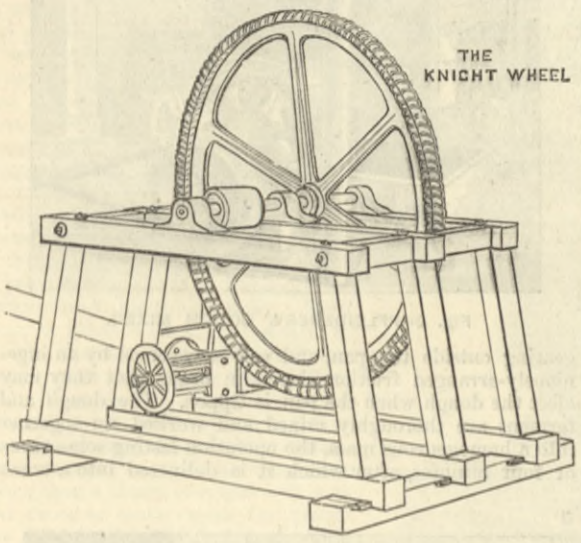
HURDY-GURDY WHEELS.

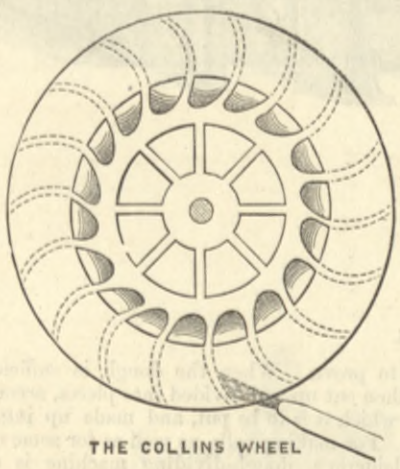
THE relative merits of impulse, and reaction, and gravity water-wheels have been frequently discussed, with the general result that the impulse wheel is condemned by almost all writers on the subject. In the case of the impulse wheel, motion is communicated by a jet of water striking against floats or vanes; Whitelaw and Stirrit's turbine is a true reaction wheel; the overshot and breast systems of construction represent the gravity wheel; while Jonval's turbine is an impulse and gravity wheel combined. Rankine gives the efficiency of the impulse wheel as about 33 per cent. only, and he states that for falls over about 4½ft. it should not be used, although it is the best type for smaller falls. It must not be forgotten that the experience of nearly all authors who have written on this subject has been limited. They have had to deal only with comparatively small heads, and there is some reason to think that their reasoning may not apply in practice to very great falls. For heads of over three or four hundred feet either turbines or water-pressure engines have hitherto been employed, which are necessarily expensive, especially in the matter of

FIG. 1



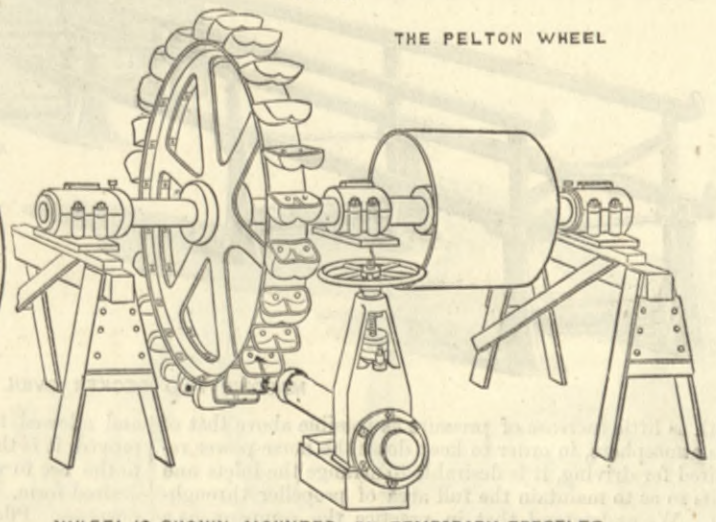
foundations and maintenance. The comparatively rude miners of California have, it would seem, almost unwittingly hit upon the construction of a wheel which we are told on good authority gives as high a percentage of useful effect as the best and most expensive turbine. The efficiency, indeed, under some circumstances has risen to 82 per cent., and this, be it remembered, has been obtained with mechanism of extreme simplicity, small cost, and exerting very considerable power. The motor to which we allude is known

FIG. 2.



THE COLLINS WHEEL

FIG. 3.



WHEEL IS SHOWN MOUNTED ON TEMPORARY TRESTLES

as the "hurdy-gurdy wheel," and we are indebted for all the information we possess concerning it to a very able paper by Mr. Hamilton Smith, jun., read before the American Society of Engineers in February, 1884.

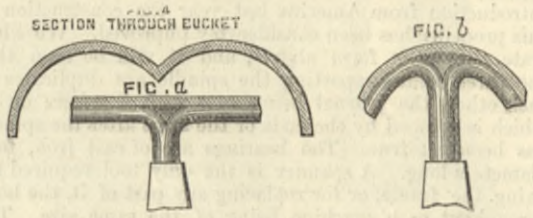
We need scarcely tell our readers that in California gigantic mining operations have been carried out by the aid of water. The sides of ravines and gorges, wide stretches of level land, rivers and channels, are traversed and crossed by flumes and pipes leading the water from the course of a mountain torrent to the locality where it is wanted. It is here used in various ways. A favourite plan is to fit to the end of the pipe a jet like that at the end of a fireman's hose but much larger. This is provided with a ball-and-socket joint, and the tremendous stream 4in. to 8in. in diameter, propelled sometimes with a head as great as 600ft., thunders against the side of a cliff of ore and disintegrates and brings down the mass in a suitable condition for further operation. Mr. Smith's paper describes a different system of working. He dealt with tunnels of considerable dimensions, such as the Bloomfield Tunnel, 8000ft. long; pumping machinery at the Idaho Gold Quartz Mine, and Texas Creek pipe and aqueduct. The water is in all these cases led through wrought iron pipes of comparatively thin material, made up in 20ft. lengths, slightly tapered, and secured together by forcing the tapered end of one pipe into the wide end of the next with screw jacks. Leaks are made good with small pine wedges. Thus, for example, one pipe described by Mr. Smith is 8764ft. long and 22in. in diameter. At present, however, we are not dealing with pipes but with wheels, and to these last we must confine our attention.

Figs. 1, 2, and 3 illustrate respectively the Knight, Collins, and Pelton wheels. Fig. 4 is a section through one of the buckets of the Pelton wheel, which is said to be the most effective yet tried.

The Knight wheel is made of cast iron with curved buckets set close together. The nozzle is a narrow slit, curved to fit the outer edge of the wheel, the idea being to make the jet strike the buckets at as small a distance as is possible. With muddy water the wear on this form of nozzle becomes objectionable; with considerable heads a jet of circular section will, according to Mr. Smith, probably show better results. At the Providence gold quartz mills, near Nevada City, a Knight wheel did actual work amounting to about 54 per cent. of the power of the water, in addition to overcoming friction of machinery. Mr. Browne, a Professor of Engineering in the University of California, found, in experimenting with curved buckets—section arc of circle—a maximum efficiency on the wheel shaft of 65$\frac{6}{10}$ per cent., with a periphery speed of about 44 per cent. of theoretical velocity of water. This was with a ⅜in. tapered nozzle, and a head of 50·4ft.

The Collins wheel, when placed at the Providence Mill as a substitute for the Knight wheel, did the same work with $\frac{94}{110}$ths the amount of water. This mill has forty stamps, each weighing 750 lb., drop 8in., ninety-two drops per minute, aggregate work of lifting the stamps 1,840,000 minute foot-pounds. There are also one rock breaker and sixteen Frue vanners—concentrators—requiring fully 8-horse power more, making in all say 2,104,000 minute foot-pounds—64-horse power. This work is done by a Collins wheel 6ft. in diameter, running 250 turns a minute; the water is conducted to it through 1856ft. of wrought iron pipe—1156ft. being 22in. and 700ft. 15in. in diameter—and discharged under a head of 389ft. through a 1¾in. nozzle. The water used amounts to very nearly 136 cubic feet per minute. Assuming 2ft. head as lost by friction in pipe, 387 × 136 × 62·4 = 3,284,237 foot-pounds

FIG. 4.
SECTION THROUGH BUCKET

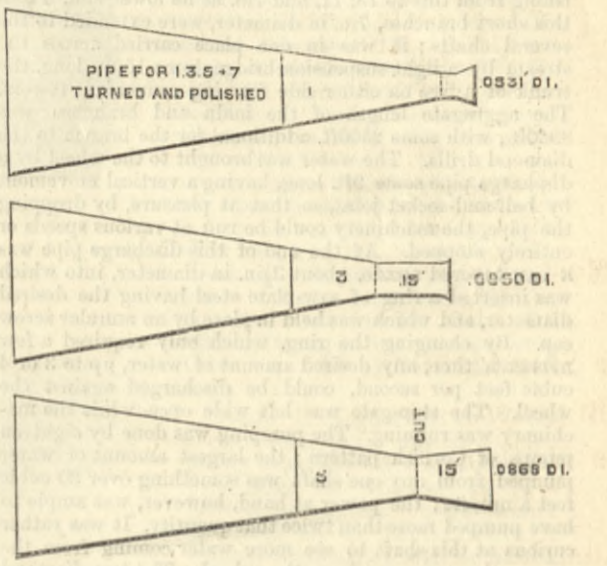


per minute; 2,104,000 ÷ 3,284,237 = 64 per cent. as useful effect in moving machinery.

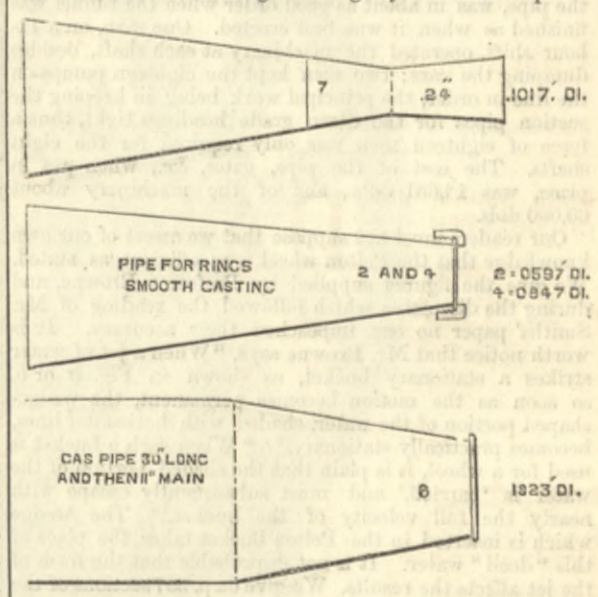
In the Pelton wheel the jet is split as it strikes the bifurcation of the bucket. The line of the jet should be tangential to the wheel. Where much power is needed two discharge pipes can be used, and any desired form of nozzle applied. Mr. Browne found with one of these wheels, which was not built on the most approved model, the following results: Wheel, 15¾in. in diameter; nozzle, ⅜ths in. tapered; head, 50·2ft.; maximum efficiency on wheel shaft, 82½ per cent.; best speed of bucket, very nearly one-half the velocity of the jet (substantially $\frac{1}{2}(2gh)^{\frac{1}{2}}$. With the same nozzle, and a head of only 8ft., he obtained a useful effect of 73 per cent.; with a ¼in. nozzle, the best result was 75·6 per cent.; with a $\frac{7}{16}$in. nozzle, best result was 82·6 per cent. A number of tests of various hurdy-gurdies was made at Grass Valley some months since, under charge of disinterested parties. These experiments, according to Mr. Smith, appear to have been properly made with a Prony brake and weir measurement of water, and showed for the Pelton wheel, while doing 107·4-horse power of work, under a head of 386ft., the wonderfully high efficiency of 87·3 per cent. The other competing wheels showed a much lower rate of duty. These experiments were made with a Pelton wheel 6ft. in diameter; nozzle, 1·89in. in diameter; supply main, 6900ft. long, 22in. in diameter, with a head of 386½ft. above nozzle. The water used was measured over an iron weir, ⅛in. thick, 3·042ft. long without end contractions. The depth as measured by a Boyden hook gauge, reading to ·001in., was ·4146ft. The discharge by formula $Q = 3{\cdot}31\,l\,h^{\frac{3}{2}} + {\cdot}007\,l$, would be 2·709 cubic feet per second. With water section of × 3·04 × 1·5, velocity of approach was ·6ft.; with $h^a = \frac{V^2}{2g}$ head due to this velocity would be ·0056; to be safe, ·0056 × 2 = ·0112 = h^a = additional head due to velocity of approach. Fteley calls in general $h^a = 1{\cdot}5\frac{V_2}{2g}$. This makes a total head of ·4146 + ·0112 = ·4258; then with same formula as before, Q = 2·819 cubic feet per second. The head lost by friction in pipe, with formula $V = 50\left(\frac{d\ hf}{l}\right)^{\frac{1}{2}}$ would be $1{\cdot}8 = hf^1$, reducing total head of 386·5 to effective head of 384·7ft. The Bourdon gauge used showed a pressure of from 165 lb. to 162 lb., indicating a head of say 380ft. The work done was measured by a Prony brake, bearing vertically down upon a platform scale, and which showed a weight of 200 lb. upon the scale beam when the brake gear was suspended by a cord from the point *a* immediately above the wheel shaft; this made a constant minus correction of 200 lb. The friction pulley had a face of 12in., was kept wet by a jet of clean cold water, did not heat much, and ran without much jumping. There were thirteen tests made, showing pretty even results. The first four were as follows:—

	A. Weight shown by scale.	B. Net weight (—200 lb.)	C. Revolutions of wheel-shaft per minute.	BC.
1	665	465	254½	118,342
2	665	465	255	118,575
3	660	460	256	117,760
4	660	460	256½	117,990
		Totals	1,022	472,667
		Means	255½	118,167

The arm of the brake was 4·775ft. from centre of the wheel-shaft to the point resting on the scale, and hence described a circle with a circumference of 30ft. The work done was therefore (118,167 × 30) 3,545,000 minute foot-pounds = 107·4-horse power. The theoretic power of the



water was (2·819 × 60 × 384·7 × 62·4) 4,060,253 foot-pounds; useful effect was, therefore, 87·3 per cent. The effective head being 384·7ft., the velocity of the escaping jet due to gravity would be 157ft. per second, or 9420ft. per minute. The wheel was 6ft. in diameter, hence circumference = 18·85′, with 255½ turns per minute, ratio of bucket speed to theoretic velocity would be 51 per cent., or ·51 $(2gh)^{\frac{1}{2}}$. The nozzle of 1·89in. diameter had an area of ·0195 square feet; hence its co-efficient of discharge was ·92. The hook gauge was only 2ft. back from the weir, and doubtless gave a slightly too small depth of



water; the co-efficient of ·92 for the nozzle, as above, is rather small, also indicating slightly greater discharge than that estimated. However, these experiments show in any event a duty of fully 85 per cent., which agrees with the results found by Mr. Browne.

An inspection of a small Pelton wheel, running at a very high velocity, showed that it "carried over" a surprisingly small amount of water. This fact proves the excellence of this particular form of bucket. Mr. Smith at first found it difficult to believe in such high percentages, but from the evidence before him is now satisfied that, with a wheel properly designed, and with heads above 100ft. or even less, a larger amount of work can be got out of water by the hurdy-gurdy than by any other form of wheel. Water pressure engines may possibly give as good or better results, but their great cost—due to the solidity with which their working parts and column must be built to withstand the shock of arresting the moving water—will prevent them from coming into general use. Where a wheel is so placed that it will at times be submerged by back water, the turbine is, of course, preferable to any other wheel. In other regards, however, the hurdy-gurdy possesses almost every advantage. The chief misapprehension as to the hurdy-gurdy has been in considering it simply as an impact and not also as a pressure wheel, which, when properly designed, as Mr. Browne points out, it clearly is. An examination of a hurdy-gurdy with either flat, recessed, or curved buckets while at work shows that the wheel carries over a large amount

of water, the force of which is consequently lost, and in fact becomes an additional load to lift.

A description of the mode of using water-power for driving the North Bloomfield tunnel in California, some years since, will give a good illustration of some of the advantages of the hurdy-gurdy. This tunnel was originally about 8000ft. long, through a slate highly metamorphosed, with its general line passing under a good-sized stream at a depth of about 190ft. There are eight working shafts, each about 200ft. deep, which, with the lower entrance or portal, gave sixteen working faces. Diamond drills were used at the lower heading requiring power; the other fifteen headings were driven by hand-work. It was uncertain how much water would be encountered, but from the location it was evident that a large quantity might be struck in any shaft, and hence it became necessary to have ample power at hand at each opening in readiness for such an emergency. A pipe main was laid along the general line of the tunnel, with its penstock 285ft. vertical above the surface of the upper shaft and 549ft. above the lowest shaft. It was made of single rivetted sheet iron, No. 14 Birmingham gauge, in lengths of 20ft., put together stove pipe fashion, with the joints made tight by cloth tarred strips and pine wedges. This pipe has a diameter of 15in. at the penstock, diminishing from this to 13, 11, and 7in. at its lower end. From this short branches, 7in. in diameter, were extended to the several shafts; it was in one place carried across the stream by a light suspension bridge, some 150ft. long, the trunk of a tree on either side forming convenient towers. The aggregate length of the main and branches was 9960ft., with some 2500ft. additional for the branch to the diamond drills. The water was brought to the wheel by a discharge pipe some 9ft. long, having a vertical movement by ball-and-socket joint, so that at pleasure, by dropping the pipe, the machinery could be run at various speeds or entirely stopped. At the end of this discharge pipe was a cast tapered nozzle, about 3½in. in diameter, into which was inserted a ring of saw-plate steel having the desired diameter, and which was held in place by an annular screw cap. By changing the ring, which only required a few moments' time, any desired amount of water, up to 3 or 4 cubic feet per second, could be discharged against the wheel. The stop-gate was left wide open while the machinery was running. The pumping was done by eighteen pumps of Cornish pattern; the largest amount of water pumped from any one shaft was something over 30 cubic feet a minute; the power at hand, however, was ample to have pumped more than twice that quantity. It was rather curious at this shaft to see more water coming from the pumps than was used on the wheel. The two diamond drills were driven by a small hurdy-gurdy set on the rear of the drill carriage. This, but at another tunnel, was afterwards modified by placing a separate hurdy-gurdy on a sleeve of each drill rod, the advance movement of the drill being given by hydrostatic pressure on an annular piston, thus doing away with all gearing. These eight sets of machinery were run for nearly 2½ years', the only break being that of a spur-wheel, doubtless caused by the careless dropping of a steel bar between it and its pinion. Aside from this accident, practically not a dollar was spent for repairs, and the machinery, including the pipe, was in about as good order when the tunnel was finished as when it was first erected. One man, on a 12-hour shift, operated the machinery at each shaft, besides dumping the cars; two men kept the eighteen pumps on the line in order, the principal work being in keeping the suction pipes for the down grade headings tight, thus a force of eighteen men was only required for the eight shafts. The cost of the pipe, gates, &c., when put in place, was 14,631 dols., and of the machinery about 60,000 dols.

Our readers must not suppose that we assert of our own knowledge that the Pelton wheel is as efficient as stated. We give the figures supplied by Professor Browne, and during the discussion which followed the reading of Mr. Smiths' paper no one impeached their accuracy. It is worth notice that Mr. Browne says, "When a jet of water strikes a stationary bucket, as shown in Fig. *a* or *b*, so soon as the motion becomes permanent, the wedge-shaped portion of the water, shaded with horizontal lines, becomes practically stationary." "When such a bucket is used for a wheel, it is plain that the shaded portion of the water is 'carried,' and must subsequently escape with nearly the full velocity of the bucket.'" The wedge which is inserted in the Pelton bucket takes the place of this "dead" water. It is not improbable that the form of the jet affects the results. We give on p. 397 sections of the nozzles used, with particulars.

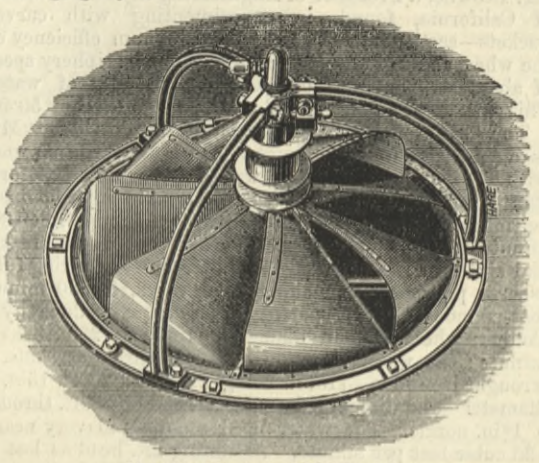
The whole subject is one of considerable interest. It will be seen that the hurdy-gurdy wheel is very simple and inexpensive, and in our slate quarries and in other situations where large heads of water are available, English engineers may perhaps be able to follow with advantage the example set by their American brethren.

Public Works in Genoa.—The new harbour works at Genoa have lately been pushed along actively, and a limited number of passenger vessels as well as cargo steamers can now lie alongside, and could be discharged by cranes if there were any; but at present they are discharged in the old way by means of lighters, except coal, which is in part discharged direct into the trucks. The outer mole is now above water for nearly its whole length, and many of the quays and moles in the interior of the harbour are finished and in use. A double line of rails has been laid round the quays at present in use; but it is stated that the great evil connected with the railway management at Genoa, viz., want of trucks, continues without any improvement being made. Several very important works which the Municipality of Genoa had projected for execution in concert with the Government have been decided upon and the contracts signed. The fortifications on the east side of the town, known as the "Fronti basse," are to be pulled down, and the ground gained will in part be converted into a military parade ground, and the rest be built over. The "Marble Walk," which extends round the bottom of the harbour, is also to be pulled down and the space gained given up to trade. The Custom House is to be removed to a new and more suitable building, and the present one will be turned into an art museum. Many other changes are to be made with a view of fitting Genoa for its increased and increasing trade, and some of these changes will destroy much that is picturesque, and recalls the great days of the old Republic.

MACHINERY AND MECHANICAL APPLIANCES AT THE INTERNATIONAL HEALTH EXHIBITION.

No. IV.

The Blackman Air Propeller Ventilating Company, Limited, Fore-street, E.C., show several of their propellers, two of which are driven from the main shafting, one of 48in. diameter, blowing air into a building which represents a factory or workshop, and another 36in. diameter, fitted inside the same building, from which it exhausts, discharging by a louvred turret on the roof. Since its

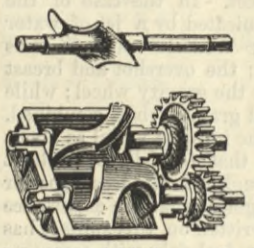


BLACKMAN AIR PROPELLER.

introduction from America last year the construction of this propeller has been considerably improved. We illustrate the latest form above; and it will be seen that the three arms supporting the spindle are duplicates of each other, the journal being cast with a sphere on it, which is gripped by the ends of the arms after the spindle has been set true. The bearings are of cast iron, four diameters long. A spanner is the only tool required for fixing the frame, or for replacing any part of it, the bolts throughout each machine being of the same size. The object of this propeller being to move large volumes of air with as little increase of pressure as possible above that of the atmosphere, in order to keep down the horse-power required for driving, it is desirable to arrange the inlets and exits so as to maintain the full area of propeller throughout. We understand that in practice the company, as a rule, find no difficulty in attaining this, and there is, therefore, seldom occasion to provide more power than that necessary for moving free air at the required velocity, plus the friction of the apparatus, a 48in. propeller only taking one actual horse-power for moving nearly 16,000 cubic feet of air per minute at 20ft. per second, representing about 7687 foot-pounds of work done per horse-power. Where pressure is not wanted, this fan gives a cheap and expeditious method of ventilation, and it has been found of great service in clearing out steam and foul air from buildings, and in producing currents for drying purposes, where it is generally found more desirable to bring large volumes of air at a comparatively low temperature in contact with the material, instead of using a smaller quantity heated to a high degree. The propeller is very easily fixed, and can be placed wherever an opening can be made in a wall, ceiling, or floor, the chief points to be observed being to keep the air ducts up to the full area between the blades, and to allow a clearance of about one-fourth the diameter all round the outside of the fan.

In the mechanical bakery department, which is entirely driven by Otto gas engines, many well-known firms have contributed to make a very interesting display, the various processes of bread, cake, and biscuit-baking being shown in their entirety. We now propose to describe these in terms such as we think will be acceptable to most of our readers, but without entering into minute details, and we will commence with the hygienic bakery of Messrs. W. Hill and Sons, Bishopsgate-street, E.C., which seems to have been fitted up with great care and completeness. All the water used in this establishment is filtered through one of Johnson's filter presses, in which arrangements are made for readily changing the filtering medium, so as to avoid the possibility of the carbon itself becoming a source of contamination, as is often the case in ordinary filters. The flour is stored above the bakehouse, and is delivered into one of Pfleiderer's sifting machines, in which, by the aid of a spiral brush, a sack may be sifted in a very few minutes, and from this into the dough-maker or kneading machine, the sponge or ferment being added at the same time. This latter machine is illustrated in Figs. 1 and 2. It is arranged to act as a mixer, stirrer, and kneader, so that the sponge can be set and the dough mixed in one machine, instead of requiring separate ones for each operation, as is generally the case. It consists of a pan of sheet steel or gun-metal, in which are revolved two sets of peculiar shaped blades, and which is mounted upon a frame so that it can be tipped by hand or steam power, according to the size of the apparatus. The blades are revolved by

Fig. 1



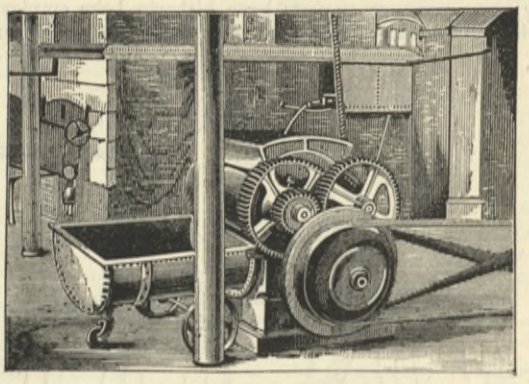
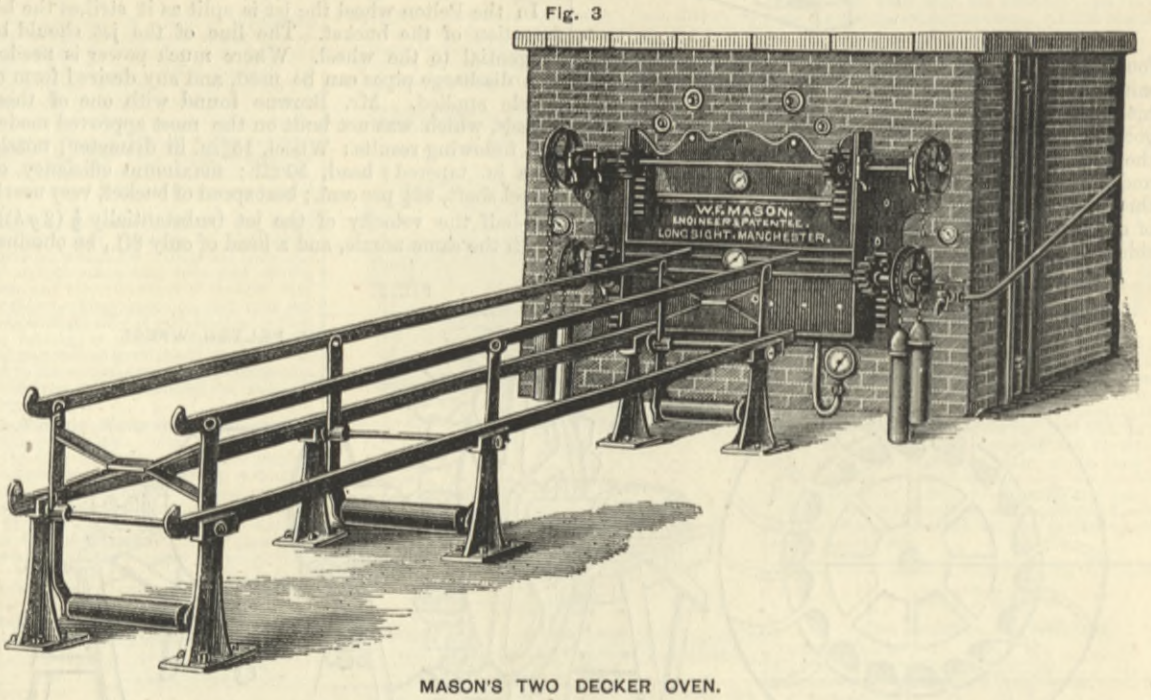


Fig. 2—PFLEIDERER'S DOUGH MIXER.

gearing outside the pan, and can be reversed by an ingeniously-arranged friction clutch, in order that they may eject the dough when the pan is tipped. The dough and ferment are thoroughly mixed and worked up together into a homogeneous mass, the operation lasting some three or four minutes, after which it is delivered into a truck and allowed to prove. When the dough is sufficiently proved, it is then cut up and divided into pieces, according to the use to which it is to be put, and made up into the desired form. For making rolls, as well as for some other purposes, Pfleiderer's dough-dividing machine is used. In this apparatus a piece of dough of the necessary weight is placed in a circular metal box, in which

Fig. 3



MASON'S TWO DECKER OVEN.

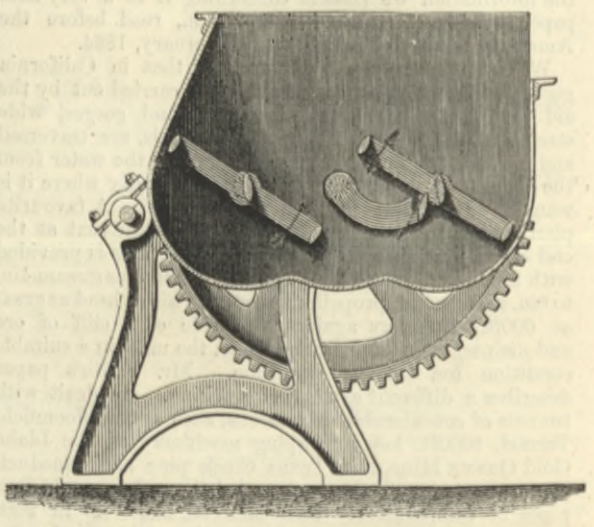
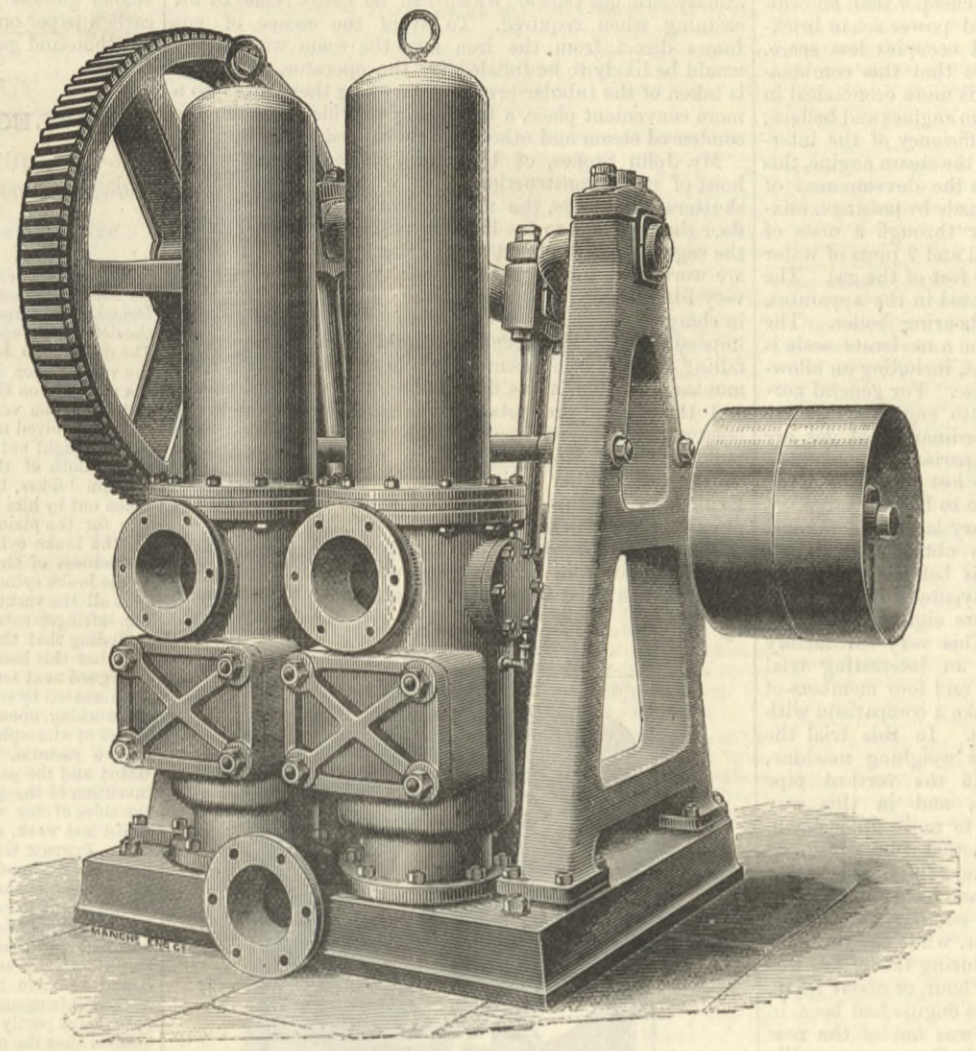


Fig. 4—MELVIN'S DOUGHING MACHINE.

by a movement of a handle, a number of knives are caused to rise through slits in the bottom, and these passing through the dough divide it into thirty distinct pieces, each of the same weight. The operation only takes about half a minute, and when it is considered that in many bakehouses several thousand rolls are made every night, it will be evident how large a saving there must be over the ordinary method of breaking up by hand. The ovens are the invention of Mr. W. F. Mason

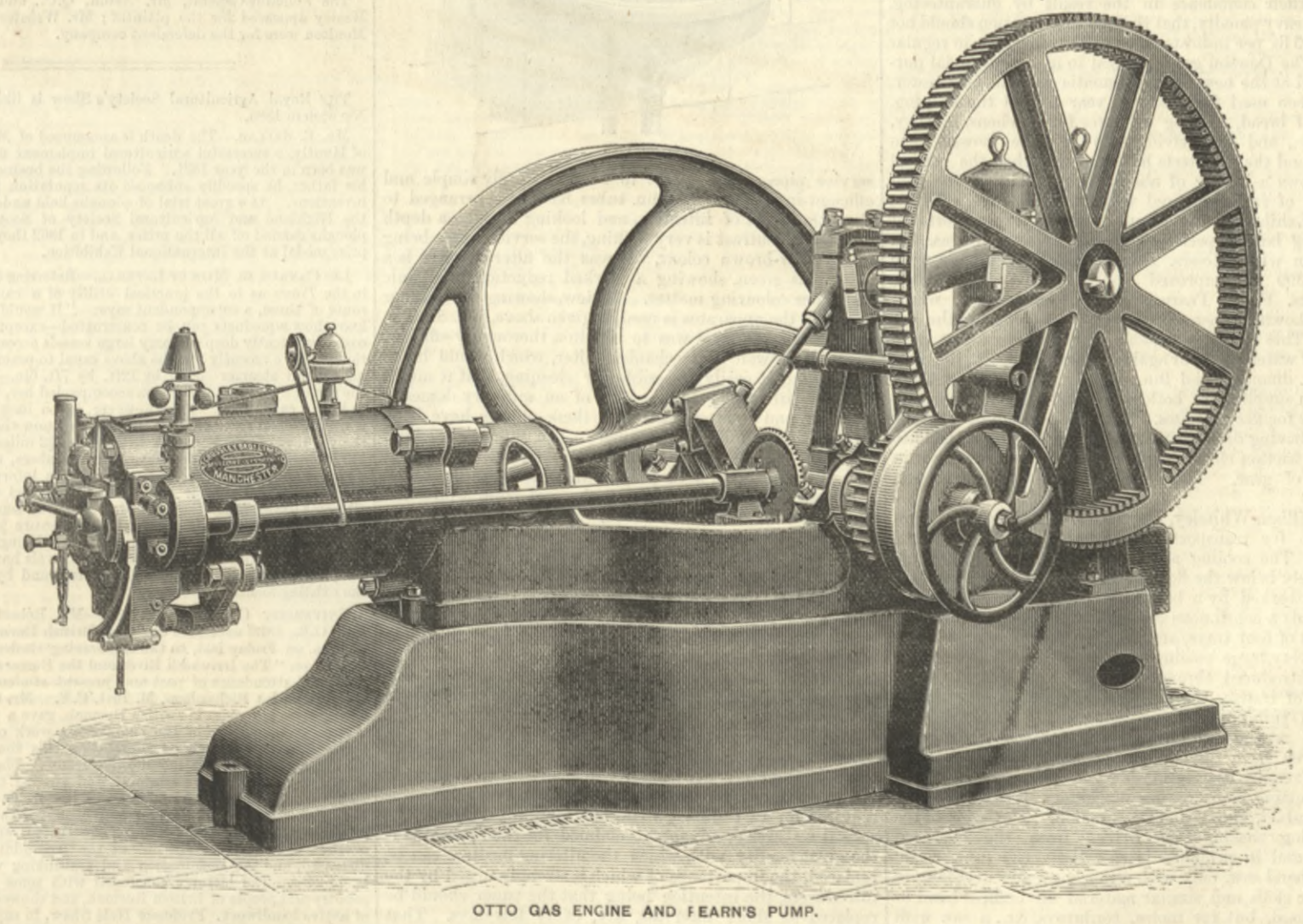
Longsight, Manchester, and consist of a two-decker and a single one, the latter being fitted with a travelling baking plate. The heat is generated in a furnace at the back, from which run a number of flues arranged so that the front of the oven is always kept at the highest temperature. In many other systems the reverse is the case, and as the bread which is set first comes out last, it is not only exposed to heat for a longer time than that at the back, but the heat itself is more intense. Another important feature is the arrangement by which the heat can be diverted wholly to the top or bottom, and by which it can be turned direct to the chimney as soon as the oven is sufficiently hot. The introduction of the travelling baking plate is also a step in advance. It enables the whole of the batch to be set and withdrawn at once, thereby ensuring an equal baking and a uniformity of colour, besides preventing dryness and loss of weight, which cannot well be obviated when the batch is slowly withdrawn by the use of a peel. Besides this, the expense of an expert setter may be dispensed with, as any lad can fill the baking plate and run it in and out, and the labour of setting and drawing at the mouth of an oven, with its stream of hot air and steam issuing into the baker's face, is avoided. The furnace being placed at the back, all dirt arising from the fire and ashes is kept away from the bakehouse, and as coke is used the fire is smokeless. The oven doors are made to close quite tight without caulking, and an arrangement is provided for allowing the steam to escape direct into the chimney. Each oven is fitted with a pyrometer to enable the attendant to maintain the temperature at the proper degree. We illustrate by Fig. 3 one of Mason's patent continuous two-decker ovens with travelling baking plates. Such an oven occupies no more floor space than a single one, and will turn out twice as much work for nearly the same consumption of fuel, while the first cost is very much less than that of two single ovens. The baking can proceed continuously without waiting for firing up between the batches, and the cost of fuel is stated to be not more than 2d. per sack of 280lb. A somewhat different system of baking is shown by Mr. Marshall, Strand, W.C., the machinery having been supplied by Mr. T. Melvin, Glasgow. The flour is delivered into a patent mixing and sifting machine, which consists of an iron casing bolted to the underside of the bakehouse roof, within which a number of blades revolve and thoroughly blend the whole in about a couple of minutes. A shutter is then opened, and the contents discharged into the sifting apparatus, which is placed below. Here there is a wire sieve of large mesh, above which agitating blades revolve rapidly in close proximity to the surface of the sieve, and break down all lumps at the same time that the flour is driven towards the periphery of the blades and through the sieve. For cleanliness, all the bearings within the machine are fitted with self-lubricating bushes requiring no oil. The flour is then passed into the sponge stirring machine, and by means of revolving blades is mixed up with the proper proportion of yeast and water in about four minutes. The blades are then withdrawn, and the tub removed, in order that the dough may stand from one and a-half to two hours, to allow fermentation to take place,



PEARN'S PUMP.

and in the meantime a second and third batch may be prepared in a similar manner if required. When fermentation is sufficiently advanced, salt, and a little more water are added, and the dough stirred again for a couple of minutes. It is then passed into the doughing machine, of which we give a section in Fig. 4, in which seven mixing blades of Siemens' steel, rotated by strong gearing outside the casing, press, and cut, and turn over the dough in such a manner as to form it into a perfectly homogeneous mass, every particle being brought under their influence. The blades are so formed that when they approach one another, their action is not simultaneous over their whole length, but gradual, thereby reducing the strains on the machine, and they extend to the bottom of the casing, so as to treat the whole mass of dough. The three driving shafts are arranged at such a level as to avoid all leakage at the points where they pass through the case, and to allow of proper lubrication. The machine is emptied by tilting it over by means of worm gear, the rotation of the blades assisting in discharging the dough. In some instances this machine is used for preparing the sponge, but the makers consider it best to carry out the two operations separately, as here described. The dough thus prepared is ready for dividing, this being done by hand or by machinery according to the articles it is desired to produce. Mr. Melvin also exhibits a biscuit brake, consisting of a pair of 8in. diameter rollers, 24in. long. The oven used by Mr. Marshall is heated by gas, on the patent of Messrs. Gilson and Booer, London. The system can be very easily applied to any ordinary oven of good construction, and it consists in the introduction of a number of atmospheric burners at the front, just below the roof, the stream of burning gas flowing over to a flue at the farthest end, while the products of combustion, still at a very high temperature, are led back along one side to the chimney. The consumption of gas at the Exhibition is said to be about 270 cubic feet per hour, and the result seems in every way satisfactory, the apparatus being easily managed, and well under control. The patentees not only claim the advantages resulting from increased cleanliness and facility in working, but say that there is an actual saving in flour which is sufficient to pay for the whole of the gas consumed in baking; and we understand that Mr. Marshall's experience in his own bakehouses fully confirms this statement.

