Shares.
Wm. Royle, 5, Bedford-row, solicitor	1
L. E. Beisner, Cairo, merchant	1
F. Perry, Alexandria, merchant	1
H. Favarger, Cairo	1
F. Lanzon, Alexandria, clerk	1
A. Meyer, Cairo, clerk	1
Henry Simond, Alexandria, clerk	1

Mr. Leopol E. Beisner is appointed manager.

Cheshire Alkali Company, Limited.

On the 21st inst. this company was registered with a capital of £300,000, divided into 46,000 preferred and 14,000 deferred shares of £5 each, to carry on the business of chemical manufacturers, salt masters, and distillers, dyers, and dealers in brine. The subscribers are:—

	Shares.
A. Wilson, 1, Cleverton-road, Hornsey-rise, N., accountant	1
D. Hammond, 17, Gracechurch-street, merchant	1
Lt.-Col. F. Lean, 20, Regent's-park-terrace, N.W.	1
C. Dunlop, 40, Motley-avenue, printer	1
J. Wright, Upper Norwood and Tipton, engineer	1
J. A. Brain, Leadenhall-buildings, merchant	1
F. Clark, 12, Warner-road, Camberwell-new-road, clerk	1

The number of directors is not to be less than two, nor more than seven; qualification of first directors, £100 of capital, and of subsequent directors, £500 of capital. The first directors are G. Woodyatt Hastings, Esq., M.P., Colonel S. Lloyd Howard, H. Weld Blundell, Esq., Captain Douglas Galton, C.B., and the Hon. Allan de Tatton Egerton, M.P.; remuneration, £1500 per annum, and 5 per cent. upon all profits distributed to the shareholders after 7 per cent. has been paid on both classes of shares, provided that £3000 per annum be the maximum remuneration.

Condy's White Lead Company, Limited.

This company proposes trading as manufacturers of white lead, paint manufacturers, colour grinders, drysalters, painters, and oil and colourmen. It was registered on the 20th inst, with a capital of £200,000 in £5 shares. The subscribers are:—

	Shares.
R. Condy, 6, Duke-street, Adelphi, drug merchant	1
S. J. Ancrum, 37, Hugh-street, Eccleston-square, solicitor	1
W. Kern, 44, Hereford-road, Bayswater, merchant	1
W. Reed, M.D., Church-road, Upper Norwood	1
W. F. Lawrence, C.E., 38, Duke-street, St. James	1
C. Henderson, 23, Bucklersbury, architect	1
E. Freemantle, 18, Avenue-road, Clapton, accountant	1

The number of directors is not to be less than three, nor more than seven; qualification, £200 in shares or stock; the subscribers are to appoint the first; remuneration, £700 per annum, with an additional £150 in respect of each director above four in number.

Continental Union Waterworks Company, Limited.

This company proposes to supply water to the cities of Leghorn, Messina, Lavona, Porto Maurizio, and Oneglia, kingdom of Italy, and to any other places on the continent of Europe. It was registered on the 20th inst., with a capital of £1,000,000, in £5 shares. The subscribers are:—

	Shares.
John Draper, Copthall-court, stock and share broker	1
H. Wollaston-Blake, 90, Leadenhall-street, manufacturer	1
F. Kirk, 110, Cannon-street, contractor	1
R. Hesketh Jones, J.P., Beckenham	1
W. R. Bland, Elm-grove, Finchley	1
E. Galt, J.P., 6, Beach-mansions, Southsea	1
G. F. Smith, 86, Cannon-street, merchant	1

The number of directors is not to be less than four, nor more than seven; qualification, £500 in shares, stock or debentures; the subscribers are to appoint the first, and are to act *ad interim*. Remuneration, £2000 per annum in respect of the first £200,000 of capital issued, and provided 6 per cent. dividend is paid, and £500 more in respect of every additional £100,000 of capital issued besides one-tenth of every 1 per cent. dividend in excess of £6 per cent. per annum.

E. H. Bayley and Co., Limited.

This is the conversion to a company of the business of E. H. Bayley and Co., of 42, Newington-causeway, wagon and carriage builders. It was registered on the 23rd inst., with a capital of £100,000, in £5 shares, with the following as first subscribers:—

	Shares.
A. Martin, 72, Bishopsgate-street Within, merchant	1
W. Collins, 87, Coburg-road, Old Kent-road, clerk	1
A. Schon, 89, Highbury-quadrant, merchant	1
F. A. Moore, King's Wear, Streatham	1
F. Faithful Turner, 13, Redcliffe-gardens, merchant	1
J. W. Long, High-road, Leytonstone	1
C. H. Oakden, 51, Melbourne-grove, East Dulwich	1

The number of directors is not to be less than three, nor more than six; qualification, 100 shares; the first are Edward Hodson Bayley, Esq., Sir A. H. Gordon, K.C.B., Rear-Admiral Chapman, John Clowes Bayley, Esq., and the Rev. Charles H. Middleton-Wake. The remuneration of the board will be as follows: £750 per annum if there are six directors, £625 per annum if there are but five directors, and £500 per annum if there are but four directors. E. Hodson Bayley, Esq., is appointed chairman at a salary of £500 per annum, in addition to his share in the remuneration of the board.

French Simplex Type Writer, Limited.

