THE INSTITUTION OF MECHANICAL ENGINEERS.

It will be remembered that our report of the proceedings of this Institution was brought down last week to Wednesday morning, when, as we have said, a paper was read by Mr. Sandiford, of Lahore,

On the Working of Compound Locomotives in India.

The author gives particulars and results of the trial which in the early part of 1883 he determined to make on the Scinde, Punjaub, and Delhi Railway, for testing the value of the compound principle when applied to locomotive engines working under the conditions met with on that line. These conditions are altogether so different from those under which the principle has been tried on the Continent by M. Mallet, and in England by Mr. Webb, that its success on the Indian railway appeared sufficiently doubtful to render this independent experiment desirable. In order to carry out the trial at a moderate cost, and in such a manner that in the absence of success it should be easy to revert to the ordinary plan, two engines were selected—the Vampire and the Vulcan—which had come into the shops for heavy repairs, both of them requiring new cylinders. Each had 3ft. 6in. leading wheels, and four 5ft. wheels coupled. The Vampire had 15in. cylinders

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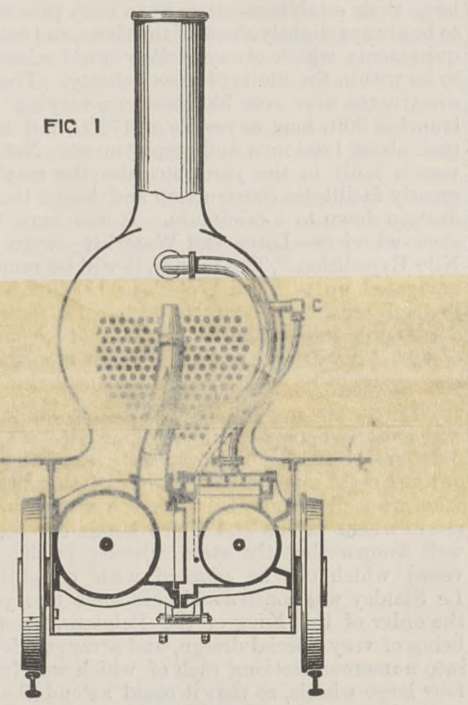

VAMPIRE.

with 23in. stroke, and the Vulcan 16in. cylinders with 24in. stroke. As the alterations were confined almost wholly to

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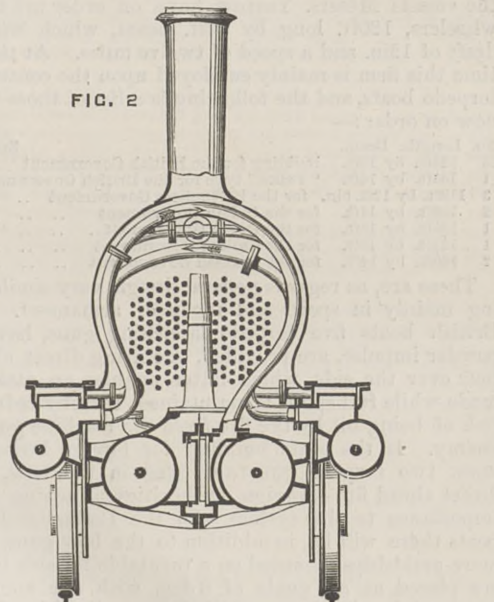

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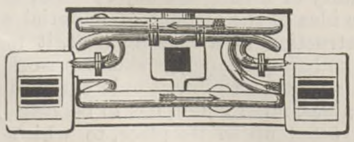


VULCAN.

the cylinders and valve gear, the accompanying engravings will make his arrangements clear.

In the Vampire, Fig. 1, the two original 15in. cylinders were replaced by an 18in. high-pressure and a 24in. low-pressure cylinder, these being as large as could conveniently be got in; the original stroke of 22in. was retained in each cylinder. The slide valve of the low-pressure cylinder is worked direct, and that of the high-pressure through the intervention of a rocking shaft. Excepting the slight modification thus rendered necessary, the gear remains precisely the same as it was, the distribution being controlled by a Stephenson link motion; the arrangement works exceedingly well and gives no trouble. To meet the contingency of the high-pressure cylinder sticking on a dead centre, a cock is provided, by which steam can be admitted direct from the boiler into the steam-chest of the low-pressure cylinder. As the result of an extended trial the engine has been found to work satisfactorily, and there has been no difficulty whatever in starting. Being regularly employed on goods and mixed trains, which are timed at eighteen to twenty-two miles per hour, the engine takes with ease a gross load of 500 tons including itself, and consumes 13½ per cent. less fuel than an ordinary coupled engine with 16in. × 24in. cylinders. The records of performance in running 6555 miles showed an average consumption of 33·10 lb. of coal per train-mile, with an average gross load of 489 tons, at an average speed of twenty miles per hour. For the ordinary engines on the same run the average consumption was 38·28 lb. of coal per train-mile, under very similar conditions as to load and speed. The fuel used was Bengal coal, which is of very fair quality.

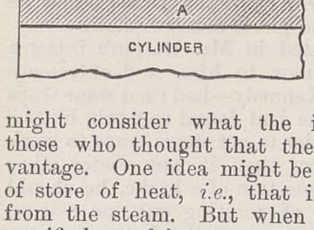
The other engine, the Vulcan, Figs. 2 and 3, as now compounded has four cylinders, the two original 16in. cylinders having been replaced by a pair of 11¾in. high-pressure outside cylinders and a pair of 17in. low-pressure inside cylinders; the original stroke of 24in. has been retained for all four cylinders, and the crank pin of each high-pressure cylinder is fixed opposite to the crank of the corresponding low-pressure cylinder. Here, again, the distribution is by a Stephenson link motion, with the addition of rocking shafts for working the slide valves of the high-pressure cylinders, and the arrangement is found to work well. The two high-pressure cylinders being, of course, connected to right-angled cranks, the engine, as might be supposed, starts freely in any position. It is regularly employed on goods and mixed trains, which are timed at 18 to 22 miles an hour; and hauls gross loads of 500 to 550 tons, including itself. It has been fairly tested over an extended period in charge of a driver of ordinary capabilities, with the result that in the first half-year of 1885 he took the highest prize for economy in fuel, and in the last half-year the Vulcan was still at the head of the list, being nearly 13½ per cent. lower in consumption than any of the ordinary engines in the same district. The first records of performance were obtained in running 14,830 miles, in which the consumption averaged 33·13 lb. of Bengal coal per train-mile, with an average gross load of 520 tons, at an average speed of 20 miles per hour.

In recent discussions upon the workings of locomotives, a good deal of stress has been laid on the disadvantage of coupling-rods; and in the author's opinion much more has been said against them than they deserve. Having found their brasses run for years with scarcely any appreciable wear, he believes that whatever wear there is will be more than counterbalanced by the unequal wear certain to be produced on wheels which can revolve at different speeds, as can the uncoupled wheels of the three-cylinder compound locomotives. In the four-wheel coupled engines, with solid coupling-rod ends and brass bushes forced into the rod ends, the wear is very small; from three to three and a-half years, or from 70,000 to 90,000 miles is a common record, and then the play is inconsiderable, say one-tenth of an inch. Regarding the blast, the four-cylinder-engine has a good deal a sharper blast, and is capable of steaming better than the two-cylinder; but the latter is never short of steam, although it has only one puff against the other's two. There is no doubt the four-cylinder engine can do more, and makes more steam when pushed, than the two-cylinder. In consumption of oil there is a small difference against the four-cylinder engine, which is only natural. The line which these engines work is practically level, but is exposed to strong side winds. The stoppages are numerous, the runs averaging less than six and a-half miles. Fuel being exceedingly expensive, economy is imperative.

This paper being concluded, the discussion on Mr. Borodin's paper was resumed, both papers being taken together. It was begun by the secretary reading a letter from M. Malet. The substance of this letter was that two cylinders should be used in preference to a greater number; that the ratios of these cylinders should be two to one, and that there should be an independent cut-off for each cylinder. The letter described a triple compound invented by M. Malet, with one high-pressure cylinder 18in. in diameter, one intermediate 26in. in diameter—these actuated four-coupled wheels—and two additional 26in. cylinders, into which the intermediate cylinder exhausted, worked a third pair of wheels. In the discussion which followed, very little information of any kind was supplied by the few locomotive superintendents present. Little, indeed, was brought forward that is not already more or less well known, and it might be stated that the greater portion of what was said was a criticism of Mr. Borodin's test shed arrangements. There were, however, two notable exceptions in the utterances of Professor Kennedy, of University College, and Professor Ryan, of Bristol College. Both these gentlemen dealt with theory and practice combined, and we, using our discretion, believe that we shall better serve the interests of our readers by giving what they said in detail than by supplying an abstract of what was advanced by other speakers.