Messrs. J. Hughes and Co., Great Dover-street, S.E., exhibit in the bakery department a small flour-mill, with stones 3ft. diameter, having a little crane attached for convenience in raising the top runner when it requires dressing, as well as various other improvements. They also show several specimens of mill furniture, among which we may mention a nicely made dressing machine, with mahogany cylinder 4ft. long, with brushes, &c., for separating the bran and pollard from the flour. Messrs. Hughes' object is to illustrate to many of the large agriculturists who may visit the Health Exhibition, and who generally possess a portable engine or some other source of motive-power, how they may, if they choose, prepare their own flour, and save the expense of sending back and forwards to a mill, situated perhaps at a considerable distance from the farm. This is a difficulty frequently experienced in this country, as well as in the Colonies. The machines are made specially light and portable, and are easily fixed by bolting to the barnfloor. The mill will grind oats, barley, and other grain for cattle and poultry.



OTTO GAS ENGINE AND PEARN'S PUMP.

The Dowson Economic Gas Company exhibits a complete set of plant in operation, the gas being used for driving the twin-cylinder 12-horse power Otto engine described in The Engineer of 16th inst. This engine indicates about 25-horse power, and has a brake power of about 20-horses, the space occupied by the gas plant being only 10ft. by 7ft. by 8ft. high, and the cost erected complete £175; so that it is not only cheaper than an ordinary horizontal steam boiler of equal power set in brickwork, but it requires no chimney and occupies less space. A point of still greater importance is that this combination of Otto engine and Dowson gas is more economical in consumption of fuel than the best steam engines and boilers; and bearing in mind the superior efficiency of the internally-fired gas engine compared with the steam engine, this exhibit marks a distinct advance in the development of this important subject. The gas is made by passing a mixture of superheated steam and air through a mass of incandescent fuel, about 13 lb. of coal and 7 pints of water being required to produce 1000 cubic feet of the gas. The steam can be produced and superheated in the apparatus, or it can be taken from a neighbouring boiler. The average cost of the gas when made on a moderate scale is stated to be 3d. per 1000 cubic feet, including an allowance for wages of attendant, repairs, &c. For general purposes about four times and for the Otto engine about five times as much of this gas as of ordinary coal gas are required; so that in making a comparison of effect, the increased consumption must not be lost sight of. Even then, however, the saving would seem to be very large.

In our annual review of 4th January last we mentioned that Mr. Dowson had succeeded in obtaining a horse-power for 1½ lb. coal per hour, this being the average result of a trial extending over seventeen days at the works of Messrs. Crossley Bros., where eight Otto engines are worked daily with his gas. This very satisfactory result has since been confirmed by an interesting trial made in the presence of the engineer and four members of a Local Board, who desired to make a comparison with steam power for a pumping station. In this trial the gas generator, &c., was placed on a weighing machine, there being a loose water joint in the vertical pipe conveying the gas to the engine, and in this way the weighing machine was quite free to move up or down, and readings were taken of the actual fuel consumed during the trial. The engine was kept fully loaded at a speed of 160 revolutions per minute, and frequent indicator diagrams were taken. The general result was that the engine indicated about 32-horse power, while the fuel consumed, including ashes, and waste during the night, was 1·23 lb. per indicated horse-power per hour, or about 1·5 lb. per brake horse-power per hour. The engine had been in daily use for nearly two years, and was not of the new type, which gives the best results with Dowson gas. We understand that these results were much better than those offered with steam by all the competing firms, and showed an annual saving of £230 in working cost compared with steam engines of the best makers; and we believe the committee have therefore recommended the Board to adopt this system of motive power, especially as Messrs. Crossley showed their confidence in the result by guaranteeing, under a heavy penalty, that the fuel consumption should not exceed 1·5 lb. per indicated horse-power per hour in regular work. The Dowson gas is applied to many industrial purposes, and at the new County Lunatic Asylum, Gloucester, it has been used for nearly a year for all the cooking, baking of bread, heating of water for kitchens, laundry, baths, &c., and for driving two 12-horse power Otto engines, and the architects have reported that the general result shows a saving of about 50 per cent. in the consumption of fuel compared with ordinary fires. At the Health Exhibition, the company shows a new form of circulating boiler, specially made for heating by gas. In connection with Messrs. Dowson's exhibit we illustrate on page 399 an improved double ram pump made by Messrs. Frank Pearn and Co., Manchester, which is being shown in operation driven by a belt from the gas engine. This pump is capable of delivering about 8800 gallons of water per hour against a head of 200ft., the rams being 7in. diameter and 9in. stroke. A number of them have been supplied for both water and sewage pumping, as well as for fire purposes. The same design of pump is used for driving direct with mortice gearing from the Otto engine, a friction clutch being provided for throwing it in and out of gear. This arrangement we illustrate on page 399.

Mr. William Whiteley, Bayswater, W., shows a refrigerator van for transporting perishable foods in warm weather. The cooling apparatus is placed in a movable box entirely below the floor of the van, and consists of a small fan worked by a belt from one of the hind axles, which sends a continuous current of air over ice contained in a series of four trays, arranged in such a manner as to expose a very large cooling surface. The refrigerated air is then introduced through a hole in the bottom of the van, and, of course, the supply continues as long as the vehicle is running, the ice being easily replenished as required. At the Exhibition the apparatus is shown at work driven by a Bischop gas engine, which is too well known to require description here.

Cloth-cutting and ironing machinery is exhibited by Messrs. Aublet, Harry, and Co., London. The larger of the two cutting machines is driven from the overhead shafting, and in principle is essentially the same as an ordinary band saw, only with a much greater overhang of arm. For cloth and similar material an endless band or knife is used, but for moles, corduroys, &c., a saw with teeth about 1in. pitch is adopted. This machine is capable of cutting the heaviest canvas, linen, leather, &c. It is fitted with self-sharpening gear for the endless knife, and an improved spring arrangement, which allows the upper pulley on which the band runs to give a little when any undue strain comes upon it, in order to prevent the snapping of the knife. The small cutting machine is constructed to be worked by treadle, hand-power, or by belting, and is of precisely the same construction as the larger one, though not quite so complete in details. As an example of its capacity, it is stated that 500 dozen complete shirts have been cut out in one week by one cutter and three assistants. The ironing or pressing machine, which is worked by hand-power, consists of an iron carried by a hinge at the end of a tubular sliding arm, and an adjustable board, which can be raised and lowered by a treadle. The iron is hollow and heated internally by an atmospheric gas burner, which can be easily removed for cleaning when required. To avoid the escape of gas fumes direct from the iron into the room where they would be likely to be inhaled by the operator, advantage is taken of the tubular arm for conveying them away to a more convenient place, a tray being provided to catch the condensed steam and other matters carried off by it.

Mr. John Stones, of Ulverston, shows a steam-power hoist of usual construction fitted with his patent safety shutters and doors, the main feature being that at each floor the openings to the hoistway are always closed unless the cage happens to be at that particular floor. The doors are worked by the cage itself in a very simple manner, very little attention being required on the part of the man in charge. In this way it is claimed that it is next to impossible that any accident should occur from persons falling through the openings, while in case of fire, communication between one floor and another would be closed, and the flames prevented from ascending through the hoistway and spreading to the upper storeys of the building. Mr. Stones exhibits a number of revolving shutters and other contrivances in another part of the Exhibition, but these hardly come within the scope of the present series of articles.

Messrs. S. H. Johnson and Co., filtering engineers, Stratford, E., exhibit in Class 21 a novel household fitting in the form of a fixed water filter for attachment to the main

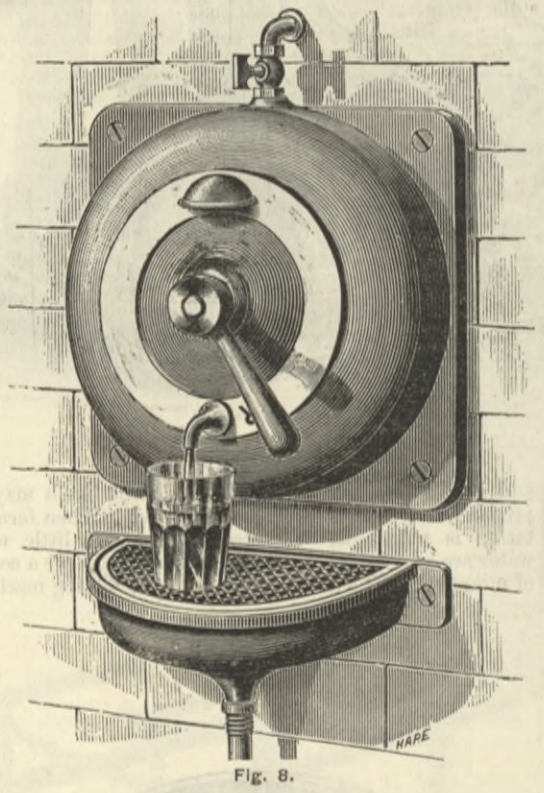


Fig. 8.

service pipe, which seems to be exceedingly simple and efficient in action. Two 3in. tubes have been arranged to show the effect of filtration, and looking through a depth of 8ft. the contrast is very striking, the service water being of a yellow-brown colour, whereas the filtered water is a clear blue-green, showing a marked reduction in organic and other colouring matter. A view, showing the manner in which the apparatus is used, is given above, Fig. 8. The object in designing it was to obtain a thoroughly efficient chemical as well as mechanical filter, which would be so simple, and so easily accessible for cleaning, that it might be left with safety to the care of an ordinary domestic servant; and it is claimed that these objects have been attained in the following manner:—The filtering medium employed is a disc of thick paper of close texture, formed of a pure vegetable fibre pulp, with which is incorporated a certain proportion of animal charcoal from which the phosphates have been removed. The filter consists of a wall plate provided with a raised rim truly faced, and the recess thus formed is the supply chamber of the filter, which is put into communication with the main. On the wall plate is placed a disc of the prepared paper, which is kept in position by a cover plate, which nips the paper all round the raised rim, and makes a water-tight joint, the whole fixing being accomplished by means of a single central bolt, as shown in the cut. The price of the paper is 4s. per 100, so that the cost of replacement need be no bar to its being frequently done. It is stated that through a filter of this kind only 12in. in diameter, fifteen gallons of water will pass per hour, and there is therefore no necessity for any store of filtered water, as it can be drawn off continuously as fast as is required for an ordinary drinking fountain. One of the special features of advantage claimed for the apparatus is the great facility with which the filtering medium can be replaced, the importance of which is strongly urged by the introducers, the intention being that the paper should be replaced at short intervals, say, every few days. That this is a step in the right direction will probably be manifest to every one who has ever taken the trouble to examine the state of the filtering medium in the old-fashioned filters where the impurities were allowed to accumulate for a long time. The removal of the phosphates is also considered important, for not only is the animal charcoal rendered ten times more active, but the foul growths which are promoted by the existence of the phosphates are avoided. Other forms of this filter are shown, in which a battery of such filtering cells are employed like an ordinary filter press, and by means of these it is proposed to filter the whole supply in the main service pipe, and since the resistance occasioned by the filtering medium is small, the ordinary pressure of the main is not only enough for this purpose, but affords a sufficient residual pressure to meet the requirements of ordinary services. These main filters are now made sufficiently large to filter 50,000 gallons per day, and the cost of filtration through carbon paper on this scale is said to be only one halfpenny per thousand gallons.

LEGAL INTELLIGENCE.

QUEEN'S BENCH DIVISION.

(*Sittings in Banco, before* Mr. Justice Grove *and* Mr. Baron Huddleston.

WESTINGHOUSE *v.* LANCASHIRE AND YORKSHIRE RAILWAY COMPANY.

This was an action brought for the infringement of letters patent for two inventions of the plaintiff, and was tried before Mr. Justice Denman and a special jury in September last, the verdict being for the defendants upon one patent, and for the plaintiff upon another. The defendants had thereupon given notice of motion to set aside the verdict upon the part of the case which was found in favour of the plaintiff, on the ground of there being no evidence of infringement, and the verdict being against the weight of evidence. The motion involved misdirection by the learned Judge, on the ground that he ought not to have left the question of infringement to the jury. Both of the patents taken out by the plaintiff relate to vacuum brakes, his 1873 patent being for brake rigging, and that taken out by him in 1874 being for the brake cylinder. The verdict was for the plaintiff on the brake rigging, and for the defendants on the brake cylinder. No question was now raised as to the correctness of the finding of the jury in the defendants' favour as to the brake cylinder—of which Mr. Westinghouse, indeed, alleges that all the vacuum brakes in this country are, practically speaking, infringements; the question whether the jury were justified in finding that the defendants did not infringe the patent of 1874, and that this had in certain particulars not been new, will have to be argued next term. In brakes by compressed air, or brakes which are actuated by vacuum, the power is obtained either by compressed air working upon a piston head and driving the brakes on, or by power of atmospheric pressure acting in some way where there has been a vacuum, or a partial vacuum, in the pipes underneath a train; and the patent taken out by the plaintiff in 1873 was for the invention of the gear by which the power is brought to bear upon the sides of the wheels. The arguments in the present case were heard last week, and

Mr. Justice Grove, in delivering a judgment lasting over an hour, on Wednesday, in the case with reference to the 1873 patent, said he had come to the conclusion that no reasonable evidence of infringement to go to the jury had been adduced at the trial. The learned Judge who had tried the case had informed him that if he had had to decide the question without a jury he would have arrived at the same conclusion, but he had considered himself bound to leave the question to the jury. The question of the alleged infringement by the defendants of the plaintiff's letters patent was partly one of law and partly one of fact, and he was of opinion that the plaintiff had failed to establish that his combination had been infringed. The only other question which had to be now decided was whether or not the Court had materials before it on which it could order a verdict to be entered for the defendants on the issue as to whether or not they had infringed the patent taken out by the plaintiff in 1873. He (the learned Judge) was of opinion that it had such materials, and must order the verdict and judgment to be so entered now for the defendants.

Mr. Baron Huddleston concurred.

The Solicitor-General, Mr. Aston, Q.C., and Mr. Chadwyck Healey appeared for the plaintiff; Mr. Webster, Q.C., and Mr. Moulton were for the defendant company.

The Royal Agricultural Society's Show is likely to be held at Norwich in 1886.

Mr. R. Sellar.—The death is announced of Mr. Robert Sellar, of Huntly, a successful agricultural implement maker. Deceased was born in the year 1821. Following the business established by his father, he speedily enhanced its reputation by his numerous inventions. At a great trial of ploughs held under the auspices of the Highland and Agricultural Society of Scotland, the Sellar ploughs carried off all the prizes, and in 1862 they were awarded a prize medal at the International Exhibition.

Les Canaux du Midi et Lateral.—Referring to a recent article in the *Times* as to the practical utility of a canal following the route of these, a correspondent says:—"It would be interesting to know how aqueducts can be constructed—except at a prohibitive cost—sufficiently deep to carry large vessels across the rivers mentioned. We recently put the above canal to practical use by sending a small steamer—59ft. by 12ft. by 7ft. 6in.—through it, and the son of a member of our firm accompanied her, with instructions to keep a careful log. This, however, is too long to send you, but it may interest some of your readers to know that the length of the waterway from Bordeaux to Cette is 332 miles, there are about 115 locks—some of which have two chambers, others three, and one at Fouserannes has nine—and we are informed the summit level is 800ft. above the sea. The little vessel we sent through, although drawing less than 5ft. 6in., struck on some stones in parts of the canal. The time occupied in the entire journey was eight days, owing to the delays incurred passing through the locks. We should like to know if more practicable levels have been found for the proposed maritime canal than were found by the engineers of the existing ancient waterway."

University College, Bristol.—Mr. Robert Gordon, Mem. Inst. C.E., chief executive engineer, British Burmah, delivered an address, on Friday last, to the engineering students of the above college, on "The Irriwaddi River and the Burmese." There was a very good attendance of past and present students, presided over by Mr. Charles Richardson, M. Inst. C.E. Mr. Gordon, who has been for twenty years in British Burmah, gave a most interesting account of the nature of the engineering work on which he had been engaged, and took as illustrating this the special task of dealing with one of the mountain torrents. The Kantha, which rises in the Pegu Voma mountains, and passing under the Prome and Rangoon Railway, flows through the Heine Valley and the Pega Sub-Goma plains. This had caused great destruction of property by its channel becoming obstructed, and a consequent overflow of its banks. The flow of the Irriwaddi itself was then discussed, and the reclamation and embanking works, which are in process. The lecturer concluded with some remarks on the country and people of British Burmah, and showed some specimens of native handiwork. Professor Hele Shaw, in supporting a vote of thanks to Mr. Gordon, stated that he hoped this, though the first, was only the first of a series of such addresses, which must be of the highest value and interest to young engineers. Their school had most satisfactory and encouraging progress to report. The number of engineering students was thirty-two, and no less than twelve were this year students of civil engineering, as against three in that department last year, when it was specially formed. The opening of the college workshops to the students had been much appreciated, and the number who had attended was such as to necessitate building a larger one, in which there would shortly be a 50-ton testing machine and other necessary appliances for an engineering laboratory.

RAILWAY MATTERS.

THE Caledonian Railway Company has issued a circular increasing the working hours from ten to twelve hours. The proposal is strongly objected to by the men, and strong action will be taken by them.

AT Denmark-hill is a cutting in sloping strata which has given the Brighton Company lots of trouble. On Wednesday night, or rather early yesterday morning, the tunnel which joins the cutting fell in. The driver and stoker have been got out, alive.

THE Dore and Chinley Railway Bill has passed the Committee of the House of Commons. This railway will open up to travellers some of the most beautiful parts of North Derbyshire; and Mr. Ruskin will again say something about "machine and devil-driven England" and scenery spoilt by the vulgar gaze.

THE 5ft. 3ft. gauge of the Great Southern and Western Company of Ireland has enabled it to build some capital first-class carriages, with lavatory accommodation and seats convertible into beds, for its night mail trains between Dublin and Cork. The convertible seats occupy about three-fourths of the width of the whole compartment, and when turned completely over disclose soft woollen mattress and pillow, and a comfortable rug.

THE fiftieth anniversary of the establishment of railways in Belgium was celebrated on Saturday, May 24th, by the closing of what is called the Arsenal, that is to say, the Locomotive Works of the Belgian State Railways, and the issuing of free passes to enable the 2309 men to visit the principal towns of the kingdom. Belgium, it will be remembered, was the first country to follow England in adopting railways, and the first continental locomotive was made by John Cockerill at the Seraing Works. Accordingly a movement is on foot to add to the usual *fêtes* a special railway celebration like that held at Darlington in 1875. The committee of the Bourse des Nétaux has voted the sum of £1000 towards the *fêtes*, and has called upon the ironmasters to co-operate, and thus show their appreciation of the benefits conferred by railways.

IN a report on a collision which occurred on the 15th February, at Doncaster station, on the Great Northern Railway, Major Marindin says:—"This slight collision was due to the adoption of a stupid practice on the part of the driver of the 10.40 a.m. down train. In order to save himself the trouble of holding up the flap-valve for releasing the vacuum-brake, which he had used for stopping at the ticket platform, he put a piece of wood under the flap and then forgot all about it. Consequently, when he had started again and tried to stop his train at the platform, as usual, behind the 5.35 p.m. train, by using the ejector and applying the continuous brake, he was unable to get a vacuum, and the brake was useless. It should be remarked that, with an automatic brake, the fact of such an important part of the machine being in a wrong position would have applied the brake, instead of making it of no value whatever."

A MAP has been published by the Board of Trade showing the area within which metropolitan railways are to be subject to a passenger duty of 2 per cent. The area embraces 116 miles of railway and 177 passenger stations. The most distant points are Forest Gate and Plumstead on the east; Stoke Newington and Stroud Green on the north; Hammersmith and Shaftesbury-road on the west; and Wandsworth, Herne-hill, and Nunhead on the south. The following shows approximately how far the operation of the clause affects the different companies owning lines within the metropolis:—East London Company, 4½ miles of railway and 8 stations; Great Eastern, 14½ miles, 24 stations; London, Brighton, and South Coast, 18 miles, 18 stations; London, Chatham, and Dover, 12¼ miles, 20 stations; London and South-Western, 10 miles, 13 stations; Metropolitan, 14¼ miles, 28 stations; Metropolitan District, 9 miles, 17 stations; North London, 11½ miles, 19 stations: South-Eastern, 10 miles, 13 stations.

IN a report on an accident which occurred on the 26th January, near Letterkenny station on Letterkenny branch—3ft. gauge—of the Londonderry and Lough Swilly Railway, when, of a mixed train, running slowly round a curve of fifteen chains radius, up a gradient of 1 in 57, and on an embankment about 15ft. high, all the vehicles composing the train left the rails, owing probably to a violent gale prevailing at the time, having blown over the three carriages—which had less stability than the other vehicles—and these having dragged over with them the wagons in front and the brake van behind, Major-General Hutchinson says:—"The lesson to be derived from this accident, and from the almost similar one which occurred at about the same time at Stranorlar, is the importance of not using vehicles of a great length on narrow-gauge lines, as the power of resisting wind pressure decreases rapidly as the length increases; and it is a question deserving the most serious consideration of the directors of this narrow-gauge railway whether they should in future provide any carriages or other vehicles with a greater length than about 18ft., and also as to what means they should adopt to increase the stability of the long carriages now in use on the line."

A REPORT has been published on the explosion of the outer shell of the fire-box of a pilot engine at Exeter station, on the Great Western Railway, on the 13th February. In concluding it Major Marindin says:—"It is seldom that so accurate a description of the manner in which a boiler exploded can be given as in this case, where the leading fitter and the driver actually saw the exact spot where the plate first commenced to give way. This spot was at the joint of the top plate and the left-hand side plate of the fire-box shell, and at a point about 18in. from the back of the box. An examination of the boiler shows that at this point, and more or less all along the joint, there was an old flaw on the inside face of the butt-strip extending at some places through nearly a third of the thickness of the metal, and it is evident that the explosion was due to the weakness of this joint. The butt-strip at the corresponding joint on the other side is also flawed in a similar manner. This form of joint is a bad one, as where there is only one butt-strip an unequal strain is thrown on the two sides of the metal, and any small flaw is very liable to develope to a dangerous extent. The metal of the boiler-plate itself was in good condition. There are in all eighteen engines belonging to the Great Western Railway Company with similar joints, the whole of them having been built for the Bristol and Exeter Railway Company between 1870 and 1875. The joints in these are being strengthened by removing the outside $\frac{5}{16}$in. butt-strips and fitting instead two $\frac{7}{16}$in. strips."

ON Tuesday Major-General Hutchinson, on behalf of the Board of Trade, made an official inspection of the new line of tramways from Dudley to Stourbridge. The line is $5\frac{3}{8}$ miles in length, single, on Barker's system, which consists of a steel rail fixed with keys to cast iron continuous sleepers resting on lias lime concrete. Each single rail weighs 42 lb. per lineal yard, and each sleeper 112 lb. or thereabouts, giving 66 tons of steel rails and 176 tons of cast iron sleepers for each mile length of single line of two rails. The depôt and grounds contain an area of some 1200 superficial yards, and is situated closely adjoining the London and North-Western Railway Station in the Tipton-road, Dudley. Accomodation is provided for eight engines and eight cars, and there are also erected suitable buildings for boardroom, offices, repairing shop, coke and oil stores, &c. The engines are Kitson's, about eight tons weight. The cars have been supplied by the Starbuck Company, of Birkenhead. They are specially constructed for steam traction, and have two four-wheeled bogie frames. The cars are provided with powerful brakes, which can be applied by the driver of the engine or by the conductor on the car from either platform to the whole of the eight wheels at the same time. The works have been carried out by Mr. John Fell, contractor, of Leamington, from the design and under the personal supervision of Mr. E. Pritchard, M. Inst. C.E., Mr. Robert Dodd and Mr. M. Seaward have been the engineer's inspectors; while Mr. Robbins and Mr. Jenkins have represented the contractors.

NOTES AND MEMORANDA.

IN London, for the week ending May 17th, 2556 births and 1536 deaths, or 15·2 and 9·14 per hour, were registered. The births were three and the deaths were twelve below the average of the last ten years. The annual death rate from all causes, which had been 20·0 and 20·6 per 1000 in the two preceding weeks, declined last week to 19·19.

THE time occupied in running the Derby on Wednesday was 2 min. 46·2 sec. The distance is given as about a mile and a half. The average speed of the horses was thus 32·6 miles per hour. The maximum speed was probably 45 miles an hour. Last year the time occupied as measured by Benson's Chronograph was 2 min. 48·4 sec, not quite so fast as this year.

THE Central Rhine Towing Company possesses eight towing barges running between Bonn and Bingen, and seventeen working between Rotterdam and Bonn, and between Bingen and Mannheim. The main towing cables were renewed in 1879 and 1880. In the space of three years, the new cable, made of galvanised wires, broke but three times, while the previous cable, of wire not galvanised, broke nine times in the three years. The old cable was sold for 16 per cent. of what it cost.

SOME paper-making statistics have recently been compiled on the Continent by some busy figure lover, from which it appears that there are 3985 paper mills on the face of the earth, in which annually 1904 million pounds of paper are manufactured. Half of this paper is used for printing; 600 million pounds only for newspapers, the consumption of which has risen by 200 million pounds during the last ten years. As to the use of paper by individuals, an average of 11½ lb. is used by an Englishman, 10¼ lb. by an American, 8 lb. by a German, 7½ lb. by a Frenchmen, 3½ lb by an Italian or Austrian, 1½ lb. by a Spaniard, 1 lb. by a Russian, and 2 lb. by a Mexican.

PAPER bottles are now, it is again reported, made on a large scale in Germany and Austria. The paper must be well sized. The following is said to be a good receipt for the paper: Ten parts of rags, 40 of straw, 50 of brown wood pulp. The paper is impregnated or coated on both sides with 60 parts of defibrinated fresh blood, 35 parts of lime powder, 5 parts sulphate of alumina. After drying, ten or twelve rolled leaves are coated again, placed over each other, and then placed in heated moulds. The albumen in the blood forms a combination on pressure with the lime which is perfectly proof against spirits, &c. The *Paper World* says the bottles are made in two pieces, which are joined afterwards.

FOR the week ending April 26th, 1884, in thirty-two cities of the United States, having an aggregate population of 7,304,600, there died 2880 persons, which is equivalent to an annual death-rate of 20·5 per 1000, against 21·5 for the previous week. For the North Atlantic cities the rate was 19·2; for the Eastern cities, 22·0; for the Lake cities, 18·4; for the River cities, 15·9; and in the Southern cities, for the whites, 19·7, and for the coloured 36·0 per 1000. The *Sanitary Engineer* says:—"Of all the deaths, 35·5 per cent. were under five years of age, the proportion of this class being highest in the Lake cities, viz., 45·4 per cent. Consumption caused 17·9 per cent. of all deaths in the North Atlantic cities, and 17·8 per cent. in the Southern cities among the coloured."

THERE is a good deal of waste sawdust in America, and so two Western inventors have recently obtained patents, the *Scientific American* says, for the use of sawdust instead of sand in plastering compositions, and this, it is conceived, may be a matter of considerable importance to the owners of sawmills in the principal lumbering towns. One patent is for the use of nearly equal parts of plaster of Paris or cement and sawdust, with the ordinary amount of plastering hair and water; the other calls for the use of about 4½ lb. each of slaked lime and sawdust to 1 lb. of plaster of Paris, ¼ lb. of glue, and $\frac{1}{16}$ lb. of glycerine, with plasterer's hair. Whether or not either of these described plasters would be cheaper than those made in the ordinary way, they would certainly be lighter, and it is believed that they would better adhere to the walls, and not be so liable to chip, scale, and crack. Sifted sawdust has before been used to some extent by experienced workmen for mixing with mortar for plastering external walls, exposed to the alternate action of water and frost, as a preventive of scaling.

AT a recent meeting of the Berlin Physical Society, Dr. Frölich spoke of some modifications of Wheatstone's bridge which had been applied to the measurement of the electric resistance of galvanic elements and batteries. Wheatstone's bridge consisted, as was known, of a wire quadrilateral and two wire diagonals. Of the two diagonals one contained a battery of constant electromotive force, the other the galvanometer. In these circumstances the resistances of the four lateral wires showed the proportion $W_1 : W_3 = W_2 : W_4$ For the purpose of measuring the resistance in a galvanic battery, the arrangement was so far empirically changed that the battery to be measured was inserted in one of the lateral wires. A second empirical method consisted in inserting the galvanometer into one diagonal wire and interrupting the second; the battery to be measured was placed on a lateral wire. Dr. Frölich showed that both arrangements were only modifications of Wheatstone's bridge. The way in which these modifications originated might be conceived by supposing that the bridge was formed of cords, and that the angles of the square were successively shifted; the proportion which applied to Wheatstone's bridge would still hold in the new case. Dr. Frölich laid down a general law applicable to all individual cases. If in a Wheatstone bridge an element be inserted into each wire, while one diagonal wire contained the galvanometer, and the other was interrupted, if, moreover, on opening this wire, the electro-motive force in the other diagonal remained unchanged, then the proportion above stated between the resistances of the lateral wires would still hold. Whether this general law included such a case as could be applied practically and with certainty to the measurement of the resistance of elements must, *Nature* says, be determined by experience.

WITH the help of carbolic acid pigments, colours for glass and porcelain can be prepared without difficulty and without any noticeable separation of any insoluble metallic compound. The *Deut. Ind. Zeitung* gives the following:—"For bismuth: Ten grammes of metallic bismuth are dissolved in aqua regia, and evaporated in a porcelain dish to a thin syrup. When cold 50 grammes of carbolic acid liquefied by gently warming in hot water are added. It is then left standing a few hours, for if warmed and stirred at once an energetic reaction takes place with violent foaming. At the end of this time it is well stirred with a glass rod and heated awhile in a steam bath, when there will be an evolution of hydrochloric acid vapours. It is taken out of the steam bath as soon as a drop taken out on a glass rod will dissolve clear in nitrobenzol. When this point is reached, the mass is dissolved in nitrobenzol or a mixture of nitrobenzol and oil of spike, when the preparation will be ready to use. For tin: Ten grammes of pure tin are dissolved in aqua regia and the solution evaporated to a thin syrup, then mixed with 50 grammes of carbolic acid in the manner above described. The remainder of the operation is the same as for bismuth. For uranium: Fifteen grammes of nitrate of uranium are mixed with 40 grammes of hydrochloric acid and dissolved. This solution is also mixed with 50 grammes of carbolic acid, as before, and treated as already described. For iron: Fifteen grammes of perchloride of iron are dissolved in pure hydrochloric acid, and any excess of water removed by evaporation, so the solution when cold will have the consistence of a thin syrup. To this are added 50 grammes of carbolic acid; and it is then treated as described under bismuth. A manganese pigment can be made from the chloride of manganese; and nickel and cobalt pigments from their chlorides in precisely the same manner as that of iron is made from its chloride. The finished preparation can be diluted to any desired extent, as the concentration of the original preparation leaves plenty of play for the dilution. The different pigments above described may be mixed with each other to form all kinds of combinations."

MISCELLANEA.

THE South-Eastern Brush Electric Light and Power Company has removed its offices from 110, Cannon-street, to 68A, Cow Cross-street, E.C.

THE Glasgow Town Council have confirmed the decision of a sub-committee refusing permission to a London firm of electricians to carry wires overhead, or in tubes beneath the ground, for the purpose of supplying electric light to several large warehouses.

THE report by Professor Wanklyn and W. J. Cooper on the water supplied by the London water companies during April gives the albumenoid ammonia, which is the real test as to purity, as three one-hundredths of one part in a million for the Kent chalk well water, and four one-hundredths of one part in a million for all the other companies except the West Middlesex.

A NEW screw steamer, the Engineer, recently built by Messrs. Murdock and Murray, Port Glasgow, and engined by Messrs. James Howden and Co., of Glasgow, who were the contractors for the ship complete, made her trial trip on Tuesday, the 27th inst., at the measured mile at Skelmorlie, when a speed of over 11 knots was obtained, everything working smoothly. This vessel has been built expressly for the conveyance of larger packages below deck than any steamer afloat, it being possible to put below two ordinary torpedo boats of 85ft. each in length.

THE eighth annual report of the Inspectors of Explosives, Colonel Majendie, Colonel Ford, and Captain Cundill, has just been published, and it contains an unusual record of mischievous explosions. It deals with the year 1883, during which 179 explosions took place, causing 39 deaths and 109 cases of injury. The new Explosives Act came into force during the year, and four new explosive factories were established. The dynamite trade has grown considerably, and the number of licensed storage magazines has increased from 320 to 329, and the total of registered premises in the kingdom is 19,386.

IN an article entitled "Two Centuries in Bath," in the *English Illustrated Magazine*—which is, as usual, well illustrated—it is mentioned that an entry in the Bath Council-book records a resolution by "generall consent" of the City Fathers "that five-and-twenty shillings shall be quarterly paid for a *Newes-Letter* to be sent to the Mayor of the City for the tyme being, and to remayne at his house for the publique view of this Corporation, the first quarter beginning from the sixth day of the present February." To this ancient forerunner of the piles of "dailies" which the 5.30 a.m. train from Paddington now delivers each morning, the visitor, it seems, was permitted access.

ON the 17th inst., at the West Riding Court at Doncaster, the Earl of Scarborough was summoned by the Lower Strafforth and Tickhill Highway Board for the sum of £11 3s. 9d., damages caused by his traction engine on a road at Stainton. Evidence was given that the road was badly made, but the claim was granted. Andrew Burniston, traction-engine proprietor, Conisbro, was next summoned for damages, to the extent of £2 9s. 6d., caused to a road between South Slinsall and Horton Pagnall. In this case the evidence against the traction engine was not even good enough for the magistrate, who refused to make an order, stating that the damage had not been sufficiently brought home.

THE canal through the Isthmus of Corinth is now converting the quiet Isthmus into a scene of active engineering operations. A new town, called Isthmia, of about 200 houses and stores, has arisen on the shore of the Gulf of Ægina. The dredging of the approaches of the canal has been commenced at each end at the rate of some 5000 cubic metres of sand and soil every twenty-four hours, and a large number of men are employed on the central portion. To convey the material a railway of 15 kilometres in length is worked by four locomotives, and 180 tip wagons. Two large dredging machines have also just arrived from Lyons, which will move 13,000 cubic metres per day.

THE colliery owners in the Dortmund coalfield have agreed—according to the *Leipziger Tageblatt*—upon a general limitation of the quantity to be offered for sale between 1st April, 1884, and 31st March, 1885. Each colliery is bound not to offer a larger quantity than during the year 1883 or during the period from 1st April, 1883, to 31st March, 1884. Coals exported to distant countries or sent through the St. Gothard tunnel are not included in such computations of quantity. A fine of 2s. per ton on the excess is imposed for the contravention of this regulation. The final confirmation of the regulation was made dependent upon the adhesion of colliery owners representing 90 per cent. of the output for 1883.

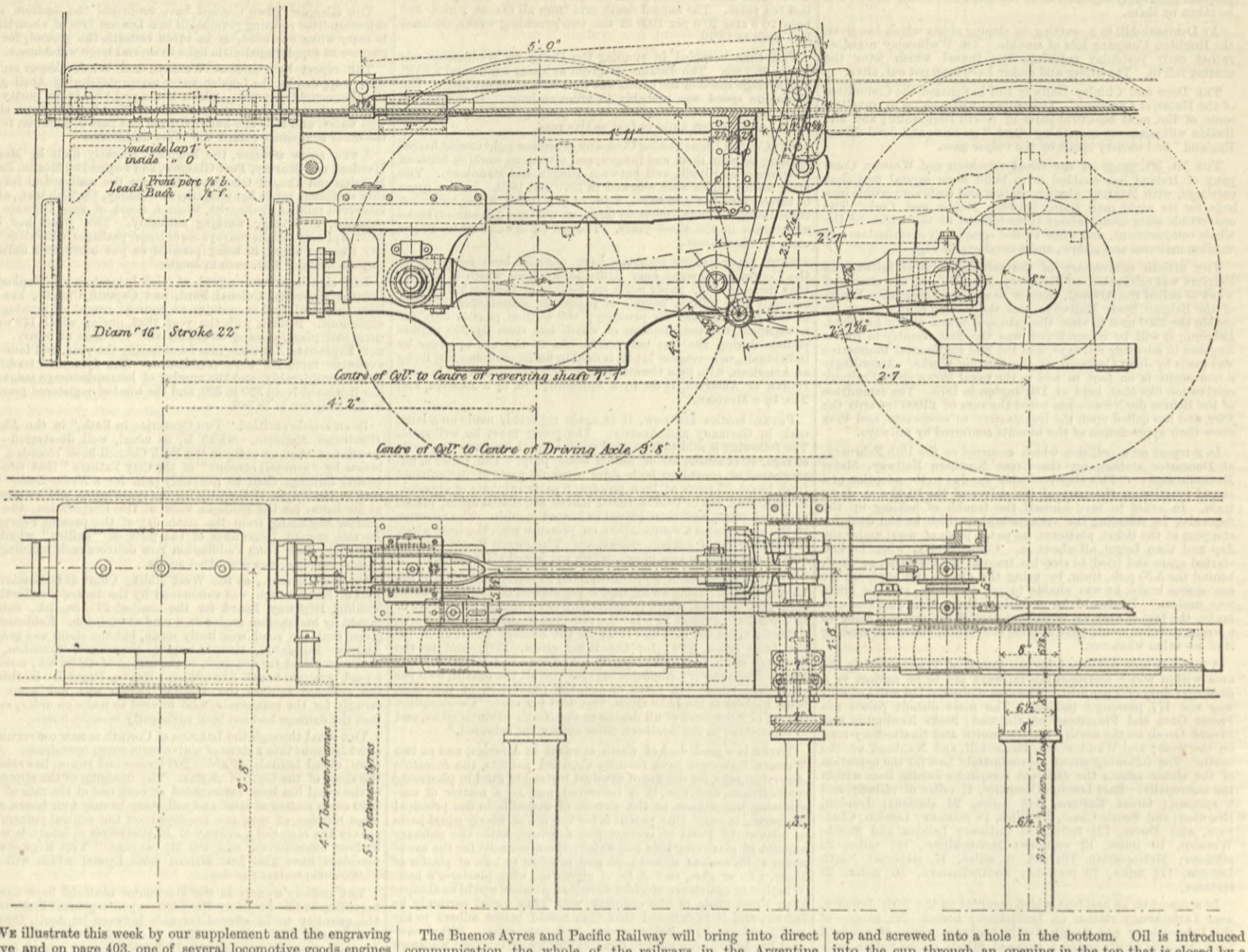
A NEW steamer, forming a valuable addition to the new coaling station at Perim Island, left the Mersey on Tuesday week. She was built by Messrs. Cochran and Co., of Birkenhead, of steel, and is fitted with a pair of inverted direct-acting compound surface-condensing engines, having cylinders 10in. and 20in., by 14in. stroke. The boiler, which is also made of steel, is of Cochran's patent multitubular type, and gave an abundant supply of steam. The vessel, which is called the Midge, was built for the special requirements of the new coaling station at Perim, under the personal superintendence of Messrs. Hinton, Spalding, and Co., and their consulting engineers, Messrs. Harvey and Bower, of Liverpool. The speed on trial which could be steadily maintained was about 9·3 knots per hour.

MESSRS. PONTIFEX AND WOOD are introducing what is named the "Farringdon" patent blowing lamp, for blowing joints, burning off paint, and loosening metallic joints when set with corrosion, and more especially for putting india-rubber tires on bicycles and tricycles. The novel part of the blowing lamp consists of a cylinder with two pipes, one telescoped over the other. One of these pipes—about 1⅝in. long—is attached to the top of the cylinder, and has a very fine jet formed upon its upper end. The other and longer tube, which slips closely over the fixed pipe, has two lateral openings, through which a proper admixture of air with the gas takes place, so as to obtain a pure blue flame, and around the bottom end of this pipe a small saucer is formed to hold spirit for starting the flame. When in use the cylinder is filled with pure benzine, and then the saucer nearly filled with methylated spirit. When this is ignited sufficient heat is conveyed to the cylinder to cause a stream of spirituous vapour to issue from the orifice with considerable energy, when it at once becomes ignited by the flame from the methylated spirit in the saucer, and can be applied as desired. The lamp is much safer than the French blowing lamp, as, unless the aperture for the escape of the vapour is open, there is no heat by which fresh vapour can be generated, and an explosion from this cause is therefore impossible.