This company proposes to carry on the business of manufacturers of type-writers and of mechanical engineers, in France, and elsewhere on the Continent. It was registered on the 18th inst., with a capital of £50,000, in £1 shares. The subscribers are:—

	Shares.
J. Meeking, Surrey-square, S.E., printer, &c.	1
J. Horne, 165, Essex-road, N., engineer	1
F. Gowlett, Tyer-street, Lambeth, writer	1
G. Holmes, 224, Hackney-road, stationer	1
J. Kenney, High-road, Tottenham, manufacturer	1
C. Smith, Kennington-road, agent	1
J. May, High-street, Kensington, artist	1

The number of directors is not to be less than three, nor more than ten; the first directors and manager will be appointed by the subscribers; remuneration, chairman £150 per annum, each director £100 per annum; qualification for subsequent directors, 20 shares.

Lloyd, White, and Company, Limited.

This is an amalgamation and conversion to a company of the business of steel founders and manufacturers carried on at James Bridge Steel Works, near Wednesbury, Stafford, by Mr. Francis Henry Lloyd, and a like business carried on at Pontymister Foundry, near Newport, Mon., by Mr. Henry White. It was registered on the 22nd inst., with a capital of £75,000, in £10 shares. The subscribers are:—

	Shares.
*F. H. Lloyd, James Bridge Steel Works	1
*H. White, Pontymister Steel Works	1
*P. C. Gilchrist, 9, Bridge-street, Westminster, metallurgist	1
T. Twyman, 54, Minford-gardens, West Kensington-park, chemist	1
J. Hemming, Wednesbury, engineer	1
W. T. Barnsley, Wednesbury, chemist	1
C. E. Walduck, 148, Gresham House, metal merchant	1

The number of directors is not to be less than two, nor more than seven, the first being the subscribers denoted by an asterisk; qualification, after the first general meeting, 25 shares; the company in general meeting will determine remuneration.

Lorenz Ammunition and Ordnance Company, Limited.

This company proposes to acquire the patent rights of Herr Wilhelm Lorenz, of Carlsruhe, for improvements in the manufacture of ammunition and machinery and appliances therefor; and also to acquire the Northumberland Works, Millwall, with the business carried on there. It was registered on the 19th inst., with a capital of £250,000, in £5 shares, with the following as first subscribers:—

	Shares.
Wm. Lorenz, Karlsruhe, engineer	50
R. Koeller, Karlsruhe, banker	50
Latimer Clark, C.E., 6, Westminster-chambers, S.W.	50
Major-General M. Tweedie Wisborough, Billinghurst, Sussex	50
E. Clapham, Broomhouse, N.B.	50
Rear-Admiral J. Bythesea, 22, Ashburn-place, S.W.	50
S. W. Pomeroy, 5 and 7, Fenchurch-street, merchant	50

The number of directors is not to exceed nine; the subscribers are to appoint the first; qualification, 50 shares; minimum remuneration (managing director excepted), £1200 per annum, and in every year in which not less than 7 per cent. dividend is paid, such further amount as the company in general meeting may determine.

Northern Enamelled Iron Company, Limited.

Registered on the 19th inst., with a capital of £10,000, in £1 shares, to carry on the business of enamelling iron and other metals, glazing bricks, tiles, and earthenware goods. The subscribers are:—

	Shares.
*J. Summers, Stalybridge, ironmaster	1
A. Summers, Stalybridge, ironmaster	1
*H. H. Summers, Ashton-under-Lyne	1
R. Frost, Altrincham, barrister	1
*C. F. Hall, Fairfield, near Manchester, analytical chemist	1
J. W. Summers, Stalybridge, ironmaster	1
Walter Summers, Ashton-under-Lyne	1

The number of directors is not to be less than three, nor more than five; the first are the subscribers denoted by an asterisk; qualification, £100 in shares or stock. Mr. H. H. Summers is appointed managing director at a salary of £100 per annum.

Transvaal Prospecting Company, Limited.

This is a reconstruction of an existing company of the same name in course of liquidation, having for its object the prospecting for mineral properties in the Transvaal, or other parts of South Africa. It was registered on the 20th inst., with a capital of £100,000, in £1 shares, with the following as first subscribers:—

	Shares.
E. Latham, 16, Mildmay-park, broker's clerk	1
A. Hicks, Bromley, Kent, clerk	1
B. L. Johnson, Cosford, Beckenham, clerk	1
F. W. Sellick, 12, Warwick-road, Forest Gate, secretary to a company	1
A. W. Boon, 10, Warner-road, Camberwell, clerk	1
M. E. Williams, 51, Angus-road, Streatham	1
G. Neville, 16, Dennington-park, West Hampstead, solicitor	1

The number of directors is not be less than two, nor more than seven; qualification, 200 shares; the subscribers are to appoint the first; remuneration, £150 per annum each.

"Eclipse" Electric Battery Company, Limited.

This company was registered on the 30th ult., with a capital of £100,000, in £1 shares, to acquire the patents Nos. 8288 and 4744, dated respectively 7th July, 1884, and 30th March, 1887, for improvements in voltaic batteries. The subscribers are:—

	Shares.
Major-General W. Pole Collingwood, 18, Green-street, Park-lane	1
H. Owen Lewis, J.P., 62, Lancaster Gate	1
J. C. Howe, Sutton, Surrey, Cape merchant	1
P. J. Foley, 8, Lyden-road, Clapham, manager of an assurance company	1
H. Pearson, 74, Portsdown-road, W.	1
H. Plumbley, 23, Philpot-lane, stationer	1
F. W. Morton, 6, Clements-lane, accountant	1

The number of directors is not to be less than two, nor more than nine; qualification, 200 shares; the subscribers are to appoint the first; remuneration, £1000 per annum.