Professor Kennedy said that perhaps the most valuable kind of paper that could be presented to the Institution was a record of accurate work done, and so recorded that all readers might be able to estimate its value for themselves, and even to work out from it their own conclusions. To a very great extent Mr. Borodin's paper came under that description, and certainly it was one which from every point of view the Institution might cordially welcome. It had perhaps a double aspect. It might be looked upon simply as a record of experiments in relation to certain important points connected with steam engine economy; or, it might be regarded as a record of trials of certain systems of locomotive working varying more or less from those in general use. As he had not the good fortune to be a locomotive engineer, he would confine himself to speaking of the paper from the first point of view. He wished to ask Mr. Borodin two or three questions, the answers to which would perhaps give completeness to the paper. First, was it to be understood that the jackets were not discharged by hand, but always worked through the trap; secondly, were the cylinders in any way covered; and thirdly, the water from the overflow was, he presumed, all measured separately, but it was not mentioned in the paper. It would also be interesting to know how the feed-water was measured on the train trials. As to the results themselves, Mr. Halpin had already made one remark which he—Professor Kennedy—had noted, viz., that he feared the arrangement of the indicator pipes must have seriously affected the indicator curves; he felt sure that it had affected them sufficiently to throw a rather serious doubt on the absolute—perhaps not so much on the comparative—value of all calculations from indicator card pressures. Indeed, he was not sorry to have an opportunity of recording his opinion very emphatically that, at the very best, calculations based upon indicator card pressures must be very cautiously accepted, and only regarded as approximate. Without special care as to the position of indicators, the arrangement of the pipes, and of the indicator gear, and the verifying of the springs of the indicators themselves—all of which were only too often done haphazard—such calculations had neither scientific nor technical value. For himself, he might say that in a little compound engine on which he had four indicators, three of them close to the cylinders—as close as they could go—the fourth with a perfectly straight ½in. pipe 6in. long, he had reason to believe that even that pipe affected the card taken from the indicator. He had had to alter it with some trouble in order to get rid of the difficulty. He had but little doubt that when Mr. Borodin put indicators close to the cylinders he would find a gratifying increase of indicator horse-power which would make his engines look better economically than they did at present. He wished to say a word or two about the calculations of heat. At page 16 of the paper it was assumed that practically all the steam condensed in the jackets had been condensed by giving up the heat to the cylinders inside. He was sorry to say that in his own experiments that was not even approximately true. If Mr. Borodin would measure the trap discharge from his jacket, if the traps acted properly, when the engines were stopped and standing hot, he would find that it amounted to a disagreeably large percentage of the whole discharge when the jacket was fulfilling its proper function and the engine running—at least, he was sorry to say that that had been his own experience. It was necessary to take that into account in any complete theory of the action of a jacketted engine, and also not to lose sight of one theoretical point which, if he did not mistake, had been overlooked in a good many valuable engine trials which the Alsatian engineers had made, viz., that the heat received by each pound of jacket steam was not the same as the heat received by each pound of steam which went to the engine. The remarks made by Mr. Borodin in his paper as to the difference in the efficiency of jackets under different conditions of cut-off might very well be carefully noted by those interested in the matter. As to those and some other remarks by the author, he thought it must be said once for all that a jacket that was not properly drained by some automatic arrangement was not only useless, but a source of great waste. Not being an engine maker he hoped he might be excused for saying that engine makers sometimes forgot that point, thinking that when they had provided that annular space round the cylinder which dictionaries called a steam jacket, and put some connecting pipes to it, their duty was done. Certainly unless they also provided some means for draining the space automatically they had much better put a blank flange in the jacket admission pipe and say nothing more about it, because it was really only waste. He wished also to say a word as to Mr. Halpin's interesting contribution to the discussion. They were entirely in agreement as to the necessity of draining jackets, and he was glad that Mr. Halpin had put it in so emphatic a way. He was exceedingly interested in Mr. Halpin's injector proposal, which was quite new to him, and extremely ingenious. He—Professor Kennedy—had used some traps which he was happy to say he had found to work, but he had no doubt that it was easier to get steam traps to work continuously in a laboratory than it was under other circumstances. As to the question of a brake, he should like to take the opportunity of pointing out one matter. Mr. Halpin's mode of getting rid of the hot water was most ingenious; he was charmed with it, and hoped to see it at work. As the question had been raised he should like to point out that there was a very distinct error in the use of an Appold lever arranged in the fashion sketched by Mr. Halpin; at least he believed so. This was explained by a drawing on the black-board. He hoped that the Royal Agricultural Society would look into the matter before they made further trials, and, if he was right, make the necessary alteration. In conclusion, he wished to thank Mr. Borodin for the very frank way in which he had stated his results, failures as well as successes. It added greatly to one's confidence in such results when they were candidly recorded, without any endeavour to make them uphold some favourite scheme. He hoped Mr. Borodin would be able to continue his experiments with more perfect apparatus, and that on a future occasion he would increase their indebtedness to him by giving further results in the form of another paper.

Dr. Ryan, Professor of Engineering at University College, Bristol, said he should not have thought of interfering in this discussion, in which they were all anxious to hear the experience of practical men, were it not for the fact that one or two principles had been enunciated which he thought ought not to pass unchallenged. Mr. Halpin had had the temerity in that room to challenge the authority of Sir Frederick Bramwell. It was not any undue respect for authority which induced him to answer Mr. Halpin's remarks, but he wished to call attention, first of all, to this statement—that it was a very popular fallacy that when they had surrounded their cylinders completely with steam—that was, that they had surrounded the cylindrical sides and ends—that they had then jacketted it as far as it was possible to do so. This seemed very plausible, and he must admit that it was the view which he held. Mr. Halpin had exhibited a diagram showing the ratio of surface, of area, of volume when he jacketted the barrel on the cylindrical portion only, and then when he jacketted it on the two ends, and also on the four ends. He—Dr. Ryan—was a little puzzled by those four ends till he found that he admitted steam within the piston, and in that way had what practically might be called four ends. In fact, his barrel had a top side and a bottom side, an inside and an outside, and he jacketted all these sides. That was very well, but he went further, and showed a diagram in which the cylinder was ribbed, and in that way he explained it was possible to get more heat from the jacket into the cylinder than if they merely used a simple parallel thickness for the cylinder. That did not appear to be quite correct; it did not seem to accord with the theory of Fourier on the conduction of heat, and he proposed to make some remarks on that point. He should state that he spoke to Mr. Halpin on the previous evening, but he did not admit the accuracy of his (Dr. Ryan's) contention at all, and he further said that he would not be able to reply. He was exceedingly sorry for this, because he felt quite certain, from what he saw of Mr. Halpin yesterday, that he should suffer in the argument, and that no doubt he would attach his (Dr. Ryan's) hair to his waistbelt by the end of the discussion. But even at the risk of taking an unfair advantage of Mr. Halpin, he must say what he had to say on the subject. In the first place, he must apologise for going into the elements of the subject, and for drawing attention to the fact that the rate of flow of heat across any surface depends upon a certain number of elements. It depended first of all on the difference of temperature at the two sides that were under consideration; it depended on the thickness of the plate to be heated; it depended on the time, and on the area. Mr. Halpin's idea seemed to be that if they could increase the area subjected to the heating on the one side in proportion to the volume of the cylinder, they would then have gained some advantages, just as in the case of an electric accumulator, if they increased the surface of the plates they then got a corresponding increase in the lasting power of the cell. But here it was not that we increased the flow of electricity, but increased the source of electricity, and therefore the parallel which one might think at first sight was a good one did not apply. The area in Fourier's theorem and the area stated was the area normal to the lines of flow, and it did not follow that if they increased the area in any other direction they got any advantage. This was at the bottom of the fallacy that, in his opinion, Mr. Halpin had been guilty of. Taking the steam in the jacket as 180 deg. Cent., and supposing the mean temperature in the cylinder to be 150 deg., they had 30 deg. Cent. to cause the overflow, and they had to drive the heat with that motive force through the plate of the cylinder. If they doubled the thickness of the plate they halved the quantity of heat that passed in a certain time; therefore if they increased the thickness of the cylinder by two they had a double thickness to send the heat through, and only got half as much heat through in the same time. That was Mr. Halpin's error. If his rib was twice the thickness of the cylinder they only had one-half the quantity of heat passing from the top to the inside of the cylinder. Even granting, which was not quite correct, that the whole of the rib assumed the temperature of the steam in the jacket, they would simply have got their isotherm 180 deg. Cent. at the same level that they would have got it if they had not got the rib at all, as shown by the dotted line at A in the sketch; so that the rib on the very best terms was equal to nothing at all; that was the theoretical treatment of the subject, but there was more to be said, and one might consider what the idea was in the mind of those who thought that these ribs were of some advantage. One idea might be that the iron rib was a sort of store of heat, *i.e.*, that it got saturated with heat from the steam. But when they remembered that the specific heat of iron was very much less than the specific heat of steam, they would see that the rib was only about one-fourth the value as a storer of heat as compared with the same amount of steam, so that it would be far better to have that space filled up with steam than with iron. Another oversight was this, that those who believed in this theory seemed to forget that steam in the jacket was a source of heat, and the iron was only the medium by which the heat was conveyed to the inside of the cylinder. Putting these ribs seemed to him very much like increasing a road across a desert, as if they were to come from a distance of five miles and make a road ten miles, on the supposition that the more road there was the better it would be for them. The fact was, the less iron they had, and the less road, the more directly the heat could go, the better it would be; and therefore the thinner they could make their cylinder the more heat they would get through in the same time. But there might be an answer of this character, that by putting in these ribs they could make their cylinder thinner, that by ribbing it in that way they could use a thinner cylinder than if they actually had the side parallel. A little consideration would show they gained nothing there in the rate of flow, but it was a point one could not very well illustrate popularly. One idea appeared to be that it did not depend so much upon the conductivity of the iron as upon its receptivity and its emissivity, the power of emission. That was a question between the amount of heat the iron received from the steam on one side, and that it gave up to the steam on the other side. He did not think it was a question of that nature. The iron got the heat from the steam in contact with it, he believed principally by contact; but even if it got it by radiation it did not make any difference. They must admit the surface was at the temperature of the steam or very nearly. Of course, if there was hot water on the one side and ice-cold water on the other, it was probable there would be a slight gradient in the water. Where there was so small a difference as this, they might practically take it that the isotherm was close to the surface, and therefore however the iron got the heat it did not matter, and whatever heat it got passed through it and came into the steam on the other side. Then there was another illustration,