A GREAT variety of building stone is available in New South Wales. In and around the city of Sidney there are numerous quarries in the sandstone of Hawkesbury formation, which is one of the upper members of the carboniferous group. The sandstone, is most commonly used in public and private buildings in Sidney. Extensive deposits of marble, of Silurian and Devonian ages, occur in several places in the colony. The black variety from the Marulan, and the white from the Cow flat marble quarries, have been used in flooring the Great Hall of the Sidney University. The marble near Wallerawang is thus described by Mr. C. S. Wilkinson, L.S., F.G.S., Government Geologist, on his geological survey map of the Wallerawang and Bowenfels District:—"Thick beds of coraline limestone of very pure quality. It forms a compact marble of various tints, white, cream, and dove-coloured, and sometimes with pink markings. It dresses well, takes an excellent polish, and may be obtained in blocks of almost any required size and quantity. Situated as it is, only seven miles from the Wallerawang Railway Station, it will be available for the iron-smelting works in the districts, and will afford a source of large supply for the Sidney market. The limestone consists almost entirely of corals—Favosites Gothlandica, Favosites polymorpha, Lithostrotion, and others, and molluscs as yet undetermined."

LOCOMOTIVE FOR THE BUENOS AYRES AND PACIFIC RAILWAY.

MR JAMES CLEMINSON, M.I.C.E., WESTMINSTER, ENGINEER-IN-CHIEF



We illustrate this week by our supplement and the engraving above and on page 403, one of several locomotive goods engines built from the designs of Mr. J. Cleminson, M.I.C.E., engineer-in-chief for the Buenos Ayres and Pacific Railway. The gauge of railway is 5ft. 6in., constructed by Messrs. R and W. Hawthorn, of Newcastle. These engines are mounted on eight wheels, of which six are coupled together, and have a diameter of 4ft. 3in. on the tread, the middle pair of wheels being without flanges. The leading wheels are 2ft. 8in. diameter on tread, and are mounted on Mr. Cleminson's arrangement of radial axle, and the cylinders are 16in diameter, with a stroke of 22in. The working pressure is 160 lb. per square inch. The whole of the plates composing the boiler are made of ductile steel, having a tensile strain of not less than 25 tons per square inch with 25 per cent. of elongation. The barrel of the boiler has a minimum internal diameter of 4ft. 1¼in., and a length of 9ft. 6in. The holes for the rivets throughout the boiler are drilled, and all rivets are fixed in place by hydraulic pressure. The fire-box is made of selected copper plates, and stayed by copper stays. The fire-box is made extra large for wood fuel. The tubes are all solid drawn brass, and 197 in number by 1⅞in. in diameter. The safety valves are of the equilibrated type. The main frames are of best Yorkshire plates, shaped out to the required form. The buffer beams are also of wrought iron plates. The cylinders are castings of a hard mixture of metal; they have the steam chests on the top. The cylinder covers are fitted with polished casings. The slide valve, glands, bushes, &c., are of phosphor bronze. The piston-rods are of steel. The crossheads are of cast steel, and fitted with phosphor bronze slippers. The slide bars, of which there is one of strong proportions to each cylinder, are also of steel. The connecting and coupling rods are of forged steel, and fitted with phosphor bronze. The valve gear is of the Joy type as illustrated above, forged of steel. The reversing of the gear is effected by a wheel and screw working through a phosphor bronze nut.

The wheel centres are of cast steel, and are fittted with cast steel tires secured in place by set screws. The axles are of mild Bessemer steel. The crank pins are of cast steel. The axle-boxes and hornblocks are of tough cast iron fitted with well-adjusted bearings and phosphor bronze bushes. The bearing springs are made of cast steel, and are balanced on Mr. Cleminson's principle; the equilibrating beams are also made of cast steel.

The boiler is fed by means of two No. 8 injectors and a donkey pump, and the feed pipes are of large size and made of good solid drawn copper. The steam pipes are also made of copper, the exhaust pipe being of cast iron. The engines are fitted with the usual mountings.

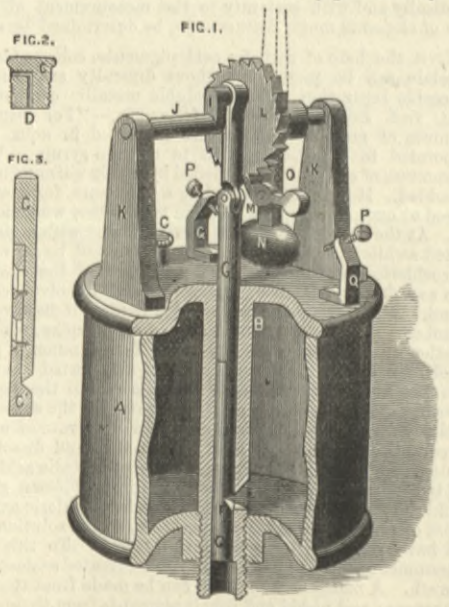
The cab is built of wrought iron, and fitted with hinged lights in the front and slide windows on each side. The cab covers the footplate, the roof extending well back over the footplate of the tender. The engine is fitted with a brake equilibrated throughout and with the brake gear of the tender, the whole of which is worked by a steam cylinder fixed on the engine. The brake blocks are of cast iron throughout. The front of the engine is fitted with side buffers having wrought iron cases, also a cow-catcher, which is built of pitch pine. The tenders of the engines are fitted with central buffers as well as side buffers, owing to the railway joining at its western end a network of lines, whose stock has only central buffers, whilst at its eastern end it unites with railways having only side buffers.

The Buenos Ayres and Pacific Railway will bring into direct communication the whole of the railways in the Argentine Republic save the East Argentine Railway, and is destined to become an important feature in the development of this wonderfully rich region. But its greatest importance lies in that it will become the highway between Buenos Ayres and Valparaiso, for it is part of an original and complete scheme conceived by Mr. Mateo Clark and his brother for the uniting of these two leading centres in South America. Messrs. Clark held the concession for the construction of this railway and for that portion of the system represented by the line under consideration, as well as of the railway now being made by the Government from the Andes termination of the Buenos Ayres and Pacific Railway to the city of Mendoza; they also hold the concession for the railway from Mendoza over the Andes to join the Chilian lines, the work of which latter section will involve some of the boldest feats in engineering.

When this gigantic scheme is completed—and it is now in a fair way to that end—the journey between the cities of Buenos Ayres and Valparaiso will be shortened by ten days, a boon which travellers and commerce alike will hail with satisfaction. We shall have more to say in reference to this trans-continental undertaking at a future date.

IMPROVED VALVE OILER.

The accompanying engraving shows an invention—which we copy from the *Scientific American*—recently patented by Mr. S.



D. Mershon, of Rahway, N.J., which is designed to facilitate the oiling of the moving parts of machinery, and also to secure regularity in the amount of oil delivered. Through the centre of the oil cup A passes a tube B, which may be made solid with the top and screwed into a hole in the bottom. Oil is introduced into the cup through an opening in the top that is closed by a cap C, having a hole D through it, as shown in the sectional view, Fig. 2, in order to admit air to the cup to take the place of the oil as it is discharged. In the lower part of the tube B is an opening E, through which oil passes to the interior and enters the recess F in the rod G. This rod fits accurately in the tube, and its lower portion is made up of two halves held together by screws passing through short slots in the extension part G^1, as indicated in the longitudinal section, Fig. 3. When the rod is raised, the recess comes opposite the opening and becomes filled with oil; as the rod moves downward, the oil in the recess is carried with it, and flows out through the lower part of the tube to the surface to be oiled. The upper part of the rod is jointed, and its upper end is attached to a crank formed upon a shaft J, revolving in bearings as shown. At each revolution of the shaft the recess F discharges its contents. On the shaft is secured a ratchet wheel L, into the teeth of which meshes the end of a pawl M, which is pivotted to and operated by the swing of the pendulum N. The pawl is held in gear with the wheel by the weight on the arm O. The jar of the engine will keep the pendulum in motion; but it may be extended as indicated by the dotted lines and actuated by an arm attached to some moving part of the machinery. The swing of the pendulum is limited by the set screws P, passing through the upper ends of the standards Q. By means of the set screws the movement of the pendulum can be regulated so as to move the wheel through the space of one or more teeth, thereby increasing or diminishing the time required for the shaft to make a revolution, and thus regulating the time between the discharges of oil.

COMPOUND ROLLING MILL ENGINE.

The engine which we illustrate on page 406 has been made by Messrs. Tannett, Walker, and Co., of Leeds, for the new plate-rolling mill of the Butterley Iron Company at Codnor Park. In another impression we shall give further illustrations and description of the mill designed by Mr. Hollis, the engineer of the works.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—David Wilson, chief engineer, to the Belleisle; James A. Shawyer, Edwin J. Comley, Alexander F. M'Intyre, George E. M. Key, and William T. C. Brewer, chief engineers, to the Vernon; William H. Grant, engineer, to the Belleisle.

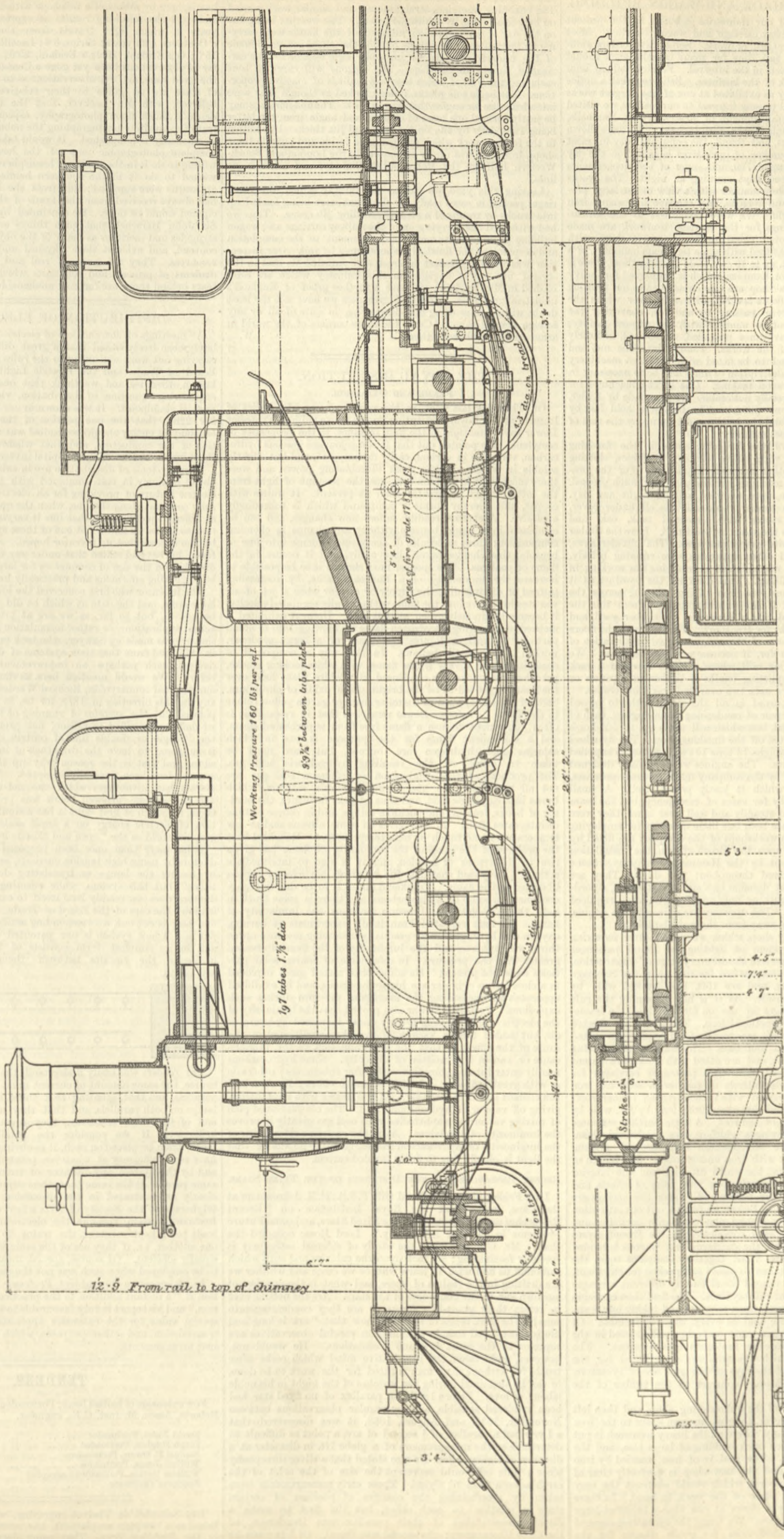
Railway Accident.—A New York Central Railroad express train coming from St. Louis was crossing the branch line at the grade near Rochester, New York, about midnight of Sunday, when a goods train on the branch line ran into it, throwing seven sleeping coaches from the line. Twenty persons were injured, including Prince Yamashina, of Japan, and eleven members of his suite.

The Forth Bridge.—On Monday afternoon the South-West Queensferry caisson of the Forth Bridge was successfully launched in the presence of the Lord High Commissioner to the General Assembly of the Church of Scotland and a large number of spectators. The caisson is 70ft. in diameter, and the total weight is about 200 tons. Its depth, when launched, was 44ft., and when finished it will be about 55ft. This is the first of four caissons required for the bridge. The ceremony of launching was performed by Miss Phillips, daughter of the managing partner of the firm of contractors, Messrs. Tancred, Arrol, and Co.

LOCOMOTIVE FOR THE BUENOS AYRES AND PACIFIC RAILWAY.

MR. JAMES CLEMINSON, M.I.C.E., WESTMINSTER, ENGINEER-IN-CHIEF.

(For description see page 402.)



RAILWAY CARRIAGE AND WAGON BUILDING.

Hardly any one of our industries is busier at the present time than that of railway carriage and wagon building. Most of the large firms are full of work. Some have orders sufficient to occupy them full time for many months, even should they receive no contracts in the interval. Foreign railway lines are supplying the bulk of the business. Believing that a notice of the current activity as exhibited at one of the largest works in the Midlands would possess interest to our readers, we visited a few days ago the establishment of Messrs. Brown, Marshalls, and Co., of the Britannia Works, Birmingham. We were shown all through the works, and found the company busy in most departments. The number of operatives engaged on the day of our visit was close upon 700, and some of the departments were, we were informed, kept running at night. The works are laid out in a complete manner with a view to the large production of carriages and wagons, and carriage and wagon iron frames in the best style. We were taken first to the smiths' shops, where the forgings for the carriage ironwork are made from superior scrap iron. These are two extensive shops, with sixty fires, and they are fitted with some ten steam hammers, of a capacity of from 10 cwt. up to 40 cwt. each. Besides these, there is another powerful steam hammer, which is employed for heavy forgings. In the same shop are two circular saws for treating sectional iron. The floors are laid with rails, over which the workmen's wagons were passing to and fro, conveying the forgings from one spot to another with the utmost facility; and this system of conveyance prevailed, we noticed, in nearly all the departments of the works. Passing into the nut and bolt shop, this we found to be fitted with excellent machinery for turning out every description of nuts and bolts necessary in railway carriage or wagon making. One of the machines for heading bolts was especially noticeable. It was made by Ryder, of Bolton, on Marsden's patent. The bolt was held fast by clamps on either side, and the head was driven up by the ram of the machine in a perfect manner.

Finer than either of the foregoing shops is the finishing shop. It is crowded with lathes, shaping machines, slotting machines, drills, and other automatic appliances. For the product of some of these machines the company was much pressed. The drills, for instance, were, we were told, on night and day. After glancing at the timber yard, which is all under cover, and which is well stored with seasoned teak, oak, and mahogany, we came to the spacious wood mill. Here the timber is sawn into the requisite shapes and sizes. The circular saws, planing machines, and other apparatus were running briskly. Our especial attention was called to a revolving fan working in one corner of the building. This drew all the sawdust as it fell from the machines into iron piping running across the workshop, and whirled it into an accumulator. From this the sawdust was discharged into a hopper in the timber yard, and is then loaded into sacks for transport. The fan keeps the floors perfectly clear, and allows of the uninterrupted continuation of work at the machines for, if necessary, weeks together. We next looked in at the log mill, where a frame saw and a rack saw were erected for splitting baulks of timber into panels or boards, and where there were two overhead travelling cranes.

The machinery employed in all the shops hitherto passed through is driven by a pair of condensing beam engines, each of 50-horse power nominal, but which will work up to 500-horse power. They are located off the finishing shop. The fly-wheel is 20ft. diameter, and weighs 16 tons 10 cwt. Steam is supplied by a set of three boilers. The engines were specially designed and made throughout by the company upon its own premises, a circumstance upon which it justly prides itself. A small engine is erected close by for cases of emergency, but the beam engines have worked so steadily and well ever since they were laid down, that there has been but little necessity for employing the lesser engine. The workshops of the company are fitted up with the electric light upon the Brush system, the installation having been carried out by the Hammond Company. Some forty lamps are scattered throughout the shops. They are supplied by a forty-light dynamo or a six-light dynamo, according as several departments or only one department is required to be kept on at night. The dynamos are driven by an engine, situate in its own house away from the main buildings.

In the carriage body shop, which we visited after inquiring into the company's system of lighting, we found passenger carriages and goods wagons in almost every stage of construction. Certain of the covered wagons are for use upon the Santiago and Valparaiso Railway, and are 15ft. long by 8ft. wide by 7ft. 6in. high on the inside. As it is fast becoming the rule with wagons and carriages for use on foreign lines, the framework is made entirely of sectional iron. The bodies are sheeted with red deal. The roofs are to be of galvanised corrugated iron carried upon T iron roof bars. The wagons have sliding doorways on either side, and are fitted with Newhall's patent brake. We also noticed third-class passenger carriages for Jamaica, the body made entirely of teak with sectional iron frames. These are provided with arched ribbed timber roofs of light construction, and are about 26ft. long by 8ft. wide by 7ft. high to the inside of the roof. A little further we came upon long passenger carriages, which at once proclaimed themselves intended for the Metropolitan Underground system. The bodies are of teak with iron underframes. The length of the carriages is 39ft. 6in., the width 8ft. 3in., and the interior height 7ft. 2in. They travel upon four pairs of wheels, and to allow of the more easy turning of curves the springs are hung in long link fashion. Before we passed out our attention was called to some first, second, and composite carriages and brake vans which were being completed for the Buenos Ayres and Pacific Railway. All the carriages and wagons intended for foreign despatch are fitted together complete upon the premises, and are then taken to pieces and packed for shipment. In the paint shop were ranged some twenty different carriages intended for three or four railway lines. The first-class carriages for Buenos Ayres we found, upon entering and taking our seats, to be perfectly complete and in every way comfortable. Of course, there were the usual cane seats, but upholstered in the same manner as an English first-class compartment. The louvre blinds, with which the windows were fitted for the admission of air without the rays of the sun, are of sycamore. This wood formed a pleasant contrast to the timber of the carriage bodies.

We took a hasty view of the upholstering shop, and then left the buildings, only, however, to cross an open space to the iron frame shop of the company, where all the heavy ironwork is put together. This is an open brick building of large size, and the greater part of it is new. The roof is of iron, carried by iron principals and girders, and the new shop is perfectly clear of any pillars or other supports, which would obstruct the easy removal from place to place of the work in hand. In these shops the company can put down at one time a hundred large iron frames for goods wagons. We found the operatives engaged chiefly upon heavy underframes for goods wagons for the Western Railway of Buenos Ayres. The frames are of angle and T iron, of Staffordshire make, and are very substantial. The punching, shearing, straightening, and similar work carried on here is all done by hydraulic power. The weather being fine on the day of our inspection, numbers of the hands were carrying on operations in the yards outside the shops proper. Some of the underframes are for immense bogie wagons for the carriage of timber in Santiago. The wagons will carry 25 tons each, and the iron of which they are built is of massive proportions. The bogie sole plates, indeed, looked as though they were intended more for engine than wagon work. The underframes may be justly termed one mass of channel and angle iron, the latter being 12in. deep by 4in. on the web, and $\frac{3}{4}$in. thick. In addition to the foreign work which was going on inside and outside these shops, ironwork was under execution for the London and South-Western Railway, the Metropolitan Railway, and other home lines.

Leaving this yard, we gained the railway siding, where carriages packed in cases ready for shipment were being loaded up into trucks by means of a steam travelling jib crane. Thus we had witnessed the carrying on of the railway carriage and wagon building trade from its very commencement to the completion and despatch of the finished manufactures by rail. Our inspection was of the greatest interest, and satisfied us that in the several fine works engaged in this industry which are established in Mid-England, we have a further proof of England's industrial greatness. And that greatness we have not the least doubt will go on growing and developing, in spite of all or any foreign competition. "Come the three corners of the world in arms, and we will shock them." W.

THE ROYAL INSTITUTION.

Flame and Oxidation.

On Thursday last week, in the course of one of a series of lectures at the Royal Institution on the above subject, Professor Dewar gave attention, in the first instance, to the properties of acetylene. He pointed out that it is a colourless gaseous hydrocarbon, very rich in carbon, easily decomposed, and but slightly soluble in water. It has great illuminating power, and were there more of it in London coal gas, the amount of light from the latter would be greater than at present. It unites with copper, and thereby forms a compound which is exceedingly explosive. Acetylene readily suffers new changes, and can be condensed into liquid benzole without any change in chemical composition; three molecules of acetylene condense into one of benzole; this change takes place easily, and it occurs in the flame of coal gas. The speaker next showed it to be possible to increase the luminosity of a Bunsen's flame, by increasing, instead of diminishing, the supply of air; for when a jet of air was steadily blown into the flame with carefully regulated velocity, it became luminously green at that part. He next exhibited a method of colouring a hydrogen flame by blowing into it small particles of various liquids by means of a spray producer, worked by a small bellows. In this way a compound of chromium gave a very white flame, with white-looking smoke, yet when the smoke was condensed on a white plate held over the flame, it proved to be the bright green oxide of chromium. Salts of sodium applied in a similar manner gave a yellow colour to the flame. Professor Dewar remarked that in research it is often convenient to use a flame free from superheated steam, and a convenient flame for the purpose is one in which chlorine and hydrogen are burned, but care must be taken to carry off the resulting hydrochloric acid gas. The products of the combustion of common coal gas are not all harmless; the gas always contains sulphur, which burns into sulphuric acid, and thus attacks furniture, the binding of books, leather, and suchlike things, and in course of time disintegrates them. It also gives off some nitrous acid at low temperatures, and much at high temperatures. He added that the problem of the cause of the luminosity of flame has given rise to differences of opinion, and it is due to intermediate actions. Davy said that it is due to small particles of carbon liberated in the flame. Frankland states it to be due to highly condensed vapours of hydrocarbons, and there is some truth in both these allegations. Pressure increases the luminosity of flame. He here repeated Frankland's experiment of burning oxygen and hydrogen under gradually increasing pressure up to thirty atmospheres, and the luminosity of the flame increased greatly with the pressure. In this flame, of course, solid particles were not present He added that mixed gases exploded in a closed glass cylinder are highly luminous, and he exhibited apparatus for measuring the maximum pressure during such explosions. Professor Dewar also proved that the luminosity of the electric spark increases greatly under increased pressure of air, but added that a variety of hypotheses will explain the cause of the effect, so that the determination of the primary cause or causes is a matter of difficulty. Some hydrocarbons readily enter into combination with other substances; others do so with great difficulty. A little bromine will rapidly absorb all the olefiant gas in a large jar. It also unites with naphthaline, giving off vapour of hydrobromic acid. The old-fashioned plan of mixing vapour of naphthaline with coal gas greatly improves the luminosity of the latter. As to the various explanations of the luminosity of hydrocarbon flames, there is no doubt that the light is chiefly due to finely divided carbon.

Recent Researches on the Distances of the Fixed Stars.

Last Friday night Mr. David Gill, F.R.S., H.M. Astronomer at the Cape, lectured at the Royal Institution on "Recent Researches on the Distances of the Fixed Stars, and some Future Problems in Sidereal Astronomy." Lord Rosse occupied the chair. Mr. Gill said that the study of sidereal astronomy is specially fascinating; we look upon the galaxies and suns which surround us and wish to learn whence we come and whither we are drifting in the realms of space, and what is the position of our own sun in the concourse of the stars. Are the nebulæ ever to retain their ghost-like forms, or are they condensing into suns? The discoveries of the past show that "art is long and life is short," and that in the long run careful observations are superior to the most brilliant speculations. He would not, however, undervalue the imaginative mind which seeks after truth, for without it no man is fitted for the work to be done, or can be sustained during the watches of the night in his noble labour of love. Before 1832 the parallax of no fixed star had been rendered sensible, and by regular observations between November, 1835, and August, 1838, it was discovered that α Lyræ had a parallax of $\frac{1}{4}$ second of arc, a point as difficult to determine as the measurement of a globe 1ft. in diameter at a distance of eighty miles. He also stated that a silver threepenny piece a mile off would represent the size of the orbit of the earth as seen from 61 Cygni. These early measurements were taken by ascertaining the changes of position of certain stars in relation to each other, but the first to make a direct measurement of their parallax was Henderson, of the Cape Observatory; the second was Bessel. Of late years he —Mr. Gill—and a young American astronomer, Dr. Elkin, had been measuring the distances of some fixed stars in the southern hemisphere by means of a telescope with a divided object glass, and with the following results as expressed in the number of years in which light travels from them to the earth:—α Centauri, 4·36 years; Sirius, 8·6; Lacaille (9352), 11·6; ϵ Indi, 15·0; O 2 Eridani, 19·0; ϵ Eridani, 23·0; ξ Tucanæ, 54·0. So far as observations have yet gone α Centauri is the nearest of the fixed stars, and eye-observations as to the relative brilliancy of stars are no guide to their relative true distances. He believed, with Mr. Lockyer, that the future of astronomy depends much upon photography, especially since the recent feat of exquisitely photographing the nebula of Orion had been so efficiently accomplished. It would take ten years to make a complete photographic map of the heavens. Dr. Elkin was willing to do it in the northern hemisphere, and he—Mr. Gill—wished to do it in the southern hemisphere if the necessary apparatus were supplied; this, from the kind consideration he had always received from the Lords of the Admiralty, he anticipated would be done. He concluded by quoting the words of Sir John Herschel, that such things are quite as worthy of struggles and sacrifices as many of the objects for which nations contend, and exhaust their physical and moral energies and resources. They are gems of real and durable glory in the diadems of princes, and conquests which, while they leave no tears behind them, are for ever unalienable.

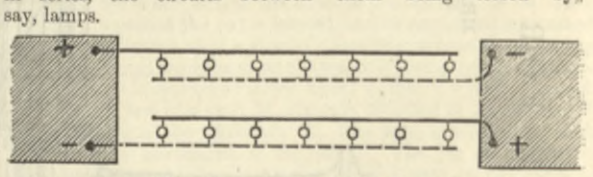
DISTRIBUTION OF ELECTRICITY.

At meetings of shareholders of electric light companies it has lately been freely stated that a great difficulty in the way of carrying out work was owing to the rules and conditions of the Board of Trade, and the Electric Lighting Act. Some have known otherwise, and we think that one difficulty lay in the engineering question of distribution, viewed from the commercial standpoint. It was shown in our impression of February 22nd, that the one portion of the apparatus in which economy in outlay should be studied was the weight and insulation of the conductors, and that whatever tended to reduce these was so much saving of capital invested.

Many systems of distribution are in existence having for their object economy in cost, combined with the no less important electric feature of providing for an electro-motive force practically constant along the line, when the quantity of current used at different points along that line is varying from hour to hour, but, so far as we know, not one of these systems has proved to be the success that its inventor hoped. As we mentioned, Professor Forbes had stated that under any then existing system of distribution the size of conductors for large installations would be something enormous and practically impossible.

The inventor who first conceived the idea of distribution on a large scale, and the date at which he did so, will probably never be known, but so far as we are at present aware, the first actual application—or rather formulation of the idea into actual shape—was made by Sawyer, who took out a patent in America in 1877, and from that time systems of distribution have been devised, each perhaps an improvement on what has gone before. We would mention here, as due to his memory, that our adopted countryman, Richard Werdermann, did as much as any in this direction in 1878, for he, in his patent No. 2477, pointed out the systems of running or laying conductors that we daily see ascribed to Edison, now pretty generally known as the "single or double line of centres system." This system is supposed to have the drawback of inadaptability to extensions, and that is the reason why up till now the net-work system has been generally adopted. The line of centres system has advantages which the net-work system has not, and the system reviewed below was probably founded upon them, although at first sight it has a similarity to the distribution of electric energy on a small scale, known in the telegraphic world as the "open and closed circuit system."

It has more than once been proposed to economise in conductors by using high tension currents, as in the Sawyer system, by having the lamps or translating devices in "series multiple;" but this system, while effecting a great saving in conductors, does not readily lend itself to extensions, and moreover is under the care of the Board of Trade. In it, also, when any one lamp is cut out, a corresponding artificial resistance must be put in. A new system is one patented by Mr. J. S. Beeman, and in its simplest form consists of two dynamos worked in series, the circuits between them being closed by, say, lamps.



Our readers will easily understand the diagram, and that, of course, the same amount of current must be circulating on both parallels, and that, granting that there is an equal number of lamps on both parallels, and that they are equally distributed and of the same resistance, they must all be of the same brilliancy. If we consider the parallels as rails, and a motor train be placed on each, it is obvious that the motor will have equal efficiency at whatever point it may be on the line, and by this system any number of trains can be run on the same parallel at the same time, thus supplying a want that was clearly demonstrated in the discussion after the lecture on telpherage at the Society of Arts a few days since, for, by Mr. Beeman's system, through the electro-motive force along the leads being kept constant, the trains do not tend to overtake one another, *i.e.*, if they are of the same weight and their motors equally efficient. Of course, special means would always have to be employed when such was not the case.

In his report on this subject, Professor Forbes says the invention is "a distant addition to the practice of electrical distribution," and his report is very favourable to the invention as having special value for the extensive applications of electricity for transmission and other purposes, which are too costly by present arrangements.

TENDERS.

For extension of ballast bank, Portmadoc Harbour. Mr. Thomas Roberts, Assoc. M. Inst. C.E., engineer.

	£	s.	d.
David Jones, Portmadoc	328	0	0
Hugh Hughes, Portmadoc	324	0	0
Samuel P. Owen, Portmadoc	272	0	0
William Jones, Portmadoc	255	9	0
William Davies, Portmadoc—accepted	250	6	0
Engineer's estimate	265	0	0

The Salterhebble Viaduct engraving, which we recently published as a two-page supplement, has somehow reproduced itself in the *Building News*. That paper does not, of course, know where it came from.

LETTERS TO THE EDITOR.

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

RAILWAY SIGNALS.

SIR,—I was glad to see that you thought the subject of our correspondence of sufficient importance to devote some of your space to a leader on it. Your correspondents seem entirely to ignore that part of my letter in which I say that there are exceptions to every rule, and that I am aware there are lines on which the signalling is defective, for the reasons I stated. I merely disagree with Mr. Stretton, that I do not consider railway signalling deserves such wholesale condemnation as he seems to think, although, as I inferred, it was not perfect. I also quite concur with you in thinking that drivers are a far more intelligent set of men than Mr. Stretton seems to consider them. He also states that he thinks I have entered into this important discussion without sufficient consideration of the subject. This is hardly the case, as it is a matter which I have and have had for some years almost daily before me, which is perhaps more than he can say. No good purpose can, however, be served as you justly remark in your leader, by exaggeration of any kind, or by personalities; what we require to do is to arrive at facts.

I do not think Mr. Ahrons exactly understands my point about distant signals. To be more explicit. Some companies work the distant as a home signal, by making it a stop signal, as well as the home, instead of allowing trains to draw past and stop at the home as usual. I quite believe that some of the oldest companies have the most defective signal arrangements, because, as I stated, they were opened before the Board of Trade had its present authority, and before railway working had become as much of a science as now. I know from experience, and any railway man who has been present at the Government inspection of a new line will concur with me, that the Board of Trade officers are most exacting and particular—and rightly so—about the signal arrangements. Amongst other things they notice how far the signal can be seen by the driver, whether there is a good back ground, or any intervening objects, and in the case of a signal not being visible from the cabin, they insist upon a repeater. To give you an example. I remember the case of two starting signals—main and back platform—being on one post, the top signal being of course left-hand road. The inspector would not pass the post, but insisted on a bracket post being substituted. In your article you mentioned electricity, and cited some instances where it could be applied.

I have recently made some experiments with regard to this, taking the rail as a conductor. It was first brought to my notice by your article on the Chicago Railway Exhibition. I found, however, that the resistance of the fish-plates was too great, there was not good enough contact, and of course separate contacts at each joint mean expense. I think for the cases you mention a lock bar is a good arrangement. The North London have fitted all their stations with a platform fouling bar. The great difficulty with hydraulic, pneumatic, and electrical arrangements, is their liability to get out of order, and the great care required in maintenance. On a railway nothing should be left to chance, and careful watching means expensive maintenance. To prevent the error you mention, of the signalman forgetting he has a train "on" and giving "line clear," there is a beautiful system of electric locking in vogue, called "the union of the block and interlocking systems" and the "electric slot signal." At the time of the Royal Show at Kilburn, Messrs. Saxby and Farmer, the owners of the patents, opened their museum to visitors, and explained the working of this arrangement. It has, I believe, been adopted on the London, Brighton, and South Coast, and on some French lines. They summarise its advantages in the following way:—(1) Points and outdoor signals must be in proper position before "line clear" can be telegraphed for an expected train. (2) No movement of points can be made for shunting or giving access to a line signalled by telegraph as clear for an expected train, the points remaining firmly locked until the train has passed out of the block section. (3) Having once sent "line clear" on the telegraphic block instrument, and the permission to send a train on having been accepted, and acted on by the signalman at the next station, it is impossible to transmit a second message of "line clear" until the expected train has passed; thus two trains running on the same line of rails cannot be signalled to enter the same section at once, the first train must have left the section before the second one can be permitted to enter. (4) The outdoor starting signal cannot be given to permit entrance into a block section without the consent and concurrent action of the signalman at both ends of such block section; and by means of the electric slot the outdoor signal at one station can be instantaneously changed from the "safety" to the "danger" attitude from any other station, irrespective of distance. (5) The mechanism makes it compulsory that the outdoor starting signal shall be reset to "danger" behind every train; and that upon the entrance of a train into a block station, the signalman at the station in advance shall give to the signalman at the station in the rear the proper signal of line blocked behind the coming train. (6) The signal "train on line" must be transmitted to the station in advance before the outdoor signal for a train to enter a block section can be given, so that it is not possible for a train to enter a block section unannounced by telegraph to the station in advance.

I find I have wandered rather far from the original starting point, though I am on the same subject; but the largeness of the subject, and the ground covered by your article, must be my excuse.

WM. MARRIOTT,
Assoc. Mem. Inst. C.E.

May 21st.

THE PRESENT PROSPECTS OF YOUNG ENGINEERS.

SIR,—The present prospects of our young engineers can hardly be considered satisfactory—in fact, one has only to look through the columns of any of our engineering papers to be assured of the fact by the great number advertising for employment; and if he need further proof, let him insert an advertisement for an assistant or draughtsman at even nominal salary, and he will have, perhaps, 200 or even 300 answers; then will his eyes be opened to the true state of affairs, and he will ask himself, "When will all these applicants be employed?"

If he take any further trouble in the matter, as the writer has, to find out anything about the qualifications and abilities of these applicants, he will find that a number of them are men not only of high character, but also of considerable ability and experience, and men who would prove an acquisition to any staff to which they might be appointed.

It is sad to think that these men may have spent not only many years in study and hard work, but also a great portion of their earnings, and are now unable to recoup themselves; or that the younger ones, having paid large premiums to be apprenticed to learn their professions, and having served their time creditably, are turned into the world to seek occupation how and where they can, their late master thinking he has done his duty conscientiously when, on returning them their articles, he promises "to do what he can to further their interests," and then thinks no more about them. This to some will appear hardly credible, but nevertheless it is a fact; and having carefully looked into this subject, I know several instances where such has happened, and will quote one. A tailor having saved a little money, and having given his son a good education, resolved to apprentice him to an engineer. He accordingly paid this engineer a premium to take him into his office for four years, and the engineer also promised to give him a little practical experience as well. From the day the boy entered the office to the day he left, the engineer never taught him anything, but left it entirely to his manager. The manager was a man who thought that, as he received no portion of the premium, it was not incumbent upon him to take any great trouble with the boy, and simply taught him how to trace and copy drawings. The boy, however, being an industrious lad, attended evening classes in designing and mechanical drawing; he also took private instruction from an engineer in estimating, taking out quantities, strains on girders, &c., thus spending a great deal of money, although he was receiving no salary at his office. The result was that at the end of the four years he turned out a good draughtsman and mathematician, and although he had never had any practical experience in shops, he was competent to accept any situation in the drawing-office. His master, on returning his articles to him, promised to try and get him a place, and wished him every success; yet the young man had no sooner left his office, than he—the engineer—thought no more about him, and for nearly two years the young man was without employment, and at the end of that time he went abroad, and is now doing well.

I could quote several other instances, but feel confident that this one will be quite sufficient to show what a serious matter it really is, when one looks into it, for our young engineers to get employment.

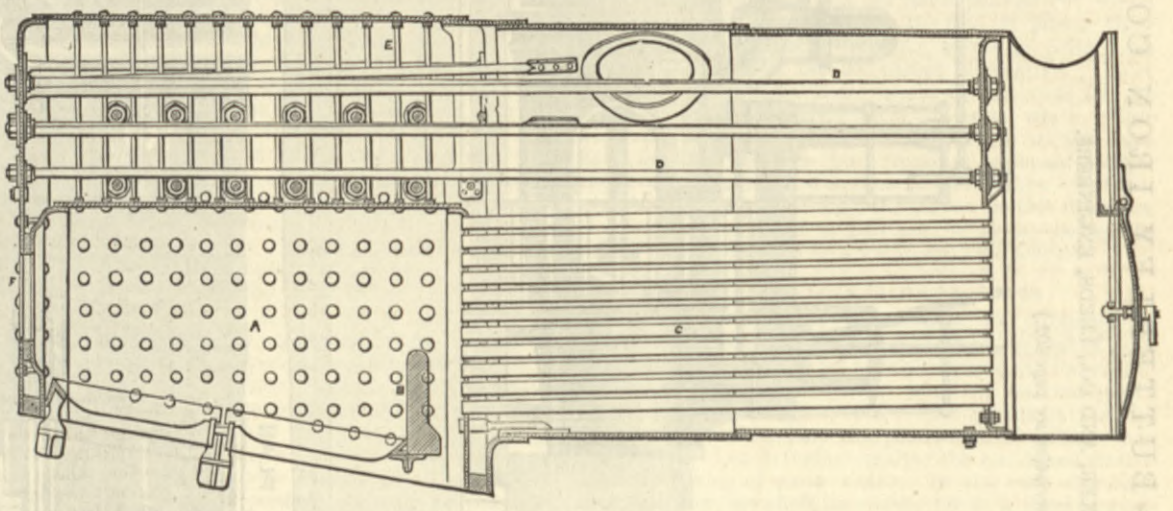
And now, How can this be remedied? It can be partially remedied in two ways: (1) A certain firm with which I was once connected used to get their assistants all the way from Germany! Surely this is quite unnecessary. It is easy enough to get just as good assistants at home; and if German employés are a little cheaper, they cannot be much cheaper, and it becomes a duty for those firms which send abroad for their assistants—and I believe there are many—it becomes a moral and patriotic duty, to assist our own countrymen, and those who may be near at hand, perhaps in want, instead of passing them by to go to foreigners. (2) Could not an agency be started for the purpose of inviting all engineering assistants in search of employment to send such particulars as their names, ages, copies of testimonials, work previously employed on, &c.; such agency to publish weekly or monthly a journal containing these names, and send a copy to most of the chief engineers, and to charge no preliminary fees, but a small commission on the first year's salary to all for whom they should find employment?

And now I must conclude. This is a subject which I have long wished to see introduced into our engineering papers, and if by these few lines I have caused any readers to interest themselves on the subject, I shall be more than rewarded for my trouble.

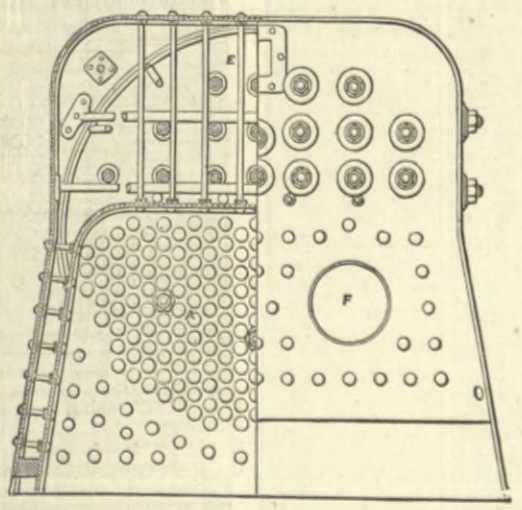
CLAUDE E. H. AUDAIN, C.E., Assoc. Soc. Eng., &c.
42, Devonshire-chambers, Bishopsgate-street,
May 27th.

LEAKAGE IN TORPEDO-BOAT BOILERS.

SIR,—One of the inconveniences experienced in the boilers of torpedo boats is the leakage of the tubes at the fire-box end. The boilers, as is well known, are of the locomotive type, and a longitudinal and cross-section of one of them, as made by Messrs.



Thornycroft, are given in the annexed figures, where A is the furnace, B the bridge, C the tubes, D the longitudinal stays, E the crown stays, and F the furnace door. In this boiler the furnace was originally made of copper and the tubes of brass, nothing being left undone to make the boiler as efficient as possible. The draught through the tubes was, as usual, maintained by a fan forcing air into the stoke-hole, and it was found on repeated trials that, so long as the fan was kept going, there was no leakage at the ends of the tubes within the furnace, but when the fan was eased or stopped at the conclusion of the experiment, the tubes at once began to leak, and soon leaked so much as to put the fire out altogether. On examination of the boiler when cold, it was found that the tubes were invariably slack in the furnace tube-plates, and



in some cases were oval in the vertical direction, and in other cases in the horizontal direction; in one case one of the tubes was found broken off.