Woodhouse and Rawson, Limited.

This is the conversion to a company of the business of Messrs. Woodhouse and Rawson, of 11, Queen Victoria-street, electricians. It was registered on the 29th ult. with a capital of £200,000, divided into 39,980 shares of £5 each, and 100 founders shares of £1 each. The subscribers are:—

	Shares.
Lt.-Gen. J. Stokes, Haywards Heath	1
A. V. Hoster, Grove House, Sydenham, engineer	1
J. Kincaid, C.E., 11, Great George-street	1
F. L. Rawson, 68, Cornwall-gardens, electrical engineer	1
W. Augustine Spain, 76, Coleman-street, accountant	1
H. Foote, 11, Gloucester-walk, W., electrical engineer	1
W. S. Rawson, 68, Cornwall-gardens, electrician	1

The number of directors is not to be less than three, nor more than nine; qualification, one founders' share or 100 other shares; remuneration, £2000 per annum.

Union Match Company, Limited.

This company proposes to acquire the interest of Herman Zappert in an agreement of the 1st April, 1887, with the Citizen's Match Company, of Troy, U.S.A., for the acquisition of the letters patent granted to George Eastmar Norris and W. Elijah Hagan, for improvements in machines for making match splints (dated 23rd May, 1887, No. 6343), and for improvements in machines for making matches (dated 9th March, 1886, No. 3343), together with the rights to use the box-making machinery of Mr. Hagan. The company also proposes to acquire Mr. Zappert's inventions for coiling mechanism attached to the said machines; for composition for matches, and for compounding same, and also the interest of Mr. E. Nelson Hole in an agreement for the lease of a factory at Upton Park, Essex. It was registered on the 20th inst., with a capital of £25,000, in £1 shares. The subscribers are:—

	Shares.
A. Norman, 29, Stapleton Hall-road, Stroud Green	1
C. S. Jenkins, 47, Coldharbour-lane, S.W.	1
W. G. Aspland, Harlesden, N.W.	1
V. M. Elkington, 57, Windsor-road, Holloway, clerk	1
A. R. Hanson, Lorne-road, Forest Gate, clerk	1
J. F. Williams, 34, South Island-place, Brixton	1
W. Scott, Hop Exchange, broker	1

Registered without special articles.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

26th July, 1887.

10,372. Satchels, E. de Pass.—(*E. Posen and Co., Germany.*)
10,373. Wire Safety Pins, J. Jenkins, London.
10,374. Piano, G. Steck, London.
10,375. Paper-pulping Engines, W. J. Ashworth, London.
10,376. Grates, C. H. Perrot, A. Habershon, and J. C. Richmond, Rotherham.
10,377. Fire-proof Floor Construction, W. Youlten, London.
10,378. Feed-water Valve, B. K. Noy and A. C. Bewers, Hythe.
10,379. Wire Ropes, J. Williams, Wishaw.
10,380. Brazing Band Saws, T. Duncan and D. Mills, Heywood.
10,381. Preventing More than One Shock in Automatic Electric Machines, W. J. Woodward, London.
10,382. Shears, E. Wright, Sheffield.
10,383. Shears, P. Ashberry, Sheffield.
10,384. Gas Engines, C. Ridealgh and C. J. Fairman, Newcastle-upon-Tyne.
10,385. Slag Cement, E. Larsen, London.
10,386. Wool-combing Machines, W. H. Bailey, Keighley.
10,387. Open Hearth Steel Melting Furnaces, J. W. Wailes, Liverpool.
10,388. Automatic Car Couplers, J. R. Avery, London.
10,389. Slide, T. Bowskill, J. Abson, and G. Dawson, Rotherham.
10,390. Palette Fitting, J. Hughes, Cobridge.
10,391. Cruet Frames, J. Dawson, Park.
10,392. Securing Barbed Wire to Iron Standards, J. T. Stanyon, Eastworth.
10,393. Hot Air Bridge Walls, E. W. Tucker, London.
10,394. Screw-necked Bottles, J. B. Fenby and F. A. Bird, Birmingham.
10,395. Shuttles, J. K. Macdonald.—(*Singer Manufacturing Company, United States.*)
10,396. Sickle, B. Hinckesman, Bridgenorth.
10,397. Chromatic Printing Presses, P. M. Justice.—(*D. S. Clark and W. C. Wenitté, United States.*)
10,398. Railway Crossings, F. H. Lloyd, London.
10,399. Braces, H. W. Everard, London.
10,400. Coating Metals, W. J. Wilder, Liverpool.
10,401. Raising Liquids, I. Shone and E. Ault, Liverpool.
10,402. Expansive Power of Heat, A. J. Boult.—(*W. C. Shaffer, United States.*)
10,403. Boots, A. B. Warhurst, Manchester.
10,404. Spring Motors, J. B. Powell, R. M. Popham, D. P. Dieterich, London.
10,405. Flexible Tubes, J. Y. Johnson.—(*H. Knight, United States.*)
10,406. Metallic Ingots, H. J. Allison.—(*B. Atha and W. R. Hinsdale, United States.*)
10,407. Lamps, J. D. Young, Barnstaple.
10,408. Cartridge Cases, W. E. Heath, London.
10,409. Preventing Snarls in Yarn Spun in Ring Spinning Machines, C. H. Maxsted and T. Coulthard, London.
10,410. Bottling Beer, A. W. Gillman and S. Spencer, London.
10,411. Receptacles for Ink, R. Marshall, London.
10,412. Storing of Fabrics in Show-rooms, R. Baird, London.
10,413. Ships' Berths, E. Lawson, London.
10,414. File for Binding Sheets of Paper, J. Spear, London.
10,415. Smoke Consumers, A. E. Adlard, London.
10,416. Steering, &c., Vessels, T. B. Heathorn, London.
10,417. Utilisation of Motive Power, B. Boothroyd, Liverpool.
10,418. Tailoring, E. F. Lucy, London.
10,419. Gravity Cable Railways, L. M. A. Thompson, London.
10,420. Waterproof Fabrics, W. Green, London.
10,421. Railroad Ties, J. Splane, London.
10,422. Sheep-shearing Machines, H. E. Newton.—(*The Australian Electric Company, Victoria.*)
10,423. Magazine Guns, J. Schulhof, London.
10,424. Awning, G. Hatchell and N. W. Wallace, London.