that in the case of modern stoves they were ribbed in this way; instead of simply having flat surfaces there were large ribs, perhaps six inches in depth, spreading all round them, and these were found to give largely increased heating power. That was no doubt so, but how was the heat affected in this case? It was a case of iron being made hot by the fire and giving up that heat to the air; the air passed in between the narrow ribs, got heated by contact and rose by convection, so that there was continually a fresh supply of heat coming in, and there the surface did give a measure of the efficiency of the apparatus. So much for the steam jacket. He believed Mr. Halpin was followed by a gentleman, Mr. Davey, who commented on the steam jacket, and pointed out that for the last fifteen years it had been a fruitful cause of dissension and discussion. No doubt it had, and for a very much longer time. They had had experiments proving that steam jackets saved 30 per cent. of heat, and experiments showing that steam jackets lost 10 per cent., and they had to determine for themselves what the exact value of steam jackets was. He believed the real cause of this was that they always lost sight of the precise kind of engines to which they were applied, and the conditions under which they were applied. As Mr. Rich pointed out, there could be no doubt whatever that in the case of slow working engines of large expansion, such as mill engines, steam jackets would be, and must be, useful. The use of the steam jacket, or, at all events, the effect that it produced in any particular case, no doubt depended very much on the rate at which the heat could pass from the steam outside to the steam inside, and if the engine was a quick working one a certain mean temperature would be achieved in the cylinder, and the iron of the cylinder would not be able to convey any sensible amount of heat from the steam jacket during a portion of the stroke. On the other hand, in a slow working engine the mean temperature inside would be very much lower, the gradient of the temperature would be greater, and the time allowed for the transmission of heat would be greater, so that in these cases there must be a distinct advantage in the use of the steam jacket. On the other hand, in the case of a locomotive with a quick working engine, it was almost equally certain that there would be very little advantage derived. He believed the experiments of Mr. Borodin, as far as he knew them, bore out this fact, and in the case where he had worked his trains rapidly, the effect of the steam jacket seemed to be, if anything, negative. Mr. Davey appeared to have gone on to show wherein the error in all these experiments had lain, and he proposed to bury his cylinder in a great mass of steam. These experiments would be very interesting to theorists, but he was afraid practical men would not care much for experiments made on those terms, because they were never likely to have any bearing on practice. It was not safe to prophesy unless one happened to know, but he thought engineers would never make reservoirs in order to plant their cylinders in them. The only thing they could do was to put them in a boiler like Trevithick did, or some of the early engineers; and now that they were using such very high pressures he was sure it would be difficult to make the boiler sufficiently strong to carry steam jackets of the size indicated. They might safely say that large jackets would not be worn by steam engines next winter. Mr. Borodin stated the economy in steam to be about 23 per cent., and in the fuel 32 per cent. To what was this economy in the fuel due? If the economy in the fuel had been 23 per cent., the same as in the economy in the water used, and it had been said to have been due to the compound engine, it would have looked very much as if it were due to the furnace and boiler of the compound engine, and they would have very carefully eliminated the two things. They would want to know the efficiency of the engine. Mr. Borodin did remark that it might have been due to extra careful stoking. In the absence of any evidence alleged to the contrary, he thought they must conclude that it was due either to the stoking or to the furnace, because there did not appear to be any sufficient reason for this difference in the 32 per cent. gained in the fuel and the 23 per cent. in the case of the water. One thing that possibly might affect it was the difference in the blast, because in some varieties of the compound engine there might be just half the number of exhausts to what they got in the ordinary locomotive, and possibly this might add to the even burning of the fire in some way, or possibly having to produce less steam in a given time might enable more perfect combustion and evaporation to take place. He did not wish to give an opinion on either of these points, but he thought in the one case Mr. Borodin did not send the exhaust steam into the chimney, but condensed it in order to find out how much heat there was in it. So that, on the whole, he thought it must be said that this gain in the fuel over the water was due to more careful stoking, or to some difference in the boiler of the engine, and therefore that 10 per cent. ought to be rather deducted from the gain in the water. They must admit that the boiler and furnace of the compound engine were more efficient than those of the simple one, and therefore they must make a deduction from the gain shown by the engines. Then there was another point in regard to the throttling of steam. Mr. Borodin showed that as the regulator was closed the pressure of the steam in the cylinder differed from the pressure in the boiler, and that as they closed the regulator the pressure became greater. Mr. Halpin attributed this in part to the narrower steam pipes, but in the absence of any evidence with regard to the opening of the regulator in this case he did not think they ought to take into consideration the steam pipe, because if they had only three square inches in the regulator and eight in the steam pipe, even though they admitted the steam pipe was not large enough for its work, yet there was no good making it larger so long as the regulator was only opened to that amount; and it distinctly followed from what Mr. Borodin had said that the diminution in these pressures given was due to the closing of the regulator and to that alone. Mr. Borodin had omitted certain tests—he was very sorry that should have been the case—which were not congruous with others or not in accordance with what one would expect. He should earnestly entreat all experimentalists to give them all the results in their entirety — to give them in their naked hideousness, whether they liked them or not, because many advances had been made in scientific discovery and other things simply by the consideration of these anomalous results, and it was a pity that any records in such a valuable series of experiments should be omitted simply because they did not seem to agree well with others.

Mr. Borodin replied briefly on the whole discussion, and after votes of thanks and general business had been transacted, the meeting broke up. All the proceedings being terminated, the remainder of the week was devoted to various excursions. To two of these we have already referred. On Thursday a large party visited Woolwich Arsenal and Tilbury Docks. The latter has been so frequently described in our pages that we need add nothing now concerning them. On Friday the Southern Outfall Pumping Station was visited, Messrs. Westwood, Baillie, and Co., Poplar, and the torpedo boat works of Messrs. Yarrow and Co., Isle of Dogs. These works are situated on the Thames, near Blackwall. They were started twenty years ago, and at first were devoted to the construction of steam launches. Since then improvements have followed in rapid succession, and Messrs. Yarrow and Co. have been forced to continually enlarge their establishment so as to keep pace with, or rather to be always slightly ahead of the times, and ready to meet requirements which always follow what science first shows to be within the limits of practicability. There have been constructed here over 700 steamers, varying in size from launches 30ft. long to vessels of 170ft., and at the present time about 1200 men find employment. Not only are the vessels built in the yard, but also the machinery, which greatly facilitates construction and keeps the cost of production down to a minimum. It was here that the two stern-wheelers—Lotus and Waterlily—were built for the Nile Expedition. The former, it will be remembered, was navigated up to Lord Wolseley's headquarters at Korti, through numerous cataracts which previously were considered quite impassable for any kind of steamer, and owing to which it will be remembered the rowing-boat scheme was resorted to. In fact during one period of the Nile Expedition the communication between Cairo and the army was entirely dependent upon these two steamers, and in consequence of their remarkable success the Government ordered eight more stern-wheelers of this firm. To those who are well acquainted with the navigation of shallow rivers where rapids and sharp bends are met with, it is well known that the stern wheeler is the only type of vessel which can be adopted with certainty of success. Le Stanley was constructed here some two years since, to the order of the King of the Belgians, for the Congo, it being of very special design, and arranged for subdivision into numerous sections, each of which was furnished with four large wheels, so that it could ascend the river where navigable, and elsewhere be transported overland, each section being transformed with its four wheels into an ordinary wagon. By the latest advice we hear this steamer is now successfully working above Stanley Pool. Among the vessels Messrs. Yarrow have on order are two stern-wheelers, 120ft. long by 24ft. beam, which will have a draft of 12in. and a speed of twelve miles. At the present time this firm is mainly employed upon the construction of torpedo boats, and the following is a list of those they have now on order:—

No.	Length. Beam.		Speed—knots.
23	125ft. by 13ft.	building for the British Government ..	19 to 20
1	135ft. by 14ft.	"Falke" type for the British Government	22 to 23
3	119ft. by 12ft. 6in.	for the Portuguese Government	20
2	140ft. by 14ft.	for the Italian Government	22
1	125ft. by 13ft.	for the Dutch Government..	20
1	125ft. by 13ft.	for the Chilian Government	20
2	140ft. by 14ft.	for the Spanish Government	23

These are, as regards general design, very similar, differing mainly in speed and mode of armament. In the British boats five torpedo launching guns, having gunpowder impulse, are provided, one firing direct ahead and four over the side, which latter enables an attack to be made while full speed is maintained, thereby reducing the risk of being hit by the fire from the machine guns of the enemy. In the boats building for foreign Powers, in all cases two torpedo guns are fixed in the bow, both for direct ahead fire—foreign authorities attaching the most importance to this system. In the Italian and Spanish boats there will be, in addition to the bow guns, also two more amidships mounted on a turntable for side fire; these are placed at an angle of 6 deg. with one another, and arranged for simultaneous discharge. By this plan much greater certainty of hitting the object aimed at is secured. To give some idea of the amount of material which enters into the construction of a torpedo boat, it may be mentioned that the bars forming the skeleton work of the hull, if laid out in a continuous line, would extend for a length of over two miles, all of which has to be bent into shape, punched and fitted up in its place, to which framework the outside skin plating of the hull is attached. Among the most notable torpedo boats built by Messrs. Yarrow of late may be mentioned the Falke and Adler, constructed for the Austrian Government, in which a speed of 24 knots —equal to 27½ miles—was obtained, this being the highest speed on record; and we understood Mr. Yarrow to say that he was prepared to considerably improve upon this and guarantee thirty miles an hour.