Now what is the cause of these anomalies? They have never been explained, and the perpetuation of them has greatly embarrassed the construction of such boilers in the future. Messrs. Thornycroft had to remove the copper fire-box and the brass tubes, and to substitute a fire-box and tubes of iron, by which, for the time, the evil was surmounted; but surely the copper and brass would have been much better but for this intractable leakage, and it is very important to find out what is the cause of it. My belief is that the evil arises from the unequal expansion of the shell and of the internal parts of the boiler, consisting of the fire-box and the tubes. Brass and copper expand more than iron at the same temperature, and the internal parts, being hotter, will also expand more on that account. The consequence is that the tubes are compressed endways, and bend sideways, under the strain, making the holes oval, sometimes in one way and sometimes in another. So long as the high temperature is maintained the bent tubes in the oval holes remain tight, but immediately the temperature is reduced the tubes, being released from the bending strain, become straight again, when the tubes, being left slack in the holes, necessarily leak. If this diagnosis of the ailment be correct, the proper remedy appears to me to lie in the corrugation of the boiler-shell, so as to permit its elongation with the expansion of the tubes. The sides and top of the furnace might also be corrugated, and the tubes, instead of being quite straight when inserted, might also be somewhat bent, the holes being made slightly oval to permit a tight fit being made at the ends. Instead of bending each tube, however, it might be made somewhat spiral, when the holes in the tube-plates might be round, as at present, but be placed a little further apart.

H. CANNING.
Muswell Hill Engineering College,
May 21st.

TORPEDO BOATS.

SIR,—Now that torpedo warfare has become a national institution, may I recall the following, that have from time to time appeared in your valuable paper:—

In 1868 I explained to the Floating Obstruction Committee the plan I read a paper on at the British Association meeting at Edinburgh in 1871.

In a letter from the Admiralty, dated the 26th August, 1868, "Their Lordships consider that, although your method shows very considerable ingenuity, they are not of opinion that it is likely to be of use to H.M. Navy."

In THE ENGINEER of 20th October, 1871, a communication from me contains these words:—"There is no doubt that the introduction of invulnerable and efficient torpedo boats must revolutionise the whole system of armour-plated ships, whose weight and unwieldiness would only favour their own destruction, without enabling them to evade or paralyse this mode of attack."

I still maintain that the system I explained in 1868 is the best, and the discussion at the United Service Institution still further strengthens that opinion.

PHILIP BRAHAM.
7, Miles's-buildings, Bath,
May 26th.

NOMINAL HORSE-POWER.

SIR,—With reference to the letter you have received, and the article you have written commenting on the indeterminate character of a nominal horse-power, allow me to suggest that it would be the simplest and most judicious course to discard altogether a unit of measurement the magnitude of which is unknown, and the retention of which, in technical parlance, only perpetuates confusion. There are two rules for nominal horse-power well known to engineers, and from which all the others have, I think, been derived. The first was given forty years ago by the principal of this College in his "Treatise on the Steam Engine," and according to it the square of the diameter of the cylinder in inches, multiplied by the cube root of the stroke in feet, and divided by 47, will give the nominal power. The second is what is called the Admiralty rule, which was given to the Admiralty by Mr. Laurie, of Glasgow. It is a modification of the rule of the late Mr. Barnes, which is expressed by the formula $\frac{(d-1)^2 v}{5640}$, where d is the diameter of the cylinder in inches, and v the velocity of the piston in feet per minute. The first of these rules was applicable to paddle and geared screw engines, the speed of which in feet per minute was about 128 times the cube root of the stroke. The second was applicable also to direct-acting engines, as it took into account the element of speed, but not the element of pressure, and so it would not express any uniform relation between the actual and the nominal power. I see no reason, indeed, why we should perplex ourselves by trying to establish such a relation; or why we should retain so indeterminate a unit as the nominal horse-power at all. The power of an engine is the dynamical energy it is able to exert, and if the expression nominal power occurs in Acts of Parliament and other documents, the common sense course is, I submit, to translate the phrase into such an equivalent of actual horse-power as the date of the document would approximately fix by the prevalent ratio then subsisting between the actual and the nominal horse-power.

A. E. A. EDWARDS.
College of Practical Engineering,
Muswell Hill, May 27th.

HYDRAULIC LIFTS.

SIR,—We have read a letter in your last week's issue under the above heading from a correspondent who signs himself "Economiser," and who objects to your use of that word in describing our patent hydraulic balanced lift. We do not know whether your correspondent does not understand the nature of the patent and desires information, or whether he merely desires to criticise; but if he will give his name and address to us direct, we shall be very pleased to show him lifts working on our principle and explain to him wherein the economy is obtained by our patent, which under certain conditions is economical as well as effective. Though what we chiefly claim for it is its safety and efficiency rather than economy; though on the latter point also it will compare favourably with the systems of other manufacturers.

R. WAYGOOD AND CO.
Falmouth-road, Great Dover-street,
London, S.E., May 28th.

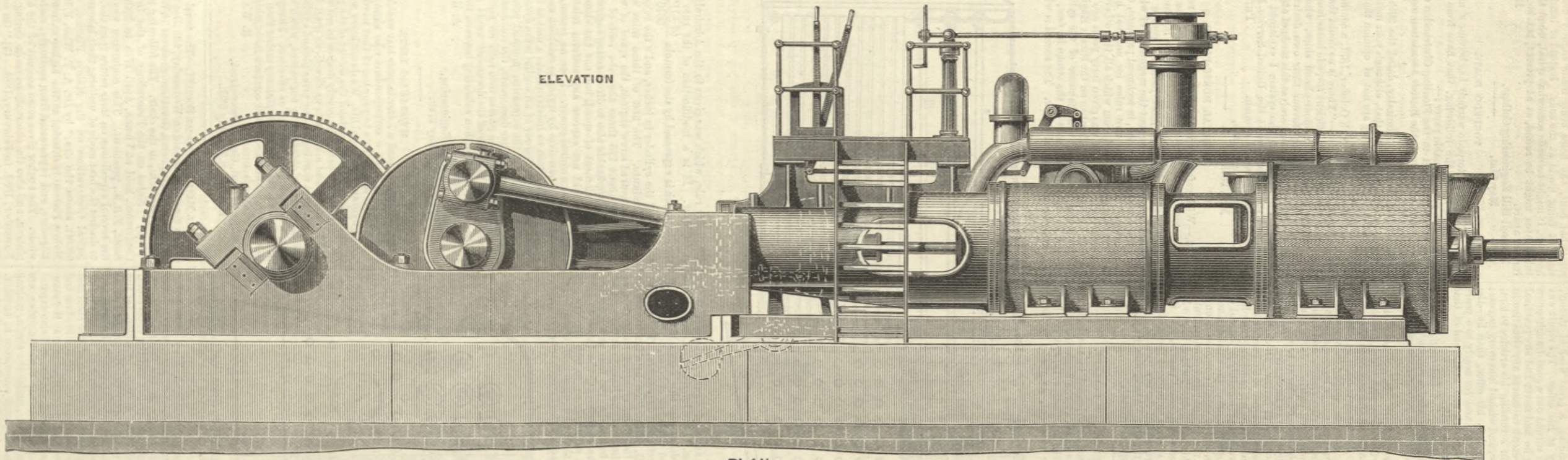
ROYAL METEOROLOGICAL SOCIETY.—The usual monthly meeting of this Society was held on Wednesday, the 21st inst., at the Institution of Civil Engineers, Great George-street, S.W.; Mr. R. H. Scott, F.R.S., president, in the chair. The following papers were read:—"(1) "Notes on the Proceedings of the International Polar Conference, held at Vienna, April 17th to 24th, 1884," by R. H. Scott, F.R.S., president. This conference was held to welcome the several expeditions on their return from the Arctic regions, and to discuss the best mode of utilising their labours. (2) "Meteorological Observations on the Maloja Plateau, Upper Engadine, 6000ft. above the Sea," by Dr. A. T. Wise, F.R. Met. Soc. The Maloja Plateau is situated at the higher extremity of the Upper Engadine, and is protected from northerly, easterly, and southerly winds. The author gives some account of the meteorology of this plateau, and also the observations made during the four months, November, 1883, to February, 1884. (3) "On some Results of an Examination of the Barometric variations in Western India," by A. N. Pearson, F.R. Met. Soc. (4) "Illustrations of the Mode of taking Meteorological Averages by the Method of Weighing Paper Diagrams," by R. Inwards, F.R. Met. Soc., F.R.A.S. (5) "Ten Years' Weather in the Midlands," by Rupert T. Smith, F.R. Met. Soc.

COMPOUND REVERSING ROLLING MILL ENGINE.—BUTTERLEY IRON COMPANY'S WORKS, CODNOR PARK.

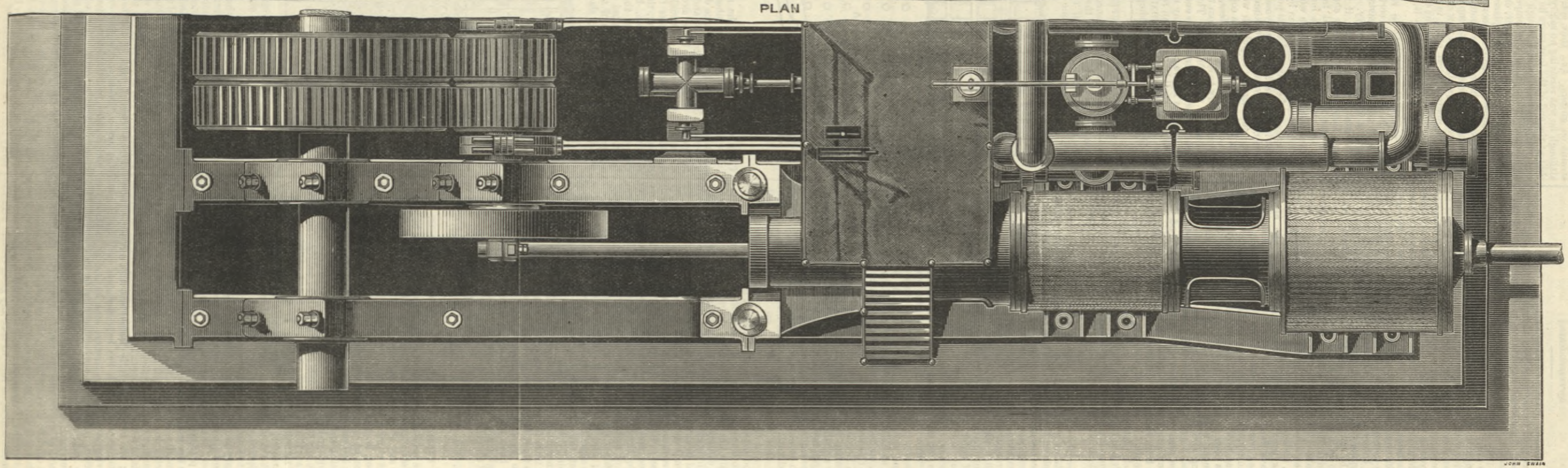
MESSRS. TANNETT WALKER, AND CO., LEEDS, ENGINEERS.

(*For description see page* 402.)

ELEVATION



PLAN



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BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—MESSRS. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

PUBLISHER'S NOTICE.

**** *With this week's number is issued as a Supplement an Engraving of a Locomotive for the Buenos Ayres and Pacific Railway. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

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

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ARROWROOT MACHINERY.

(To the Editor of The Engineer.)

SIR,—I shall be glad if any of your readers can tell me the names of makers of complete plant for preparing arrowroot for the market.

London, May 27th. N. B.

TURBINE TAILRACE.

(To the Editor of The Engineer.

SIR,—Would some of your readers kindly give me the solution of the following problem? What depth will the water stand in a tailrace if 16 cubic feet per second will flow out of a turbine, the race being square, 6ft. wide, built of bricks, and the first 2880ft. quite level, an inclination of 1 in 1000 beginning after this level portion?

Mexico, May 8th. A MEXICAN SUBSCRIBER.

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THE ENGINEER.

MAY 30, 1884.

LIVERPOOL DOCK ACCOMMODATION.

THE large and progressive development of the trade of the port of Liverpool is daily making it more evident that more dock accommodation is required there, and it is equally certain that the available land faced by deep water in its immediate vicinity on the eastern bank of the Mersey is entirely occupied, and that consequently any extension of that accommodation must be sought upon its western shore. The river Mersey undoubtedly presents difficulty of access. Large vessels arriving are, owing to the bar at its entrance, constantly delayed by the insufficient depth of water over it at low tide from proceeding up the river, and have therefore either to anchor or to beat about until the tide shall have risen. This obstacle is not felt by outward bound vessels, the masters of which can at their will choose the hour of their departure; but incoming ships are exposed during the hours of waiting to considerable dangers, not the least of these being due to fogs. Many losses have arisen from this cause, and a remedy for the defect is most earnestly desired. We have had submitted to us a scheme with which the name of Mr. Henry C. Baggallay, C.E., is associated for providing such a remedy; and it appears to us, after full consideration, that his scheme may be found to be practicable, and that it offers an easy and certain means of surmounting both the difficulties as to dock extension and the danger and inconvenience we have above pointed out. This proposal contemplates the cutting of a canal three miles and a-half in length from the head of the Wallasey pool, in connection with the Great Float, through the solid land, in the direction of the Horse Channel, which channel it is proposed to make the entrance for all incoming vessels, those outward bound still adhering to the present route. As the Horse Channel does not receive any of the mud-charged waters of the rivers Dee and Mersey, it is anticipated that there will be no difficulty in maintaining its present depth, which is already almost sufficient for the largest vessels at the lowest state of the tide; while by the inexpensive system of guide banks proposed by Mr. Baggallay, such maintenance will not only be ensured, but increased depth will be obtained by the scour induced. Between the deep water of the Horse Channel and the western end of the proposed canal—at which a pair of locks will be provided to keep the water up to the present level of the float, which is 13ft. above old dock sill at Liverpool—there intervenes a flat known as the Mockbeggar Wharf, through which it will be necessary to dredge a channel to be provided with the guide banks above named, and breakwaters, for slightly over a mile, and this channel and the canal before referred to will ensure deep-water communication between the Great Float at Birkenhead and the Horse Channel, the latter being then available for incoming vessels during all states of the tide. The strip of Cheshire which intervenes between the Dee and the Mersey offers practically unlimited scope for extension of dock accommodation. In the neighbourhood of the proposed canal the land is quite flat, and its surface only a foot or two above sea level at high water, conditions which not only favour the construction of the canal at a cheap rate, but would also greatly lessen the cost of any docks which it might be found desirable to make.

Having thus briefly sketched out the leading features of Mr. Baggallay's proposal, which appears to us to present little or no difficulties of an engineering character, it will be desirable to refer to the probable cost of carrying out the work. It is well-known that dock construction at Liverpool has always been costly, owing to the fact that each dock has had to be provided with expensive river water and separate entrances; and that owing to the great rise and fall of the tide in the Mersey, which at springs is fully 30ft., such works have had to be made of a very substantial, and consequently expensive character; but as, according to the present scheme, the entrances to the new docks would be from the canal, in which the water would always be maintained at one level, such exceptional expenditure would be avoided. Then, again, as vessels would enter at one end of the canal and proceed outwards from its other extremity, the necessity existing in the present docks for ships to enter and leave by a single entrance during the short period available at the top of the tide will not be experienced; in fact, as Mr. Baggallay puts it, this arrangement would give "all the advantages that a double line of railway has over a single line in facilities for working, as the two lines of traffic do not pass each other." The facts above quoted afford *primâ facie* evidence of considerable possible economy as compared with past experience in dock construction for Liverpool.

The canal itself, it is suggested, should be 30ft. deep, and 150ft. wide at the bottom, with side slopes of 2 to 1, which figures are in considerable excess of those existing on the Suez Canal, and of those proposed for the Manchester Ship Canal. The estimated cost of this work is £300,000. The pair of locks, each 600ft. long and 80ft. wide, the second being necessary to guard against accidents, at the Horse Channel end of the canal, are estimated at £350,000, and an additional lock which would be required to that already in existence at the Mersey end is set down at £200,000. The estimate for the three locks, £550,000, is certainly not a high one; but then it must be borne in mind that all excavation, both for them as well as for the canal itself, would be in soft and sandy soil, an alluvial deposit only, which is easily removed by the shovel. Progressing westwards from the Horse Channel end of the canal, we arrive at the channel it is proposed to dredge through the shoal intervening between the canal and the deep-water entrance. To this channel it is intended to assign a width of 600ft. as a minimum, greater width being allowed to its entrance to allow sufficient steerage space. The shoal to be removed is sandy, and the cost of the dredging to be done is set down at £150,000. Two miles of guide banks would have to be provided; but for more than half of this length they would be constructed above low water, and their cost would from that fact be relatively small. Mr. Baggallay put this down at £350,000, a sum which he considers may be made to include the proper lighting arrangements for the entrance between the banks. The total of all these several proposals amounts to £1,350,000; and if for so moderate a sum the advantages set forth can really be attained, it seems a trifling price to pay for getting rid of the difficulties now existing, and for which relief is certainly urgently demanded. That the advantages can be secured for the amount named, Mr. Baggallay expresses himself to be confident; and when it is remembered that the value of the imports and exports for one year at Liverpool is now £200,000,000, we can hardly anticipate that the amount to be expended will be found prohibitory.

There is another and important consideration, apart from those of an engineering and financial character, which may well be considered with reference to this matter. Increasing difficulties are year by year experienced in providing employment for convict labour. We should have to look forward for a long time to state any period at which employment for a large amount of such labourers could not be found on these proposed works. Not only on these themselves, but on the extension of dock accommodation, which we may regard it as almost certain would follow their execution, a very large force could for many years be employed; while the flat and dreary waste across which it is proposed to cut the canal would be admirably suited to the requirements of a convict establishment. Such a site would be healthy, for the sea breeze would at all times sweep across it, while its surface would afford but little hiding ground which would tempt to trials at escape. From the same establishment also could be undertaken reclamation works in the estuary of the river Dee, which would furnish employment long after such had been required on the works immediately proposed, or on the prospective extension of dock accommodation.

It may be as well briefly again to review what would be secured by the execution of this work. First and most important, we should have the ensured provision of the docks the increasing trade of Liverpool urgently demands. We should then have removed the primary cause from which has arisen enormous loss to life and property in the detention of vessels outside the bar at the entrance to the Mersey, while the additional risk at present entailed by the outward and inward streams of traffic passing each other in a crowded river would be avoided. Further, we should have dock entrances no longer exposed to the disabilities of being only available at exceedingly limited states of the tide, and to crown all we have the question solved of "What shall we do with our convict labour?" for many years to come. We believe that it will be generally agreed that such results from the proposed expenditure of £1,350,000 are far more than commensurate with the outlay. We cannot, of course, pledge ourselves to the opinion that the estimated expenditure would suffice; but having regard to the very favourable conditions of soil, &c., the cost does not appear to us to be stated unreasonably low. Presuming that further inquiry justifies this opinion, and that Mr. Baggallay's scheme will bear fuller investigation, it would have to be considered under what circumstances of financial responsibility such a work should be carried out. Should it be left to a harbour trust, or committed to the tender mercies of a company; or should it be regarded as an Imperial work in view of the certainly Imperial character of the interests involved in the maintenance at a high standard of efficiency of a great national port like Liverpool? The advantage that we have pointed out would accrue to the Government from the field of labour these works would provide for convicts, seems to point most strongly in favour of the last-named alternative. Under Government direction there would be no scope for the intrusion of those merely local interests which, while deserving of the most ample consideration in this case, have in many instances been found to seriously hamper the development of great national undertakings. But it is premature perhaps to discuss the matter in this direction. Our immediate object is achieved by laying before the public what appears to be a well-considered scheme.

THE BREAKAGE OF SCREW SHAFTS.

IN our impression of March 21st we published an article on the breakage of screw shafts, a subject of such importance that we feel no apology is necessary for returning to it. In the article in question we commented on the dearth of information available for the guidance of engineers as to how best the percentage of failures may be reduced. Let us further analyse the conditions attending the working of screw shafts. In the case of a large ocean steamer, her shaft, as usually fitted, is simply a horizontal column of iron or steel of, it may be, 80ft. long and 1ft. in diameter. Practical conditions of manufacture and handling necessitate its division into a number of lengths. These are united together in the most rigid and unyielding manner possible. On the one end is fixed, also in the most rigid method practicable, a propeller weighing several tons, intended to rotate at—considering its weight and the conditions of its working—a very considerable velocity. Such a propeller, when at full speed, has a very large amount of power stored up in it, and under fair conditions it acts, in its relations to the engines and the ship's hull, as well as to the sea, as a fly-wheel. It operates, therefore, at least theoretically, in a favourable manner towards the shaft and engines, in so far as its inertia hinders that racing of the engines which ensues when it is raised out of the water by the pitching of the ship. The power it thus absorbs it returns in aid of the shaft as soon as it is itself again plunged into the water. Its *vis viva* helps to overcome the arresting action opposed by the water to the momentum gathered by the engines during the time the propeller was out of the water, and which its weight was insufficient to absorb altogether.

This suggests the idea that if it were in any way practicable to fit a heavy fly-wheel close up to the propeller, it would probably act beneficially as an equaliser of stress. Unfortunately this cannot be effected; all that can be done in this direction is to give the propeller, as much as possible, the character of a fly-wheel. At the same time it must be borne in mind that this sort of action, operating as it might for some revolutions, at a speed in excess of that to which the then speed of the ship is due, would cause some thrashing action on the water and consequent vibration. On the other end of our shaft we form cranks whose weight and disposition are out of balance, and to these cranks we connect a number of heavy working parts often weighing several tons; and we cause these to reciprocate at a high velocity, say, at a speed of 450ft. or more per minute on an average, the pistons, with their rods and guides, attaining at two periods in every revolution of the crank, velocity of no less than 900ft. per minute, and this high speed is operating when the steam is acting, in the case of the high-pressure piston, with its maximum effect. If, by the pitching of the ship the propeller be just at this instant submerged perhaps much below its normal depth, we have a combination of conditions operating against the shaft so great as—under present modes of fitting—to render a fracture not only likely, but extremely probable. The endurance of a propeller shaft depends on a variety of conditions, some of them, of course, beyond our control; others, however, are not beyond it, and about these we may speak. The material of a shaft as well as its disposal are controllable, and of these we may say that all is being done that can be done to improve things, so far as securing excellence of material and workmanship are concerned.

This is not enough, however. The steel-maker and the shaft-forger do not get fair play for their work, nor will they receive it so long as naval architects and marine engineers devote themselves wholly to attaining one end, namely, great speed. These gentlemen—and we trust that they will accept our remarks in the spirit of courteous and polite criticism in which we write—have done nothing to help propeller shafts. They seem to think that so long as they obtain or provide the best shafts that can be procured, they have done enough. It is time they took broader views. The finest shaft that it is humanly possible to make must fail if improperly put to work, and we do not hesitate to say that the existing method of fitting up propeller shafts is opposed to all sound mechanical principles. What is the existing method? A shaft or column of iron, 70ft. or 80ft. long, is laid horizontally in an iron trough, as we may define the ship's hull to be. We bind this rigid, or nearly rigid, column into the trough at certain points as tightly and inflexibly as it is possible to do it. This column we prevent moving in any direction, save rotating on its axis. We have said this column is nearly rigid. Experience has taught engineers how difficult it is, with the most staple foundations on shore, truly and accurately to centre a pair of bearings but a few feet apart if they are not, by being in one and the same casting, capable of being bored coincidentally; and even in this case truth is not attained unless the casting is carefully designed, of sufficient strength, and most accurately bedded.

Neither the naval architect nor the marine engineer can, with our existing knowledge of rivetted ironwork, ever obtain a perfectly inflexible set of bearings for propeller shafts, and they cannot too soon recognise the fact. No matter how strongly and carefully the hull of an iron ship is built, it will very soon begin to "work" in a seaway. We have just shown that in its conditions of working a propeller shaft is, in every sense, very severely tried. In addition to this, however unintentionally, it is called upon to act the part of another keelson. In fact, at one and the same time it is exposed in an extreme degree to three different, and at times violently opposing forces, namely, torsion, compression, and lateral bending, while it is deprived as nearly as possible of all power to accommodate itself to resist these diverse strains to the best advantage. What can be done to remedy all this? In our last article we advocated the adoption of flexible couplings, or of universal joints in the shaft. The fact that the latter are in successful use by French engineers ought to encourage us to try them. If well and carefully made, there are excellent reasons for their adoption. We will be glad to hear, and we will publish in our correspondence columns, the objections that may be advanced against them. Experiments on a large and practical scale, too, ought to be made. To this suggestion we will perhaps receive a reply as to the great cost of such experiments; but if the enormous loss of property involved in the destruction of even one large steamer and her valuable cargo be considered, we cannot but think that money may be prudently expended on testing different forms of flexible shafts and couplings, and on other methods of conveying the power of the engines to the propeller.

The present system of trying to guard against broken shafts only by making them thicker and sounder is not the most scientific method to pursue. Under existing modes of fitting we should try to use thinner, not thicker shafts, because thin shafts will be more flexible than thick, and less liable to break, because of the springing of the bearings caused by the working of the ship. The scientific as well as the common-sense course is to admit that rigidity of bearing cannot be maintained, and, recognising the unpleasant fact, to ascertain by experiment what is the best mode of giving flexibility to the shaft so that it may accommodate itself to its bearings. The shaft of a large steamer in anything of a sea is on a foundation for ever in a state of earthquake, and should be fitted accordingly. A committee of shipowners, insurance representatives, and engineers, as well as shipbuilders, ought to be formed, a subscription list opened, and a sum of money collected to defray the expense of experiments having for their object the determination of the best method of transmitting the power of the engines to the propeller.

BRIGHTON ELECTRIC RAILWAY.

Some time since we gave a short account of the electric railway made and worked along the Brighton foreshore by Mr. M. Volk. Since a few days before Easter this line as laid out this year has been in successful operation, and some figures have been obtained which must be looked upon by electrical engineers and the public as of much importance, as well as of considerable interest. As we have already said, the line is built and worked under conditions which are in some respects unique. The Corporation granted to Mr. Volk, for himself, and not for any syndicate or company, the right to construct and work an electric railway along the upper part of the beach. Mr. Volk constructed about a mile of light single railway, and put down one 8-horse gas engine, and one Siemens generator and exciter. With this plant, and one car to carry thirty people, and with the necessary small terminal structures, one of which is not yet finished, no less than 34,000 passengers have been carried during eight weeks. The line includes 230 yards on a gradient of 1 in 100; 100 yards with gradient of 1 in 45; 50 yards at 1 in 16; 50 yards at 1 in 30; and 200 yards at 1 in 150; the remainder being nearly level. The car is fitted with an epicycloidal driving pulley, by means of which the gradient of 1 in 16 is worked at one-third the usual speed, eight miles an hour, the other gradients being worked direct. This gear is brought into action by a simple friction clutch, and is very simple. Along the level the power consumed is but 1·75 brake horse-power. The working of the line has been most satisfactory, and the financial results are very encouraging. The whole cost of the line and equipment was £2500, exclusive of whatever charge the owner, Mr. Volk, would add to this as electrical engineer of the work, which, of course, occupied a good deal of time, and included the design of the car, station, &c. The gross earnings have been £278 14s. 3d., or £34 15s. per week, while the expenses have been £17 19s. per week, leaving a profit of £16 16s. per week. The expenses include the cost of about 1600 cubic feet of gas per day at 3s. 3d. per 1000 cubic feet, or £1 10s. per week; lad driving engine, 12s.; car driver, £1 4s.; conductor, £1 4s.; station clerks, £1 10s.; lineman, £1 1s.; labourer, 18s.; electrical and general management, £3 10s.; repairs, £1; depreciation and interest, £5; and rent of an arch, 10s. This is for one car running about 500 miles per week, and seating thirty passengers. It will be seen that the working expenses are small, but are such as can be repeated for any similar undertaking, which does not belong to a limited company with its numerous salaried officers. A second car is about to be added, a turnout being provided at mid length of the line. Though this will double the carrying capacity, the working expenses will be increased to but a small amount, as may be gathered from the above figures. The popularity of the line may be gathered from the figures we have given, and although only a mile in length, this railway shows what may be done with plant economically and carefully worked. It shows that when the capital employed is only that necessary for the work, an excellent profit may be made, but with anything like the public company ideas of capital, the profits would be lost. From it, however, a much wider lesson may be gathered. It may, for instance, be seen that what is done on this one mile, which, however, will probably be increased to two miles, may be repeated on any number of miles, and for large traffic much lighter stock can be used than can or is used on steam lines, and the cost of maintenance should be small.

THE MANUFACTURED IRON TRADE.

The falling off in the shipbuilding industry is now beginning seriously to affect the manufactured iron trade. So far as the North of England is concerned, we have official records of the extent and value of the trade. At present there is a monthly production of manufactured iron to the extent of 37,500 tons, whilst about six months ago the total production was 58,000 tons; and the average value of the iron sold by the associated firms is much less—it was £6 0s. 6½d. per ton in October, it is now £5 8s. 11d. Since the last ascertainment of prices the fall has not been so large, but it is appreciable. That return was that for February last, and the price was £5 13s. 7d., so that the fall in two months is nearly 5s. per ton. As in the same time the extent of production has fallen, it must be evident that the trade is much worse than it was. The return of February was the one on which the arbitrator—Dr. Watson—based his award, but it is evident that the reduction then given was inadequate; and it must be looked upon as a certainty that an attempt will be made to reduce wages further, though it cannot be said when it will be attempted. The fact is that the trade is sinking rapidly to its lowest level, and that there will need to be an adjustment of the cost of production to that level before the trade can have any revival.

LITERATURE.

The Scientific Papers of James Prescott Joule. Vol. I. Published by the Physical Society of London. Taylor and Francis, London. 1884.

Dr. Joule in his short preface which he has written for this volume explains that its publication was due "to the flattering proposal of the Physical Society of London to collect and reprint the papers on scientific subjects which have appeared in my own name, and those under my own in association with the Rev. Dr. Scoresby, Sir Lyon Playfair, and Sir William Thomson. In this the first volume I have endeavoured to fulfil the former part of the design." These sentences explain pretty clearly of what the volume consists.

Every engineer, man of science, nay, every student of science, has heard of "Joule's Equivalent," but their ideas of the life work of Joule himself are in many cases extremely hazy. A perusal of the volume before us will do much to dissipate an ignorance in some respects excusable. Joule is by no means a voluminous writer, nor did he ever belong to the ranks of those who are never so happy as when they are attracting public attention. This collection of papers written at various times during a period extending from the 8th of June, 1838, to 24th June, 1878, is a remarkable evidence of the versatility of the author's mind. The range of subjects which he has handled is large, but it is as nothing to the variety of ways and methods in which he has handled them. As far as in him lay, Joule exhausted every inquiry he entered upon. While anything remained to be known he was unsatisfied; and one result is that his inquiries anticipated much that has been done during recent years, while another is that even those portions of the volume written nearly fifty years ago will be found full of instruction, and extremely suggestive. At an early period he commenced the study of electro-magnetism, and it may almost be said that what he did not learn about electro-magnetism is not worth knowing. Some of his experiments point to conclusions which may be useful to those who design dynamo-electric machines, while others bear on Mr. Hughes' theory of magnetism. It is quite beyond our power to do more than refer briefly to a few points which deserve attention. The book is beyond criticism in most respects, because it is simply a record of facts, and descriptions of the methods by which the facts were ascertained. We can take examples of his facts at haphazard. For example, it is tolerably well known that an electro-magnet even if made of very soft iron retains its magnetism after the current is cut off, provided the keeper is left in contact with the poles. But Joule has gone further, and shown that a surprisingly minute current will suffice to keep an electro-magnet excited, if we may use the word. "Having," says Joule, "subjected magnet No. 1 to 90 deg. of electric force, a quantity adequate to bring its power to 560 lb., I reduced the current to a lower intensity, and then found the weight requisite to detach the armature. . . . A voltaic cell, the size of a common sewing thimble, was quite sufficient to produce 31 deg. of electric force in No. 1, and consequently to sustain a magnetic power of about 300 lb., and it is easy to perceive that by increasing the size of the electro-magnet and the quantity of conducting wire, this minute source could support a magnetic virtue of indefinite amount." This was written in 1840, when volts and ampères were unknown, and Joule had to construct a standard of current for himself.

Joule at this time was earnestly labouring to construct an electro-magnetic engine, and he very early made the important discovery that what is now called internal resistance was "the principal obstacle to the perfection of the electro-magnetic engine; and in proportion as it is overcome will the motive power increase. It therefore claims our first attention." This does not refer to the mere resistance of the wire regarded as a conductor. "The augmentation of the intensity of each element of the battery is very important, as it is attended by a proportional increase of duty."

Some of the results obtained by Joule with electro-magnets are sufficiently remarkable. He seems to show, although he does not directly state as much, that the power of an electro-magnet increases with the breadth of its poles. To make this clear, let us suppose that our electro-magnet is made of a strip of boiler plate, ½in. thick and 6in. wide, bent into a horseshoe shape, the whole bar being 2ft. long. If, now, we take a bar similar in all respects, but 12in. wide instead of 6in., then, the current and wire remaining unaltered, the second magnet will be much more powerful than the first. The most noteworthy feature, perhaps, about all this is that Joule shows that a great many coils are not needed to produce an intense magnetic field, and we would specially direct the attention of modern electricians to the papers on magnetic forces, pages 27 *et seq.* One of the magnets he tested was made of stub iron, such as that used for making the barrels of fowling pieces, coiled on a mandril, and welded into a thick tube. A slice was then planed off this so as to open the internal hole by a long slot, and an armature was planed to fit, so that when the two were put together the whole formed a tube 2ft. long, ½in. in diameter inside, and 1·42in. diameter outside. Into the larger portion were screwed eye bolts, by which it could be suspended in a horizontal position, with the slot down. The armature was fitted with similar bolts to which a weight could be suspended. To excite this magnet—which weighed 6 lb. 11 oz., the weight of the armature being 3 lb. 7 oz.—a copper rod ⅜in. in diameter covered with tape was passed down one side of the magnet, brought back through the inside, and again passed down the outside in a shape somewhat similar to a very long S. Through this rod a current from eight large cast iron cells, each of which presented an effective surface of two square feet, was sent. It will be seen that the inductive influence of the wire must be small, because it made really but one turn round the magnet; yet this magnet sustained a weight of no less than 1350 lb. The magnet No. 1, to which reference has been made, had a very small quantity of wire on it. It was a wrought iron cylinder 8in. long, with a hole 1in. diameter bored down its axis, and a piece planed off so as to open a slot down it, the two sides of the slot forming the poles. It was wound with four copper wires covered with silk, each 23ft. long and $\frac{1}{11}$in. diameter, just enough to fill the hole and cover the external surface of the cylinder. This magnet carried 8 cwt. when the current generated by a single pair of 4in. plates of iron and amalgamated zinc was sent through its coils, and a pair of platinised silver and zinc plates, giving only two square inches of area, gave an attraction so great that it was almost impossible to slide the armature by hand. On p. 43 of the volume will be found a drawing of Joule's ring magnet, in which the exciting wires are used much as the coils of tape are in the Ferranti dynamo. This magnet weighed but 7 lb., and it sustained 2710 lb. Including the armature, the whole weight of magnetised iron was 11·57 lb., and each pound of it sustained 234 lb. When we compare these results and others like them with those obtained from the field magnets of dynamos, we are tempted to ask whether in these latter days we get nearly as good results out of a given weight of wire as did Joule.

In one sense, the most interesting part of the whole volume is that devoted to a description of the successive steps by which he ascertained Joule's equivalent, 772 foot-pounds per British thermal unit. The last paper in the volume contains a long description of the apparatus finally used—similar to one devised by Hirn—and particulars of the results of numerous experiments. The final conclusion of the author is: "The equivalent at the sea level and the latitude of Greenwich will therefore be 773·492 foot-pounds, defining the unit of heat to be that which a pound of water, weighed by brass weights when the barometer stands at 30in., receives in passing from 60 deg. to 61 deg. Fah., with water weighed in vacuo, the equivalent is finally reduced to 772·55 foot pounds."

We have said the range of subjects dealt with by Dr. Joule is very large. Besides those on his magnetic engine, we find in the present volume papers on such subjects as the electric origin of the heat of combustion; the calorific effects of magneto-electricity; the changes of temperature produced by the rarefaction and condensation of air; specific heat; matter, living force, and heat; the velocity of sound; some amalgams; the utilisation of the sewage of London and other large towns; the surface condensation of steam, &c. &c. Joule's views on the disposal of sewage may be briefly summed up by saying that he is fully impressed with the value of sewage, but he holds that cesspools should be used in which to collect it, and from which it should be pumped in a more or less concentrated state. The arrangements which he proposes would no doubt be efficient, but he has overlooked the fact that the cost of the system would be enormous. We do not dispute the value of sewage; but assuming it to be worth 30s. per ton, it will not pay to spend £2 in collecting it and putting it on the land. This is really the whole difficulty in the disposal of sewage, or at least is so great a difficulty that all others are comparatively insignificant. In 1882 Dr. Joule added a curious note to this paper. "From the estimates," he writes, "of loss by our sewage systems there ought to be set off the immense stores which return to us in the shape of mollusks and fish. It has been observed that the best and most nutritious fish are found in seas contiguous to fertile land, where rivers bring down organic matter. On the whole, considering the enormous quantities of imported food, this country must be acquiring great fertilising potentiality at the expense of America and other lands which are being impoverished to supply our present needs."

The paper on surface condensation is probably little known to engineers; yet it deserves careful attention. One

point alone we shall mention in connection with it. By putting spiral wires round vertical copper condensing tubes, he augmented the rate of condensation—in other words, the efficiency of the apparatus—from 166 to 413, or nearly three-fold.

The volume contains 657 octavo pages. It is fairly well indexed, and admirably printed in large type on good paper. Where necessary the text is adequately illustrated by good engravings. The frontispiece is a capital portrait on steel, engraved by Mr. Jeens. It originally appeared in *Nature*. The volume should, and no doubt will, have a place in the library of every one interested in science.

SOLUTIONS OF IODIDES IN MINERALOGICAL RESEARCHES.

Two important papers on the use of solution of the two double iodides, potassium and mercury iodide, and barium and mercury iodide, for the above purposes, have recently been published by V. Goldschmidt and C. Rohrbach. It is to be regretted that the subject of the separation of the constituents of a rock has been neglected of late, in consequence of the success which has attended microscopic investigation, as the excuse in which the latter method cannot be relied on. The attempt to describe the constituent of a section of a rock by microscopic examination is greatly overrated. The separation may be effected chemically or mechanically; in the latter case advantage is taken of the difference in the specific gravity of the substances. In 1877, Mr. Church, in a paper in the *Mineralogical Magazine*—"On a Test of Specific Gravity"—proposed to separate the constituents of a rock according to their specific gravity by the help of an aqueous solution of the iodides of mercury and potassium. The papers give at some length an account of J. Thoulet's researches on the same subject.

On investigating the subject further, Goldschmidt decided to employ a solution in which the weight of potassium iodide present is to the mercury iodide as 1 is to 1·239; and this solution has a specific gravity of 3·196, so that fluorspar floats in it, while the solutions of Thoulet and Church gave as the maximum specific gravity 2·77 and 3·01 respectively. The maximum density is, however, not constant. It depends on the moisture of the atmosphere and on the temperature. In summer the maximum was 3·196, whilst in winter it was only 3·17.

The difficulties which attend this simple method of separation of the rock constituents according to the specific gravity are due to the variation in the specific gravity of the predominating mineral; the close combination of the constituents; the smallness of the grains; the great similarity, or, in some cases, the identity of specific gravity of different minerals occurring together, such as quartz and oligoclase, the tendency of the lighter grains when they are in great excess to bring the heavier with them to the surface, and the liability of the solution to change by evaporation or by taking up water.

In considering this method, the question arises, Is the value of the specific gravity constant enough for the mineral to be determined by it; and if a separation is effected between narrow limits of weight, can it with certainty be asserted that the mineral sought for has been separated? Theoretically it is so. In order to answer the question practically, Goldschmidt submitted the felspar grains to the strictest investigation, and came to the conclusion that, with fresh material and perfect separation, the determination of the specific gravity gives an exact conclusion as to the nature of the felspar.

The apparatus used for the separation of the rock constituent proposed by Thoulet is described, but Goldschmidt prefers to effect the separation in small beakers of about 40—50 c.c. capacity, the principal advantage of which is that the parts swimming above can be better manipulated with the glass rod, and, consequently, the heavier grains which are enclosed more easily separated. A number of minerals whose specific gravity has been exactly determined are used as indicators of the solution. The powdered rock and the indicators are introduced into about 30 c.c. of the concentrated solution and stirred, then allowed to subside, and the lighter parts removed. The success of the separation depends on the skill of the experimenter, on the choice of the indicator, but, above all, on the nature of the substance to be separated.

It is evident, then, that Thoulet's opinion, that the constituents of a rock can be qualitatively and quantitatively separated, holds good only very rarely; and it would be necessary also in most cases to make use of auxiliary methods, such as treating the powder with various re-agents or with the magnet.

Rohrbach's paper appeared late last year; and he it is who has employed the barium salt and mercury iodide for the separation of individual species in a complex rock. He says, that from the great resemblance that exists between the double salts of the mercury iodides and the alkaline iodides with the iodides of the alkaline earths, it appeared to him desirable to prepare the barium and mercury iodide for use as a dense solution; and provided it was found to be equally soluble, it was to be expected that a still denser solution would be obtained than in the case of Thoulet's liquid—corresponding, in fact, with the greater density of barium over potassium. It turned out that the maximum density of the new solution was 3·588.