27th July, 1887.

10,425. Take-up Mechanisms of Looms, R. L. Hattersley, J. Hill, and S. Jackson, Keighley.
10,426. Lifters, &c., for Skylights, &c., T. Moore, Belfast.
10,427. Glass Bottle Needle Lubricators, T. Cockerill, Bolton.
10,428. Feeding Wool to Carding Engines, E. Wilkinson, Halifax.
10,429. Steam Engine Governors, J. G. W. Fairbairn, Birmingham.
10,430. Rolling Steel Beams or Bars, A. Campbell and D. Elliott, Glasgow.
10,431. Printing Floor-clothes, &c., Sir J. Farmer, Manchester.
10,432. Drop Box Looms for Weaving, W. H. Hacking, Manchester.
10,433. Curtain Hooks, S. Reeves, Birmingham.
10,434. Lubrication for Bearings, W. E. Heys.—(*E. Verny, France.*)
10,435. Securing Wheels, &c., to their Axles, T. Fox, Sheffield.
10,436. Walls, Floors, &c., J. Wilson, Liverpool.
10,437. Chopping or Mincing Meat, F. W. Follows, Manchester.
10,438. Mashing or Straining Vegetables, &c., F. W. Follows, Manchester.
10,439. Necktie Protector, C. H. Wood, Sheffield.
10,440. Shutting-off Gas, J. Palmer, Lewisham.
10,441. Grazing Hatches for Rabbits, &c., F. E. Manby, London.
10,442. Saucepan, P. Cohen, London.
10,443. Metallic Cement, C. P. Tabary, London.
10,444. Roller Bearings for Shafts, V. J. J. Hirbec, London.
10,445. Motive-power Engine, R. Roberts, Birmingham.
10,446. Plaster of Paris, C. J. Howe, London.
10,447. Producing Pure Oxygenated Drinking Waters, A. and L. Q. Brin, London.
10,448. Chains, C. A. Klauke, Germany.
10,449. Boring Bits, P. H. Bettle, London.
10,450. Breech-loading Fire-arms, P. T. Godsal, London.
10,451. Consuming Smoke and Gases in Steam Boiler and other Furnaces, O. D. Orvis, London.

28*th July*, 1887.