Various other works were visited also. The whole of the arrangements were admirably carried out, and appeared to have given general satisfaction.

Several Belgian engineers availed themselves of an invitation to visit the North. Thirteen of them duly arrived on Tuesday morning under the guidance of Mr. Percy C. Gilchrist, at Middlesbrough; they were met at the station by the President of the Institution of Mechanical Engineers; by Sir Lowthian Bell, ex-president; Mr. Gjers, president of the Ironmasters' Association; Mr. J. Wilson, M.P. for Middlesbrough, and various other of the leading men of the district. A special train, provided gratuitously by the North-Eastern Railway Company, was in readiness to convey the party to the works on the programme, and a special steamer was placed at their service by the Tees Conservancy Commission. The visitors included MM. Mayer, from Nancy; Maurice and Gustave Trasenster, D'Audriment, Servais, Krechlingir, Koch, Muller, Galland, Lefevre, Osmonde, and Delaine, all of whom were from Liége, or the neighbourhood. The train first went to Newport, where the blast furnace plant of Messrs. B. Samuelson and Co. was visited. Next the Ayresome furnaces, belonging to Messrs. Gjers, Mills, and Co., were inspected. Half of the furnaces at these works were smelting Bilbao ore, and the other half ordinary Cleveland ironstone. Next the party went through the works of the North-Eastern Steel Company, and saw the basic process in full operation. Only one-fourth of the output appears to be now in rails, the other three-fourths being in ingots, blooms, tin bars, and wire billets. The experience of the North-Eastern Railway Company's engineers is that there is no difference whatever in quality as between basic and acid steel rails. But for ship or boiler building steel, Lloyd's rules at present virtually exclude basic, and compel the use of steel made from foreign ores. From the steel works the party embarked on board the steamer in waiting, and crossed the river to the Port Clarence Works, belonging to Messrs. Bell Brothers. After luncheon, the furnaces, the salt, and the new soda works were inspected, and then, re-embarking, the party went down the river and out to sea, returning eventually to the South Gare Breakwater, whence the special train conveyed them to Saltburn. In the evening a banquet was given at the Zetland Hotel in honour of the visitors by members of the Cleveland iron trade, Sir Lowthian Bell presiding. On Wednesday the party visited some iron mines, and then, after luncheon at Saltburn, went by special train to Darlington. From thence, after visiting the steel works of the Darlington Steel and Iron Company, the visitors took train to Newcastle, where Mr. Percy G. B. Westmacott was ready to receive them and conduct them through various Tyneside works.

LETTERS TO THE EDITOR.

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

BECKTON GASWORKS.

SIR,—Your descriptive and very interesting account, with plan annexed, in last week's ENGINEER, of the Beckton Gasworks of the Gas Light and Coke Company, mentions as follows:—"As might be expected from the marshy ground, some difficulty was experienced in finding foundations for the structures necessary for these unrivalled gasworks. Gravel was found at an average depth of about 20ft. from the surface, but the beds were not sufficiently consolidated to be trusted for any considerable weight. Mr. F. J. Evans, in seeking foundations for the retort houses, judged it prudent to excavate below the gravel, and went down 40ft. from the surface, so as to reach the blue clay." There is a mistake or two here. The foundations to the whole of the Beckton buildings, including all the retort houses, repose on the Thames ballast substratum, which lies below the peat and silt of the marshes, and which ballast was the bed of the Thames estuary formerly flowing over the site of Beckton. There is neither blue clay nor London clay below Beckton at any part; it entirely disappears from this locality. There is a considerable depth of river ballast below the peat and silt upper crust; and under this ballast there is the chalk. This is generally the case in the Essex marshes. Only in one part of Beckton does the chalk crop up above the ballast, and that is in the bed of the river fronting Beckton, and a few of the cast iron cylinders of the pier are embedded in the same. The ballast is met with at depths varying from 30ft. at the river front to about 16ft. in the rear of the site, below the marsh level, which is about 6ft. generally below Trinity high-water mark, and which latter is the formation level of the works and the coke holes. The cast iron piles for the viaducts and the stages of the retort houses are driven down to depths varying from 30ft. to 50ft. below the marsh, and penetrate from 15ft. to 20ft. into the solid ballast to obtain the standard of resistance adopted upon the works, due to the fall of 6ft. of a one-ton monkey, and so that four blows would not drive the pile more than ¼in., giving a carrying capacity to each pile of over twenty tons. The cast iron piles are blunt-pointed, and were driven with a short wooden dolly on the head of the pile to prevent fractures.

The concrete is placed under the buildings in detached pillars or blocks, dispersed over the areas under the main points of support, and so that, in the event of any settlement taking place in a foundation, it would be local, and not affect a long length of structure. There are some thousands of separate pits of concrete under the structures at Beckton. A similar arrangement of concrete foundations has been adopted at other places in this country and on the other side of the Atlantic where ground of compressible material has been met with at great depths. The weight on each foundation is generally from two to three tons per square foot of surface bearing, but I have in a few special cases imposed as much as seven tons per superficial foot on the Thames ballast without any settlement.

You also mention in your description of Beckton that "the original design of these works is due to the late Mr. F. J. Evans, who was then—1868—the gas company's engineer." If you mean this remark to apply merely to the selection of the site you are right, but it would not be correct with reference to the designs and engineering details. I hope I may do no injustice to one who has gone from us over to the great majority when I state that for more than thirteen years—1868 to 1881—I was designing and building the Beckton works, and for eleven years of that period I was alone the responsible constructing engineer recognised by the board of directors. For the two first years of the building operations—1868 to 1870—Mr. Evans was the official engineer, but I never saw any of his engineering details structurally. After this period he retired on the board of directors, and he affixed a memorial tablet upon the clock tower to the effect that he was the engineer. At this time—1870—scarcely one-fifth of the present Beckton had been accomplished.

Four-fifths of the whole of Beckton I built for the gas company, despensing with the usual contract system, the company performing their own building operations, purchasing materials, burning their own lime, paying for the labour direct, and saving the intermediate profits, excepting for the general ironwork. Would that other companies practised this system more generally, and insured good, sound, economical work.

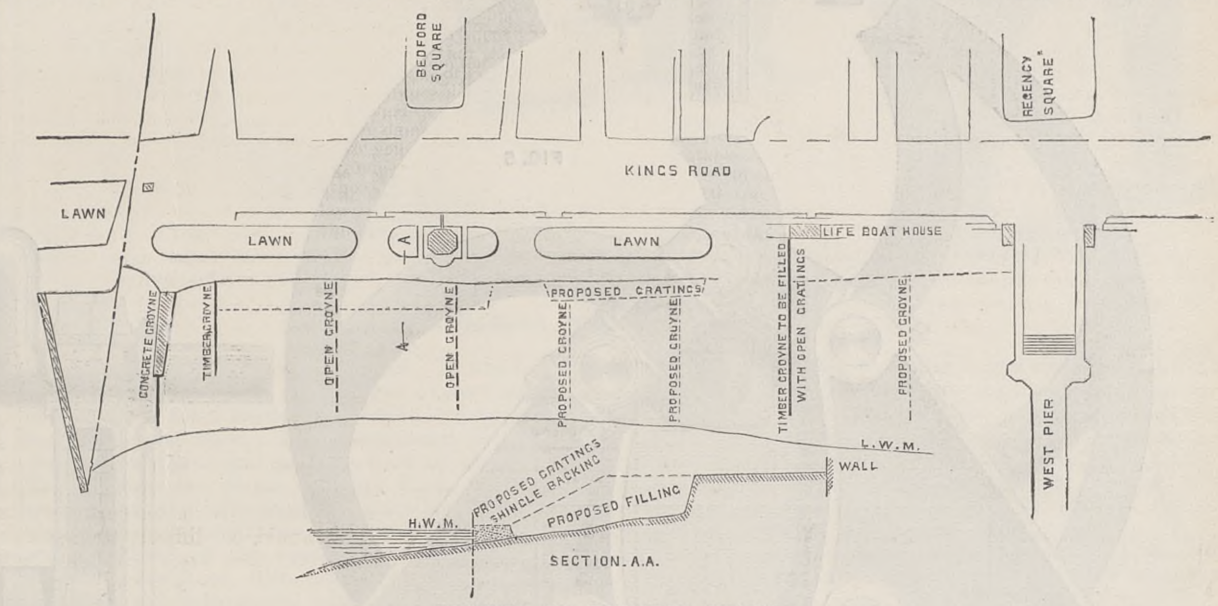
The very plan you published is copied from my original plan of the works, added to from time to time as the structures advanced. During the early part of my time at Beckton I had to shape my ways like unto a celebrated diplomatist, who wrote at the end of a busy life thus:—"I often planted the seed corn in the ground, and when the plant grew up and could be seen by all, I knew how to ascribe the merit to others, and I had to do it."