In preparing it, regard must be had to the fact of the ready decomposibility of the barium iodide, and it must be made quickly; 100 parts of barium iodide, which may be obtained in a state of great purity from Tromsdorf, in Erfurt, and about 130 parts of mercury iodide—hydrarg. bijodat. rubr.—are to be quickly weighed out and be well shaken together in a dry flask, and after the addition of about 20 cb.cm. of distilled water, the flask is to be placed in an oil bath heated to 150 deg. to 200 deg. Cent. The rapid solution of the materials and formation of the double salt is as much as possible promoted by continuous shaking and stirring with a bent glass rod held between the fingers. When all has dissolved, it is to be boiled for a short time and then evaporated on the water bath in a porcelain dish until a crystal of epidote from the Sulzbach Valley, used as an indicator, swims in it. On cooling a small quantity of a yellow double salt separates; but in spite of this the specific gravity of the solution increases by the combination, and in the cold liquid a piece of topaz will swim. To remove the double salt, which has separated, it is best to let it stand for several days in a closed flask, and then carefully decant the clear liquid. Filtration of this liquid has certain disadvantages, especially in the case of large quantities of it, for the paper is converted by the solution into a leather-like material which does not adhere to the platinum cone. The solution, thus prepared, without difficulty attains at ordinary temperature a specific gravity of 3·575 to 3·588; it strongly refracts light, and has a very high dispersive power, as the following numbers show:— ${}^{n}C = 1{\cdot}7752$, ${}^{n}D = 1{\cdot}7928$, ${}^{n}E = 1{\cdot}8265$, ${}^{n}F = 1{\cdot}8488$, ${}^{n}F - {}^{n}C = 0{\cdot}0736$, $\frac{{}^{n}F - {}^{n}C}{{}^{n}C} = 0{\cdot}0409$. In the violet strong absorption takes place. The high index of refraction, which exceeds that of arsenic bromide = 1·78, and that of the Thoulet's solution = 1·733, recommends the use of barium potassium iodide in a high degree for the determination of indices of refraction by means of total reflection.

The ready decomposibility of barium iodide by the carbonic acid of the air supplies an exact test of this solution in that respect; a current of pure carbonic acid passed through for a space of two hours did not produce the slightest change in it, nor was a fragment of calcite or of chalk in powder, which was left in the solution for the space of ten days, attacked in the slightest degree.

By means of this liquid, as opposed to the other at present in general use—the liquid referred to by Goldschmidt above—a whole series of minerals can be separated at ordinary temperatures. Among them may be mentioned axinite, cyanite in part, epidote, the black micas, some garnets, almost all the hornblendes, jade, olivine, orthite, ottrelite, almost all the members of the pyroxene group, some spinels, staurolite in part, most of the titanites, topaz, and pyknites, black turmaline, vesuvian, zoisite, and among the rocks all the basalts and some felsparless rocks.

When mixed with water at ordinary temperatures the concentrated solution deposits crystals of red mercury iodide, which do not redissolve in the cold. To prepare, therefore, a liquid of definite density it is most convenient to add some diluted solution prepared by heating the concentrated liquid at the boiling point and adding to it water drop by drop. There are several other precautions to be taken to which attention is drawn. Quite recently, since writing the above, we hear of the use of cadmium borotungstate, recommended by Daniel Klein, in the *Bull. de la Soc. Chim.*, 35, 492, and *Compt. rend.*, 93, 318. The solution has a density of 3·28.

FOREIGN NOTES.

THE following ships-of-war have been launched for various Governments during the last few weeks, viz.:—At the Finnboda Dockyard, near Stockholm, a gunboat named Siwitsch, intended for the Siberian squadron of the Imperial Russian Navy. The Siwitsch is 187ft. long by 36ft. wide, and will be propelled by twin-screw engines of 1000 indicated horse-power. She will carry eight guns, and her cost is 800,000 Swedish crowns. The Fusée, the first of a batch of ironclad gunboats for the defence of the French coast, was launched at Lorient on the 8th inst. The class to which this vessel belongs is one that has never found favour in the eyes of the British Admiralty since the days of the Viper, Vixen, and Waterwitch, as it was found that a far more efficient and economical substitute was available in the gunboats of the Staunch type and in torpedo boats. It is apparent that, in sanctioning the designs of the Fusée, the French Admiralty have had in view the German gunboats of the Wespe type; but it must be remembered that these latter boats are intended for a very different field of action, viz., the shallow coasts of the North Sea and Baltic. The most probable conjecture is that the French vessels are intended for operations in the Mediterranean, for covering landing parties, &c., for which, owing to their light draught, they are no doubt well adapted. The dimensions of the Fusée are:—Length between perpendiculars, 165ft.; extreme breadth of beam, 32ft. 7in.; depth in hold, 16ft. 11in.; draught of water, 10ft. 6in.; displacement, 1045 tons; material of hull, steel and iron; guns, one 10⅝in. and one 3½in. breech-loaders, the former of which is mounted *en barbette* in the bow. The armour is 9½in. thick, and she is provided with a tube for discharging torpedoes. Her cost, including armament, is estimated at about £68,000. It may be interesting to compare the chief dimensions, &c., of this French vessel with those of her German prototype, the Wespe. This boat was built at Bremen in 1876, and is 142ft. 9in. long, 35ft. wide, 11ft. 2in. deep, draws 10ft. of water, and has a displacement of 1109 tons. She is protected by 8in. armour, and carries a 12in. breech-loading gun, as well as apparatus for discharging torpedoes. Her total cost was £51,700. The Caïman, which will be launched at Toulon in the course of the present month, is the third ironclad added to the French Navy since January, whilst but one British ironclad, the Warspite, has been launched during the same period, and the displacement is 18,148 tons and 7390 tons respectively. The French Government have at present thirteen ironclads, with a total displacement of 70,119 tons, on the stocks; whereas only five ironclads, with a total displacement of 49,200 tons, are building for the British Navy, exclusive of so-called "protected" vessels. The Caïman is a barbette ship of 7239 tons, 278ft. 7in. in length, 59ft. in breadth, 24ft. 8in. deep, and a draught of 24ft. of water. She will be fitted with twin-screw engines of 4800 indicated horse-power, and is expected to realise a speed of 14½ knots. Her armament consists of two 13½in. breech-loading guns and four small guns, besides which she is fitted with apparatus for discharging torpedoes. The maximum thickness of her armour is 19¾in. A small ironclad, named the Bremse, built to the order of the German Government, was lately launched from the yard of the Weser Company, Bremen. She has a displacement of only 870 tons, and as she is provided with comparatively powerful engines, viz., 1500-horse power, it is anticipated that she will attain a speed of 15 knots per hour. Her hull is built of steel, protected by 8in. compound armour, and she carries one long 8¼in. Krupp gun, as well as a supply of torpedoes.

Messrs. Normand and Co., of Havre, have obtained an order for six sea-going torpedo boats from the French Government in consequence, it is said, of the satisfactory results shown by a sample boat built by them. Two well-known firms at Stettin and Bremen have each been ordered to build a number of large torpedo boats for the German Government. Some of these boats are now ready for trial, and they will probably give very satisfactory results—at least in so far as can be judged from the high class of workmanship which a close inspection of their construction, both hulls and engines, proves to have been expended on them.

THE MANCHESTER SHIP CANAL BILL.

THE decision of the House of Lords' Committee upon this scheme was announced too late for our last issue, but although those who happened to be really interested in the matter speedily learnt what the result of this protracted inquiry was, there is yet something to be said which is certainly not without interest in regard to so large and bold a project. During the forty days of the investigation over which the Duke of Richmond so ably presided, we have kept our readers informed of the leading features and incidents of the inquiry, and as this is a scheme which, if carried out, would affect very much wider interests than those simply of Liverpool and Manchester and the intervening districts, it is well, if not indeed necessary, to show how the examination of this scheme ended so far as the Committee of the Upper House was concerned. During the inquiry no less than 151 witnesses were heard for or against the Bill, and nearly 26,000 questions were asked, while Mr. Pember's concluding speech on behalf of the promoters lasted fully twelve hours, spread over three days. So powerful and able speech has rarely been heard before a Parliamentary Committee, and the learned counsel's mastery of the most minute details of the scheme, and of every point of evidence, throughout was very striking and effective. An advocate's speech cannot, of course, be taken as showing how the verdict is to go, but when Mr. Pember ended, falling hopes on the part of the promoters were vigorously revived, and visions of victory on the other side became correspondingly fainter. The Committee assembled on Friday last to give their decision, but they sat in close conference for more than two hours. Meantime, a crowd of counsel, agents, witnesses, and other interested parties waited with more or less patience outside the doors, anxiety and doubt increasing as the time advanced—the prolonged conference suggesting difficulties and controversy among the five noble lords. When at last the room was thrown open, there was a rush and a scramble for places, and some moments elapsed before quiet could be obtained.

The Duke of Richmond briefly and concisely announced that the Committee were of opinion that it was expedient to proceed with the Bill subject to the insertion of a clause which Mr. Pember had previously offered, staying the commencement of the work until five millions of the required capital of ten millions had been subscribed and issued. Upon this declaration there arose what is most irregular and most unusual—a hearty cheer from the friends of the Bill. Then there followed a helter-skelter scamper along the corridors, down the lofty staircase, and across the public lobby, to the telegraph office; and in a few minutes Lancashire was apprised of the triumph. The scene was exciting in the extreme, and altogether unparalleled in the history of Private Bill Committees. But to return to the Committee-room. The decision having been given in the terse form indicated, some further information was required, and it was explained by the Chairman that the Committee intended that some limit of time should be fixed for raising the five millions, and that one-fifth of that amount must be absolutely paid up, and that the subscribers of that amount should be made responsible for the rest. Following this elucidation came another novelty, both in Lords' and Commons' Committees. Mr. Pember, on behalf of the promoters, and also of all the counsel engaged in the case, expressed their sense of the patience and ability with which their lordships had conducted this inquiry. This sentiment being endorsed by general assent, the Duke of Richmond, so far from resenting this piece of flattery, or even disregarding it, responded by saying that he and his noble colleagues felt that the case had been most fairly and properly put before them with immense ability on both sides, and, further, that the parties had been perfectly justified in occupying the length of time they had. After this exchange of civilities and compliments, the Committee adjourned for awhile. On resuming, they proceeded to deal with the clauses, and in a short time the Bill was disposed of and ordered to be reported to the House of Lords.

Upon the consideration of the clauses, all the petitioners save one withdrew from further action, and that one was the Manchester Racecourse Company. If the scheme is carried out the racecourse will be appropriated, and for the protection of the company's interests it was eventually agreed that the promoters should undertake to give an informal notice to "treat" for the land before they had raised the five millions, and should deposit £50,000 to cover any loss the company might suffer during the period of notice by interference with their arrangements or from other causes. The clause required by the Committee was drawn up and agreed to in the following terms:—"The company shall not execute any of the canal works, docks, or of the estuary works under the powers of the Act unless and until within three years after the passing of the Act shares for £5,000,000 are issued and accepted, and the company has proved to the justice who is to certify under the 40th section of the Companies Clause Consolidations Act, 1843, that shares for the whole of the said sum of before £5,000,000 had been issued *bonâ fide*, and are held by the persons or corporation to whom the same were issued, or their executors, administrators, successors, or assigns, and that such persons, or corporation, or their executors, administrators, successors, or assigns are legally liable for the same, and upon production to such justice of the books of the company, and of such other evidence as he shall think sufficient, he shall grant a certificate that the proof aforesaid has been given, which certificate shall be sufficient evidence thereof."

In the course of the evening of Friday intelligence reached London from Manchester that the required five millions were already virtually provided, and in view of that circumstance it is pretty certain that the promoters, despite the enormous sum they have already spent, are prepared to fight the thing out when it comes, as it soon will, before a House of Commons' Committee. No one but the Committee themselves can tell absolutely how their lordships went in regard to the Bill, but positive rumour has it that the Duke of Richmond was strongly opposed to passing the preamble, and was supported by Viscount Barrington; but Lord Dunraven, Lord Lovat, and Lord Norton, and especially the last-named, were sufficiently in favour of the Bill to carry it against their colleagues.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending May 24th, 1884:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 12,118; mercantile marine, Indian section, and other collections, 3269. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1545; mercantile marine, Indian section, and other collections, 162. Total, 17,094. Average of corresponding week in former years, 17,589. Total from the opening of the Museum, 21,051,171.

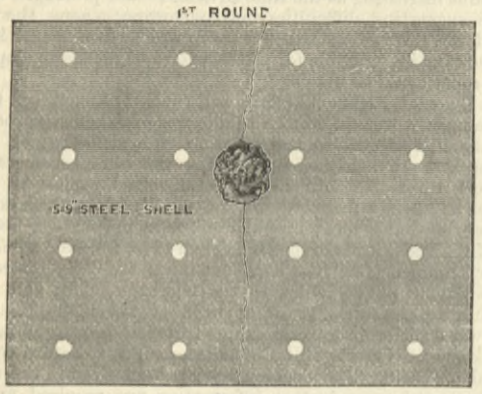
A WATCH MADE TO BE POUNDED.—When a visitor to the office of the American Bank Note Company sat down to talk to Mr. Lee, that gentleman put a piece of white paper under a stamp, pounded on it, and laid the paper aside. When the visitor arose to go away, Mr. Lee put the paper under the stamp again, and pounded it once more. "You talked eight minutes," said he; "that wasn't bad." He showed the piece of paper to the caller, who saw upon it two printed clock dials. One showed the hands at four minutes to four o'clock, the other showed them at four minutes past four o'clock. "We keep that stamp," he said, "so that you sha'n't go away and say that you came here at eleven o'clock in the morning, or that you had to wait an hour and a-half, or make any other misstatements which can be guarded against." "No," he added a moment later, "that stamp is the latest wrinkle in office furniture. It is an ordinary stamp with a clock attachment. The hour hand is simply a raised point upon a movable circle. The minute hand is an arrow on another revolving circle. The usual inked tape passes over these indicators and the outer circle of hour figures. Beside the clock face is a cylinder with several faces, each bearing a word—one is 'approved,' another is 'wired,' another is 'answered,' others are 'delivered,' 'Lee,' 'received.' Thus a business man is able whenever he sends away a letter, telegram, or package, receives an order, or transacts any business whatever, to record the precise moment at which the thing was done. It costs 20 dols. I did not invent it; I bought it."—*New York Sun.*

OFFICIAL PHOTOGRAPHS OF COPENHAGEN COMPETITIVE ARMOUR-PLATES.

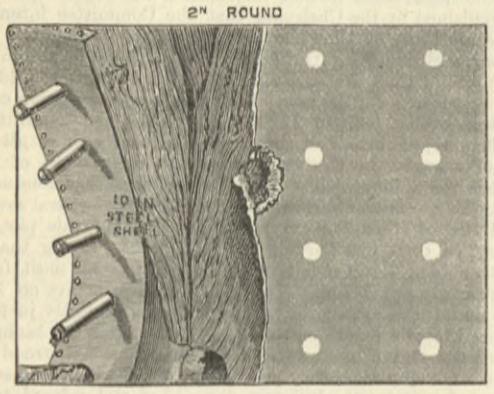
The competitive trial of steel and compound plates at Amager, near Copenhagen, on March 20th and 21st last, was reported in The Engineer of March 28th, the report being accompanied by sketches. We have had a good deal of correspondence on the subject of these plates and the effects produced by each round, and we have had some detailed features in our own sketches objected to.

SCHNEIDER STEEL.

1ST ROUND



2N ROUND

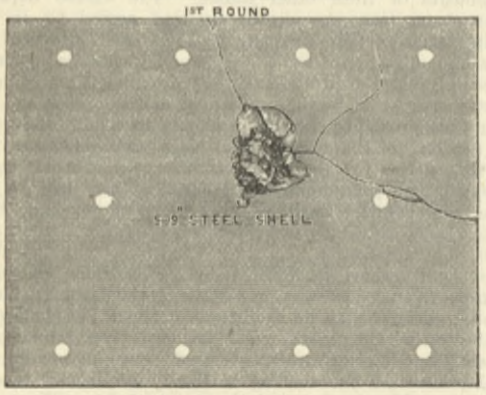


No 3rd Round was Fired at Schneider's Plate.

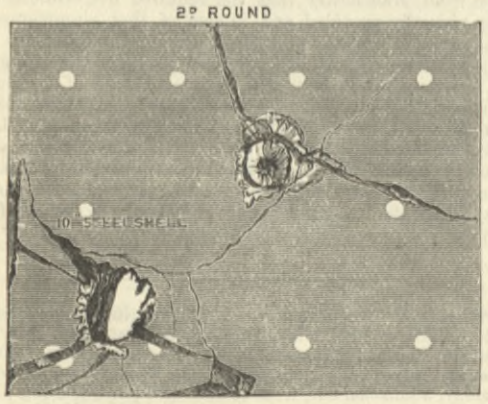
We have now seen other sketches made on the ground, as well as the Government photographs. We find that the other sketches also differ slightly from the photographs. In one case—the second round at Brown's plate—there are two independent sketches showing a long crack, of which there is no trace to be detected in the photographs, even with a powerful magnifying glass, until the third round.

MARREL STEEL-FACED.

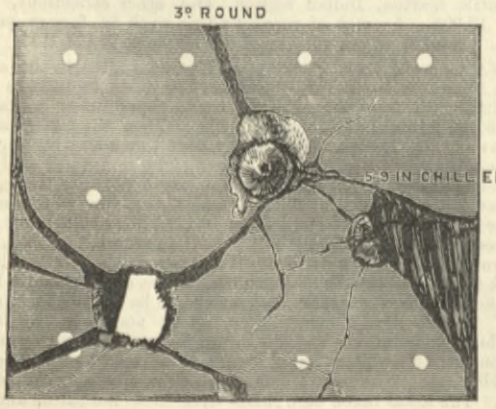
1ST ROUND



2º ROUND



3º ROUND



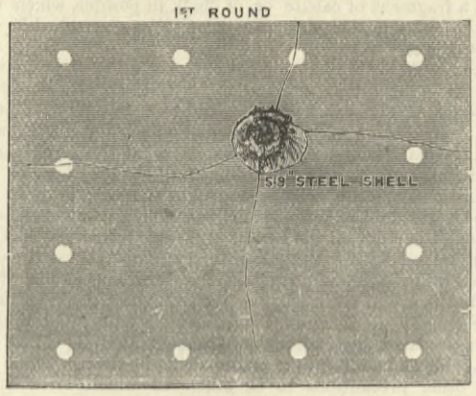
Under the circumstances we think it best to give an engraving depicting the visible effects, copied carefully from the photographs, especially as an important competitive trial of this kind calls for a brief review.

Our engraving shows the plates not quite as they stood in the actual trial. We have, for the sake of convenience, arranged them so as to show in the upper engraving the effect of the first round, in the second place that of the second round, and in the third that of the third round at each plate, in the cases where a third round was fired. The nature of each round is entered near the point of impact.

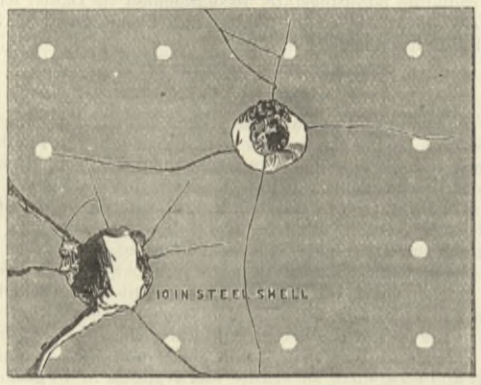
The following is a brief summary of what took place :—The plates were all 6ft. 6½in. long, 5ft. high, and nearly 9in. thick ; they were curved, so as to represent a portion of

CAMMELL STEEL-FACED.

1ST ROUND



2ND ROUND



Target Shot away by 3rd Round—10in. Solid Chilled Iron Projectile.

a turret 10ft. 9in. inside radius. The backing was oak with iron skin and bolts—shown in detail in our report of March 28th last. Krupp's plate was solid steel, held up by sixteen bolts ; Marrel's, Cammell's, and Brown's were steel-faced ; Marrel's and Cammell's being made on Wilson's patent, and Brown on that of Ellis. Marrel's had eleven bolts, and Cammell's and Brown's twelve each. The position of the bolts is shown by white spots. The first round at each plate was fired with a Krupp's 5·9in. steel shell, with a striking velocity of about 1742·2ft.; weight, 112·44 lb.; and striking energy of 2364 foot-tons. Estimating the plates at about 5¼ tons weight, this would amount to about 450 foot-tons per ton of plate. The second round at each plate consisted of a Krupp steel 10in. shell, weighing 402 lb., with a striking velocity of 1410·8ft., and consequently a total energy of 5551 foot-tons, or nearly 1041 foot-tons per ton of plate.

The effect on all the plates of the first round was more considerable than might have been expected. At Ochta the lightest blows were 427 foot-tons, and the heaviest 711 foot-tons per ton of plate. At Spezia the lightest were 654, and the heaviest 1046 per ton of plate. At Shoeburyness in 1880, a blow of 541 foot-tons per ton of plate produced an insignificant effect on a steel-faced 18in. compound plate. The results of this first round are decidedly greater than those of the lighter Spezia or Ochta rounds. This is true of the whole of the plates, and as we cannot conceive for an instant that Schneider, Cammell, and Brown, have all deteriorated in their manufacture, we must attribute it to the fact that Krupp's steel are better than the English or Italian chilled iron projectiles—a very natural conclusion, but one which we wish was fully impressed on England. Comparing the plates together, we see at this stage little to remark. The steel of Schneider's plate appears to be good, the lower crack exactly resembles those made at Spezia in its character; the short broken lines are very characteristic. We understand that Cammell's plate had a harder steel face than Brown's, and that the penetration in it was less deep; but Brown's exhibits less cracking, and looks peculiarly well.

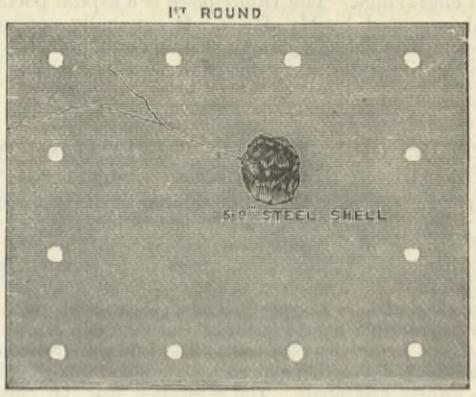
The second round of course tested the plate much more severely, being 1041 foot-tons per ton of plate, instead of 450 only. The effects are proportionally great and their shape is instructive. The shot makes an absolute breach or hole through the steel-faced plates, and we have no doubt that had the plates been harder, more of the shock would have been distributed through them. They yielded, in a measure, locally. On the other hand, half of Krupp's plate was bodily carried away. There are three possible reasons for this—one, that, as a mass, the steel is harder than the compound plate—in fact we repeat what has been said before now, that we have never seen a hole made in solid steel; secondly, the flank target is a little less strong and less well supported at its outward end; and thirdly, we believe that cracks in steel are almost always through cracks, whereas in steel-faced plates they are very often confined to the steel surface.

The third round at Cammell's broke it up, being another round with the 10in. gun. The third round at Marrel's and Brown's consequently was fired with the 5·9in. with a chilled iron projectile. The effect appears to be as great as that of the first round; but if the fact of the plates being so far broken up is taken into account, we think it may be said to be actually a weaker blow, as we have stated above; but no comparison can really be made.

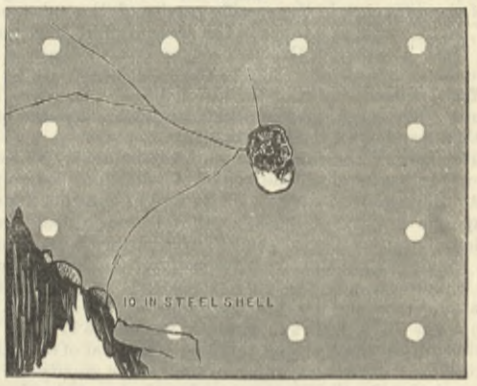
On the whole, we think that the compound plates must be said to have held their own. Brown's and Cammell's appear to have held together better than Marrell's. The tests were not very well suited to exhibit the powers of the plates, but may perhaps have answered the particular object of the Danish Government better than something which was more truly matched to the powers of the plate. To exhibit the actual powers of the plates on service, the backing should correspond as closely as possible to the iron or steel structure of a ship, or to the wall of a fort. As armour becomes harder, and as the blow is transmitted more through its mass, the strength of the supporting

BROWN STEEL-FACED.

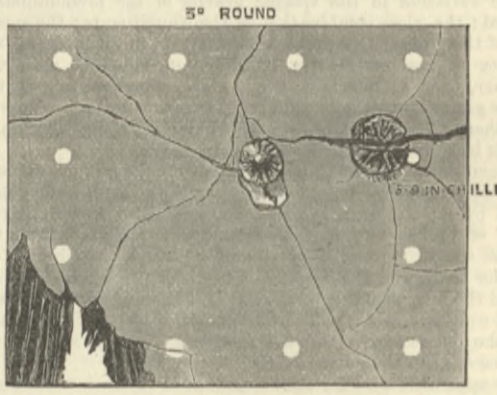
1ST ROUND



2ND ROUND



5º ROUND



structure is called more into play. A hole in a plate generally means a hole in the backing, and the passage of some langridge into the interior, but the movement of a shield bodily tests the supporting frames as a structure.

Navigation of the Weaver.—The members of the Manchester Association of Employers and Foremen, to the number of about 150, on Saturday week paid a visit to the important works which have been constructed for the improvement of the navigation on the river Weaver. For the conveyance of the members along the river a steamer had been kindly placed at their disposal by Mr. Lionel B. Wells, C.E., the engineer to the river Weaver Trustees, and the first portion of the programme was a visit to the river and canal hydraulic boat lift at Anderton, which was designed by Mr. Williams when acting as engineer to the trustees, and as he proposes to construct two similar lifts in connection with the projected Manchester Ship Canal, a few details of its arrangement will be of interest. The lift is constructed to enable boats to pass from the river to the Trent and Mersey canal, which is 50ft. 4in. above the river and *vice versâ*. The works consist of a basin opening into the canal, from which a wrought iron aqueduct leads the water to a lift pit which is connected with the river Weaver by a side channel. The lift is double, so that one barge or two canal boats can be passed each way at one operation. Each lift consists of a trough constructed of wrought iron, the sides forming girders. At each end of the trough or caissons, and at the end of the aqueduct, are lifting gates, which are all closed when the lift is in motion. The troughs are each 75ft. long by 15ft. wide, capable of holding one barge or two canal boats. The weight of the caisson and load is 240 tons. The depth of water in trough in descending is 5ft., and in ascending 4ft. 6in., self-acting syphons abstracting the 6in. of water as the caisson rises, and the time occupied in the lift to the total height of 50ft. 4in. is three and a-half minutes. The rams are 60ft. long by 3ft. diameter, and the pressure 530 lb. per square inch. The diameter of the pipes between main presses is 5in., thence to accumulator 4in., and waste pipes 2in. The accumulator has a stroke of 13ft. 6in., and diameter of ram 1ft. 9in. When working the caissons nearly balance each other, one descending as the other ascends, and the extra power required to work them is comparatively small. The work, which was let and put in hand when iron was at about its highest price, cost £48,428, and was carried out by Messrs. Emmerson and Murgatroyd, of Stockport. The new locks on the river, and the flood sluices which have been erected at Dalton from the designs of Mr. L. B. Wells, C.E., the present engineer to the company, were next visited. The largest of the new locks is 220ft. long, 40ft. wide, and has 15ft. of water on the sills, and is of sufficient capacity to pass one steam barge and three loaded flats in tow, representing about 1000 tons at one lockage, the average time occupied in passing vessels through being about eight minutes. The lock gates are opened and shut with hydraulic power, obtained from turbines, and the water, if desired, can by a sluice arrangement be run from the full lock into the empty one till both attain the same level, thus saving about one-third of the water. The flood sluices at Dutton have been erected in a most substantial manner, a series of lifting gates being carried on massive abutments of masonry, and upon which is worked overhead a travelling crane for raising the gates in succession as required. These sluices have been constructed to prevent floods in the Weaver, and in this they have been most successful, for while in 1852 a flood recorded 12ft. of extra water at Nortwich, since the new sluices have been in operation the water has never risen above 3ft. 6in. By an arrangement of telephonic communication with various points on the river the engineer receives timely notice of any coming floods, and the various sluices are at once got ready for them, thus preventing any backing up of the flood water.

THE INSTITUTION OF CIVIL ENGINEERS.

HEAT ACTION OF EXPLOSIVES.

THE sixth of the course of lectures on "Heat in its Mechanical Applications," was delivered on Thursday evening, the 3rd April, by Captain Andrew Noble, C.B., F.R.S., M. Inst. C.E., the subject being, the "Heat Action of Explosives." The chair was occupied by Sir J. W. Bazalgette, C.B., the president.

The lecturer commenced by pointing out that the salient peculiarities of some of the best-known explosives might roughly be defined to be the instantaneous, or at least the extremely rapid, conversion of a solid or fluid into a gaseous mass occupying a volume many times greater than that of the original body, the phenomenon being generally accompanied by a considerable development of measurable heat, which heat played a most important part not only in the pressure attained, if the reaction took place in a confined space, but in the energy which the explosive was capable of generating. Fulminates of silver and mercury, picrate of potassa, gun-cotton, nitro-glycerine, and gunpowder, were cited as explosives of this class. The lecturer asserted that substances such as those just named were not the only true explosives. In these solid and liquid explosives, which consisted generally of a substance capable of being burnt, and a substance capable of supporting combustion, in, for example, gun-cotton or gunpowder, the carbon was associated with the oxygen in an extremely condensed form. But the oxidisable and oxidising substances might themselves, prior to the reaction, be in the gaseous form; as, for instance, in the case of mixtures of air or oxygen with carbonic oxide, of marsh gas with oxygen, or of hydrogen and oxygen. He added that these bodies did not complete the list, and that, under certain circumstances, many substances ordinarily considered harmless must be included under the head of explosives, making a reference to finely-divided substances capable of oxidation, or certain vapours which when suspended in, or diluted with atmospheric air, formed mixtures which had been the cause of many serious explosions.

These instances served to show that an explosive might be either solid, liquid, or gaseous, or any combination of these three states of matter. In the first place, a brief account was given of the substances of which some explosives were composed, illustrated by the composition of one or two well-known types. In the second place, the lecturer showed the changes which occurred when explosives were fired, and gave the substances formed, the heat developed, the temperature at which the reaction took place, and the pressure realised, if the products were absolutely confined in a strong enough vessel; relating the experiments which had been made, and the apparatus which had been used, either to ascertain or to verify the facts required by theory. He further supposed all the explosives to be placed in the bore of a gun, and traced their behaviour in the bore, their action on the projectile, and on the gun itself. He also described the means and apparatus that had been employed to ascertain the pressure acting on the projectile and on the walls of the gun, and to follow the motion of the projectile in its passage through the bore. He mentioned that the potential energy stored up in a mixture of hydrogen and oxygen forming water was, if taken with reference to its weight, higher than that of any other known mixture, and explained why such an explosive, whose components were so readily obtainable, was not employed as a propelling or disruptive agent, the main objection being that if a kilogram of gunpowder, forming a portion of a charge for a gun, was assumed to occupy a litre or a decimetre cubed, a kilogram of hydrogen, with the oxygen necessary for its combustion, would at zero and at atmospheric pressure occupy a volume sixteen thousand times as great.

The lecturer next passed to gun-cotton, described its composition and the various forms in which it was manufactured, referring especially to the forms which were so largely due to Sir Frederick Abel. The various forms of gun-cotton were exploded, and the lecturer remarked on the small quantity of smoke formed, as an indication of the small amount of solid matter in the production of combustion. Also, that instead of the explosions which took place when gaseous mixtures were fired, gun-cotton appeared rather to burn violently than explode. This was due to the case with which the nascent products escaped into the atmosphere, so that no very high pressure was set up; but it was pointed out that by a small charge of fulminate of mercury, or other means, a high initial pressure was produced, and the harmless ignition shown would be converted into an explosion of the most violent and destructive character. This transformation differed materially from those which he had hitherto considered. In both of these the elements were, prior to ignition, in the gaseous state, and the energy liberated by the explosion was expressed directly in the form of heat. In the present instance a very large but unknown quantity of heat disappeared in performing the work of bringing the products of explosion to the gaseous state.

Captain Noble then showed that gunpowder, the last and most important sample selected, was also by far the most difficult to experiment with, as well as the most complicated and varied in the decomposition which it underwent. One great advantage for the artillerist which gunpowder possessed, in being a mixture not a definite chemical combination, was that when fired it did not explode in the strict sense of the word. It could not, for example, be detonated as could gun-cotton or nitro-glycerine, but it deflagrated with great rapidity, that rapidity varying with the pressure under which the explosion was taking place. As a striking illustration of the effect of pressure in increasing or retarding combustion, he showed an experiment devised by Sir Frederick Abel. It consisted in endeavouring to burn powder *in vacuo*, and he demonstrated that it would not burn until sufficient pressure was reached. He exhibited the various forms under which gunpowder was manufactured, and ignited some samples of powder, pointing out the essential difference between their combustion and that of gun-cotton, namely, the large quantity of what was commonly called smoke slowly diffusing itself in the air. He also exhibited a portion of the so-called smoke of a charge of 15 lb. of powder, collected in a closed vessel.

Captain Noble next described at some length the experiments made with gun-cotton and gunpowder by Sir Frederick Abel and himself. With reference to the latter, he reiterated their opinion that, except for instructional purposes, but little accurate value could be attached to any attempt to give a general chemical expression to the metamorphosis of a gunpowder of normal composition. He further pointed out that heat played the whole *rôle* in the phenomena. He explained that a portion of this heat, to use the old nomenclature, was latent; it could not be measured by a calorimeter—that was, it had disappeared or been consumed in performing the work of placing a portion of the solid gunpowder in the gaseous condition. A large portion remained in the form of heat, and performed an important part in the action of the gunpowder on a projectile.

After describing the apparatus used by Sir Frederick Abel and himself, Captain Noble illustrated the progress that had been made in artillery by mentioning that thirty years ago the largest charge used in any gun was 16 lb. of powder. The 32-pounder gun, which was the principal gun with which the Navy was armed, fired only 10 lb.; but he had fired and absolutely retained in one of these vessels no less a charge than 23 lb. of powder and 5 lb. of gun-cotton.

The lecturer next referred to erosion and its effects, and added that he was not one of those who advocated or recommended the use of gunpowder giving very high initial tensions. If such a course were followed, much would be lost and little gained. The bores of guns would be destroyed in a very few rounds. There was no difficulty in making guns to stand pressures much higher than those to which they were normally subjected, but then they must be in a serviceable condition. Nine-tenths of the failures of guns with which he was acquainted had arisen, not from inherent weakness of the guns when in a perfect state, but from their having, from one cause or another, been placed in a condition in which they were deprived of a large portion of their initial strength. He added that, with a given weight of gun, a higher effect could be obtained if the maximum pressure was kept within moderate limits. He stated that the actual pressure reached by the explosions of gun-cottons experimented with by Sir Frederick Abel and himself, assuming the gravimetric density of the charge to be unity, would be between 18,000 and 19,000 atmospheres, or say 120 tons on the square inch. While at the same density, in a closed vessel with ordinary powder, the pressure reached about 6500 atmospheres, or about 43 tons on the square inch, he had found it possible to measure the pressures due to the explosion of charges at considerably higher density, and had observed pressures of nearly 60 tons with a density of about 1·2.

The lecturer then considered the case of a charge of gunpowder placed in the chamber of a gun; he supposed the gravimetric density of the charge to be unity, that it was fired, and that it was completely exploded before the shot was allowed to move. He exhibited on a diagram a curve indicating the relation between the tension and the density of the products of combustion when employed in the production of work; and observed that in this diagram the tension was represented by the ordinates, the expansions by the abscissæ, and the energy developed by any given expansion was denoted by the area between the corresponding ordinates, the curve, and the axis of abscissæ. He said that if this theoretic curve was compared with the curve deduced from experiments in the bores of guns, after the charge might be supposed to be completely consumed, the agreement was most remarkable, and afforded ample evidence of the approximate correctness of the theory. He had stated that he could not agree with those who were in favour of the strongest—meaning by the term the most explosive—powder manufactured. To show the advance that had been made by moving in exactly the opposite direction, he exhibited diagrams of two guns of precisely the same weight, but differing in date by an interval of ten years. One of these guns was designed to fire the old-fashioned R. L G., the other, modern powders. The maximum pressure in the older gun was nearly double that in the modern gun, while the velocity developed by the latter was twice, and the energy not far from three times, that of the former; and if the foot-tons per inch of shots' circumference were taken to represent approximately the respective penetrating powers of the projectiles, the superiority of the modern gun would be still more apparent. He directed attention, however, to one point. The new gun was, as a thermo-dynamic machine, much less efficient than the old. This arose chiefly from the fact that although the new gun was absolutely much longer than its rival, it was, taken in relation to the charge, much shorter; that all the gases were discharged at the muzzle at a much higher tension. It remained to consider the total amount of energy stored up in explosives. In the case of the most important, gunpowder, he stated that the total energy stored up was about 340,000 kilogrammetres per kilogram of powder, or in English measure a little under 500 foot-tons per lb. of powder. He said that if the potential energy of 1 lb. of gunpowder was compared with that stored up in 1 lb. of coal, his audience being accustomed to the enormous pressures developed by gunpowder, might be somewhat astonished at the results of the comparison. The potential energy of 1 lb. of gunpowder was as nearly as possible $\frac{1}{10}$ of that of 1 lb. of coal, and $\frac{1}{5}$ of that of 1 lb. of hydrogen. It was not even equal to the energy stored up in the carbon which formed one of its own constituents. As an economic source of power coal had the advantage by at least two thousand to one. He had stated that the total theoretic work of gunpowder was a little under 500 foot-tons per lb. of powder, but it might be desirable to mention what proportion of this theoretic work was realised in modern artillery. He concluded by arguing that were it necessary to urge the claims of the modern science of thermo-dynamics, he might take, as perhaps the most striking instance, the progress of artillery during the last quarter of a century. Twenty-five years ago our most powerful piece of artillery was a 68-pounder, throwing its projectile with a velocity of 1600ft. per second. Since then the weight of our guns had been increased from 5 tons to 100 tons, the projectile from 68 lb. to 2000 lb., the velocities from 1600ft. to 2000ft. per second, the energies from 1100 foot-tons to over 52,000 foot-tons. Large as these figures were, and astonishing as were the energies which in a small fraction of a second could be impressed on a projectile of nearly a ton weight, they sank into the most absolute insignificance when our projectiles were compared with other projectiles, velocities, and energies existing in nature. Helmholtz had given an estimate of the heat that would be developed if the earth were suddenly brought to rest; but if, looking at the earth in an artillery point of view, and following the principles he had laid down, the earth was considered as an enormous projectile, and if, it was proposed further, that the whole energy stored up in gunpowder could be utilised, there would yet be required a charge 150 times greater than its own weight, or 900 times greater than its volume, to communicate to the earth her orbital motion.

The President moved that the cordial thanks of the meeting be tendered to Captain Noble for his exceedingly valuable lecture, and also expressed the indebtedness of the Institution to the other lecturers who had taken part in this course, namely, Professor Osborne Reynolds, Mr. W. Anderson, Mr. E. A. Cowper, Professor Fleeming Jenkin, and Mr. A. C. Kirk. The motion was carried by acclamation, and having been acknowledged by Captain Noble, the proceedings terminated.

ON THE COMPARATIVE MERITS OF VERTICAL AND HORIZONTAL ENGINES, AND ON ROTATIVE BEAM ENGINES FOR PUMPING.

AT the Ordinary Meeting on Tuesday, the 22nd April, Sir J. W. Bazalgette, C.B., president, in the chair, the paper read was "On the Comparative Merits of Vertical and Horizontal Engines, and an Rotative Beam Engines for Pumping," by Mr. Wm. E. Rich, M. Inst. C.E.