10,463. Envelopes, A. W. Montgomery-Moore, London.
10,464. Attaching Handles to Doors, S. and J. Wilkes, Bloxwich.
10,465. Spinnaker Sail, C. D. Durnford, Guernsey.
10,466. Holdfast Castor, R. A. Moon, Ardmore.
10,467. Mechanical Trick Pendant, L. H. Hart, London.
10,468. Attachment for Bicycle Lamps, P. P. Burt and S. B. Edmunds, Birmingham.
10,469. Picking Sticks, &c., for Looms, J. H. Blackburn and J. Sharples, Halifax.
10,470. Window Fastener, T. M. Norris, Liverpool.
10,471. Castor for Furniture, &c., J. W. T. Stephens, Cardiff.
10,472. The Smokers' Bracket, H. H. Peach, Leicester.
10,473. Cheese Wire Handles, B. Tupholme, Sheffield.
10,474. Dynamo-electric Machine, E. de Pass.—(*The Firm of Cuénod, Sautter, et Compagnie, Switzerland.*)
10,475. Automatic Chairs, &c., B. Hallet, London.
10,476. Moulding Machine for Cylinders, &c., G. Holdsworth, Manchester.
10,477. Splitting, &c., Grain, F. Bosshardt.—(*A. Ricci, Algeria.*)
10,478. Roller Blind Furniture, F. H. Collins, Birmingham.
10,479. Mechanical Pencil-cases, C. H. J. Clayton, East Dulwich.
10,480. Sight Lubricators, J. Holland and J. Lever, Manchester.
10,481. Water-meters, S. Alley and J. A. MacLellan, Glasgow.
10,482. Hydraulic, &c., Brakes, O. Reynolds, Manchester.
10,483. Machine for Mixing Fuller's Earth, S. Fenton, Halifax.
10,484. Spring Backs for Account Books, C. Yates, Manchester.
10,485. Reversible Washing Scarf, W. J. Burkill, Manchester.
10,486. Whist and other Markers, A. W. Patching, Birmingham.
10,487. Breech-loading Small-arms, T. Brain, Birmingham.
10,488. Portable Revolving Brush, W. B. Brooker, Liverpool.
10,489. Tooth-brush, W. P. Thompson.—(*H. L. Hofmann, Merane.*)
10,490. Tram-car and Omnibus Lamps, R. Marston, Liverpool.
10,491. Photograph Holders, W. D. Wilkinson and F. Fowler, Birmingham.
10,492. Breech-loading Rifle, T. and W. Hawkins, Landport.
10,493. Door-spring, H. A. House and H. A. House, jun., London.
10,494. Making Drive-chains, H. Fisher and J. Harrison, Sheffield.
10,495. Imparting Motion to Wheels, J. C. Sellars, Liverpool.
10,496. Window Tickets and Labels, W. Broadbent, London.
10,497. Automatic Lock, J. and C. H. Swithenbank, London.
10,498. Umbrellas, A. E. Jolley, London.
10,499. File for Bills, E. W. Allen and H. J. Davies, London.
10,500. Stoppering Bottles, W. G. Cloke, London.
10,501. Ships, J. Long, London.
10,502. Blotting Pads, J. A. Game and M. Aflalo, London.
10,503. Type-writers, H. A. H. Guhl, London.
10,504. Operating Railway Wagons, T. Buck, jun., London.
10,505. Duplicate Writing Machine, E. T. Ponting, London.
10,506. Mechanism for Swing Looking Glasses, &c., L. Dove and J. S. Bush, London.
10,507. Brush Duster, H. F. Dale, London.
10,508. Threading Needles, J. Döbbel, London.
10,509. Employing Steam for Motive Power, A. Reis, London.
10,510. Electrical Insulators, &c., J. S. Lewis, Helsby.
10,511. Automatic Flushing Apparatus, W. N. Swettenham, London.
10,512. Storing Liquids, J. Stewart and T. Charlton, London.
10,513. Storing Liquids, J. Stewart and T. Charlton, London.
10,514. Storing Electricity, V. J. J. Hirbec, London.
10,515. Musical Tops, H. Jones, London.
10,516. Material for Decorating, M. Abrahams, London.
10,517. Glove and Sleeve Suspenders, C. Rolfs, London.
10,518. Explosives, J. Nicholas and H. H. Fanshawe, London.
10,519. Fencing, &c., Posts, J. B. Petter, London.
10,520. Lamp Wicks, P. de Bondini and T. Tubini, London.
10,521. Scrap Album, F. Bishop.—(*A. Lenegre, France.*)
10,522. Decorative Article, A. and G. Tuck, London.
10,523. Syrup Pumps, R. S. Lloyd, London.
10,524. House-affixed Fire-escapes, W. Cluse, London.

29*th July*, 1887.

10,525. Mechanical Toys, G. Cole, London.
10,526. Paper-cutting Machines, E. de Pass.—(*E. Debié, France.*)
10,527. Giving Warning to Ships, F. Chamberlin.—(*H. Chamberlin, New Zealand.*)
10,528. Heel-tip for Boots and Shoes, J. W. Oldfield, Erdington.
10,529. Imitation Electric Call-bell, J. Thropp, Aston.
10,530. Burning Cement, J. W. H. James and F. Ransome, Liverpool.
10,531. Lamp Trimmer, E. Baller, Birmingham.
10,532. Truss Springs, I. A. Best, Birmingham.
10,533. Pocket Camera, W. Watson, London.
10,534. Infants' Chairs, A. Plant, Glasgow.
10,535. Air-compressing Pumps, H. Davey, London.
10,536. Steam Traps, W. Vavasour, London.
10,537. Hoes, T. Tysack, London.
10,538. Smelting Ores, C. E. Miles, London.
10,539. Cans, C. Cunliffe, Blackburn.
10,540. Securing Wedges in Railway Chairs, T. H. Heard, Sheffield.
10,541. Rollers for Spinning Machinery, W. and S. Lord, London.
10,542. Taps, J. Breeden and R. Bateman, Birmingham.
10,543. Indicating the Number of Persons Passing through a Turnstile, H. Kershaw and T. Sutcliffe, London.
10,544. Securing Spur Wheels on Shafts, E. Murgatroyd, London.
10,545. Steam-engines, J. Y. Johnson.—(*A. Normand et Cie., France.*)
10,546. Swing Bridges, R. Haddan.—(*A. J. van Alstein and G. J. M. M. van Nieuwkuyk, Belgium.*)
10,547. Movable Stage or Bridge, G. E. Lanfranconi, London.
10,548. Sliding Window-sashes, W. Burt and C. H. S. Payn, London.
10,549. Stoppers for Bottles, &c., J. S. Davison, London.
10,550. Tip Carts, J. Rickard, London.
10,551. Pipes, C. J. Coventry, London.
10,552. Hand Punches for Making Bore Holes, H. Johnson, London.
10,553. Water Meters, W. G. Kent, London.
10,554. Liquid Blue, J. A. Walton, London.
10,555. Electrical Batteries, C. P. Elieson, London.
10,556. Brick Making Machines, T. Buck, jun., London.
10,557. Foot-warmers, W. McLaren, London.
10,558. Lighting by Means of Gas, O. E. Guibout, Liverpool.
10,559. Invalids' Convertible Chairs, J. Mole, Liverpool.
10,560. Fire-box Plates, J. H. Fraser, London.
10,561. Basic Slag, A. Neujean, London.