V. WYATT,
Late constructing engineer of the Beckton Works.
"Ivor," Goldhurst-terrace, Priory-road, Kilburn, N.W.,
August 23rd.

GROYNES ON SHIFTING BEACHES.

SIR,—Having read your interesting article of the 6th instant, will you allow me to make the following observations? You very justly remark that the open groynes at Brighton have not had a fair chance. They have had to contend with many difficulties not met with on a beach free from other structures. For instance, they are placed between a high concrete groyne to the west, and a high timber one to the east. These large solid groynes produce cross currents, which cause the shingle to travel in deeper water, and check its being cast up near the open groynes. It is also much against the open groynes that only two of them were erected; as only two small structures of this kind are insufficient to raise the beach beyond their immediate surroundings. In spite of these serious drawbacks, two open groynes—shown on the accompanying plan—continued to collect and retain shingle, without damage to themselves, during the exceptionally heavy weather in the winter of 1884, while at the same time their costly neighbours both east and west were seriously damaged. This state of affairs lasted until last autumn, when a considerable portion of the timber groyne to the east was washed away, and a large quantity of shingle was suddenly released, so that an extensive area of the foreshore was lowered, and shingle was taken from the open groynes. This not only prevented the open groynes from doing useful work, but endangered their own safety. Matters were made still worse by the continued construction of large groynes to the westward, which further reduced the amount of shingle allowed to enter the embayment where the open groynes were placed.

It must be remembered that these open groynes were put up as an experiment, as some of the authorities considered that light structures of this nature were not capable of withstanding the heavy seas met with on this part of the coast. Two groynes were never supposed to protect the embayment in which they were placed. My proposal was to have four of them and to substitute iron gratings for the planking of the timber groyne, and had this been done, as I frequently urged, the state of this embayment would now be very different. There can be no doubt that the open groynes have not had a fair chance, and unless my original proposal to have more of them is carried out, it is probable that the existing ones will be seriously damaged or washed down, as I warned the authorities in November last, after the damage to the timber groynes occurred. To make all clear to your readers, I may perhaps add that the object of open groynes is to allow shingle, &c., to be trapped and retained, without impeding the free passage of the waves. These groynes consist of vertical iron gratings, so arranged that when shingle has accumulated near them, they can be raised when it is desired to cause a further deposit on a higher level. The waves then have a longer incline on which to spend themselves, and break further from the cliff.



GROYNES ON BRIGHTON BEACH.

With regard to the solid groynes, I may mention that the one opposite the lifeboat house, built about two years ago, has during that time caused such a scouring away of the beach on its eastern side that a pipe which for more than twenty years had been buried, is now exposed several feet above the surface of the beach. Before this groyne was built there was shingle nearly to the top of the cliff, and now the cliff is exposed vertically several feet, so as to endanger the manhole of the sewer. Under the West Pier the junction of some bracing rods, which was nearly on a level with the beach, is now about 10ft. above it. The principal concrete groyne is the one opposite Paston-place, Kemp Town. This has cost over £11,000. On its western side this groyne has accumulated shingle which may be reckoned by acres, but on its eastern side the beach has been scoured away, so that the roadway has only been maintained by the frequent cartage of chalk, &c. A large hole has also been made through the groyne, so that shingle from the western may be washed through to the eastern side.

With regard to the shingle you noticed against the Hove groynes, you may perhaps not be aware that during the last two years the Commissioners have caused a large quantity to be barged and deposited opposite the groynes, and I believe that the shingle now seen may be due to this rather than to the action of the groynes. As to the amount of shingle which now travels past Brighton, the prevailing local opinion is that less shingle is now deposited on the foreshore, because the sea carries less from west to east than it used to do. For my own part I cannot help feeling that this is a mistaken idea. Doubtless the gasworks' and other groynes have to a certain extent reduced the travel of shingle, but local phenomena lead me to think that the chief cause of its not being deposited on the beach is the action of the large solid groynes, which drive the shingle into deep water, so that it travels past the town without being stopped.

In conclusion, I think it has been proved beyond a doubt that solid groynes do as much or more harm than good, while there is every probability that a sufficient number of small and inexpensive open groynes will not only protect, but raise the level of the foreshore. Instead of having new open groynes, the planking of the existing timber ones all along the beach can be removed and open gratings substituted for them, as I have already proposed. If this were done there would soon be a radical change in the condition of the beach. The shingle would be less wandering and uncertain. The public would be able to move about on the beach with greater freedom, and without having to climb up to the parade as a means of getting over the present huge groynes. The cost of maintenance would at once be reduced. Lastly, large portions of the existing groynes, which are so unsightly, would soon be buried in shingle.

A. DOWSON.
3, Great Queen-street, Westminster, August 18th.

PITCH FOR RIFLED SMALL-ARMS.

SIR,—In the article on "The Enfield Small-arms Factory and Military Rifles," on 20th August, the twist of rifling is presumably expressed in inches—that is, a twist of 1 in 15 means that the rifling makes one turn in 15in., or the pitch of the spiral screw is 15in. Although this is convenient in the process of manufacture, for purposes of comparison between different diameters of bore, it is necessary to express the pitch of the twist in calibres, which is done immediately by dividing the pitch in inches by the number of inches in the calibre. We have then a measure of the twist of the rifling suitable for any bore, large or small. Counted in this manner, the pitch of rifling of the Martini-Henry rifle is 22 ÷ ·45 = 49 calibres.

From a theoretical investigation, I make out that a solid bullet like the Martini-Henry bullet, three diameters long and of density 10·9, requires for stability of flight the rifling to have a pitch of 50·74 calibres. Again, the pitch of rifling of the Martini-Enfield is 15 ÷ ·4 = 37·5 calibres, and the bullet weighing 384 grains, against 480 grains in the Martini-Henry bullet, is presumably about 3·5 diameters long, requiring from theory a pitch of 42·4 calibres in the rifling.

Of course, it is necessary to give a slightly sharper twist than the theoretical value, in order to secure a reserve of stability. Still, I think that for the Martini-Enfield the pitch of rifling might be increased to 16in., or 40 calibres, without impairing the stability of the bullet in its flight. At the same time, the fouling would be diminished and the initial velocity slightly increased.

In the following table the pitch of rifling of the small-arms given in your article has been expressed in calibres, and the length of the bullet in diameters or calibres, inferred from its weight and diameter compared with the Martini-Henry bullet as a standard, 3 diameters long, and then the theoretical pitch in the third column, the numbers being taken from a table calculated by Captain J. P. Cundill, R.A., and Mr. A. G. Hadcock, Inspector of Ordnance Machinery, R.A., from a formula obtained from theoretical investigations on certain working hypotheses:—

System.	Pitch of rifling in calibres.	Length of bullet in calibres.	Theoretical value of the pitch.
Werndl	64·7	2·6	60·26
Gras	50·8	2·7	57·55
Mauser	50·8	2·7	57·55
Vetterli	63·7	2·6	60·26
Jarman	55·4	3·1	48·82
Berdan	50	2·9	52·72
Remington	46·2	2·8	55·09
Springfield	48·8	3·1	48·82
Martini-Henry	48·8	3·0	50·74
Enfield-Martini	37·5	3·5	42·40

It will be observed from this table that the Werndl, Vetterli, and Jarman rifles have less rapid twist than the theoretical value, while in the Springfield the coincidence is almost complete; in the remainder the twist of rifling is more rapid than for the theoretica value, and on the whole a curious divergence of practice is observable. A curious optical illusion is experienced in attempting to estimate the pitch of the rifling in looking through the bore of a rifle or gun. Thus the twist of a Martini-Henry rifle appears much more rapid than that of a field gun; but really the pitch of the latter is probably about 30 calibres, while that of the rifle is about 50, the illusion being due to the greater relative length of the bore of the rifle in diameter, so that the rifling makes about a turn and a-half, while in the field gun it does not make a complete turn.

A. G. GREENHILL.
August 23rd.

SMOKY CHIMNEYS.