The author commenced by enunciating the principles that "no single pair of brasses forming a bearing should be subjected to wear on two or more axes at right angles to one another, and all bearings should be adjustable in the direction in which they wear." He pointed out the several ways in which a horizontal engine almost of necessity departed from these principles, while it was easy to observe them in vertical engines, whether they were direct-acting or of the beam type. The main bearing of a horizontal engine necessarily had to withstand the alternate thrust and pull of the connecting rod horizontally, and at the same time the load of the fly-wheel and crank shaft vertically, and possibly the resistance of some driving gear in another direction. This bearing ought, therefore, to be made in four or in three pieces, as was usual in good portable engine practice; but in large engines, for the sake of simplicity, it was more frequently made with two brasses, inclined at an angle of 45 deg., which could not possibly be kept in perfect adjustment. The wear of the cylinder, piston, and glands vertically, and the necessity for supporting the weight of the piston and rod by means of blocks working on guides, both fore and aft of the cylinder, were also alluded to. An objection to a tandem arrangement of two or more cylinders and pumps in line was the difficulty of disconnecting their working parts, and a horizontal was not so efficient as a vertical treble-valve air pump, and sometimes caused accident in starting, in consequence of the condenser overflowing into the cylinder. To drive any sort of vertical pump off a horizontal engine, some complicated driving gear was necessary. Usually this was a bell crank, which also wore its brasses both vertically and horizontally. A horizontal engine of the ordinary type, not steam jacketted, lodged water at both ends of the cylinder, especially if the valve-chest was on the top of it. Messrs. Donkin avoided this by keeping the valves low down on the side, while in Corliss engines separate exhaust valves were provided at the bottom of the cylinder. Some compound horizontal engines, with two cylinders working on cranks at right angles, with Cowper reheater, made by Messrs. Easton and Anderson for Messrs. Siemens, and a three-cylinder compound horizontal engine working sixteen pumps for the ship lift at the Victoria Docks, were then illustrated and described. The compound horizontal pumping engines, made by Messrs. Simpson for the Odessa Waterworks, were next referred to. These were of the same type as those for Messrs. Siemens, but were much larger and fitted with a double-acting pump behind each cylinder. The author argued that most of the above blemishes were avoided by adopting vertical instead of horizontal engines. The several bearings required vertical adjustment only, the pistons and cylinders were free from all load, except that due to the spring rings, and they wore uniformly round their circumferences, and the air pump was on the vertical principle. The engine could be easily made self-contained on a compact bed-plate; it occupied little floor-space, and the foundations were very simple. In many winding and factory driving engines, and in several centrifugal pumping engines, the crank shaft was above the cylinders; but vertical marine and blast furnace pumping engines were generally of the inverted cylinder type. Beam engines were specially suited for pumping, as they permitted a high piston speed and a low pump speed at the same time, and several vertical pumps could be driven from one engine. They were also easily balanced, and were convenient for the introduction of the Woolf compound principle. Their longevity and steadiness of working, when properly balanced, also kept them in favour for factory driving in many parts of England, and in Rouen and Ghent on the Continent; though in consequence of the lower first cost and greater working speed of horizontal engines, they were almost universally adopted on the Continent for such duties. The universal adoption of the vertical engine in the mercantile marine, and the recent introduction of it in the Royal Navy, even at the cost of additional armour-plating to protect it, in order to obtain the advantages which vertical engines possessed over the horizontal engines formerly used, were then discussed; and allusion was made to the extravagant wear of the largest class of horizontal engines on long voyages. In concluding this section of the paper, discussion was invited as to whether the modern continental engineers were right in adopting horizontal engines for nearly all purposes, or was the author right in advocating a much larger use than hitherto of vertical engines for land purposes, and using them almost invariably where large pumping power was required. He admitted the very low first cost of the horizontal engine in its simplest form, and that for small high-pressure engines it was frequently the best type to adopt; but if it was condensing and fitted with quadruple or triple main bearing brasses, it became as dear as a vertical engine, and not so enduring; and if it was also on the compound principle, and fitted for working pumps in a well, the cost of it, with its buildings and boilers, would be very nearly, if not quite, as much as a Woolf beam engine with similar belongings, and the maintenance of it would cost twice as much. The author then proceeded to describe the type of beam engine constructed by Messrs. Easton and Anderson in recent years. Their aim had been to make it, as far as possible, self-contained, on a massive cellular bed-plate, cast in one piece, and to carry the cylinders, valve gear, main bearing, beam carriages, and engine entablature entirely on this foundation casting, so as to leave the whole engine nearly, or entirely, free from the engine-house walls, which could then be of a much lighter construction than was necessary when the entablatures were supported by them. The bed-plate took the place of the expensive ashlar work required in most engine foundations, and shallow pumps could be bolted direct to the underside of it. The general effect of the self-contained principle was to add to the cost of the engine proper, but to reduce that of the engine-house and foundations to a greater extent; so that the total cost of the pumping station was reduced. In the earlier engines of this type the entablature was carried on six round vertical columns; but the angularity of the connecting rod caused vibration longitudinally of the superstructure, and the two centre columns were therefore replaced by ornamental A-frames, which in the most recent examples had given way to cellular A-frames of a very stiff box section. In all first-class engines the cylinders were steam-jacketted, and usually the high and low-pressure cylinders were placed side by side on the same bed-plate with adjustable expansion slides of the Meyer type, improved by the author, on the high-pressure cylinder. The cylinder-capacity ratios were usually from 3½ to 4 to 1; but if steam jackets were not adopted, it was useless to make the low-pressure more than three times the size of the high-pressure cylinder, as, if larger, the diagrams would be very attenuated and almost valueless, in consequence of the lodgment of water, especially at the upper end. The details of some experiments were then given, showing the slow rate at which an unjacketted low-pressure cylinder warmed. At one hour and a-half after starting water was present in it during steam admission at a temperature of only 150 deg.; at three hours it was 175 deg.; and only after about five hours did it reach 192 deg. Diagrams taken during the trials were exhibited. The necessity for the accurate adjustment of governors when adopted was then referred to, and the cases in which governors were frequently dispensed with when an attendant was always close at hand in the engine-room. The regulation of the expansion by the governor was rarely necessary or desirable in pumping engines, which had usually tolerably uniform work. When an engine pumped through a long main it was best to keep the stop valve wide open, and to regulate the engine by the expansion gear alone. The Hartley colliery disaster led to the adoption of wrought iron beams, but they were costly and not entirely satisfactory. Latterly beams of a mixture of cast iron and steel had been preferred. It was a mistake to burden a pumping engine with an abnormally heavy fly-wheel. If only carefully balanced, and the work indicated and work to be done on the up and down strokes respectively were carefully equalised, a light fly-wheel was really better than a heavy one. At a large pumping station it was better to have several engines of moderate dimensions than one or two of colossal proportions. As regarded engine speeds, beam engines might be worked faster than had been the usual practice, if they were well balanced, were not unnecessarily heavy in their working parts, and were fitted with pumps having large valve area. With shallow pumps they could be worked faster than with deep well pumps. The Brighton engines worked at 14 revolutions, the Winchester at 24, the Lambeth, Antwerp, and Sutton at 22, and the Portsmouth at 22 to 26 revolutions per minute. It was not only necessary that engines should be economical in their steam consumption; it was equally important that as much as possible of the power indicated should be utilised for useful work. The position of the pump under an engine beam had much to do with the loads on, and friction of, the working parts. The principles on which air vessel capacities should be proportioned were then discussed, with the assistance of diagrams showing the variations in the discharges of various types of pumps, the practical result being that 23 gallons of air volume for a set of three-throw pumps, throwing 100 gallons of water per revolution, or 42 gallons for four-throw pumps, were as effective as 2200 gallons in a single-acting pump. The author considered that all machinery was impaired rather than improved by the introduction of ornamentation in the shape of architectural features borrowed from structures of wood and stone, and that symmetry with such outlines as conveyed the impression of stability and strength, together with good castings and workmanship, constituted the elements of beauty in such works. If decoration was desired, it was better to bestow it on the engine-house and chimney, and to call in the architect to assist in designing those structures which were essentially different from the machinery. At the same time, if economy of first cost was important, it was better to have an undecorated engine-house and high-class machinery within it than to limit the perfections of the engines, in order to get means for ornamenting the buildings. Some engine and boiler-houses could be built for about one-third the cost of the machinery, but not unfrequently they cost considerably more than their contents. Illustrations were then given of various examples of beam pumping engines,

constructed by Messrs. Easton and Anderson and their predecessors, commencing with the four Woolf engines at the Brighton Waterworks. Each of these worked two 33½in. deep-well low-service pumps, a 24in. high-service pump, and a middle-service pump, the water supply of that town being divided into three zones at different levels. The four engines at the Portsmouth works had each a double-acting piston pump, 20in. in diameter, with a length of stroke of 3ft. The South Essex Waterworks engine had two 16in. high-lift pumps. All of these depended on the engine-house walls for their stability. Then followed the self-contained Doncaster Sewage and Saratoff Waterworks engines, each with six columns supporting the entablature, and a double-acting pump between the engine centre and the crank. In the Winchester No. 2 engine, working two deep well pumps, two A-frames replaced the centre columns in the last-named examples. The Lambeth Waterworks engines had the high and low-pressure cylinders on separate bed plates, each working a double-acting pump, placed between the cylinder and beam centres and cranks at right angles. The pumps sucked their water through a surface condenser, and the condensed water from the steam jackets passed direct into the feed pump suction. There were two pairs of such engines in the same engine-house, and they were supplied with steam by five double flue boilers. The steam in its passage from the high to the low-pressure cylinder was re-heated, as in the Cowper system, by an inclined tubular heater. The beams were of wrought iron, and were surrounded with entablatures forming chequered plate platforms, which were supported by A-frames and polished wrought iron columns, and were entirely independent of the walls. A basement floor, 10ft. below the main engine-house floor, gave free access to the surface-condenser and all the pumps without artificial light. In the first trial of these engines they worked with 17 lb. weight of steam per indicated horse-power per hour, and a mechanical efficiency of 90 per cent. The temperature of the water in passing through the condensers rose about 1 deg. Fah. per 100ft. of life. The Antwerp Waterworks engines were to the same centres as those at Lambeth; but they had both a high and a low-pressure cylinder on each bed plate; the beams and connecting-rods were of cast iron and the main bearings were cast on the bed plates. No. 3. Sutton engine was an example of one fitted with three pumps, all sucking from the same well, and working under lifts of 182ft., 291ft., and 526ft. respectively, and interchangeable in their duties. The Buenos Ayres sewage pumping engines consisted of two coupled pairs, each capable of raising a maximum of 17,500 gallons of sewage on a lift of 50ft. in one minute. The A-frames were extended to include the beam carriages, and, together with the bed-plates, were of very stiff box sections. The beams were constructed of a mixture of cast iron and steel, having a transverse strength 65 per cent. greater and an ultimate deflection 54 per cent. greater than ordinary cast iron. There were two lift pumps 41in. in diameter, 46in. stroke under each engine. One of these was worked from a prolongation of the high-pressure piston rod, and the other by a rod from the beam, which was turned upwards at its outer end, to enable a single rod to be introduced for the pump, without fouling the engine connecting rod. There were four boilers in the adjoining house, and the engines were guaranteed to give a duty of 100 millions of foot-pounds in water raised per cwt. of coal. The four beam engines at the General Post-office, for the pneumatic despatch system, each had two bed-plates, one above the other, the lower one supporting two 35in. double-acting air pumps, which might be worked separately pressure and vacuum respectively, or together for either purpose. Two engines of simple design, and smaller dimensions, for a similar duty at the Prudential Assurance Office, were also described. Finally, an example of small compound beam engines working at 45 revolutions per minute, to drive, by means of gearing, two sets of three-throw pumps at 24 revolutions per minute, was given in those at the South Hants Waterworks, where the Clarke softening process was carried out.

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

(From our own Correspondent.)

Business is quite as good as a week ago, but this is not saying a great deal, since there is abundant room for increase in the number of orders arriving, and more especially in the prices realised. In this last particular, indeed, trade was scarcely ever so unsatisfactory as now.

Competition from other districts, particularly the North of England, keeps up, and if the northern ironmasters should obtain another reduction in wages they will be in a still better position to compete with South Staffordshire for orders.

Certain of the best bar makers report this week that home orders show a little improvement.

Australian and some other shipping orders are coming forward with encouraging freedom, but they are light and are soon cleared off the books. Earl Dudley's bars are £8 2s. 6d.; other best qualities, £7 10s. to £7; second-class, £6 10s.; and common, £6 5s. or £6.

Messrs. N. Hingley & Sons' bars were quoted to day—Thursday—in Birmingham; Netherton crown best, £7 10s.; Netherton crown best horseshoe, £7 10s.; best rivet, £8; double best plating, £9; double best crown Netherton, £8 10s.; treble best crown Netherton, £9 10s. These prices applied to rounds and squares ½in. to 3in. and flat bars 1in. to 6in. Angles were 10s. per ton extra, and tees 20s. per ton extra.

The bars of Messrs. Bagnall & Sons were quoted:—1in. to 6in. flat, £7 10s.; 6½in., 7in., 8in., and 9in. flat, £8; ⅞in. to 3in. rounds and squares, £7 10s.; 3⅛in., 3¼in., 3⅜in., and 3½in., £8; 3⅝in., 3¾in., 3⅞in., and 4in., £8; 4¼in. and 4½in., £8 10s.; 4⅝in. and 4¾in., £9; 4⅞in. and 4⅝in., £9 10s.; 4⅞in. and 5in., £10; 5¼in. and 5½in. rounds only, £10 10s.; 5⅝in. and 5¾in., £11; 5⅞in. and 5⅞in., £11 10s.; 5¾in. and 6in., £12; 6¼in. and 6½in., £13; 6⅝in. and 7in., £14; and 7¼in. and 7½in., £15. Turning bars are £7 10s.; plating bars, £8; and horseshoe bars—"shoeing," £7 10s.

The demand for sheets is considerably within the supply, and the mills are making only about two-thirds to half time.

Prices are very varied, according to the state of individual makers' order books. Merchant singles, however, are about an average of £7; galvanising doubles, £7 12s. 6d. to £7 15s.; and lattens, £8 10s. to £8 15s. easy.

Bridge and girder and roofing manufacturers are drawing a good deal of their supplies of iron from the North of England and other districts. This severely makes against the local producers of tee, angle, and rivet iron and of plates.

Ordinary angle iron of 1½in. to 4½in. was to-day abundant at £6 5s. to £6 10s., and superior qualities at £7; T-iron, of ¾in. to 2½in., was £7 5s. to £7 10s.; and superior qualities £8. More reliable angle and rivet iron was quoted £8 10s.; best angle and rivet iron, £9 10s.; and double best, £10 5s. to £10 10s.; best T-iron was also £9 10s., while chain iron was named by the principal firms at £9 for single best, £10 double best, and £16 10s. for double best charcoal bars.

Common hoops varied from £6 10s. down to £6 5s. at works, while superior sorts from 16 to 19 b.g. were quoted £7 to £7 10s. The marked iron firms quoted £8 for hoops of from 14 to 18 b.g., and 30s. per ton extra for best qualities. Coming to hoops of 20 b.g., these were to be had from some excellent makers at £7 15s. to £8 5s. for ⅞in. size, and £8 10s. to £9 for ⅝in. size.

The Staffordshire Steel Company hopes in a fortnight's time to have made a start, and expects by that time it will be rolling ingot iron. Orders for this product it is now soliciting from local sheet and hoop and bar makers to be rolled down in its iron mills.

The present condition of trade is leading ironmasters to try to curtail outlay. For a long time past Messrs. Samuel Groucutt and Sons have been keeping on two ironworks at Bilston, namely, the Bradleyfield and the Bankfield Works. They have determined to close the Bradleyfield establishment and concentrate their operations at Bankfield. Notice to this effect has been given to the hands, some 200, who will consequently be thrown idle.

The Imperial Galvanised Iron Company has just got its works in Wolverhampton into operation. The company states that it commences with orders on hand amounting to something like 10,000 tons, and that it has an output capacity of some 200 tons a week. It is the intention of the company to produce sheets of best quality. The corrugating machinery is of local manufacture, and the engine for driving it is one of Robey's, of Lincoln.

Northampton pigs are this week about 42s. to 42s. 6d. per ton; the average of Derbyshire pigs, 43s.; and superior Derbyshires, 44s. per ton in actual business. Thorncliffe pigs are quoted 56s. 6d., but without business. Native pigs are 60s. to 67s. 6d. for all-mines, 45s. to 42s. 6d. for part mines, and about 37s. 6d. for common cinder sorts.

The ironworkers in the West Bromwich district are trying to solve the problem which has baffled even their masters. They wish to stay the depression; and they think they can do it by restricting the output. At a meeting of the men this week several suggestions were made in this direction; but they were told by their chief representative upon the Wages Board—Mr. James Capper—that in their present disorganised condition they could not possibly give effect to the proposals. However, it was ultimately resolved "That in future puddlers should only charge 4 cwt. and 2 cwt. of iron per heat;" and Mr. Capper promised to recommend the men in the other districts to come to a similar resolution.

There have been placed in Birmingham orders for portions of a machinery plant which is required to begin the manufacture of glass in China. The plant is to be very complete, and will embrace all the recent improvements. The limited liability company which has been formed to carry out the undertaking has engaged twenty-five men from the Birmingham and Stourbridge districts to go out to Hong Kong, where the manufacture will be first introduced. The silicate found in China is said to be peculiarly adapted to the successful manufacture of glass.

The Darlaston Bridge and Roofing Company is just now turning out some large girder work in connection with the New-street extension station, Birmingham. The ground and buildings under wrought for the widening of the subway at the eastern end of the station will be supported by a strong bridge of iron girders. The first of these is a box girder, 76ft. long, 2ft. wide, and 8ft. 6in. high, and weighing about 30 tons. It was placed in position this week. A number of lighter parallel girders are to be laid over the subway in Worcester, with another heavy box girder on its opposite side. Two large massive girders will be built into position on either side of the upper end of Great Queen-street. The girder on the north side, which will carry a portion of the old station roof, will also be of box pattern, with flanges of eight thicknesses of sheet iron. That on the south side will have a span of 160ft., and will be 15ft. in depth, weighing 160 tons.

Traders in the Midlands do not view with satisfaction the new Railway Bill which has been brought into the House of Commons by Mr. Chamberlain. At a meeting of the committee of the Birmingham and District Railway and Canal Rates Association, held in Birmingham on Tuesday, the following resolution was passed:—"That this Association views with surprise and extreme dissatisfaction the Railway Bill recently introduced into Parliament, as containing clauses that would deprive traders of the few advantages they now possess under the existing law, and give railway companies powers to impose additional charges to their present excessive rates. This Association therefore pledges itself to exercise every legitimate means in its power to oppose a measure which, if passed, would be disastrous to the trade of the town and district." The Dudley Chamber of Commerce incline to the same opinion. At a meeting held at Dudley on the same day, they determined to present a memorial to the Board of Trade against the introduction of a terminal clause in the new Bill.

A gas engineering undertaking of some magnitude—involving, indeed, the expenditure of nearly £12,000—is that which has been entered into by the Local Board of Fenton, North Staffordshire, to procure a supply of gas independently of the Corporation of the neighbouring borough of Stoke-on-Trent. The engineers—Messrs. Stevenson and Son, of London—have pushed on with the work, so that the manufacture of gas was begun on the 22nd. The retort house contains thirty-six retorts, whose maximum capacity is 220,000ft. per day. A 12in. main is used to convey the gas to the condensers. At present there is only one exhauster, but provision is being made for the erection of another. Adjoining the exhauster house are three boilers of 40-horse power each. The reason of so large a reserve of steam power is that the Local Board intend on the completion of a current sewerage scheme to use a portion of the gasworks as a pumping station. Laidlow's centre valve is used to work the purifiers.

Considering the opposition which is being shown to the use of the traction engine on the highway, it is strange that owners and drivers do not take the requisite care to keep out of the hands of the law. For permitting a traction engine to travel without the requisite license through Burslem on the 12th inst., its proprietor, William Pickels, of Meltham, near Huddersfield, was fined 40s. and costs by the Burslem magistrates on Tuesday, and a similar penalty was inflicted upon the driver.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—Throughout all branches of the iron trade in this district business continues dull, and the approach of the Whitsuntide holidays has tended still further to restrict operations. In view of the general closing of works—which in many cases will extend over nearly the whole of next week—there has not been much buying going on, whilst deliveries against contracts are also being suspended until after the holidays, and practically there will be little or nothing doing until well into the second week of June. So far as prices are concerned, quoted rates are nominally unchanged. In pig iron, however, the tendency continues downwards, and although finished iron prices are maintained at the figures that have been ruling for the last few weeks, the actual transactions on the basis of the present quoted rates are very small.

There was only a very inanimate market at Manchester on Tuesday. In pig iron a few sales were reported, but when they reached any weight they were based on prices under those nominally quoted in the market. Lancashire pig iron makers still quote 43s. 6d. for forge, and 44s. for foundry, less 2½ per cent., delivered equal to Manchester, and as they are fairly well off for deliveries against contracts, they are not at all anxious to press sales at less money. At the above figures, however, they are practically out of the market, and any business that is at present being done by local makers is limited to a few very small parcels to consumers in the neighbourhood of works. Quotations for Lincolnshire brands remain at about 43s. 4d. for forge and 44s. 4d. for foundry, less 2½ per cent., delivered here; but makers who hold out for these figures report that they are being undersold, and in some cases 6d. to 1s. per ton less would be taken. For North-country iron makers are maintaining a tolerably firm tone, and good foundry brands of Middlesbrough cannot be got for less than 44s. 4d. net cash, delivered equal to Manchester; but in Scotch iron, makers are gradually getting down to the low prices at which merchants have been recently selling.

In the finished iron trade quoted prices remain at about £5 15s. for good Lancashire and North Staffordshire bars, £6 5s. for hoops, and £7 5s. for sheets, and it is only in exceptional cases that orders could be placed at much under these figures. Tolerably large American orders for hoops have recently been given out; but generally the shipping trade continues quiet, and the home demand for all classes of manufactured goods shows no improvement.

In the wages of the finished ironworkers a reduction of 2½ per cent. is being put into force in this district.

The activity in the machine making trade to which I have referred in recent reports continues, but the orders that are being got are not being given out in this district. Recently large orders have been distributed amongst the leading machinists in Manchester for the fitting up mills that are being erected in the Brazils and at Glasgow.

Tool makers are also kept well employed, and locomotive builders have still so much work in hand, that recently orders for anything like early delivery have had to be declined.

Messrs. W. Collier and Co., Salford, have introduced several new arrangements into bar-cutting machines, and they have just completed a couple of machines laid out on new lines which it will be of interest to notice. One of these is a horizontal bar-cutting machine with engine attached, especially designed for heavy work, and at one end is constructed to cut bars up to 5in. by 2in. The frame is of the box trunk pattern, and very strong; the machine has a steel excentric shaft slide block and massive cast iron ram 3ft. long, having a continuous bearing on all sides to ensure a steady cut, and to provide against side pressure, strain, and wear. The other machine is a double-geared excentric double-ended bar-cutting and shearing machine of the ordinary pattern, with the exception that one end is so arranged to cut bars up to 2¼in. square or rails up to 60 lb., whilst the other end is provided with a patent double-throw cam motion, which gives two cuts at this end to one at the bar-shearing end, and is capable of cutting 1½in. square bars or plate scrap up to ⅝in. thick; the double-stroke shears being placed at an angle to admit bars of any length.

The passing of the Manchester Ship Canal Bill by the House of Lords' Committee has been one of the chief topics of conversation in business circles during the past week, and Mr. Daniel Adamson, who has been the chief and most active promoter of the scheme, has received most hearty congratulation upon the success which so far has attended his efforts. No one doubts that the construction of the canal would be a great benefit to this district, and the passing of the Bill has been received with general satisfaction, but the possibility of raising the money requisite for carrying out the scheme is still a point upon which many people are doubtful. I have, however, heard it reported that a syndicate has already been formed who have promised to raise a large proportion of the capital required, but as to the terms on which they would raise the capital I have no information.

In the coal trade business may now be said to have quieted down to the usual summer demand. Pits in many cases are not kept working more than three, and it is very exceptional where they exceed four full days a week, and at many of the collieries stocks are going down. For house-fire purposes there is very slow demand, and for general trade purposes supplies are in excess of requirements, even engine fuel, notwithstanding the lessened production of slack, being fairly abundant in the market. Quoted prices remain at about 9s. for best coals, 7s. for seconds, 5s. 3d. to 5s. 9d. for common coal, 4s. 6d. to 4s. 9d. for burgy, and 3s. 6d. to 4s. for good slack, with small concessions being made upon these figures for quantities.

The usual season for placing out gas coal contracts has now opened, and there is a fair number of inquiries in the market. There is less disposition to entertain contracts for long forward delivery; but the prices which would be taken are quite as low as last year. For better qualities of gas coal at the pit mouth prices average from 7s. 6d. to 8s. per ton, seconds about 7s. to 7s. 3d., and ordinary gas coals about 6s. 9d. per ton. On about the basis of these figures business to a moderate extent has been done.

The shipping trade is quiet, with 7s. to 7s. 3d. about the average price for Lancashire steam coal delivered at the high-level, Liverpool, or the Garston Docks.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

A dispute in the iron trade at Elsecar, which has now lasted six weeks, turns upon the refusal of the owner, Mr. George Dawes, to pay for any iron which "breaks short," *i.e.*, that will not stand the full test of bending. At a further meeting of the men, recently held, the matter was again fully discussed, and it was decided that work should not be resumed unless the firm would pay for the iron, which was stated to be the general custom of the trade.

There is still a rupture between the Stanton Coal and Iron Company and their employés. The men employed at the Butcherwood and Silver Hill collieries remain firm to the resolutions passed at the first meeting after the strike, namely, that they should not return to work unless the masters permitted them to go on as they had been accustomed to do. Mr. Clarke, the managing director of the company, it was stated at one of the men's meetings, had been asked to withdraw the home coal question for six months, and had replied, "Not a day." He was then asked whether he would withdraw the question for three months, but to this also Mr. Clarke objected. A further proposal to refer the matter to arbitration was also refused. On hearing this report of the interview, the miners resolved to remain out until the employers conceded their demands. There were about 1000 men on strike. Eleven horses were drawn from the workings to the surface on Saturday at Silver Hill, and it is feared that this is only preliminary to a general exodus from the pit in a few days.

A patent has been issued under the new Act to Mr. Arthur Benjamin Ball, of Sheffield, for improvements in the construction of spring cutlery. The invention consists in the making of the hafts of pocket and pen-knives in one solid part, and under this new process the two scales, the back, and the bunters, can be turned out altogether in nickel silver, aluminium, or other suitable substance. In the old process the different parts are held together by means of pins or rivets, and the knife is thereby less firmly constructed. Mr. Ball claims that, by his invention, the bunters act as a permanent substitute for the ends of the springs, and upon them the blades rest when open. It is claimed that in this way the knife is made very strong, and breakage made as near impossible as contrivance can secure. The patent rights have already been sold, and arrangements made for the manufacture of this new patent spring cutlery under the direct supervision and management of the patentee.

The Midland Railway Company is at present trying two experiments on the fast trains between St. Pancras and Sheffield. "The other night"—writes a correspondent—"I left London at half past five in a train lighted with electricity, which yielded a continuous and steady light; and without the engine whistling during the journey." To have more light and less noise is decidedly a double boon to which other companies—the Lancashire and Yorkshire, for example—might turn its attention with comfort to their customers.

A pleasing evidence of the good feeling existing between employers and employed at Messrs. Turton Brothers and Matthews' works was afforded on the 28th inst. Mr. W. A. Matthews, one of the partners, is about to marry a Beverley lady. The managers and workmen, on learning the news, at once subscribed to make a presentation to Mr. Matthews. The wedding gift consists of a magnificent cabinet of cutlery in pollard oak. The cabinet contains every possible requisite, and is valuable in itself, apart altogether from the kindly feeling which prompted its presentation. It was accompanied by an illuminated address, in volume form, which was also embellished with photographs of the home of bride and bridegroom, and their future home at Sheffield. The cabinet of cutlery was produced by Messrs. William Hutton and Sons, of High-street, Sheffield, and is highly creditable to that old-established firm, who, by the way, are removing to new and most commodious premises in West-street, which are rapidly approaching completion.

It is not generally known that Joseph Gillott made the first steel pens in Sheffield, and might have continued the production there had trades unionism not interposed. The premises in which he commenced his manufacture of these useful little articles are in

Blonk-street, but I hear that an enterprising local firm, for purposes of business extension, are about to pull them down.

In a Scotch paper—the *Huntly Express*—I notice the death of Mr. Robert Sellar, of the Huntly Plough Works, who has had for many years a remarkable reputation for ploughs, which he supplied chiefly for the colonies, and devised several useful inventions, to which he applied Sheffield steel very freely. One of his ideas has been practically carried out by the Carron Iron Company, who, the *Express* states, paid him a handsome royalty for it.

Messrs. Newton, Chambers, and Co., Thorncliffe Collieries, on Wednesday reduced the prices of their household coals by 1s. per ton.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

AT the Cleveland iron market held at Middlesbrough on Tuesday last the attendance was somewhat larger than it has recently been, and a moderate amount of business was done. Merchants having control of but small quantities of pig iron, begin to show more disposition to buy than to sell. Most of the sales made on Tuesday were therefore by makers, and realised 37s. per ton for No. 3 g.m.b. prompt delivery. A few lots were sold at 36s. 9d. per ton, but the quantities were not considerable. Makers have been of late confining themselves mainly to the production of foundry iron, and consequently forge qualities have become relatively scarce, and the price has stiffened. Less than 35s. 6d. per ton is nowhere accepted.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s Middlesbrough store was 58,627 tons on Monday last, being a reduction of 250 tons for the week. In their Glasgow store they hold 590,974 tons.

Shipments from the Tees are proceeding actively. The exports for May up to Monday last were 75,057 tons, being about 10,000 more than the corresponding period of April, and about 4000 tons more than that of May last year.

The finished iron trade exhibits no new feature. Orders and inquiries continue scarce, although prices are so exceedingly low. Makers appear determined to close their works rather than reduce further. The prices which have been quoted for many weeks past are still adhered to, and are as follows:—Ship-plates, £5 to £5 2s. 6d. per ton; shipbuilding angles, £4 15s. to £4 17s. 6d.; and common bars, £5 2s. 6d. to £5 5s.; all f.o.t. at makers' works; cash 10th, less 2½ per cent.

Owing to the Whitsuntide holidays, the iron market will not be held at Middlesbrough until Wednesday next week.

The accountant to the North of England Board of Conciliation and Board of Arbitration has just given his certificate for the two months ending April 30th. It shows the average net selling price of rails—iron—plates, bars, and angles to have been £5 8s. 11½d. per ton. This is equivalent to a reduction of 4s. 7½d. per ton since the end of February, and of 8s. 11½d. per ton since the end of last year. The decline for the whole of last year was but 10s. 7d. per ton. There has also been a great diminution iu the quantity produced. The total for the two months ending April 30th was 75,044 tons, as against 90,616 tons for the similar period ending February 29th, and 109,220 tons for that ending December 31st.

The employers connected with the North of England Board of Arbitration have given notice for a reduction of 1s. per ton on puddling, and 10 per cent. on all other forge and mill wages, to take effect on June 28th, when the present agreement terminates. A meeting of the Board to decide what action is to be taken in view of the said notice will be held on an early date.

Messrs. Dorman, Long, and Co., of the West Marsh and Britannia Ironworks, Middlesbrough, gave the whole of the men employed by them seven days' notice, to terminate engagements on Saturday last. This step has been taken owing to the continued depression of trade. Both works will be closed next week, but it is expected that the West Marsh works will be re-opened the week after. About 1000 men have hitherto been employed at the Britannia works and 600 at West Marsh.

The Darlington Steel and Iron Company's works are to be closed during the whole of next week.

The mills and forges at Witton Park are idle this week for want of orders, and it is not known when they will be started again.

The Middlesbrough Galvanising Company is extending its works, and adding the manufacture of iron tubes to its business.

The North-Eastern Railway Company is adding other two acres to its docks at West Hartlepool, at a cost of about £14,000. The present area of the dock is about thirteen acres.

In the opinion of the North of England iron manufacturers the time has now arrived when plate-rollers should be asked to submit to a special and considerable reduction in the tonnage rates hitherto paid to them. A return recently issued proves that these men have been in the habit of receiving from 15s. to 62s. per shift clear, after paying all their helpers. They are all paid at the same rate per ton, and the difference per shift, or day, arises from the varying outputs of the mills, according to their power, and according to the nature of the orders upon which they work. A claim will probably be sent in to the standing committee of the Board of Arbitration to have a separate tonnage rate fixed for each plate mill, according to the conditions thereof, and such that the clear remuneration to the roller will be about 15s. per shift. The standing committee have power to decide such questions, either by arrangement or by reference to Mr. David Dale, the standing referee. Should the employers obtain what they ask for, it will assist them to the extent of several pence on the ton of finished plates. It is contended that it is absurd that in times so disastrous as the present ones to the iron trade, rollers should not be content with such handsome wages as 15s. per shift.

The Cleveland district has lost one of its ablest engineers in Mr. Edward Hutchinson, who died of fever a few days since. Being in delicate health, and thinking that a change to a warmer climate would prove beneficial to him, he accepted an appointment in December last from Mr. John Dixon, of Laurence Pountney Hill, to superintend the erection of a pier at the mouth of the Amazon. Up to a month since the reports he sent home were highly satisfactory, and a letter received even after his death had actually occurred was written in a satisfactory and hopeful tone. But his physical constitution had previously been seriously weakened by the inroads of pulmonary phthisis, and he quickly succumbed to an attack which a stronger man would probably have successfully battled with. He leaves a widow and six children, resident in Darlington. Mr. Hutchinson served his apprenticeship with Messrs. Gilkes, Wilson, and Co., locomotive builders and general engineers at Middlesbrough, between the years 1850 and 1855. He then entered the drawing-offices at Messrs. Robert Stephenson at Newcastle, and became one of the best known and ablest draughtsmen in the locomotive department. For a time he again entered the service of his old employers at Middlesbrough, and for them superintended the erection of several iron trellis bridges on the Darlington and Tebay line. These bridges were designed by the late Sir W. Bouch, and were the prototypes of the subsequently unfortunate Tay Bridge. After this Mr. Hutchinson devoted himself to the study of rolling mill machinery, and in 1861 established the firm of Pease, Hutchinson, and Sedward, and built the Skerne Ironworks at Darlington. These works were successfully conducted until about 1873, when his old partners retired, and they were then transferred to a limited company, entitled the Skerne Ironworks Company, Limited. This company was not very successful, and after various vicissitudes the works fell into the possession of the debenture holders, and still remain idle. About the autumn of the year 1879, Mr. Hutchinson, encouraged by the improved prospects in trade afforded by the American "boom," acquired the Bishop Auckland Ironworks, then inoperative, and commenced rolling ship plates. A reaction in prices soon succeeded, however, and in little more than two years he was compelled to discontinue operations and abandon the enterprise. He then entered the service of the Cleveland Bridge and Engineering Company, of Darlington, and so remained until obliged by weakened health to seek an engagement in a warmer climate as already stated. Mr. Hutchinson was a "born mechanic." He was the author of various papers on mechanical subjects contributed to the Institution of Mechanical Engineers and to the Cleveland Institute; and was one of the original founders of the latter society in 1864. He was also the author of a very interesting treatise on bridge building, published a few years since and bearing his name. To his inventive powers was also due the ingenious and effective appliance known as the "Hutchinson steam lift," now largely used at the roughing rolls in North of England plate mills. When his death took place he had nearly completed the fiftieth year of his age.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE Scotch iron trade is dull in most of its departments, and as yet the signs of improvement are not visible. In the warrant market of Glasgow in the past week, business was exceedingly quiet, and comparatively little pig iron changed hands on speculative account. The demand for makers' iron for consumption is also quiet. There was, however, a large increase in the shipments last week, the quantities despatched being upwards of 16,000 tons. At the same time the general prospects of the pig iron business are not considered to have at all improved. The decrease of stock in Messrs. Connal and Co.'s stores in the course of the week has been fully 600 tons. There are now 95 furnaces in blast, as against 117 at this date last year.

Business was done in the warrant market on Friday at 41s. 4d. cash. On Monday forenoon transactions occurred at 41s. 3½d. to 41s. 3d. cash, and 41s. 5d. to 41s. 4½d. one month; the afternoon quotations being 41s. 3d. cash, and 41s. 4½d. one month. The quotations on Tuesday forenoon were 41s. 2d. cash, and 41s. 4d. to 41s. 4½d. one month; while the afternoon prices were 41s. 2d. to 41s. 2½d. cash, and 41s. 4½d. one month. The market was flat on Wednesday, with transactions at 41s. 1d. to 41s. 2½d. cash, and 41s. 3d. to 41s. 4d. one month. Thursday, business in the forenoon was from 41s. 2d. to 41s. 2½d cash, and 41s. 4d. one month; afternoon business was done at 41s. 3d. cash, and 41s. 5d. one month.

The values of the special brands of makers' iron are this week somewhat easier, the quotations in the market being as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s.; No. 3, 50s.; Coltness, 56s. 6d. and 50s.; Langloan, 53s. and 51s.; Summerlee, 51s. and 47s.; Calder, 52s. and 47s.; Carnbroe, 50s. 6d. and 47s.; Clyde, 47s. 6d. and 45s.; Monkland, 43s. 6d. and 40s. 6d.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 43s. and 40s. 6d.; Shotts, at Leith, 52s. and 51s. 6d.; Carron, at Grangemouth, 48s. (specially selected, 54s.) and 47s. 6d.; Kinneil, at Bo'ness, 44s. 6d. and 44s.; Glengarnock, at Ardrossan, 50s. 6d. and 44s.; Eglinton, 44s. 9d. and 41s. 6d.; Dalmellington, 47s. 6d. and 43s. 6d.

The demand for hematite is quiet, without change in prices.

Continued progress is being made at Wishaw with the erection of the new steel works in that town and neighbourhood. At the moment the demand for steel goods has materially fallen off in consequence of the slackness in the shipbuilding trade, and at one large works some furnaces have been put out, but the promoters of such works as these have evidently faith in the expectation that steel is destined more thoroughly to supplant iron for almost every purpose for which the latter has hitherto been in use. Besides the Glasgow Iron Company's new works for the manufacture of steel on the basic process, the Belhaven Iron and Steel and Patent Nail Company is engaged in erecting premises at Wishaw.

The manufactured iron trade is quiet, with very few fresh orders, and the prices nominally without alteration.

In the Glasgow district the coal trade is in a satisfactory state, as far as the shipments are concerned. Large and numerous cargoes are presently being despatched. Those for the past week are heavy, and the quantities now being loaded are much greater than usual. The prices at Glasgow are, however, without change. Hitherto the coalmasters have managed to meet their engagements with the shippers, notwithstanding the endeavours of the men to cause embarrassment by a restriction of labour; but their success in this matter does not occasion much surprise, on account of the wide field from which the coal is now drawn by rail. A fair business is done in coals for shipment on the Ayrshire and Firth of Forth coasts. The Lanarkshire quotations are:—Main coal f.o.b. per ton, 6s. 3d. to 7s.; ell, 7s. to 7s. 9d.; splint, 6s. 9d. to 7s. 3d.; steam, 8s. to 8s. 6d. The prices are from 9d. to 1s. less at the collieries, according to the distances that the coals have to be carried.

The action of the miners' leaders both in the western and eastern mining district at present is, to put it mildly, wantonly mischievous. If these men are at all acquainted with the circumstances of the coal trade they must know that it is quite impossible for the coalmasters at present to obtain higher prices, and consequently out of their power to grant an advance of wages. Yet the men are daily exhorted to restrict their labour, with the object of forcing higher rates of pay. In order to be successful, even from the men's point of view, restriction would need to be universal, instead of local, as is the case just now. The only effect of the policy now being pursued will be to cause still further depression in the trade.

In Fifeshire and the neighbouring county of Clackmannan, a serious dispute seems to be impending. There the men demand, or rather their leaders for them, an advance of 15 per cent., the alternation being that they will work only four days a week.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

I HAVE just heard that the Cardiff and Monmouthshire Railway Bill is to be withdrawn for the Session. The Barry drags its slow length along, and now there is an adjournment for a time to enable members to recruit, and to ponder again the *pros* and *cons*. The battle is one of giants, and must be exhaustive to those in the thick of it. The sooner over the better, and then all energies can be bent to that steady development of minerals which is so much to be desired.

In the meanwhile the Taff Vale is broadening itself out to meet all contingencies, and will be ready to grapple with a very much larger tonnage than it now has. To the outsider, who has no interest either in Barry or Cardiff, there can be but one conclusion—increase your railway arrangements to Penarth, dock the west mud, and if this does not do, then go east to the mouth of the Rhymney. There is no earthly reason in going twelve miles away from Cardiff to the west. I should be glad to see such an alternative scheme propounded by the opposition that a general agreement and shaking hands all round would follow.

In the matter of parliamentary committees an ingenious friend submits that they should be abolished and Government Commissions be appointed to be held at the very spot where it is sought to make railway, dock, or other matters. A few such incidents as the Manchester Canal Bill would soon awaken the necessary breeze of public opinion in favour of such a course.

The iron trade still flags, and I should not be surprised any day to see the initiative of Middlesbrough in the paying off of hands followed. The make of steel is 50 per cent. in excess of demand if we take the life of a steel rail into consideration. One good result of the unionism of ironmasters has been the improvement of prices. Steel rails of a certain specification are now five guineas. A little while ago they might be bought for about £4 10s. to £4 15s. This would be all very good if requirements showed any increase; but they do not, and from one end of Wales to the other this branch of industry is as bad as it can be.

As for the coal trade, business is steady, and prices for best qualities firm. House coal and secondary steam coal are rather unsteady, but there is little reason for complaint, and the progress of new sinkings is continued very energetically. By this time next year the area of coal yield will be considerably increased. The Newport Abercarn Company is advertising, I see, for the sinking of a pit 170 yards deep; Cyfarthfa, too, is progressing well with their new colliery, and the enterprise of the Brecon, Great Western, and other railways in the increase of facilities, doubling lines, &c., is aiding the coal development to a marked extent.

A meeting of the sliding scale joint committee was held at Cardiff on Tuesday, when it was decided to request the auditors, Mr. Kirk, Leeds, and Mr. Parsons, Newport, to send in their estimate of the average selling prices during the four months ending April, 1884.

With regard to the Fleuss life-saving apparatus, the committee, after full consideration, came to the conclusion not to take it up as an association, but they commended it to the consideration of private individuals, and recommended that it should be brought into use in the district in order to try its efficacy.

The complaint of the Plymouth hauliers to the effect that they were not being paid according to the standard rate was adjourned for further information. At the conclusion of the meeting it was resolved to call a gathering of all engineers and stokers connected with the collieries of Monmouthshire and South Wales on Monday next, to formulate the hours of labour and rate of wages.