30*th July*, 1887.

10,562. Flushing Closet-basins, W. Sargent, London.
10,563. Flap Paddle Propeller Mechanism, J. B. Merkl, London.
10,564. Lead Pencils, &c., W. H. Duncan, Coalbrookdale.
10,565. Horseshoes, J. Jones, Manchester.
10,566. Ballot Voting, A. Page, Leeds.
10,567. Boot and Shoe Lasts, J. C. Jefferson, Leeds.
10,568. Drawing the Contents off Barrels, G. F. Heinshall, Fallowfield.
10,569. Gloucester Window-blind Fixture, G. Newman.—(*J. Newman, United States.*)
10,570. Composition for Preparing Moulds for Steel Castings, A. E. Carrol and W. P. Burnley, Manchester.
10,571. Electro-magnets, J. Spenlé, Salford.
10,572. Automatic Alarms, J. H. Lynde, S. Walker, and G. Mills, Manchester.
10,573. Target, A. Harrison, Birmingham.
10,574. Shutters, O. and H. Smith, Bradford.
10,575. Instruments for Electric Measurements, W. Emmott and J. H. Rider, Halifax.
10,576. Domestic Fire-escape, B. Burkin and T. Melville, London.
10,577. Blackboards, W. G. Goddard, London.
10,578. Envelopes, O. Friederici, London.
10,579. Platen Printing Machine, H. P. Trueman and J. G. New, Birmingham.
10,580. Filtering Water, H. T. Wakelam, Oswestry.
10,581. Boiler Tube Cutter, G. Alexander, North Leith.
10,582. Engine Counters, A. J. Boult.—(*P. G. Close, Canada.*)
10,583. Bags, &c., J. A. Mills and W. B. Christopher, Liverpool.
10,584. Fasteners for Frame Joints, A. J. Boult.—(*W. G. and J. L. Rawbone, Canada.*)
10,585. Manufacture of Cellulose, S. Wolf, Liverpool.
10,586. Knitting Machines, A. J. Boult.—(*P. G. Close, Canada.*)
10,587. Stockings, A. J. Boult.—(*J. Blacklock and J. Simpson, Canada*)
10,588. Extracting Gold from Ores, F. Fenton.—(*J. Woolford, France.*)
10,589. Straight Bar Knitting Machines, J. Dalby, London.
10,590. Collars for Shafts, E. Murgatroyd, London.
10,591. Dyeing and other Machines, J. Robertshaw, London.
10,592. Automatic Regulator for Sectional Warping Machines, G. Burgess, H. D. Ledward, and F. Burgess, London.
10,593. Bands for Driving Spindles, J. J. Heywood, London.
10,594. Extracting Gold from Ores, C. T. J. Vautin, London.
10,595. Anemometers, J. J. Hicks, London.
10,596. Steam Engines, &c., G. Petrie and G. Dowell, Manchester.
10,597. Releasing Horses from Vehicles, A. D. Durrell, London.
10,598. Spring Mattresses, C. Bradley, London.
10,599. Shuttle Guard Apparatus, R. Charnley, London.
10,600. Spinning Yarns, M. A. Drtina and J. Just, London.
10,601. Steam Engine Governors, E. S. Hough, London.
10,602. Roller Blind Furniture, T. Harkness, London.
10,603. Incandescent Gas Fires, T. Fletcher and A. Clare, Manchester.
10,604. Sale Books for Drapers, &c., W. Penman, London.
10,605. Propelling Torpedoes, W. Allan, London.
10,606. Distributing, &c., Electric Currents, L. Gerard, London.

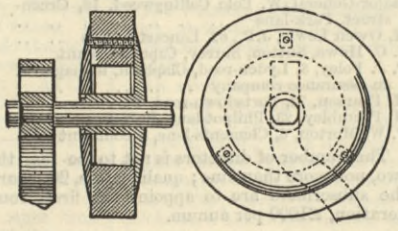
SELECTED AMERICAN PATENTS.

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

363,035. Top Drawing Roller for Spinning Machines, &c., *J. Wilcock, Philadelphia, Pa.—Filed December 13th*, 1886.

Brief.—The roller consists of a shell of composition,

363,035

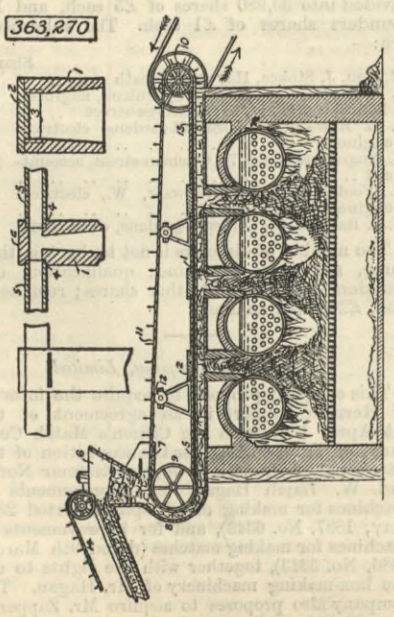


an inner elastic cushion, and plates by which the whole is secured to the shaft.

363,270. Apparatus for Burning Bagasse or other Wet Material, *R H. Yale, New Orleans, La.—Filed February 7th*, 1887.