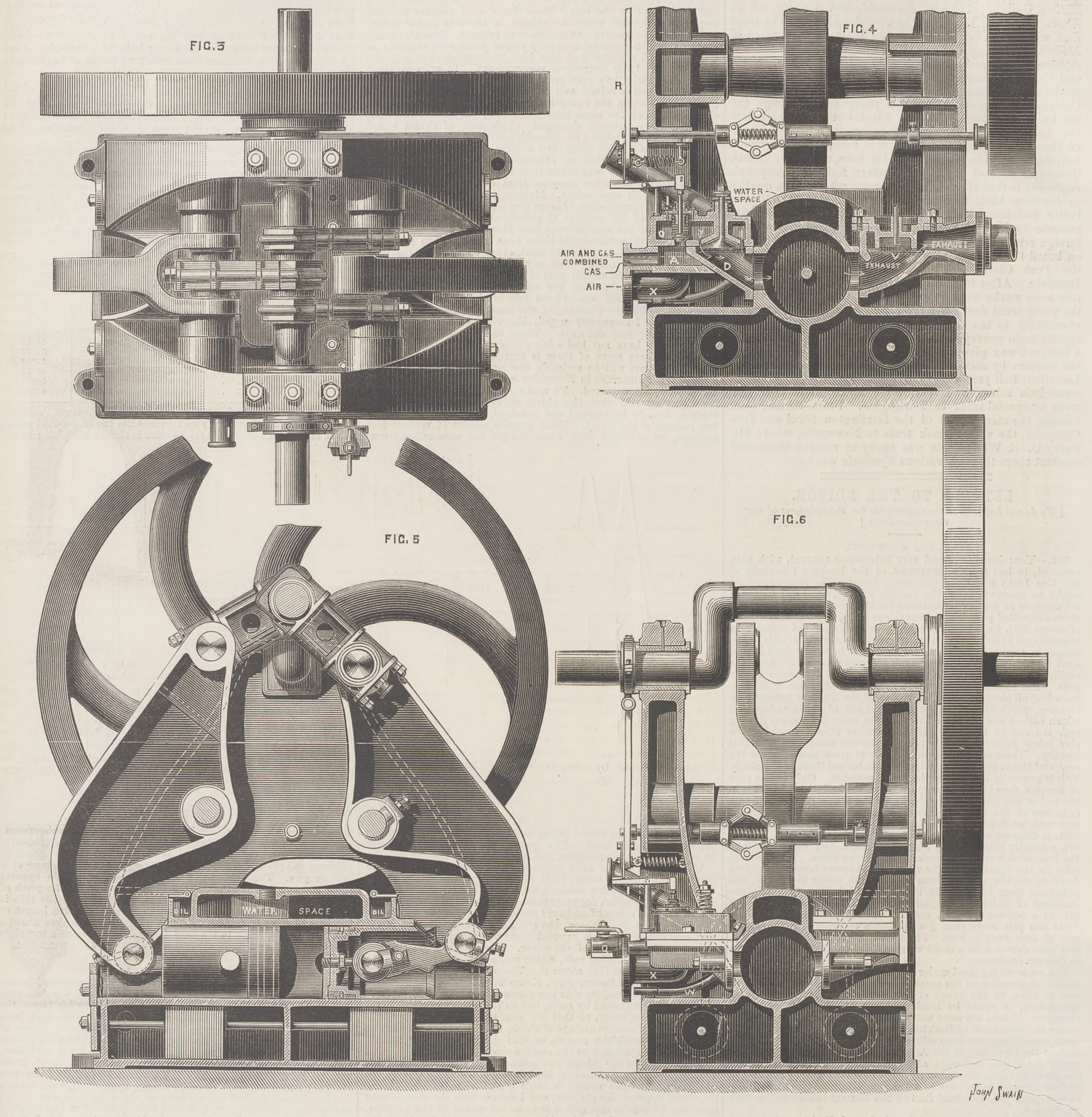
SIR,—Presuming some of your readers may be interested in our practical experience with smoky chimneys, we send the following for your perusal:—We were recently consulted by His Grace the Duke of Northumberland relative to the smoke proceeding from the chimneys of the laundry portion of the domestic offices at Syon House, Isleworth. We may remark that these offices are situate against the main building, but being of a lower elevation, the smoke from the chimneys in question—which is of great volume, comprising as it does the combined products from two boilers, a steam engine, and large ironing stove—was, with certain winds, directed against the windows of the chief apartments, and also seriously interferes with clothes drying carried on immediately around. The question was to get rid of this smoke without attaching any appliance that would deteriorate from the architectural aspect of the mansion. This we have accomplished after the manner described as under:—To the offending chimneys we have fitted a syphon, continuing this with 15in. galvanised iron tube down the side of the building where it is connected to the drains. By the aid of two of our patent annular water spray jets, fixed one near the syphon, and the other some distance below, we are enabled to direct the smoke down this shaft, and by the action of the water spray to precipitate all the floating particles of soot, leaving only the lighter portions of the smoke to be disposed of. This courses along the main drain, and what remains is finally extracted by one of our patent exhaust heads—worked by a fine jet of water—placed at the outfall of sewer a quarter of a mile from the mansion. It will be noted that this continuous passage of smoke through the drains has a deodorising effect on the sewage matter contained in them. The particular drain under consideration is very large for the purpose of a private mansion, the dimensions being 3ft. by 2ft. 4in., and as this depends upon the storm water alone for flushing, it is more or less charged with matter; but the short time our novel system has been in action, a noticeable improvement in the absence of sewer gas is acknowledged, owing also doubtless to the increased ventilation. The above is therefore a practical scheme for abating a nuisance under similar circumstances, and at the same time affording a means to an end for the continuous deodorising of sewers. In conclusion, we may add the whole arrangement is self-acting, and does not need the slightest attention.

VERITY BROTHERS.
Regent Works, 137, Regent-street,
London, W., August 18th.

[For continuation of Letters see page 166.]

SELBY DAM DRAINAGE WORKS.—The works of drainage intended to be carried out for the improvement of an extensive district comprising about 14,000 acres have now commenced. Mr. A. L. Peace, C.E., of Thorne, is the engineer to the Commissioners; and Messrs. C. Barningham and J. Leggott, of Owston Ferry, are the contractors for the sluice.

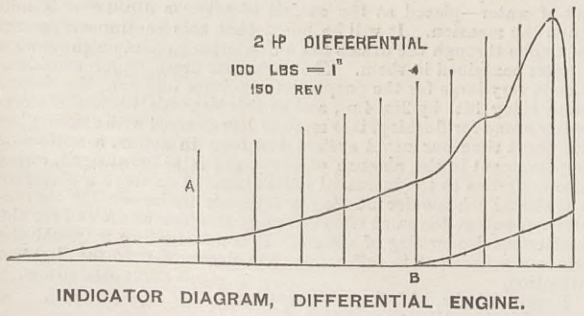
THE EDINBURGH EXHIBITION.—ATKINSON'S GAS ENGINE.



THE EDINBURGH INTERNATIONAL EXHIBITION.

No. VIII.

Mr. John Cochrane, of Barrhead, exhibits the Atkinson differential gas-engine as made by him, and as illustrated in our engravings above. These engravings show exterior and interior construction and arrangement of details. By means of the perspective view, Fig. 1, the action of the parts shown in Figs. 3, 4, 5, and 6, will



INDICATOR DIAGRAM, DIFFERENTIAL ENGINE.

be readily understood. We may refer to our account of the engine and its cycle, as given in The Engineer of the 7th August, 1885, page 99, as that, taken with the engravings now published, constitutes a complete explanation of the engine. It may, however, be here mentioned that the governor acts, as will be seen from Figs. 4 and 5, upon the gas valve in the space O by causing the end of the excentric rod R to touch or miss the piece on the end of the gas valve lever. Air enters the pipe X, gas the pipe A, and when gas is admitted at all it mixes with the air in passing from the space O through the valve into the passage D. Ignition is effected by the flame from the pipe W, which has a funnel at I, and ignites the charge when the port for the purpose is uncovered by the piston, as described in The Engineer of 7th August, 1885.

The following particulars of a brake and gas consumption test of one of these engines has been sent us by Mr. Cochrane:—

Brake Test of a 2-H.P. Engine.

Time.		Counter.	Difference.	Brake Load.	Gas.
min.	sec.			lbs.	
21	50	92,000	—	—	—
30	45	93,277	1277	42	10
38	55	94,571	1294	,,	20
47	0	95,840	1269	,,	30
55	15	97,130	1290	,,	40
3	50	98,419	1289	,,	50
11	45	99,685	1266	,,	60
20	20	00,960	1275	,,	70
58	30	8,960	8960	42	70

70ft. in $58\frac{1}{2}$ minutes = 71·8ft. per hour.

$$\frac{8960}{58\frac{1}{2}} = 153{\cdot}1 \text{ revs. per minute.}$$

Circumference of fly-wheel, 14ft.

$$\frac{153{\cdot}1 \times 14 \times 42}{33{,}000} = 2{\cdot}727 \text{ brake H.P.}$$

$$\frac{71{\cdot}8}{2{\cdot}727} = 26{\cdot}2 \text{ cubic feet of London gas, B.H.P. per hour.}$$

We have no indicator diagrams from the engine at Edinburgh, as made by Mr. Cochrane, but Mr. Atkinson has sent us those from which we have made the accompanying engravings. The diagram, as taken by the indicator, is shown in full lines. There is no part of the cylinder where an indicator can be fixed that is always open to the space between the pistons. The indicator passage is placed so as to get practically the whole of the working stroke. It opens at B, just after compression has

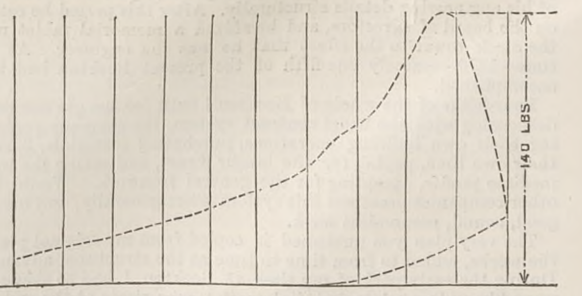
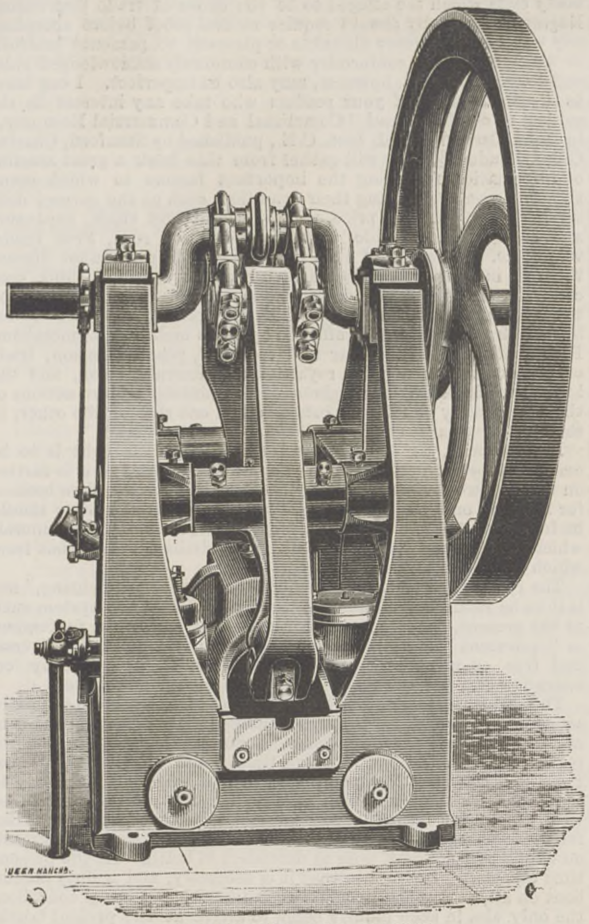


DIAGRAM PLOTTED FROM INDICATOR DIAGRAM.