I note an instance of quick despatch at Cardiff which does not support the idea of dock or railway congestion. The new screw steamer, the County of Salop, came in on Wednesday to load 3000 tons cargo and bunkers for Singapore, and it was done in twenty-two and a-half hours. The coal was put in from two movable tips and the movable crab. Tylor and Co. and Riches and Co. were the shippers.

On Saturday the new hopper and cone invented by Mr. Hunter, of the Bute Docks, was first tried in connection with the movable tipping crane at the Roath Basin, and was highly satisfactory. There is little doubt the invention will lessen breakage considerably. Mr. W. T. Lewis, Mr. Abernethy, Mr. McConnochie, and others were present.

The tin-plate trade has been unaffected by the American failures. For a few days, perhaps, prices were not quite so firm, but now they have rallied. Llantrissant Works are to be restarted. Best coke is quoted at 15s. 9d.

Activity prevails at Newport, and the total of the Welsh ports generally is a fair average.

THE *Times* says Mr. J. S. Forbes, of the London, Chatham, and Dover, and Metropolitan District, and Mr. Swarbrick, the late general manager of the Great Eastern, have joined the board of the Hull, Barnsley, and West Riding Junction Railway and Dock Company in the capacity of managing directors.

THE RIVER HUMBER.—On Saturday afternoon last a lecture was given at the Royal Institution, Hull, by Mr. A. C. Hurtzig, C.E., on "Some Tidal and Engineering Features of the Humber." After describing the characteristics of the Humber estuary, comparing it with the Severn, Mersey, and Clyde, Mr. Hurtzig pointed out its unsurpassed navigable and tidal conditions, and, having briefly touched upon the insufficiency of its defences and the facilities it afforded for attack, passed to the consideration of its tidal features. He explained the formation of the tidal wave in the Humber, copious tables being given in illustration of its range and duration. It was shown that the turbidity of the Humber waters was certainly due to the detritus which was brought down from the 10,500 square miles of country which the Humber drains, rather than from the washings of some eight miles of the Holderness coast, which the lecturer said only represented the material brought in by the sea. Samples of water taken at various states of the tides and the results of their analyses were given in support of the statement. The great tidal variations which sometimes occur at Hull were touched upon. The smallest range of tide was 5ft. 7in., and the highest reached 27ft. 6in. He described the connection between atmospheric conditions and tidal variations, illustrating his remarks by reference to enlarged weather charts, &c. Turning to engineering questions, the construction and working of the high lighthouse at Spurn, as carried out by John Smeaton, were described fully, and the excellent manner in which the lighting and buoying of the Humber was carried out under the direction of the Hull Trinity House was highly commended, no other estuary, in the lecturer's opinion, equalling the Humber in this respect. The application of hydraulic power to civil engineering works was referred to at length, several interesting photographs of hydraulic cranes, &c., being shown in illustration. A fact was pointed out which is not generally known, viz., that the Grimsby Water Tower, intended to supply water-power for dock works, was the first of its kind that had been constructed; and that at New Holland the first hydraulic accumulator was built, and the present form of hydraulic machinery there inaugurated. The Humber Tunnel, as proposed in 1873, and the drift-way as now proposed, were next described, and plans of the route, sections, &c., shown. The lecturer was enabled to place before the meeting diagrams of some interesting borings near North and South Ferriby, referring to this latter scheme. He concluded the lecture with an account of the proposed Ouse improvement line and the Humber Conservancy lines, explaining the position of sandbanks from Hull to the mouth of the Trent, and the probable effect which the diversion of the stream and their consequent shifting would have on traffic in the estuary.

THE NEW SCREW GUN VESSEL FOR THE NAVY.—On the 7th inst. H.M.S. Reindeer, screw gun vessel, which was built at Devonport and launched in November last, was taken into the Channel for a preliminary trial of her machinery, which has been fitted by Messrs. R. and W. Hawthorn, St. Peter's Works, Newcastle. The Reindeer is one of five vessels of a class which is an improvement on the Dolphin and Wanderer, recently commissioned at Sheerness. Four of the ships, including the one tried, have been or are being constructed at Devonport, those on the stocks at present being the Mariner, Racer, and Icarus. The fifth, the Acorn, is being built at Pembroke Dock. The Reindeer is fitted with six 5in. guns, two on either side, one forward, and the other aft. When the start was make the weather was very threatening, and before the ship had been long outside the wind rose to a gale. Nevertheless the trial proceeded very smoothly, the machinery working splendidly throughout. The engines are horizontal, compound, surface condensing, with high cylinder 32in. and low 54in. in diameter, with 3ft. stroke. The engines are fitted with Mr. F. C. Marshall's patent valve gear, having one excentric only for each cylinder, which reduces the number of working parts to a minimum. The engines are so arranged as to cut off steam between 17 per cent. and 60 per cent. of stroke without expansion valve. The ship is fitted with three boilers 7ft. 2in. diameter by 16ft. 9in. long. When the trial commenced the steam in the boilers was 90 lb., the vacuum in the condensers 26·25in., the mean revolutions per minute 74, mean pressure in the higher 9·8 lb., in the low cylinder 12·4 lb. For one hour the engines were worked at the highest grade of expansion, giving 106-horse power in the high-pressure cylinder, and 384 in the low-pressure cylinder—total 490. The engines were then worked at different grades of expansion with satisfactory results. The machinery was then gradually worked up to full power, the steam in the boilers being 82 lb.; the vacuum in the condensers, 26in.; revolutions, 96 per minute; mean pressure in the high cylinder, 23 lb.; in the low cylinder, 14·3 lb.; giving an indicated horse-power, high, 322; low, 572—total, 894. The engines were next tried at one hour jet injection. The mean steam in the boilers was 75 lb.; the vacuum in the condensers, 19in.; revolutions, 75·8 per minute; mean pressure in the high cylinder, 17·4 lb.; in the low cylinder, 11·4 lb.; horse-power, high, 193; low, 361—total, 554. Stopping and starting were next tried. The engines going full speed ahead were stopped in three seconds; being stopped, they were started astern in three second; going astern, they were stopped and started ahead in five seconds.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

20th May, 1884.

7941. Automatic Governing Oil Can, J. Pearson, Preston.
7942. Felt Hats, W. Whittaker and W. Wilkinson, North Denton.
7943. Ventilating Waterproof, &c., Coats, C. Spilman, Hulme.
7944. Toy Game of Skill, J. Pomfret and W. T. Fox, Preston.
7945. Gas-burners, J. Ainsworth, Darwen.
7946. Flue Bricks, H. Talbot, Higher Broughton.
7947. Stoves, I. Sherwood, Birmingham.
7948. Metallic Coverings for Roofs, &c., G. A. Nebeling, Remsheid.
7949. Steam-heated Blocks for Corsets, W. H. Milles, Southsea.
7950. Curling, &c., Hair, F. Iles, Birmingham.
7951. Boxes or Cases, W. Tickle, Liverpool.
7952. Mob-cap Machines, G. Ridgard and W. Askham, Nottingham.
7953. Vent Faucets for Bottles, H. E. Newton.—(*G. W. Clark, Brooklyn, U.S.*)
7954. Lawn Tennis Poles and Fixings, H. E. Holbrow, Gloucester.
7955. Slide-valves, E. C. Peck, Old Charlton.
7956. Water-heaters, J. Osgerby, London.
7957. Tube Expander, R. Barnard and E. Miles, London.
7958. Compound for Removing Marks of Grease, &c., A. R. Hancox, Haverhill.
7959. Drying Stereotype Matrices, G. Pepé, London.
7960. Brick Machines, W. L. Gregg, Philadelphia.
7961. Injectors, W. R. Park, Taunton.
7962. Electric Arc Lamps, P. S. Justice.—(*S. H. Short, Colorado, U.S.*)
7963. Enriching Phosphates of Calcium or Lime, P. M. Justice.—(*W. K. Keun, Luxembourg.*)
7964. Device for the Burners of Lamps, &c., W. H. Bulpitt, Birmingham.
7965. Burners for Lamps, W. C. Williams, Leamington.
7966. Lamps, W. C. Williams, Leamington.
7967. Preserving, &c., Grain, M. Gossi, Antwerp.
7968. Ships' Lamps, J. Gilchrist and D. Ballardie, Glasgow.
7969. Tool-holders for Dental Engines, A. Weber, New York, U.S.
7970. Flower-pots, J. Crute, London.
7971. Type, A. R. Least, A. Thompson, and T. Ince, London.
7972. Water-closets, &c., D. T. Bostel, London.
7973. Bathing Dress, H. J. Haddan.—(*K. Klemm, Russia.*)
7974. Producing Printing Plates, H. J. Haddan.—(*H. Riffrath, Germany.*)
7975. Braces, P. W. Martin, Birmingham.
7976. Treatment of Peat, W. H. Tooth, London.
7977. Treating Lead, &c., W. H. Tooth and J. E. Rooker, London.
7978. Stoppering Bottles, &c., E. H. Baxter, Birmingham.
7979. Cutting, Printing, &c., Letter Forms, B. C. Scott, London.
7980. Construction of Silos, E. Hernulewicz and W. H. Pullan, London.
7981. Treatment of Malt, A. Schnell, Switzerland.
7982. Obtaining Sugar from Saccharine Substances, C. D. Abel.—(*L. Harperath, Germany.*)
7983. Cutting Grooves on Rollers for use in Mills, P. Turner, Ipswich.
7984. Secondary Batteries, T. S. Sarney and W. R. Barritt, London.
7985. Pianoforte Actions, A. G. Gigney, London.
7986. Construction of Metallic Baths, J. W. and R. W. Perkins, London.
7987. Breaking Stones, &c., W. R. Lake.—(*P. W. Gates, Chicago, U.S.*)

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7988. Clerical Coat Collars, G., F. D., and A. J. Tonkin, Bristol.
7989. Fixing, &c., Collapsing Landing Net Rings, R. Heaton, Birmingham.
7990. Covers for Drawings, &c., J. J. Raggett, Birmingham.
7991. Self-inking Printing Stamps, W. P. Thompson.—(*A. C. Harvey, U.S.*)
7992. Automatic Closing Valve, W. P. Abell, near Hinchley.
7993. Fitting Metal Ships, &c., whereby they are made Waterproof, W. Welch, Portsmouth.
7994. Cartridge for use with Resetting Mechanism, J. Needham and T. H. S. Hawker, London.
7995. Automatically Resetting, &c., Fire-arms, T. H. S. Hawker and J. Needham, London.
7996. Getting Coal without the use of Explosives, W. Spours and C. D. Martin, Heaton.
7997. Soup Pot, M. Massey, Kidderminster.
7998. Steering Apparatus for Tricycles, J. A. Stephan, Fernville.
7999. Rolls used in Rolling Iron, &c., J. Summers and G. H. Parkin, Stalybridge.
8000. Separating Water from Steam in Boilers, E. Capitaine.—(*M. Schmidt, Germany.*)
8001. Purifying Water by means of Waste Heated Gases, T. Sykes, Manchester.
8002. Cutting, &c., Ring for Horses, G. F. Arthur, London.
8003. Construction of Pipes for Smoking, M. Burchardt, London.
8004. Hopper Feeder for Furnaces, T. L. Ellis, Coatbridge.
8005. Permanent Way of Railways, S. W. Smith, near Coventry.
8006. Dissectible Files, L. Müller, Dresden.
8007. Baby Jumpers for Nursery Use, C. T. Gardner, Canada.
8008. Fire-clay Gas Retorts, B. and W. P. Gibbons, Lower Gornal.
8009. Motive Power Engine, I. Ramboux, Belgium.
8010. Collecting Tickets delivered from a Cutting Machine, J. M. Black, London.
8011. Rackets for use in Lawn Tennis, J. Marshall, Hampstead.
8012. Letting-off Apparatus of Looms, H. Lomax, Darwen.
8013. Charging Blast Furnaces, A. Attwood and T. W. Barbor, Ulverston.
8014. Raising, &c., Water, J. E. Bennett and A. Lumsden, Manchester.
8015. Safe-burning Petroleum, L. A. Groth.—(*T. N. Flesch, Germany.*)
8016. Needle for Sewing Shoes, L. A. Groth.—(*F. Schumacher, Germany.*)
8017. Cleansing Drain Pipes, J. Woodman, London.
8018. Valve for Flushing Cisterns, M. Syer, London.
8019. Railway Couplings, J. B. Hannay, Loch Long, and J. Cowan, Glasgow.
8020. Coal for Hygienic Purposes, A. F. Westerlund, Sweden.
8021. Printing and Writing Inks, &c., A. D. Cohen, London.
8022. Sieving Apparatus, W. de Morgan, London.
8023. Preventing Re-filling of Cigarette Wrappers, H. E. Newton.—(*F. S. Kinney, New York.*)
8024. Fasteners for Boots, &c., J. J. Perkins, London.
8025. Pipes for Smoking, C. Neuberg, Shepherd's Bush.
8026. Curtain Hooks, W. G. Hyland, London.
8027. Differential Driving Mechanism, R. Allen and W. J. Wakefield, London.
8028. Water-closets, J. Mountain, Sheffield.
8029. Treatment of Sulphate of Iron, E. de B. Lukis, London.
8030. Self-acting Gas Cock, G. Nobes, London.
8031. Perambulators, T. McGrah, Sheffield.
8032. Connecting Sinks with Drains, G. F. Twist, Coventry.
8033. Knitting Machines, L. Woodward, Nottingham.
8034. Distillation, W. R. Lake.—(*Messrs. Wirth and Co., Germany.*)
8035. Cooking, &c., H. S. Maxim, London.
8036. Hardening Balsams, Resins, &c., A. M. Clark.—(*Wirth and Co., Germany.*)

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8037. Substitute for Caoutchouc, &c., A. M. Clark.—(*Wirth and Co., Germany.*)
8038. Wheel Skates, W. P. Thompson, Liverpool.
8039. Checking Apparatus, J. Lott, Liverpool.
8040. Cigarettes and Cigarette Tubes, E. L. Delaney, Fulham.
8041. Scarf Bands, Ends, or Tabs, G. F. Hall, Birmingham.
8042. Picture Nails, R. Collard, Birmingham.
8043. Self-acting Railway Coupling, A. Ostins, Levenshulme.
8044. Fire Alarums, E. A. Paris, London, and W. H. Scott, Wimbledon.
8045. Manufacture of Balls, E. Wright, Handsworth.
8046. Mule Spinning, S. Jackson, Hyde.
8047. Treating Water, B. Littlewood, Huddersfield.
8048. Raising and Lowering Healds in Looms, A. T. Clay, Rastrick.
8049. Billiard Cues, E. Collins, Birmingham.
8050. Ornamental Woven Fabrics, H. Lee and W. Hollas, Bolton.
8051. Sizing Machines, J. Thompson, Haslingdon.
8052. Looms for Weaving, J. Thompson, Haslingdon.
8053. Gas-producers, W. S. Sutherland, Birmingham.
8054. Obtaining Motive Power, W. S. Sutherland, Birmingham.
8055. Mills for Crushing and Grinding, W. H. Thompson, London.
8056. Purification of Water, A. Irving, Wokingham.
8057. Interlocking Railway Points, J. Steven, Glasgow.
8058. Quilting Frames, H. T. Davis, New York.
8059. Jacquard Machines, K. I. Mayer.—(*W. and A. Bernsmüller, Germany.*)
8060. Feed-water Regulator, K. I. Mayer.—(*W. Grossmann, Baden.*)
8061. Cocks, W. M. Llewellin, Bristol.
8062. Ornamentation of China, E. P. Evans and T. Sanday, Worcester.
8063. Arc Regulator Lamp, R. E. B. Crompton, London, and T. Crabb, Chelmsford.
8064. Forks, W. S. Skelton, Sheffield.
8065. Construction of Feeding Holes in Vessels, J. Heselwood, Leeds.
8066. Propelling Ships, &c., R. J. White, London.
8067. Metallic Permanent Way for Railways, B. Vogdt, Vienna.
8068. Tool-holders, G. B. Taylor, Birmingham.
8069. Knotting Apparatus, S. Bowden.—(*A. Kay, N. N. Buchanan, and A. R. Wallis, Melbourne.*)
8070. Cases, E. Horsepool, London.
8071. Opening, &c., Sliding Windows, W. Leggott, Bradford.
8072. Cap-spinning, &c., Machinery, W. Foster and D. Sugden, Denholme.
8073. Latching and Unlatching Doors, J. Kaye, Kirkstall.
8074. Self-feeding Eyelet Machines, J. Buchanan, Bristol.
8075. Chromo-lithography, A. C. Henderson.—(*P. P. Guillaume jun., Paris.*)
8076. Trusses for Ruptures, E. Capitaine.—(*E. Westphal, Berlin.*)
8077. Insulating Compounds, A. Muirhead, London.
8078. Bottling Liquids, T. Hughes, London.
8079. Printing upon Uneven, Wavy, &c., Surfaces, F. Baker, Birmingham.
8080. Gas Oven, S. Leoni, London.
8081. Non-conducting Materials to Prevent Radiation of Heat, S. Leoni, London.
8082. Gun Carriages, H. C. E. Malet, Brighton.
8083. Silico-carbon, S. J. Coxeter and H. Nehmer, London.
8084. Boxes or Cases for Jewellery, H. H. Lake.—(*Zeh and Schien, Hanau, Germany.*)
8085. Safety Apparatus for Hoists, &c, T. Gillespie, Redding, and H. A. Salvesen, Blair Bank.
8086. Circular Slide Valves, W. Payton and A. Wilson, London.
8087. Locks, W. Payton, London.
8088. Gas Lighting, H. G. Perry, Lower Clapton.
8089. Horble for Horses, &c., F. K. Smythies, Hathern, near Loughboro.
8090. Electrically Transmitting Drawings, &c , E. A. Schaeffer, London.
8091. Automatic Flushing Tank, F. Cuntz, Karlsbad.
8092. Safety Shooting Shed, R. Morris, Blackheath.
8093. Spongy Iron, G. Bischof, London.
8094. Purifying Water by Spongy Iron, G. Bischof, London.
8095. Valve Cocks, H. P. J. Kessler, Germany.
8096. Fixing Incandescent Lamps in Position, H. Edmunds, jun., London.
8097. Transporting, &c., Apparatus, J. H. Johnson.—(*M. Marolle, Paris.*)
8098. Portable Covers for Hayricks, &c., L. A. Couteau, France.
8099. Stoppering Bottles, &c., J. B. O'Callaghan, London.

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8100. Steam Boilers, J. Burrell, Bristol.
8101. Tricycles, G. Hookham, Birmingham.
8102. Fancy Metal Tassels for Chains, &c., J. Wood, Birmingham.
8103. Preventing Breakage of Yarn, S. Green, Oldham.
8104. Bottle Lock Stopper, W. Kershaw, Kingston-upon-Hull.
8105. Keeping the Spouts of Tea-pots Clear, E. Kennett, Southampton.
8106. Brown Bread, J. Pointon, Horsforth.
8107. Boots and Shoes, J. Blakey, Leeds.
8108. Buildings and Materials, W. M. Hawkins, Birmingham.
8109. Governors, J. Burrell, Bristol.
8110. Mercurial Gas Governors, T. Redman, Bingley.
8111. Travelling Grates, T. Milburn and C. W. Haydon, Stalybridge.
8112. Racquet Frames, H. P. Hodkinson, Coventry.
8113. Scoring Number of Games, H. J. and J. Rogers, Watford.
8114. Coupling Apparatus, H. Stephenson, Beighton.
8115. Insulating Electric Telegraph Wires, &c., J. C. Sellars, Birkenhead.
8116. Producing Moulded Articles, &c., F. Thiemer, Saxony.
8117. Hats, &c., H. W. Brewtnall, Thelwall.
8118. Folding Chairs, A. A. and R. Naether, Saxony.
8119. Supplying Heated Air to Gas Burners, A. H. Hearington, London.
8120. Gas Burners, A. H. Hearington, London.
8121. Water Heater, A. H. Hearington, London.
8122. Rolling Mills, D. Evans, Tredegar.
8123. Metallic Bedsteads, &c., J. E. H. Brown and E. M. Oldham, Birmingham.
8124. Cleansing, &c., Buildings, &c., G. J. C. Marie, London.
8125. Heating, Cooling, &c., Buildings, J. G. Smeaton, London.
8126. Detaching Gear, W. R. Nisbet, Wallsend.
8127. Gas Regulators, J. Stott, London.
8128. Cutting Wooden Shives or Bungs, W. Jones, London.
8129. Straightening Threads, B. J. B. Mills.—(*L. Durançon and P. Lapierre, Lyons.*)
8130. Trigger Gear, C. J. Galloway and J. H. Beckwith, Manchester.
8131. Stationary Fire-escape, L. G. F. Pyne.—(*W. R. Pyne, Trinidad.*)
8132. Non-alcoholic Beverages, A. C. L. Weigel, Brighton.
8133. Window Sash Fasteners, R. Taylor, Dennistoun.
8134. Teaching the Art of Swimming, F. K. Smythies, Hathern.
8135. Cleaning Bones, T. Berliner, Germany.
8136. Mechanical Motion, H. S. Parry, Hechryd.
8137. Hanging Bells of Large Dimensions, S. B. Goslin, London.
8138. Bottle and Jar Stoppers, F. Barclay, London.
8139. Hydraulic Presses, J. E. Hopkinson, H. Prince, and A. Muir, London.
8140. Dabbing Brushes, I. Lister & T. Brown, Leeds.
8141. Rapidly Publishing News, F. R. Spark, Leeds.
8142. Mounting Cranks of Velocipedes, H. W. Godfrey, Staines.
8143. Switch for Electric Light Circuits, H. Faraday, London.
8144. Setting Retorts and Muffles, A. W. L. Reddie.—(*Stettiner Chamotte Fabriks-Actien-Gesellschaft, vormals Didier, Germany.*)
8145. Looms for Weaving, J. Cowburn and C. Peck, Eccles.
8146. Supplying Water to Lavatories, W. H. Tylor, London.
8147. Stop Valves, J. A. and J. Hopkinson, Huddersfield.
8148. Chloroform, &c., T. Kempf, Berlin.
8149. Bottle Washers, A. J. Boult.—(*G. P. Goulding, Rochester, New York.*)
8150. Filling and Closing Bottles, &c., J. Phillips, London.
8151. Dividing Rails into Longitudinal Strips, A. and R. Hill, and C. M. Bevan, Middlesbrough.
8152. Knee and Thigh Boots, J. R. Dean, London.
8153. Guns, H. S. Maxim, London.
8154. Driving Mechanism, W. R. Lake.—(*G. E. Marshall, Massachusetts, U.S.*)

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8155. Twist-lace Machines, E. Cope, Lenton.
8156. Take-off or Winding up Apparatus, E. Cope, Lenton.
8157. Tricycle Boat, J. Brown, Coventry.
8158. Mangling, &c., Woven Fabrics, W. Robertson and J. G. Orchar, Dundee.
8159. Feeding Sheets of Paper into Machines, W. Archer, Edinburgh.
8160. Door Lock and Latch Furniture, J. Walker, Birmingham.
8161. Cord Rack for Window Blinds, T. Trenberth and W. Thomas, Cardiff.
8162. Air-tight Receptacles, P. Garton, Liverpool.
8163. Combing and Singing Apparatus, W. P. Thompson.—(*G. Koblinsky, Berlin.*)
8164. Sewing Machines, T. Low, Blairgowrie.
8165. Treating Hides, J. K. Tullis.—(*J. Tullis, jun., Leipzig, Germany.*)
8166. Retort for Brazing, &c., T. Duncan and D. Mills, Heywood.
8167. Opening and Closing Lids of Boxes, J. W. Wood, Birmingham.
8168. Carving Forks, A. J. Jones, Moseley.
8169. Incandescent Electric Light Lamp Holders, C. G. and F. Smith, Birmingham.
8170. Masticators, W. B. Hatfield, Heeley.
8171. Tanks for Cooling Yeast, J. W. Johnstone, Sheffield.
8172. Weather Bars for Doors, W. Greenwood, C. Mitchell, and H. A. Lund, Keighley.
8173. Lawn Tennis Markers, &c., A. Gowans, jun., Edinburgh.
8174. Heating and Cooling the Air, J. M. Lamb, London.
8175. Floor Cramp, A. Dobbing, Darlington.
8176. Nut and Bolt Lock, W. Morley, Plumstead.
8177. Spiral Spring Swivel, J. and W. E. Hemming, Redditch.
8178. Perambulator Bodies, G. P. Lee, Manchester.
8179. Lamp for Burning and Melting, S. Snell, London, and W. Hickin, Birmingham.
8180. Musical Instruments, &c., E. Captaine.—(*W. Spaethe, Germany.*)
8181. Locks and Latches, W. A. Pierce, Woolstone.
8182. Cooling Milk, J. H. Fergusson, Dumfries.
8183. Steam Boilers, E. Brown, Normanton.
8184. Tipping Coal, E. Brown, Normanton.
8185. Permanent Way of Railways, S. W. Smith, near Coventry.
8186. Condensing Hydrochloric Acid Gas, J. Hargreaves, Widnes, and T. Robinson.
8187. Steam and Water Valves, A. Graham, Batley.
8188. Bottle Stoppers, R. Boughton, London.
8189. Supporting Hames, H. C. Lory, Cressing.
8190. Feeding Sheets of Paper to Printing Machines, F. Hoyer, Liverpool.
8191. Veloci-tricycle Safety Boat, &c., A. Biver, London.
8192. Driving Gear for Bobbin Net Machines, E. Cope, Lenton.
8193. Knob, &c., Bolts for Doors, F. A. Harrison, Birmingham.
8194. Wire-woven Fabrics, A. Arnold and A. Winks, Halifax.
8195. Drying Tea Leaf, &c., J. A. R. Main and J. Dick, Glasgow.
8196. Fastenings for Bracelets, E. Richardson and R. Hall, Birmingham.
8197. Horseshoe Nails, J. Pearson and T. Hazlewood, near Stourbridge.
8198. Preventing Draughts from Entering under Doors, B. Baron, Accrington.
8199. Locks, G. Bolton, Wolverhampton.
8200. Consuming Smoke, J. Cornforth.
8201. Raising and Lowering the Shafts of Two-wheel Carts, A. Reading, Southsea.
8202. Spring Bolt Sash Fastening, A. Macfarlane, London.
8203. Automatic Saddle Girths, W. Rachler, Vienna.
8204. Automatic Stamping Apparatus, W. H. Beck.—(*J. Müller, Russia.*)
8205. Combined Time, Date, and Endorsing Stamps, J. M. Richards.—(*J. C. Robinson, New York.*)
8206. Trawling Nets, S. Kemp, London.
8207. Sewing Machines, W. Jackson, London.
8208. Gas Kilns, E. Cutler, Birmingham.
8209. Preventing the Escape of Infectious Diseases from Ambulances, W. Gayton, London.
8210. Generating Steam, M. P. W. Boulton, Tew Park.
8211. Compound Gas Motor Engine, H. P. Holt, Manchester.
8212. Deodorising the Fumes of Cement Kilns, E. Ashby, Southampton, and A. Ashby, Grantham.
8213. Porous Cells for Galvanic Batteries, P. Jensen.—(*G. Przibram, Vienna.*)
8214. Smoothing Irons, W. Beecroft, Leeds.
8215. Closing Leaky Tubes, J. Buchenheim, Kiel.
8216. Thrashing Machines, A. J. Boult.—(*G. W. Morris, Canada.*)
8217. Parquets, &c., A. J. Boult.—(*C. Wittkowsky, Germany.*)
8218. Permanagates, T. Kempf, Berlin.
8219. Combination Envelope and Letter Sheet, A. J. Boult.—(*A. Cox, Canada.*)
8220. Button Fastener, A. J. Boult.—(*O. W. Ketchum, Canada.*)
8221. Automatic Drinking Figure, &c., W. Britain, London.
8222. Mercurial Exhausting Pump, F. L. Willard, London.
8223. Furnace Linings, P. M. Justice.—(*T. Twynam, North Africa.*)
8224. Electro-telegraphic System, S. Roos, Turin.
8225. Double-acting Pumps, &c., A. M. Clark.—(*J McGwin, Fulton, U.S.*)
8226. Cocks or Valves, J. Joyce, Lower Edmonton.
8227. Self-closing Taps, J. Judge, Wallsend.
8228. Velocipedes, C. Lee, London.
8229. Railway Lamps, J. Harbottle, Newcastle-upon-Tyne, and B. Edgar, Gateshead.
8230. Furnaces, W. Farnworth, Swindon.
8231. Gas Engines, C. M. Sombart, Germany.
8232. Gas Engines, C. M. Sombart, Germany.
8233. Cutting Grass Sods, B. H. Smith, Norton.
8234. Ventilating Sewers, J. Parrott, Wallington.
8235. Pitch Tanks, G. Walker, Leeds.
8236. Asphalting, G. Walker, Leeds.
8237. Holders for Pencil-cases, &c., J. Appleby, Birmingham.
8238. Harbours, J. E. Liardet, Brockley.
8239. Vehicle, W. R. Lake.—(*F. Nekvasil, Austria.*)
8240. Coffee-pulping Machines, W. V. V. Lidgerwood, New York.
8241. Telephones, M. Kotyra, Cardiff.
8242. Magazine Rifles, H. S. Maxim, London.
8243. Lamp Fittings, F. H. Varley, W. Beale, R. H. Padbury, and J. R. Shearer, London.
8244. Hardening of Steel, W. R. Lake.—(*C. R. Childs, Hertford, U.S.*)
8245. Wall Papers, J. A. Turner, West Gorton, near Manchester.
8246. Cricket Bats, H. C. Crawford, Plumstead.

ABSTRACTS OF SPECIFICATIONS.

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

4374. Machinery for Cleaning Wheat, &c., *J. Ritchie, Liverpool.*—*12th September*, 1883. 6*d.*

Consists in the manufacture and use of machines for cleaning wheat or other grain having a horizontal, or nearly horizontal, shaft carrying cleaning discs, stones, or brushes, and working in a casing, the entrance to which and exit from which are regulated by valves or other equivalent.

4553. Manufacture of Envelopes, *E. Hely, Dublin.*—*24th September*, 1883. 6*d.*

The object is to provide that the gum for the seal of the envelope shall be applied at the same operation as that in which the gum is supplied to the other folds, to provide apparatus for removing the envelope when made, and for drying the gum thereon.

4598. Obtaining Motive Power, *Rev. H. Glen, Beith, N.B.*—*27th September*, 1883.—(*Not proceeded with.*) 2*d.*

Motive power is obtained from the displacement of any liquid, such as water, oil, or mercury, by one vessel contained within another vessel, and by imparting a rapid rising-and-falling motion to the liquid, and thereby moving rapidly up and down the inner vessel which serves for a piston. The power derived from the rising-and-falling motion of the inner vessel or piston is transmitted to a crank shaft, and thereby or by any other suitable mechanical devices to machinery, and thus utilised.

4745. Pneumatic Machines for Drying Corn, &c. *E. G. Brewer, London.*—*5th October*, 1883.—(*A communication from E. Delbecchi, Turin.*—(*Not proceeded with.*) 4*d.*

Relates to the arrangement of a fan or exhauster, chamber or fireplace, and a drying chamber.

4753. Washing Machines, *J. Donald, Glasgow.*—*6th October*, 1883. 6*d.*

Consists of a box or vessel, having its interior surface plain, corrugated, fluted, or undulated, in combination with a board, tray, utensil, or tub, having or not a concave or otherwise dished part, the interior surface of the dish being either plain, corrugated, fluted, or undulated.

4754. Driving Gear, called Nest Gear, *F. Jenkin, Edinburgh.*—*6th October*, 1883. 8*d.*

Consists partly of a pair of reverse cones and two sets of conical rollers contained within a nest ring, the conical rollers of each set rolling upon one of the cones and along a conical surface within the nest ring. Modifications are described.

4756. Moulding and Casting in Metals Articles consisting of two or more Jointed or Hinged Parts, *F. Gill and W. Rockliffe, Sunderland.*—*6th October*, 1883.—(*Not proceeded with.*) 2*d.*

The object is to cast articles to be jointed together, so that drilling and fitting may be dispensed with.

4757. Manufacture or Arrangement of Tubes for Refrigerators and like Apparatus, *S. Briggs, Burton-on-Trent.*—*6th October*, 1883.—(*Not proceeded with.*) 2*d.*

Consists of tubes of oval or somewhat flat shape with slightly rounded upper surface, and also with a slightly bellied under surface, whose centre in the line of the length of the tube is ribbed or formed with a gutter or channel. Tubes thus made may be drawn seamless, or have lapped or brazed seams on the upper or other surface.

4760. Producing Warmth by Absorbing Water Vapour, the Warmth Produced to be Applied for Producing Steam or other Purposes, *F. Wirth, Frankfort.*—*6th October*, 1883.—(*A communication from M. Honigmann, Aachen.*) 6*d.*

Consists in producing steam under pressure by means of chemical compounds, whose solutions have a higher boiling point than that of water.

4761. Grinding Apparatus having Traversing Grinders, *J. S. Dronsfield and C. Butterworth, Oldham.*—*6th October*, 1883. 6*d.*

Consists partly in mounting two grinding pulleys to slide upon a hollow shaft, and connecting them together, so that when one pulley is slid along the shaft by the action of the screw, the other pulley will move in unison.

4762. Apparatus for Cleansing and Separating Impurities from Machinery Oil and Grease, for Recovering Oil from Cleansing Waste, and other Similar Material, *J. Davids, Manchester.*—*6th October*, 1883. 6*d.*

Relates to improvements in the general construction of the apparatus, and to a heating apparatus.

4763. Steam Engines, *L. Chapman, Erith.*—*6th October*, 1883.—(*Not proceeded with.*) 2*d.*

The steam which escapes by the exhaust port before the piston has completed its stroke does not go to the condenser, but is allowed to escape into the reservoir or direct up the funnel, so as to produce a steam blast, or it is otherwise utilised. When or just before the piston has completed its stroke the exhaust is by suitable valves connected to the condenser, and the vacuum therein assists the return of the piston as at present

4765. Goffering or Embossing Textile Fabrics, *W. R. Lake, London.*—*6th October*, 1883.—(*A communication from C. Garnier, Lyons, and P. Depoully, Paris.*) 4*d.*

Consists partly in impregnating the goffered or embossed fabrics with, or completely immersing them in, solutions of agents or substances capable of preserving the said fabrics from the action of water.

4767. Cap or Covering for the Protection of the Teeth of Horse Clippers, *G. Twigg, Birmingham.*—*8th October*, 1883. 4*d.*

Consists of a cap made of tin or other suitable metal in the form of a V.

4778. Preventing or Neutralising Earth or Foreign Currents in Electric Telegraph Wires, *J. W. Fletcher, Stockport.*—*9th October*, 1883. 6*d.*

In block signalling apparatus the bridge spring is provided with an insulator so as to disconnect the line when the apparatus is not being used. In telegraph circuits generally the apparatus is arranged so as to bring in sufficient battery current to balance the

earth current. Two methods of accomplishing this are described and illustrated.

4772. STOPPERS FOR BOTTLES, &c., *J. S. Davison, Sunderland.—8th October*, 1883. 6*d*.
Consists in fixing stoppers in bottles or similar vessels having screwed necks, by means of a singly projecting stud in the stopper arranged to work in the thread of screw in bottle neck, so as to make, with an elastic washer, a perfectly air and water-tight joint.

4779. METALLURGICAL FURNACES, *J. T. King, Liverpool.—9th October*, 1883.—(*A communication from S. Bissell, Pittsburg, U.S.*) 6*d*.
Relates partly to a furnace provided with a suitable chamber for producing gaseous fuel by a slow combustion or dry distillation of carbonaceous matter, which gaseous fuel on being eliminated is conducted directly into a melting or metal working chamber mingled with a requisite quantity of air heated to a degree of temperature necessary for bringing about a perfect combustion and generating an intense flame. The superfluous heat or induced products of combustion pass thence into and through a regenerator or third chamber filled with openly arranged fire-brick or other refractory material, eventually escaping by way of the chimney.

4780. DYNAMO OR MAGNETO-ELECTRIC GENERATORS, *H. B. Ford, London.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
The attractive power of the field magnet upon the armature while approaching the pole is utilised to compress a fluid, the power of which is exerted in carrying the pole of the armature past the opposing pole of the field magnet.

4782. APPARATUS FOR THE TRANSMISSION OF LOADS, *C. Hodgson, London.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to the transmission of loads by wire ropes.

4784. COATING THE SURFACE OF IRON OR OTHER METAL WITH METALLIC COPPER, LEAD, ZINC, ALUMINIUM, OR NICKEL, *A. Gutensohn, London.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
A chloride of the metal, a coating of which it is desired to obtain, has the metal precipitated by pyrophosphate of soda. The phosphate, dissolved in a solution of caustic soda, is used as the electrolytic liquid.

4785. CALICO PRINTING MACHINES, *J Millar and T. McKillop, Glasgow.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
The object is to enable such fabrics as scarves and "serongs," having a transverse border between each piece, to be printed continuously in one machine and in one operation, instead of having the border separately printed by hand.

4786. FROG PADS FOR HORSES, *C C. Baird, Edinburgh.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
The frog pad is formed of rubber or rubber compounds or similar materials, and it is adapted to fit between the heel parts or calks of the ordinary iron horseshoe.

4787. ELECTRICAL SYNCHRONOUS TELEGRAPHIC AND OTHER SYSTEMS, *S. Pitt, Sutton.—9th October*, 1883.—(*A communication from P. B. Delany, New York, U.S.*) 1*s*.
The apparatus at the different stations are provided with tuning forks so arranged as to be caused to vibrate by their independent local circuits. This specification also describes at length a system of non-vibratory circuit breakers to be used with the synchronal system.

4789. LADIES' WORK-BOXES AND TABLES, &c., *W. Tween and E. Renaudin, London.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to a wood-work frame and pasteboard sides.

4790. TICKETS OR LABELS FOR ATTACHMENT TO GOODS, &c., *E. K. Dutton, Manchester.—9th October*, 1883.—(*A communication from Z. T. Hall, Philadelphia.*) 6*d*.
Consists of a strip of paper or suitable material folded to form two flaps, between which the fabric can be inserted, and having a pin formed with a head, which is concealed between one of the flaps, and having a face or covering strip, which is pasted or cemented to the said flap.

4792. BLEACHING, DYEING, &c., HANKS OF YARN, *P. Thomas and J. Zweifel, Manchester.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to the arrangement of the vats, and the construction of apparatus connected therewith.

4797. AIR COMPRESSORS, &c., *C. W. Potter, London.—9th October*, 1883. 8*d*.
Relates partly to means of stopping the action of the compressor without stopping its motion or the motion of the engine which drives it, when the pressure of the air in the receiver to which the compressor delivers the compressed air exceeds a certain degree. Several other improvements are described.

4801. PREPARING PLATES OR ELEMENTS FOR USE IN SECONDARY BATTERIES, *H. J. Haddan, London.—9th October*, 1883.—(*A communication from C. F. Brush, Cleveland, U.S.*) 8*d*.
In "forming" the elements they are alternately heated and cooled after each charging, and finally recharged, so as to bring the entire oxodised coating up to a peroxide state.

4802. VELOCIPEDES, *H. J. Haddan, London.—9th October*, 1883.—(*A communication from A. H. Overman, Massachusetts.*) 8*d*.
This relates to a suspension saddle, the covering of which can be loosened or tightened as required; to a seat spring the tension of which can be adjusted; to a steering apparatus for velocipedes; to improved pedals capable of longitudinal adjustment to compensate for wear; to roller bearings for the axle; to means for coupling a sectional axle; and, lastly, to the construction and application of rubber tires to the wheels.

4805. BEARINGS FOR JOURNALS, &c., *W. R. Lake, London.—9th October*, 1883.—(*A communication from R. W. Traylor, Virginia, U.S.*) 6*d*.
The object is to make a self-lubricating bearing which, while it acts as a non-conductor of heat, will be free from grit and provide a smooth bearing surface, and consists in constructing the bearing of sheets of mica arranged side by side, and while subjected to powerful pressure, placing them in the casing of the bearing.

4810. REGISTERING AND RECORDING BUSINESS TRANSACTIONS, &c., *W. P. Thompson, Liverpool.—9th October*, 1883.—(*A communication from J. C. Shoup, St. Louis, U.S.*) 8*d*.
This relates to the employment of two strips of paper upon which business transactions are recorded simultaneously by means of transfer paper, one strip then being coiled on a reel for use as a record, while the bills or written pieces to be issued are torn off the other strip.

4811. COUPLINGS FOR RAILWAY TRAINS, *F. T. S. Hamilton, Liverpool.—9th October*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to an automatic coupling composed of a pair of hinged or pivotted hooks at equal distances from the centre line, one on each side, a sliding pin to engage said hook, and a lever or screw arrangement for sliding or withdrawing the pin, and so releasing the hook.

4812. CATCH FOR UMBRELLAS, *W. P. Thompson, Liverpool.—9th October*, 1883.—(*A communication from V. D. Stockbridge, Washington, U.S.*) 6*d*.
The stop or catch is made of sheet metal, and works in a slotted plate secured to the stick, and beneath which a recess is made, and a spring arranged to act on the catch.

4813. SIZING PAPER, &c., *T. Morgan, London.—9th October*, 1883.—(*A communication from F. Sienan, Germany.—(Provisional protection not allowed.*) 2*d*.
This consists in the use of a solution of chloride of magnesium or sulphate of magnesia, either instead of or in combination with the sulphate of alumina or sulphate of zinc employed in the manufacture of paper for the purpose of sizing with resin.