Claim.—(1) As an apparatus for burning bagasse or other wet material, the combination with the mouth-

363,270



piece 1, of fire-clay or other refactory material and shaped as shown on the drawings and placed between the boilers, with the continuous iron box or trough 5 and the endless chain carrier 11, provided with blades operated by the sprocket wheels 9 and 10 and passing over the platform 7, and through the continuous iron box 5, over the rollers 12 and 13 and hopper 6, all substantially as set forth, and for the purpose specified. (2) In an apparatus for burning bagasse or other wet refuse material, the conveyors consisting of the continuous iron box 5 and the endless chain carrier 11, provided with the blades and operated by the sprocket wheels 9 and 10 and passing over the platform 7, through the box 5, and over the rollers or other appliances 12 and 13, all substantially as described. (3) In an apparatus for burning bagasse or other wet refuse material, the mouthpiece 1, of fire-clay or other refractory material, shaped as shown and provided with a covering, 2, all substantially as set forth. (4) In an apparatus for burning bagasse or other wet refuse material, the mouthpiece 1, of fire-clay or other refractory material, shaped as shown and provided with a covering, 2, and openings 3 3, these openings being adapted to permit the passage of the endless chain, as described.

363,127. Safety Contact Brush for Dynamo-electric Machines, *J. W. Easton, New York.—Filed March 17th*, 1886.

Claim.—The combination, substantially as hereinbefore set forth, of a commutator or collector, a contact brush applied thereto and pressing, by reason of

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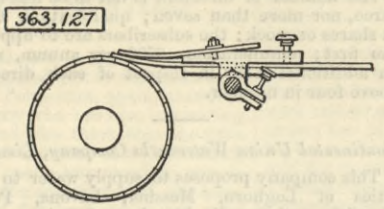

its own resilience, against the commutator, and a second brush normally out of contact with the commutator or collector, but coming in contact therewith upon the removal of the first-named brush.

363,413. Horse Hay-rake, *H. Myers, Springfield, Ohio.—Filed March 31st*, 1886.

Claim.—(1) In a hay-rake, the combination, with the head and pawl operating bar mounted upon the rear portion of the head, of a lever fitted to said bar, extending over the head and in a forward direction and terminating in a foot arm occupying a position approximately near the thills, and a disengaging arm above the foot arm, a locking bolt mounted upon said lever, and a locking plate secured to the forward side of the head and opposite to said bolt, whereby when the disengaging arm is resisted the bolt disengages from the plate. (2) In a hay-rake, the combination, with the head and the locking plate carried thereby,

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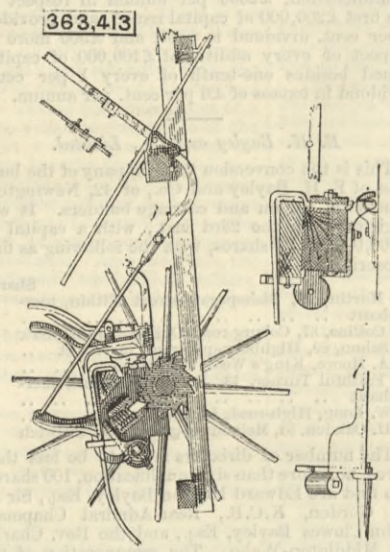
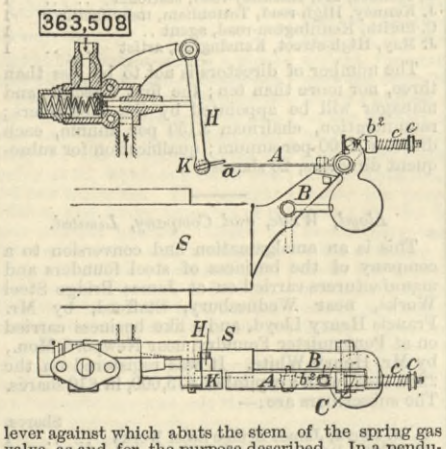


of a dumping bar carrying pawls, a lever connected with said bar and constructed with a foot arm and a disengaging arm in one piece, and locking bolt mounted upon the lever, and a pivotted trip lever, also mounted upon the lever proper and engaging with the bolt. (3) In a hay-rake, the combination, with the rake head and a locking plate having depressions or holes and secured thereto, of a ratchet actuating lever carried by the head, and having a foot and a disengaging arm, the trip lever pivotted to the other lever, and the locking bolt.

363,508. Pendulum Governor for Gas Motor Engines, *F. W. Crossley, H. P. Holt, and F. H. Anderson, Manchester, England.—Filed March 20th*, 1886.

Claim.—In a pendulum governor for gas motor engines, the combination of the weight suspended from and reciprocating with the slide S, or other proposed time part of the engine, having its swing in one direction resisted up to a certain speed by gravity, and afterward by an adjustable spring, the blade arm projecting from it and toward a notch at the end of the

363,508



lever against which abuts the stem of the spring gas valve, as and for the purpose described. In a pendulum governor for gas motor engines, the combination of the slide S, or other proposed time part of the engine, provided with the boss b^1, secured to the bracket B, the collar bolt C, carrying the helical spring *c*, provided with the fork *w*, and the elastic blade A, terminating in a sharpened edge *a*, and secured to the arm w^1 for receiving the notch in the piece K, secured to the lever H of the gas valve, and the rod b^2 for receiving the recess in the said weight, as and for the purpose described.