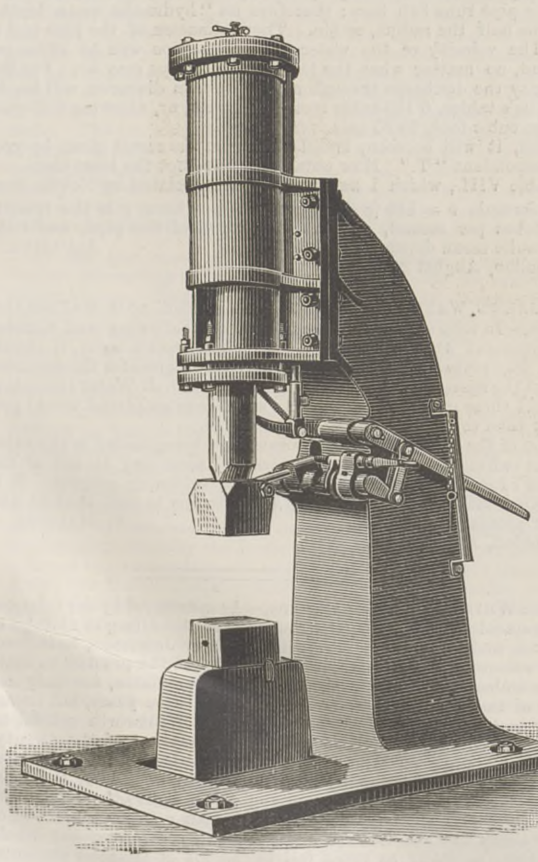
commenced, and closes at A, near the termination of the working part of the revolution, just before the exhaust is opened. The sustained line is doubtlessly due to the pressure shut up in the indicator and passage. The motion of the paper drum is obtained from the working piston, and does not correspond with equal spaces between the pistons. To compare this with an ordinary diagram, equal spaces are carefully measured off from a full-sized model, and ten divisions of a line marked off to correspond. By this means a diagram can be divided off at once for calculation, and by laying off ten equal divisions and measuring off each line, a diagram can be transposed that would be the same as if taken with a motion of paper barrel corresponding to equal spaces between the pistons. This has been done to obtain the diagram given in dotted lines, and this is the form in which it should be compared with diagrams from other gas engines. The diagram sent is the kind of



ATKINSON'S GAS ENGINE.

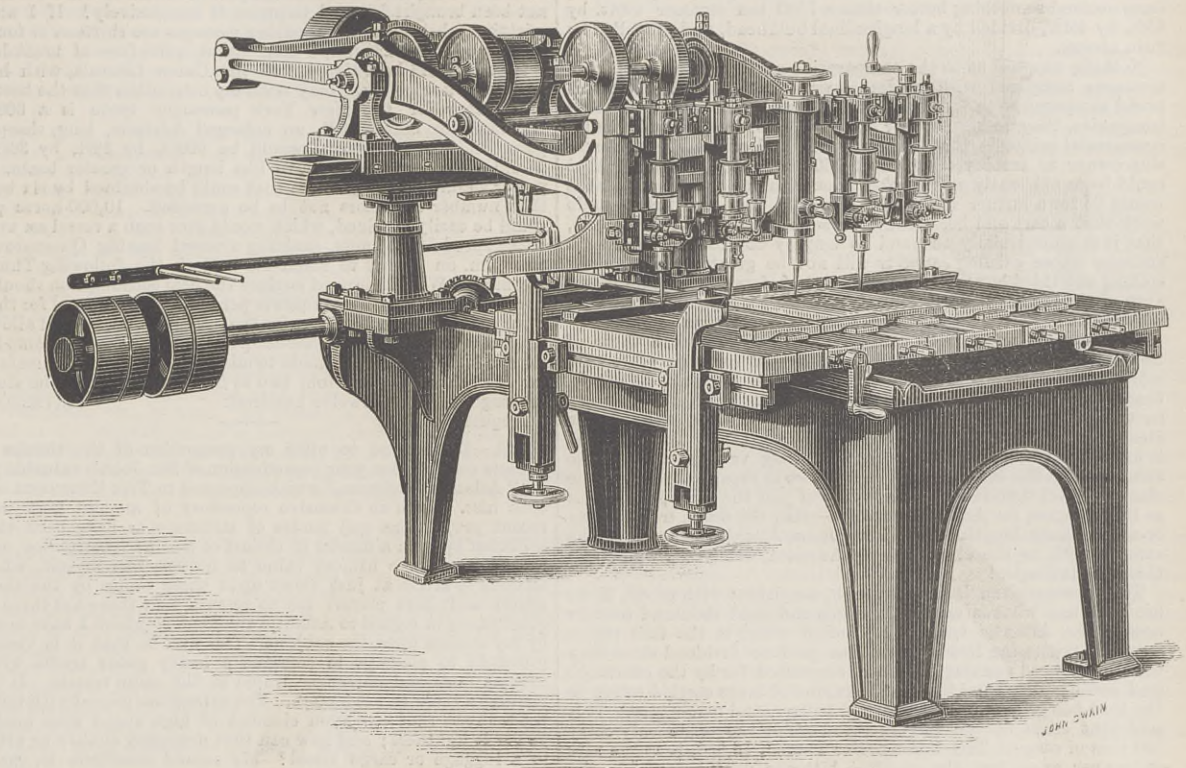
diagram the engines give when working economically. They will make a larger diagram, and give about 20 per cent. more brake-power, but not quite so economically.

Amongst other exhibits by Messrs. Glen and Ross, Glasgow, is a 5 cwt. Rigby's patent steam hammer. The hammer has a fall or stroke of 22in., the cylinder is 11in. internal diameter, with a deep mouthpiece or stuffing-box. The hammer piston is a solid forging working in the cylinder and through the gland. The gland is flat on two sides, and forms a guide to the hammer piston, which is also flattened on the two sides. The hammer face is of



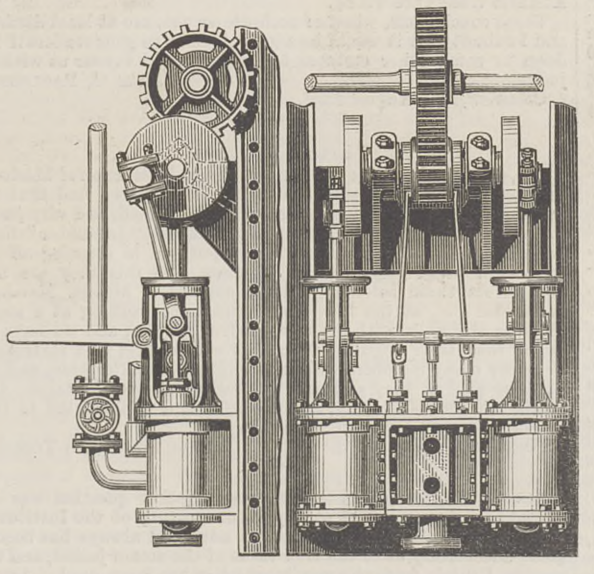
RIGBY'S STEAM HAMMER.

forged steel. The cylinder is fixed to a strong box column of cast iron, a type first introduced by the makers, and has been largely adopted. The steam valve is of the balance piston description, and the gearing is so arranged that the hammer can be worked either by hand or self acting. The cross wyper shaft carries the self-acting gear; on this shaft there is a clutch working free, and actuated by a steel rod fixed at one end, by a pin, to the hammer face, the other end slides through a projection formed on the clutch already referred to. Upon the same shaft there is a corresponding clutch made to slide on a steel feather sunk into the shaft. When the clutches are out of gear the hammer works by the long lever handle; to throw in the self-acting gear a few turns of the small crank handle bring the clutches into contact. The distance or depth at which they are geared regulates the length of stroke and force of blow, and this is controlled by the screw on the end of the small crank handle. The end of the wyper on the shaft is connected to the hand lever by short links, and thus the reciprocating motion of the hammer piston is conveyed to the valve. About 900 Rigby hammers have been turned out by the makers, and it is noteworthy as their experience that for Government workshops, both at home and abroad, self-acting gear is in great favour, while for nearly all other establishments steam hammers to work by hand are preferred. Messrs. Glen and Ross also exhibit a pair of small coupled engines with equilibrium slide valves and reversing valve. This system was invented by the makers many years ago for the purpose of securing greater durability and quiet-