4816. GAS MOTOR ENGINES, *T. M. Williamson, J. Malam, and W. A. Ireland, Southport.—10th October*, 1883. 10*d*.
This relates chiefly to engines of the type described in patents No. 1692 and No. 3685, A.D. 1880, and No. 5456, A.D. 1881, and it consists, First, in the use of metallic valves of the mushroom type, secured to the body of which is asbestos covered with a thin sheet-metal cap to protect it from the hot gases; Secondly, in gas engines on the vacuum principle, the use of an auxiliary piston for opening and shutting the exhaust valve; Thirdly, in the application of a cooling medium between the working and vacuum cylinders; Fourthly, in an arrangement for igniting the compressed charge by means of gas introduced from the power cylinder into a metal tube heated by a powerful gas-burner; Fifthly, in the arrangement of ports of engines having the power and vacuum cylinders arranged in the same line, two sets of ports being employed and arranged circumferentially; Sixthly, in employing two cylinders side by side, and placing the ports, pistons, and cranks so that the pistons act as slide valves; Seventhly, in gas engines having a vacuum cylinder, the use of a catch in conjunction with the exhaust valve, and actuated by the governor, so that when the engine runs too fast the exhaust valve will be held open; and Eighthly, in clearing the pocket of the firing slide by making communication between it and the vacuum cylinder at the proper moment.

4817. MACHINERY FOR PROPELLING VELOCIPEDES, &c., *J. T. Sibree and T. F. Stenson, Handsworth.—10th October*, 1883. 6*d*.
Relates to an arrangement by means of which, through the automatic or manipulated variation in the position of the fulcrum on which a lever turns, the effective force communicated to the driving wheels of a carriage shall be varied in approximate accordance with the resistance to be overcome.

4818. TREATMENT OF COPPER MATTES IN ORDER TO OBTAIN THE SILVER AND GOLD THEREFROM, *F. Claudet, London.—10th October*, 1883. 4*d*.
Relates to the treatment of copper mattes containing silver or silver and gold, for the purpose of obtaining silver and gold therefrom by grinding or disintegrating the mattes, and roasting or calcining them, and afterwards treating them with hydrochloric acid, so as to obtain a solution of metals, including silver or silver and gold, therefrom, and afterwards separating the silver or silver and gold from this solution by means of a soluble iodide.

4819. SEWING MACHINES, *J. McHardy, Dollar, N.B.—10th October*, 1883. 10*d*.
This consists, First, in means for enabling the spools of sewing machines to be refilled without having to remove them from the shuttles; Secondly, in substituting for the drag holes in the sides of the shuttle a slot through which the thread passes from the spool; Thirdly, in a spring attachment for driving the machine. The invention further relates to means for setting and holding needles in the needle bars.

4823. SNAP HOOKS, *B. Wesselmann, Hamburg.—10th October*, 1883. 4*d*.
The latch of the hook is formed with a bore in which is inserted a spiral spring, such spring acting upon a bolt, so as to cause it to bear on a cam surface round the hinge joint of the latch, and so compress the spring when the latch is opened. When left free the spring causes the hook to close.

4824. SHEET DELIVERY APPARATUS FOR PRINTING MACHINES. *W. Conquest, London.—10th October*, 1883.—(*A communication from Messrs. R. Hoe and Co., New York.*) 1*s*.
The object is to simplify the mode of "insetting" employed in web-printing machines, and it consists in the arrangement of tapes whereby two pathways of travel of unequal lengths are provided for the sheets required to be associated to make up a newspaper or pamphlet. Several arrangements are described.

4826. GRINDING THE EDGES OF TOOLS, &c., *A. F. G. Brown, Glasgow.—10th October*, 1883. 6*d*.
This consists in applying to an ordinary grinding wheel a series of radial rests upon which the tools are guided while being held against the face of the wheel. The rests can be adjusted in side supports or brackets.

4831. VESSELS FOR CONTAINING AND PRESERVING WINE AND SIMILAR FLUIDS, AND SOME SOLID SUBSTANCES, *R. Dunlop, Cardiff.—10th October*, 1883.—(*Not proceeded with.*) 2*d*.
The object is to prevent the surface of liquids in vessels being exposed to the action of air when part of such liquid is withdrawn, and it consists in the use of a piston which rests on the liquid.

4835. MAGNETO GENERATORS OF ELECTRICITY, *M. Benson, London.—11th October*, 1883.—(*A communication from J. P. Stabler, Sandy Spring, Maryland, U.S.*) 6*d*.
To enable varying currents to be taken off without varying the speed of the armature, the coils are wound in separate sections, means being provided for coupling these up as desired.

4836. FORMING THE POINTS OF AUGERS AND IN CUTTING THE SCREW THREAD OR THREADS THEREON, *J. W. Simpson and J. McFie, Rutherglen.—11th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to improvements in the general construction of the apparatus employed for cutting the threads.

4839. GENERATING OR PRODUCING MOTIVE-POWER FOR FACILITATING THE PROPULSION OF TRICYCLES, AND OTHER LIGHT CARRIAGES OR CONSTRUCTIONS, AND FOR DRIVING LIGHT MACHINERY GENERALLY, *E. Sturge, London.—11th October*, 1883. 6*d*.
The motive-power is obtained by the explosion of suitable cartridges.

4843. APPARATUS FOR MAKING GAS, *E. Brook, Wigan.—16th October*, 1883. 6*d*.
The lower part of the apparatus is constructed of metal and its sides formed to receive water for keeping them cool, and in conjunction therewith a revolving grate of conical form is provided and so constructed as to move the ashes and incombustible matter to its outer edge, where they drop over into the ash-pit.

4845. SUBSTITUTE FOR INDIA-RUBBER, *R. L. Kirlew, Manchester.—11th October*, 1883.—(*Not proceeded with.*) 2*d*.
Ground asbestos is used in conjunction with sufficient india-rubber to hold it together and impart the requisite elasticity to the material produced.

4847. APPARATUS FOR INDICATING THE HEATING OF BEARINGS AND OTHER RUBBING SURFACES OF ENGINES AND MACHINES, *H. P. Sherlock, Upton, Essex.—11th October*, 1883.—(*Not proceeded with.*) 2*d*.
An iron tube containing mercury is let into the bearing. On the heat expanding the mercury, it completes the circuit of an electric bell or indicator.

4850. TORPEDOES, *C. A. McEvoy, London.—11th October*, 1883. 6*d*.
This relates to appliances for firing the torpedo charge on the impact of a passing vessel. A weight placed on the top of the torpedo is dislodged on impact, and may either complete an electric circuit or put mechanism in operation.

4856. APPARATUS FOR THE MANUFACTURE OR PRODUCTION OF GAS FOR LIGHTING AND HEATING PURPOSES, *G. F. Redfern, London.—12th October*, 1883.—(*A communication from S. A. Giraudon, Paris.*) 6*d*.
This relates to apparatus for carburetting air by passing it through volatile oils of hydrocarbons. An air pump is driven by a suitable motor and forces air through the carburetted or closed vessels filled with the hydrocarbon, two of which are employed, each having a tube at bottom through which the air is forced, passing through a perforated nozzle. An air regulator or bell is placed between the pumps and the carburetters, and a gas regulator or gasometer is placed between the carburetters and the burners, and regulates the pressure of the gas. A hot air motor is described having two cylinders, one of which also serves as the air pump.

4862. CUTTING OUT MACHINE FOR WOVEN FABRICS, &c., *L. A. Groth, London.—12th October*, 1883.—(*A communication from G. Fraenkel, Germany.*)—(*Not proceeded with.*) 2*d*.
This relates to a press for cutting out, the table upon which the material rests, being moved under the press plate by the action of a treadle, and the press plate caused to descend by the action of a cam on a rotary shaft. The knives are carried in a frame attached to the upper press plate.

4866. HOLDERS FOR PENCILS, &c., *S. Moore, Manchester.—12th October*, 1883.—(*Not proceeded with.*) 2*d*.
A holder is provided with means for securing it to the dress of a person, and may be used to receive a pencil, knife, or other article.

4867. BREECH-LOADING FIRE-ARMS, *D. Bently, near Birmingham.—12th October*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to drop-down guns, and consists, First, in means for cocking the gun as the barrels fall; and Secondly, in arranging a spring or springs under the barrels for the purpose of making hammerless guns easier to open.

4868. WATER WASTE PREVENTERS, *W. Smeaton, sen., Westminster.—12th October*, 1883.—(*Void.*) 2*d*.
This relates to the use of a rack and pinion under the control of the pull of the closet, and so arranged as to create a vacuum in a dome and cause a regular flush and after flush.

4870. COMBINED LOCKET AND TELESCOPE, *H. Hoheisen, Germany.—13th October*, 1883. 4*d*.
The locket consists of a cylindrical case provided with a bow for attachment to a chain and a hinged cover at each end. The case contains a number of short sections capable of sliding telescopically one over the other, so as to close into the case or project therefrom, the smallest section carrying an eye-glass and the largest an object glass.

4872. MANUFACTURE OF CARTRIDGES FOR ORDNANCE, &c., *C. D. Abel, London.—13th October*, 1883.—(*A communication from W. Lorenz, Germany.*) 8*d*.
This relates, First, to the manufacture of cartridges for ordnance with metallic cases, instead of paper or woven fabric; and Secondly, to mechanism for firing the same. The cases may be constructed of one piece, or of a separate cylindrical part secured by a base, and after being filled they are closed firstly by a wad of felt, and secondly by a metal cap. The metal or alloy of which the case is formed may be such as to melt at the heat produced on firing. The cases are lined with tin or other substance that will prevent the production of galvanic currents in connection with the charge. Mechanism for firing these cartridges is described, the vents or touch-holes of existing guns being utilised to receive the same. An extractor is also described to remove the cases of the discharged cartridges.

4873. PUMPS OR SYPHONS FOR DRAWING ACID FROM CARBOYS AND FOR OTHER PURPOSES WHERE LIQUID HAS TO BE SYPHONED OFF, *J. Longshaw, Salford.—13th October*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to a syphon or pump, consisting of a tube to fit over the carboy, and in which works a piston, the rod of which is hollow and bent at its upper end to form a syphon through which the contents of the carbon is drawn off.

4874. RETORT CHARGING AND DRAWING MACHINES, *J. Woodward, Manchester, and W. Foulis, Glasgow.—13th October*, 1883. 10*d*.
Consists partly in placing a hopper at the upper part of the charging machines, into which coal is delivered; Secondly, in making the cylinder of the machines the moving part, while the piston and piston-rod are fixed to a movable frame on the machine; Thirdly, in improvements in working the rake.

4875. ELECTRIC ARC LAMPS, *W. H. Akester and R. Mitchell, Glasgow.—13th October*, 1883.—(*Not proceeded with.*) 2*d*.
The descent of the upper carbon is controlled by a ring engaging loosely between two projections fixed to the core of a solenoid placed in the lamp circuit. In a modification a double-acting pawl engages a spur wheel gearing with the racked upper carbon-holder.

4879. TREATING GOLD ORES OR OTHER AURIFEROUS SUBSTANCES, AND MORE ESPECIALLY REBELLIOUS OR REFRACTORY GOLD ORES AND CONCENTRATES, BY ELECTROLYSIS WITHOUT PREVIOUSLY FURNACING THE SAME, *H. R. Cassel, New York, U.S.—13th October*, 1883. 4*d*.
A suitable alkaline earth, for which any acids formed during the electrolytic action have a stronger affinity than for the compounds of iron in the ore, is used.

4881. ELECTRICAL BELTS, *C. B. Harness, London.—13th October*, 1883. 6*d*.
The belt is provided with suitable battery elements which are connected to terminals attached to the inner surface of the belt and adapted to make a contact with the body of the wearer.

4882. TILES FOR USE IN MALTING CISTERNS, &c., *L. J. Meakin, Burton-on-Trent.—13th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to the construction of perforated tiles.

4888. STREET SWEEPING MACHINES, *A. Greig, Leeds.—15th October*, 1883. 6*d*.
The inventor claims a sweeping machine, consisting of a rotary brush sweeping the dirt forward into a box or scoop, from which it is raised by an elevator and delivered into a cart or wagon; also a sweeping machine in which the dirt, having been swept by a brush into a box or scoop, is collected therein by revolving blades, and is then taken by an elevator, raised, and delivered into a cart or wagon.

4895. TORPEDOES, *R. H. Brandon, Paris.—15th October*, 1883.—(*A communication from W. E. Winsor, U.S.*)—(*Not proceeded with.*) 2*d*.
Relates more especially to that class of torpedoes which contain a motor, whereby they are made self-propelling, and consists in novel means or attachments whereby they are constantly maintained entirely submerged to such a depth that they cannot be damaged by the projectiles of machine guns and other similar weapons usually employed for the destruction of such torpedoes.

4896. TORPEDOES, *J. Mathieson, Stratford.—15th October*, 1883. 6*d*.
Consists in the use of mercury and another metal soluble therein to effect the passage of the torpedo from the passive to the active condition, the arrangement being such that so long as the latter metal remains undissolved by the former, the hammer, by which the firing of the charge is effected, is securely retained, and will not be set free by the impact of a passing vessel.

4898. COUPLING ELECTRIC ACCUMULATORS EMPLOYED FOR THE PRODUCTION OF MOTIVE POWER FOR APPLICATION TO VARIOUS PURPOSES, *A. C. Henderson, London.—15th October*, 1883.—(*A communication from G. Philippart, Paris.*)—(*Not proceeded with.*) 2*d*.
The armature circuit is supplied with a constant current, while the current to the field magnets is varied as desired.

4900. LOOMS FOR WEAVING, *A. G. Bateman, Manchester. 15th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to looms employed for weaving checks, and the object is to dispense with the necessity for repeating the same card in the chain.

4902. HAND LAMPS, *E. Grube, Hamburg.—15th October*, 1883.—(*Not proceeded with.*) 2*d*.
Relates to improvements in the general construction of lamps, and particularly to the handle, which may be disengaged from the body for the purpose of converting it into a hanging device.

4903. MILLS FOR GRINDING CORN, &c., *W. R. Lake, London.—15th October*, 1883.—(*A communication from J. M. Simon, Paris.*)—(*Not proceeded with.*) 2*d*.
The yielding roller is carried by two bearings attached to levers pivotted to the frame of the machine. By suitably arranging the position of the pivots variable pressures may be obtained between the two rollers.

4904. APPARATUS FOR HEATING AND COOLING LIQUIDS, *W. and G. Lawrence, London.—15th October*, 1883. 6*d*.
This relates generally to the construction of heating or cooling apparatus from tubes or corrugated surfaces, whereby the circulation of liquid both internally and externally is more perfect, the parts of the apparatus are readily renewable and easily cleaned, and the whole apparatus strengthened.

4905. PREPARATION AND TREATMENT OF PAPER FOR CHEQUES, NOTES, STAMPS, AND OTHER DOCUMENTS IN ORDER TO PREVENT FRAUD, *W. J. Clapp, Nantyglo, Monmouth.—15th October*, 1883. 2*d*.
The paper is saturated with a solution of gallic, tannic, or gallo tannic acid, mixed with gum and alum, and printing and writing on such paper with an ink containing ferri-sesqui chloride, or other similar preparations of iron.

4907. TREATMENT OF THE RESPIRATORY ORGANS, *W. P. Thompson, Liverpool.—15th October*, 1883.—(*A communication from J. Ketchum, Brooklyn, U.S.*) 6*d*.
The patient is enclosed in a box, in which a partial vacuum is maintained, and apparatus is applied to his mouth and nostrils, to enable him to breathe air at its normal pressure, and charged with medicinal or remedial agents suitable for the disease to be treated.

4908. FLAT WIRE ROPES, &c., *F. W. Scott, near Stockport.—16th October*, 1883.—(*Not proceeded with.*) 2*d*.
This relates to the formation of flat wire ropes of a series of strands, formed of wires twisted in the same direction, or with each alternate strand twisted in the reverse direction, the strands being placed side by side, and united by strips of flat metal passing alternately over and under the strands. A kind of loom is described for making these ropes.

4909. SKATES, *A. G. Brookes, London.—16th October*, 1883.—(*A communication from J. A. Dodge and G. R. Marble, Massachusetts.*) 6*d*.
This relates to fitting skates with independent mechanism for grasping boots at the toe and heel, the former being actuated by turning a plate, whereby pins on two grips or claws are by excentric grooves caused to approach or recede from each other, while the rear or heel clamp is actuated by turning or tilting vertically on a pivot on the blade.

4910. CONSTRUCTION OF MOTIVE POWER APPARATUS SPECIALLY DEVISED FOR PROPELLING TRICYCLES, TRAMCARS, AND OTHER ROAD VEHICLES, *W. Fletcher Faversham.—16th October*, 1883. 8*d*.
This relates to a hydraulic motor, and as applied to a tricycle an accumulator is placed in front of the back steering wheel, and contains a ram abutting against a powerful spring. Pipes from the upper part of the accumulator lead to air vessels, while at a point below the ram the accumulator is connected by a pipe with force pumps which force water from a tank on the vehicle into the accumulator, and the hydraulic pressure created is by suitable mechanism caused to actuate the tricycle. The pumps are actuated by the driver when necessary.

4913. WRITING AND DRAWING THIMBLE, *H. J. Haddan, London.—16th October*, 1883.—(*A communication from K. Weisflog, Germany.*) 4*d*.
An elastic sleeve is fitted over the end of the index finger, and to it is secured a pen or pencil.

4914. ELECTRIC ARC LAMPS, *H. J. Haddan, London.—16th October*, 1883.—(*A communication from E. Boettcher, Leipzig.*)—(*Not proceeded with.*) 2*d*.
The regulation is effected by that part of a cone which "while protruding from the coil corresponds to an approximately uniform electro-magnetic attraction for a given strength of current." The motion is transmitted by a lever mechanism, the loss of the upper carbon being compensated by the unwinding of a chain.

4917. BARRELS, *A. J. Boult, London.—16th October*, 1883.—(*A communication from G. O. Manning and W. Martien, Baltimore, U.S.*)—(*Not proceeded with.*) 2*d*.
Two thin sheets of wood are placed with their grain at right angles to each other, and to one edge bands of tough wood provided with metallic tips are secured, and the whole rolled into a cylinder on a former, and a strip of veneer covered over the joint. The heads are secured upon chine strips near each end of the body by means of retaining strips. Machines for manufacturing the body of these vessels are described.

4918. APPARATUS FOR REDUCING WOOD TO FIBRES, &c., *A. J. Boult, London.—16th October*, 1883.—(*A communication from H. Andre, fils aîné, France.*)—(*Not proceeded with.*) 2*d*.
The wood is reduced by means of two vertical runners operated by one spindle to which they are adjustably attached, the periphery of the runners being bevelled and the outer portion convex and fluted.

4919. MODERATOR LAMPS, *W. P. Thompson, Liverpool.—16th October*, 1883.—(*A communication from A. J. Lan, France.*)—(*Not proceeded with.*) 2*d*.
The object is to allow liquid hydrocarbons to be used in moderator lamps, and it consists in the special construction of such lamps to render them suitable for this purpose.

4920. PREPARATION FOR THE DESTRUCTION OF DISEASE —BACTERIA OR MICROZYMES IN MAN OR BEAST, *E. Sonstadt, Cheshunt.—16th October*, 1883. 4*d*.
This consists, First, in preventing liability to the formation of mould in a solution containing calcium iodate by addition thereto of a salt of salicylic acid; Secondly, in increasing the solubility of calcium iodate by the use of sodium or potassium citrate: and Thirdly, in the combination of the two first features, so as to obtain a mould proof and relatively strong solution. The preparation is used for the destruction of disease-bacteria or microzymes.

4921. RENDERING FABRICS, FIBROUS MATERIALS OF ALL KIND, AND LEATHER IMPERMEABLE, *F. Wirth, Germany.—16th October*, 1883.—(*A communication from Messrs. Gademann and Co., Germany.*—(*Not ceeded with.*) 2*d*.
30 to 50 grammes of oleate or palmitate of alumina are dissolved in a litre of petroleum, ether, benzine or equivalent liquid, and the articles to be rendered waterproof are soaked in the solution.

4922. MACHINES FOR SPINNING FIBROUS MATERIALS, *W. R. Lake, London.—16th October*, 1883.—(*A communication from E. S. Ormsby, Brooklyn.*)—(*Not proceeded with.*) 4*d*.
Consists partly in the combination in a nipper head of two nippers placed one in advance of the other in the nipper head, and through both of which the sliver passes, whereby the fibre of the sliver is more effectively straightened before the twist takes place, and is brought into better condition for twisting. Several other improvements are described.

4923. MAKING AN IMPROVED OR TREBLE WARP LACE ON TWIST LACE MACHINES, *T. Butler, Nottingham.—16th October*, 1883.—(*Not proceeded with.*) 4*d*.
The object is to make an improved lace on twist lace machines with jacquard attached, with three warps to one bobbin thread.

4924. BAKERS' OVENS, *A. F. Link, London.—16th October*, 1883.—(*A communication from H. Grunwald, Gross-Glogau.*)—(*Not proceeded with.*) 2*d*.
The oven is provided with two or more furnaces for the purpose of equalising and regulating the degrees of heat to be applied to the various parts of the same.

4925. SIGNAL LAMPS, *J. I. Coates, Leeds.*—16*th October*, 1884. 4*d.*

Consists in combination with a signal lamp of a passage for lateral rays with reflector and lens arranged at either or both sides of the lantern.

4926. TRANSMITTING ELECTRICAL IMPULSES TO A DISTANCE, ESPECIALLY APPLICABLE TO SUBMARINE TELEGRAPHY, *A. W. L. Reddie, London.*—16*th October*, 1883.—(*A communication from La Société Universelle d'Electricité Tommasi, Paris.*) 8*d.*

The cable is constructed in sections, and each section is provided with an "induction-relay" apparatus.

4927. PAVING STREETS, &c., *J. S. Gabriel, London.*—16*th October*, 1883. 2*d.*

Consists of a compound pavement of wooden blocks below, and over the wood an upper pavement of granite blocks or asphalte.

4928. ATTACHING BUTTONS TO FABRICS, &c., *S. Pitt, Sutton.*—16*th October*, 1883.—(*A communication from F. A. Smith, jun., Rhode Island, U.S.*) 8*d.*

Consists of creasing or folding the fabric around the eye or shank of a button, and then passing a metallic fastener completely through the creased fabric and button eye.

4929. FOLDING CARRIAGES FOR CHILDREN, *W. Singer and F. Hinterleitner, Berlin.*—16*th October*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to improvements in the general construction and arrangement of the framing.

4930. OBTAINING ALUMINIUM FROM ITS ORE, &c., *H. A. Gadsden, London.*—16*th October*, 1883.—(*A communication from E. Foote, New York.*) 4*d.*

The inventor simultaneously generates sodium vapour and a volatile compound of aluminium in two separate vessels or retorts, and mingles the vapours thus obtained in a third vessel, wherein they react upon each other, producing metallic aluminium, which is precipitated upon the bottom of the vessel.

4931. BUCKLES, &c., *E. P. Alexander, London.*—16*th October*, 1883.—(*A communication from W. R. Clough and B. Goodman, New York.*) 6*d.*

Relates to a buckle or similar fastening device made in one piece, and consisting of a loop, a separating bar, inwardly projecting arms, and teeth projecting at a proper angle to engage with and hold a strap pressed against them, and strained or pulled towards the separating bar.

4932. OBTAINING HEAT AND MOTIVE POWER FROM ELECTRICITY, *J. H. Johnson, London.*—16*th October*, 1883.—(*A communication from H. de M. de Ballore, Lyons.*)—(*Not proceeded with.*) 2*d.*

Water is decomposed into its constituent elements, and the gases are used to generate steam. Suitable apparatus is described.

4933. SHOES FOR HORSES, &c., *T. D. Richardson, London.*—16*th October*, 1883. 6*d.*

Relates to the method of rolling the shoes.

4934. TREATING PHOSPHATE OF SODA, OR POTASH, TO PRODUCE PHOSPHATE OF LIME, *C. Humfrey, Chester.*—16*th October*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to improvements in the general treatment.

4936. DRAW-BARS AND COUPLING APPARATUS FOR RAILWAY WAGONS, &c., *S. Keeton, Lenton.*—17*th October*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to the construction of an automatic coupling apparatus.

4937. MERCURIAL BAROMETERS, *H. F. Alexander, Glasgow.*—17*th October*, 1883.—(*Not proceeded with.*) 2*d.*

Consists in causing the indication to be marked by a scale of larger divisions than hitherto.

4938. SHAFT COUPLINGS, *T. L. Ellis and C. Leonard, Coalbridge, N.B.*—17*th October*, 1883. 6*d.*

A hollow circular box is bored with a double conical hollow, of which the small diameter is in the centre, and the large diameter at each end. The outside of the box is screw-threaded at each end, to receive a pair of hollow box nuts, which bear upon two tapered semi-circular wedges, fitting into the base of the box, so as to cause them to grip the ends of the shafts to be coupled.

4939. BRIDGES AND COMBINED APPARATUS, *W. Morris, Westminster.*—17*th October*, 1883.—(*Not proceeded with.*) 2*d.*

The central portion of the bridge is made high enough to allow vessels to pass, and at the sides apparatus is provided for raising and lowering the side portions to and from the level of the central portion.

4940. NIPPERS FOR CUTTING WIRE, &c., *A. M. Clark, London.*—17*th October*, 1883.—(*A communication from S. Lee, Windsor, U.S.*)—(*Not proceeded with.*) 2*d.*

One of the main levers of the nipper is in sections, extending the full length, and of such shape as to allow the other lever to work between them on a fulcrum formed by a boss on the inner face of each section. The invention further relates to the position and shape of the recesses in the lever jaws to receive removable and reversible cutters.

4941. SEPARATING AMMONIA FROM GASES AND VAPOURS, &c., *G. Chapman, Glasgow.*—12*th October*, 1883.—(*Not proceeded with.*) 2*d.*

The gases pass successively through a series of vessels, in which a shaft is arranged at right angles to the inlet and outlet, and carries a series of vertical discs with spaces between. In the lower part of the vessel a solution of sulphuric acid is placed, and covers the discs with same as they revolve. The liquor when saturated is treated with an excess of alkali, and air and steam forced through the vessels used, after which the liquid is allowed to settle.

4942. MAGAZINE RIFLES, &c., *O. Jones, London.*—17*th October*, 1883. 10*d.*

The main object of this invention is to prevent the bullet of one cartridge from coming into contact with the cap of another as they pass from the magazine to the breech. It further relates to mechanism by which the feeding, loading, extracting, and ejecting, and, if desired, the firing, is effected by the to-and-fro motion of a slide.

4943. COUPLING FOR SHAFTING, *P. Brotherhood, London.*—17*th October*, 1883. 4*d.*

The object is to couple two lines of shafting so as to allow for error of alignment and give certain freedom for end play, and also certain elasticity for driving: and it consists in the use of a diaphragm of somewhat flexible and elastic material clamped at its periphery to a flange on one shaft, and at its middle to a flange on the other shaft.

4948. PNEUMATIC MALTING APPARATUS, *F. H. F. Engel, Germany.*—17*th October*, 1883.—(*A communication from M. E. Meyer, Norway.*)—(*Not proceeded with.*) 2*d.*

The apparatus consists of two or more steeping troughs and a set of open tubs for germinating, all attached in rows one close to the other. The tubs have two bottoms, the upper being perforated, and warmed or cooled and filtered air is forced through the malt or steeped grain in the tubs.

4949. MACHINES FOR CULTIVATING LAND, *A. Greig and R. H. Fowler, Leeds.*—17*th October*, 1883. 6*d.*

The object is to enable implements to be hauled by ropes over land on which crops are growing in rows, and it consists in constructing such implements so that as it is hauled in one direction by one hauling engine, the slack rope being laid between the rows of plants along which the implement is to be hauled in its return journey by the other engine.

4952. ENVELOPES OR GUARDS FOR CARDING MACHINES, *O. Schimmel, Germany.*—17*th October*, 1883. 6*d.*

This consists in the use of an envelope of sheet metal surrounding the card cylinder and secured to discs at each end which carry the bearings for the card cylinder axle, whereby the current of air caused by the rotation of the cylinder is greatly reduced, and is directed so as not to interfere with the working of the other cylinders.

4950. TREATMENT OF ASBESTOS, *J. Dewrance, London.*—17*th October*, 1883. 4*d.*

This consists in soaking asbestos in a weak solution of caustic soda, and subsequently washing the same so as to purify and render it non-corrosive in its action upon iron.

4953. INDICATIONS OF SPEED AND DIRECTION OF ROTATING SHAFTS, *E. J. P. Gallwey, Thirsk, Yorkshire.*—17*th October*, 1883. 6*d.*

A small electric generator supplies its current to one or more indicators, the indexes of which are arranged to move according to the increase or decrease of the current.

4954. APPLICATION OF CHEMICAL AGENTS TO NATURAL OR ARTIFICIAL STONES AND TO STUCCOES IN ORDER TO DIMINISH THEIR POROSITY AND INCREASE THEIR RESISTANCE TO EXTERNAL INFLUENCES, *W. Spence, London.*—17*th October*, 1883.—(*A communication from Messrs. Faure and Kessler, France.*) 4*d.*

This consists principally in the use of fluosilicates for hardening stones, stuccoes, or moulded plasters.

4955. ELECTRIC BELLS, *F. J. E. Clarke, London.*—17*th October*, 1883.—(*Not proceeded with.*) 2*d.*

The frame is of cast iron, and forms one terminal. The hammer is attached to one end of the vibrating electro-magnet.

4956. PRINTING AND DECORATING, *E. C. Beaumont and A. Doig, London.*—17*th October*, 1883.—(*Not proceeded with.*) 2*d.*

This relates to a frame to receive type and blocks, and by means of which margins or borders may be decorated or printed on.

4957. CIGARS, *F. Wirth, Germany.*—17*th October*, 1883.—(*A communication from Messrs. Kaufmann and Co., Germany.*)—(*Not proceeded with.*) 2*d.*

Each cigar is provided with a kind of holder, consisting of a thin tube of wood inserted into its front end before being finished, the outer leaf covering such tube.

4958. DECORATION OF GLASS, *H. J. Haddan, London.*—17*th October*, 1883.—(*A communication from H. Saint-Remy, Belgium.*)—(*Not proceeded with.*) 2*d.*

The glass is roughened by acids, or is ground, and then vitrifiable colour or enamel is applied and vitrified in a muffle.

4959. APPARATUS FOR MOISTENING POSTAGE STAMPS, &c., *H. J. Haddan, London.*—17*th October*, 1883.—(*A communication from Sachs and Howorka, Germany.*)—(*Not proceeded with.*) 2*d.*

Two sponges are placed in a casing, and absorb water, which they transfer to a third sponge, pressing against a perforated cover over which the article to be moistened is passed.

4960. GAUGE-GLASSES FOR THE WATER-GAUGES OF STEAM BOILERS, &c., *A. M. Clark, London.*—17*th October*, 1883.—(*A communication from A. Guilbert-Martin, France.*) 6*d.*

In order to enable the height of the column of liquid in gauge and other glasses to be more readily seen, the glasses are provided with a white stripe of enamel applied at the rear of the liquid column, forming a background for a narrower stripe of some bright coloured enamel.

4963. BOXES FOR POSTAL PURPOSES, &c., *J. J. Hamilton, Liverpool.*—17*th October*, 1883.—(*Not proceeded with.*) 2*d.*

Relates to the formation of boxes, which can be folded flat when not in use.

4965. APPARATUS FOR HEATING AND COOKING FOOD, *R. Jackson, Leeds.*—18*th October*, 1883.—(*Not proceeded with.*) 2*d.*

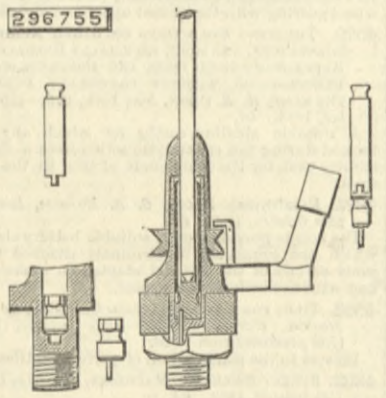
Relates to a portable cooking apparatus for travellers and workmen.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

296,755. SPINDLE BEARING, *John Kilburn, Lowell, Mass.*—*Filed June 25th*, 1883.

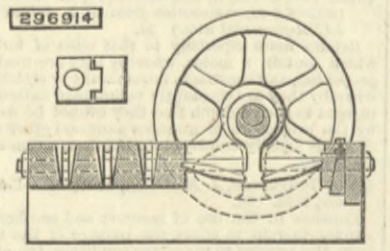
Brief.—The lower end of the bolster and upper end of the step are connected by projections and notches, and the step and bolster are prevented from being



rotated in the bolster case by a projection or stud upon the lower end of the step engaging an opening in the chamber of the bolster case.

296,914. STONE CRUSHER, *Theodore A. Blake, New Haven, Conn.*—*Filed January 21st*, 1884.

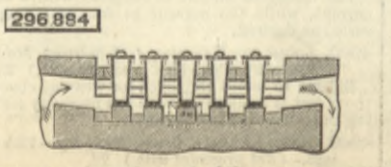
Claim.—The combination of a series of jaws, two or more, parallel guides, upon which said jaws are arranged and made movable in a path parallel to said



guides, and mechanism, substantially such as described, to impart movement to the said series of jaws, the said guides serving to support the said jaws in the same inclination with relation to each other throughout their entire movement, substantially as described.

296,884. METHOD OF MANUFACTURING METAL ALLOYS, *Gustav Selve, Altena, Westphalia, Prussia, Germany.*—*Filed June 19th*, 1883.

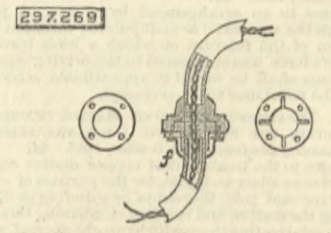
Claim.—(1) The method of smelting alloys, more particularly those of zinc, in closed crucibles that are situated with their lower parts in the furnace, while



their upper parts project out of the same, consisting in supplying the crucible with copper and melting it, then quickly adding zinc in proper proportion and brass waste, then closing the crucible and applying heat to the lower part thereof, while the upper part is externally exposed to the air, whereby the zinc vapours generated in the lower hotter layer of metal become condensed in rising up into the upper cooler layers, as herein specified. (2) In smelting zinc alloys, the method herein described, consisting in supplying the crucible with copper and melting it, then adding zinc in proper proportions and brass waste, then closing the crucible and applying heat to the lower portion of the same, and thus effecting the condensation of the zinc vapours generated in the lower part of the crucible by means of the cooler upper layers of metal therein, substantially as herein specified.

297,269. ELECTRIC LIGHT FIXTURE, *Philip H. Klein, Jun., New York, N.Y.*—*Filed December 12th*, 1883.

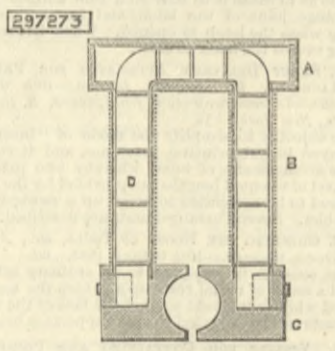
Claim.—(1) The combination of a jointed or swinging bracket having open wireways through its joints and continuous flexible electrical conductors extending through said bracket from end to end, substantially as set forth. (2) The combination of a jointed or swinging bracket having open wireways through its joints and two continuous flexible separately-insulated electrical conductors extending through said bracket from end to end, substantially as set forth. (3) The combination of a jointed or swinging bracket having open wireways through its joints, continuous flexible electrical conductors passing through said bracket from end to end, and means for preventing the bracket-arms from making a complete revolution, substantially as set forth. (4) In an electrical swinging bracket, the combination of two parts, one turning within the other, and the flexible plate holding



them together, substantially as set forth. (5) In an electrical swinging bracket, the combination of the cap on one part, the flanged sleeve on the other, fitting into said cap, and the flexible plate holding them together, substantially as set forth. (6) The combination of the cap forming one side of the joint, the sleeve turning therein, forming the other side, and the shell *f*, covering said sleeve, substantially as set forth. (7) In a swinging bracket containing continuous flexible electrical conductors extending through the bracket from end to end, the tubes of the bracket extending from the ends of the joints, substantially as set forth.

297,273. FIELD-MAGNET FOR DYNAMO-ELECTRIC MACHINE, *John W. Lawson, Harrison, N.J.*—*Filed November 16th*, 1883.

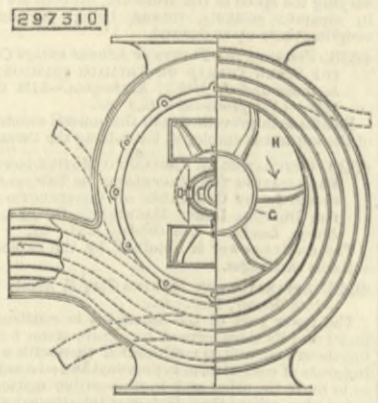
Claim.—(1) In a field-magnet, the combination of the hollow yoke A, tubular cores B, pole pieces C, and wire bundle D, and clamps for binding the said wire



bundle to the pole-pieces C, as specified. (2) In a field magnet, the combination, with the wire bundle D and pole-pieces C, of a clamp for binding the said wire bundle to the pole-pieces.

297,310. FAN BLOWER, *James E. Studley, Oshkosh, Wis.*—*Filed May 5th*, 1883.

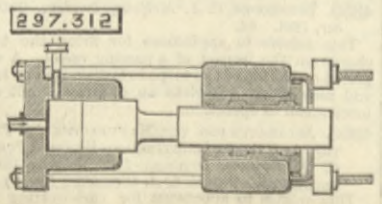
Claim.—(1) A fan blower, provided with a series of partitions within the shell, arranged, respectively, in volute form, the beginning of said partitions being at equal distances from each other and from the axis of the fan, respectively, and corresponding in number to the blades of the fan, substantially as and for the



purposes set forth. (7) A fan blower in which the air is received from opposite sides, provided with a series of partitions within the shell, arranged in volute form, and terminating in parallel lines in the eduction pipe, in combination with the fan G, having the central annular disc H, substantially as and for the purposes set forth.

297,312. SHAFT BEARING, *Harris Tabor, Allegheny.*—*Filed February 28th*, 1884.

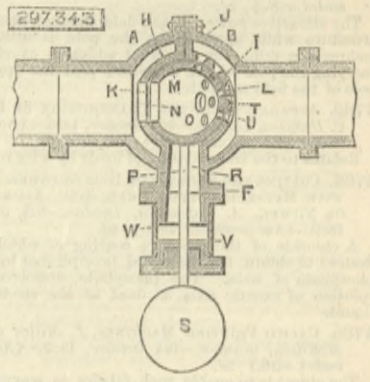
Claim.—(1) The method of forming and finishing soft metal linings for bearings, which consists in first casting a lining around a core mandril of less diameter than the journal which the lining is to receive, and thereafter expanding said lining into its bearing



or box, and coincidently truing and finishing its bore by the internal pressure of a finishing mandril of larger diameter than the core mandril, substantially as set forth. (2) As a new article of manufacture, a shaft bearing having a soft metal lining which is expanded into position into the bearing and coincidently trued and finished by the application of internal pressure, substantially as set forth. (3) The combination of a shaft bearing and a lining of soft metal, having the wearing surface of its bore trued and finished by compression exerted upon the natural skin or surface of the metal, substantially as set forth.

297,343. MARINE ENGINE GOVERNOR, *Alexander Hamilton Bell and Aspinwall Fuller, New York, N.Y.*—*Filed December 17th*, 1883.

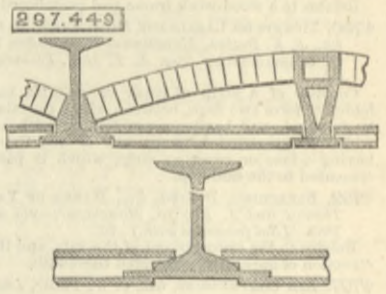
Claim.—(1) A marine engine governor, constructed substantially as herein shown and described, and consisting of the shell A B, the two-part spherical valve seat H I, having flanges J and perforations K L R, the spherical valve M, having perforations N O, and provided with a weighted valve stem P, and the stuffing box V and flexible connecting hose W, as set forth. (2) In a marine engine governor, the combination, with the shell A B, of the two-part spherical valve seat H I, having flanges J and perforations K L R, and the spherical valve M, having perforations N O, and weighted stem P S, substantially as herein shown and described, whereby the admission of steam will be regulated and stopped by the rocking and pitching of the vessel, as set forth. (3) In a marine engine governor, the valve constructed substantially as herein shown and described, and consisting of the two-part spherical seat H I, having



flanges J and perforations K L R, and the spherica valve M, having perforations N O, and weighted stem P, whereby the rocking and pitching of the vessel will move the said valve to partly or fully shut off steam, as set forth. (4) In a marine engine governor, the combination, with the valve seat H I, having vertical slot U, and the valve M, of the pin T, substantially as herein shown and described, whereby the said valve is kept from turning about the axis of its stem, and taking its perforations out of register with the perforations of the valve seat, as set forth. (5) In a marine engine governor, the combination, with the collar F of the shell A B, and the valve stem P, of the stuffing-box V, and the flexible hose W, substantially as herein shown and described, whereby the escape of steam around the oscillating valve stem will be prevented, as set forth.

297,449. FIRE-PROOF BUILDING, *Gustavus W. Rader New York, N.Y.*—*Filed January 18th*, 1884.

Brief.—A brick arch extending between and supported by I-beams has a keystone with a downward



extension. Fire-proof tiles are supported by the extension and the I-beams. Fire-proof plates extend across the bottom of the beams and are supported by the tiles.

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