363,629. Shifting Excentric, *John Grant, Chicago, Ill.—Filed October 26th*, 1886.

Claim.—(1) The combination, with an engine shaft, an excentric fixed on the shaft, and an outer excentric provided with a rack, of a pinion mounted upon the excentric which is attached to the shaft, and provided with a spiral stem, and a sliding nut engaging said stem, substantially as described. (2) The combination, with an engine-shaft, an excentric fixed upon the shaft, and an outer excentric provided with a rack, of a pinion mounted upon the excentric which is attached to the shaft, and provided with a spiral stem, said spiral stem being provided with one or more straight parts or sections, substantially as described. (3) The combination, with an engine shaft, an excen-

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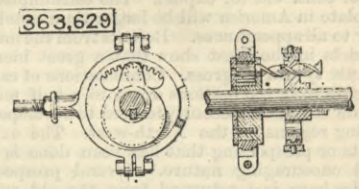
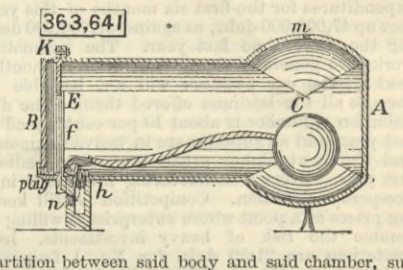


tric fixed upon the shaft, and an outer excentric provided with a rack, of a pinion mounted upon the excentric which is attached to the shaft, and provided with a spiral stem, a nut engaging the spiral stem, a slide encircling the shaft and stem and supporting the nut, and a forked shifting-lever engaging the slide, substantially as described.

363,641. Steam Trap, *S. H. Howland, Springfield, Mass.—Filed January 19th*, 1887.

Claim.—(1) In a steam trap, the combination, with the body of a steam trap, of a float actuated cock wholly within said body, and a chamber removably attached to said body that is provided with an induction and an eduction port, and a filter like adjunct between said body and said chamber, the whole arranged and operating substantially as described. (2) In a steam trap, the combination, with the body of a steam trap, of a float-actuated cock having its outlet through a supporting leg of said trap, and a chamber removably attached to said body that is provided with an induction and an eduction port, and a filter-like

363,641

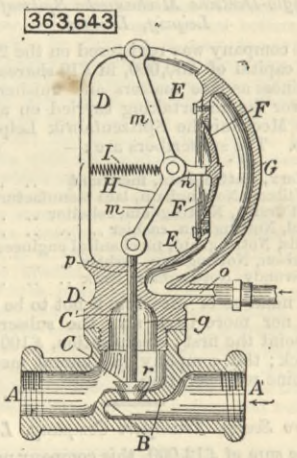


partition between said body and said chamber, substantially as set forth. (3) In a steam trap, the combination, with the body A, having one end sealed up, of a chamber removably attached to its opposite end, that is provided with an induction and an eduction port, and a filter-like partition between said body A and said chamber. (4) In a steam trap, the combination of the following elements: the body A, the float C, cock *i*, the leg *h*, the chamber B, with filter *f*, and vent *m*, the whole arranged substantially as described.

363,643. Valve, *H. E. Jacobs, Fond du Lac, Wis.—Filed August 9th*, 1886.

Claim.—(1) The combination of a passage A, a valve C, in the passage, a casing D, provided with an opening *o*, a wall E, in the casing and open near its centre, a flexible diaphragm F, covering the opening in the wall E and affording a close chamber G, a plate F^1, upon one face of the diaphragm, and a toggle lever H, connected at its joint with the plate F^1 and at its opposite extremities, respectively, to the case D and stem of the valve C, substantially as and for the purpose set forth.

363,643

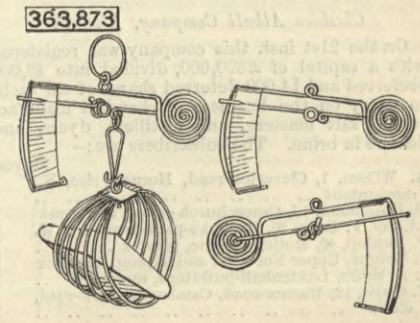


(2) The combination of a passage A, a valve C, in the passage, a casing D, provided with an opening *o*, a wall E, in the casing and open near its centre, a flexible diaphragm F, secured at its edge to cover the opening in the wall E and afford a close chamber G, a plate F^1, upon one face of the diaphragm, and provided with an arm *n*, a toggle lever H, connected at its joint with the arm *n* and at its opposite extremities, respectively, to the case D and stem of the valve C, and a spring I, secured at one end to the case and at its opposite end to the toggle level, substantially as and for the purpose set forth.

363,873. Spring Scale, *E. A. Witherell, Davenport, Iowa.—Filed June 14th*, 1886.

Claim.—In a spring scale, the combination of a flat spring coil having a scale beam extending from its central or inner end, formed with an eye for the support of the scoop and with an inwardly bent index, and having a main rod extending from the outer end,

363,873



formed with an eye at about its middle for the supporting ring, and with a downwardly bent segmental portion, and an inwardly bent portion at the lower end of the segmental portion, with an index plate secured at its ends around the outer end of the main rod, and the inwardly bent portion of the frame having the end of the scale beam and the index straddling the segmental portion and the index plate, as and for the purpose shown and set forth.