POLLOCK'S WOOD-CARVING MACHINE.

ness in the working of small engines. It was found that in forges, foundries, and other places exposed to dust, the ordinary link valve motion was liable to wear out rapidly and make great noise. The arrangement illustrated was therefore designed, and gave the most satisfactory results. The cylinders are of the ordinary kind, with a port top and bottom; the valve chest is a square box placed between the cylinders, having three cylindrical chambers cast in it, and connected by the necessary steam passages. Those chambers are lined with brass cylinders, having valve ports top and bottom, and admission ports in the middle. Malleable iron piston valves are fitted to the brass linings; the slide valves are worked by excentrics, and the centre valve is for starting and reversing the engines in lieu of the usual arrangement of link valve motion. With the lever handle as shown the engines are at rest; by raising

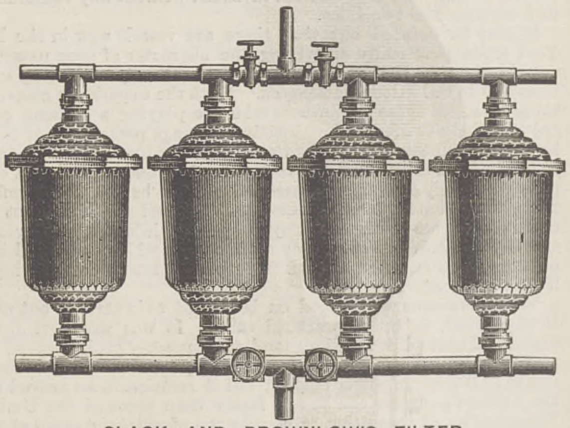


GLEN AND ROSS'S ENGINE.

it the engines go in one direction, by depressing it they are reversed. As shown above they are attached to a 40-ton crane for forging purposes, and they have been numerously applied to steam winches, planing machines, plate-bending rolls, and hoists.

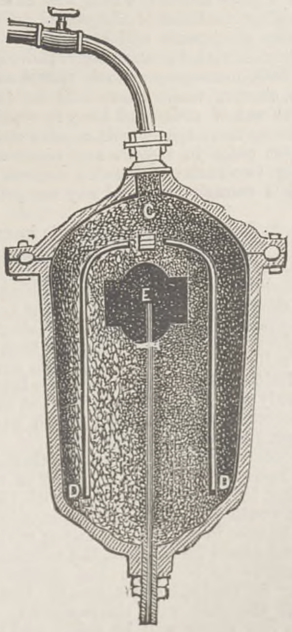
Amongst the few wood-working machines finding a place in the machinery-in-motion section, the most noteworthy perhaps is the patent automatic carver shown by the inventor, Mr. John Pollock, of the Victoria Cabinet Manufactory, Beith. Our illustration represents a front view of this machine, which is the inventor's No. 1 size, carrying four cutting spindles working on four separate panels or other subjects. Other sizes are made, however, by which through eight cutting spindles a corresponding number of panels can be simultaneously operated upon. Referring to our illustrations, it will be seen that on a frame pivotted on standards at the back of machine and provided with a back balance, five vertical spindles are carried in front. The centre one acts simply as a pointer to travel over the surface of the panel or other embossed subject to be copied, which must be of cast iron or other hard material. The other four spindles have cutters attached revolving at a high velocity, which are actuated by leather cording from pulleys on horizontal axle driven from main shafting, and cut their way across the surface of the wood panel placed underneath, all the cutters having equal set and clearance. The table on which panels are fixed moves backwards and forwards on guides formed on the base of the machine; the frame on which carving cutters are carried being lifted bodily at the end of the travel of table by back balance, which is brought into play by an arrangement of rods and levers, in order that table and panels may pass freely back to the starting point. The travel of table is repeated time after time until the whole width of the subject to be copied has been traversed by the cutters. The work is turned off the machine in a nearly perfect state, requiring only a touch from a skilled carver to impart the requisite clearness and precision to the outline. The No. 1 machine illustrated can produce at one operation four panels 12in. by 6in., in from half an hour to one and a-half hours. The No. 2 machine, carrying eight spindles, is similarly under the will of the operator; doing double the quantity of work in the same specified time.

In the class of exhibits headed "Scientific Appliances," Messrs. Slack and Brownlow, of Canning Works, Man-



SLACK AND BROWNLOW'S FILTER.

chester, show examples of their improved "compressed charcoal" filters for household and general manufacturing purposes. Our illustration shows a series of these filters, especially adapted for use in manufactories where a large and constant supply is necessary. The series may be added to, and the consequent supply of pure water increased to any extent. One or more of the filters may be uncoupled at any time for the cleaning or renewal of the carbon. The principle of these filters may be explained briefly as follows, by reference to the engraving, which shows one of them in section:—The water, which is admitted through the service pipe *a*, controlled by supply tap, passes through the solid "compressed carbon" C, on its way under the base of the glass cylinder D D, which is introduced to compel the water to take a circuitous course, and thus allow the carbon to act for a greater length of time. By this means the depth of carbon through which the water passes is taken as being twice as great as the apparent depth of the filter. Finally, the water passes through the solid block of carbon E, leaving the filter by the down tube. A treble filter, as it were, is



FILTER.

thus provided in the compass of one, the efficiency being correspondingly increased. The outer case is of cast iron, tested for a high pressure, and lined with vitreous enamel. All the fittings are of brass and block tin, so that the water is exempt from any chances of contamination from crude metallic surfaces.

LETTERS TO THE EDITOR.

(*Continued from page* 163.)

ATLANTIC STEAMERS.

SIR,—With your kind permission I should like to make a few remarks on the interesting but uninstructive paper on Atlantic steamships read by Mr. W. John at the recent meeting of Naval Architects in Liverpool. I certainly expected that the constructive and inventive talent of the Naval Architects would, in the year 1886, have evolved something better than a 7500 ton steamer 400ft. by 65ft. by 45ft., divided by a longitudinal bulkhead, and propelled by twin screws.

Nothing was said as to the comparative earning capacity of large steamers compared with moderate sized ships, or of short and broad compared with long and narrow ones. Like some steamship companies, they do not appear to have grasped the fundamental commercial principle that it is as foolish and ruinous for a steamship owner to employ a vessel of 7500 tons in doing work that could be as efficiently and quickly done with one of 6000 tons, as it would be for a farmer to employ a wagon and two horses to do work that a cart and horse could do equally well—in other words, that it is commercially unsound to employ £300,000 in building a steamer whose earning capacity will not be greater than another costing one-third less, while the amount of depreciation and insurance of the former will, of course, be much more, and swallow up what would be a fair dividend for the less costly vessel.

To revert to the proposed vessel. The proportions are those of the Great Western and the first Cunarder of forty-six years ago, while the performances of dozens of vessels of ten and eleven beams to length, for ten to eighteen years, in the most trying sea in the world, have proved the superiority of long and narrow steamers for safety, speed, and comfort in winter. To hear what is urged in favour of wide and against long vessels, it might be assumed that the latter either break in two or capsize at sea; but the class of vessel that disappears at sea is of just the same proportions as they propose for Atlantic steamers—viz., the ocean tramp of six or seven beams length. Just imagine an Atlantic steamer of the same length as the short-looking America, five yards wider and three yards deeper!

The tonnage given is far too much, consistent with profit, if we are to believe what is said of the seven and eight thousand tonners now in the Atlantic trade, in proof of which is the fact that a company possessing four of them has paid no dividend since they first commenced running. This is accounted for by the enormous coal consumption, and the small amount of cargo carried owing to the hold being taken up by engines, boilers, and machinery. It is said that some of the largest steamers in the trade only carry 500 tons of cargo. The horse-power named, 15,000, is at the rate of two per gross ton, the greatest hitherto used being $1\frac{3}{4}$ in the Etruria and Umbria. This power would necessitate a boiler room 100ft. long, and would in a 400ft. vessel, place the saloon within 60ft. of the stern, or right aft. It is also doubtful if sufficient space would be left for bunker coal. The idea of a bulkhead running through the main saloon, and cutting the saloon accommodation in two compartments—presumably one for gentlemen and the other for ladies—is not likely to commend itself to shipowners. In its relation to collision the only effect of such a bulkhead would be to put the passengers out of their misery forthwith, instead of keeping them in lingering suspense for half-a-day, as in the case of the Oregon. If cargo were proposed to be carried, the question of working cargo through hatches placed two and two would present an insuperable objection. With passengers only it would be found next to impossible to divide the passenger accommodation into two longitudinal divisions without any communication between the two sides.

It may be pointed out that there are vessels now in the New York trade practically answering the character of pure passenger vessels, the quantity of cargo being almost *nil*, while they carry from 500 to 600 saloon passengers. With the experience gained by these steamers those shipowners who are playing a waiting game are not likely to dispense with either steerage passengers or cargo, however fascinating the idea of an Atlantic saloon steamer may be. That would involve nearly doubling the fleet and capital of a company, as purely passenger steamers could not be run with profit in the winter months, for the reason that a vessel which may get 550 cabin passengers in summer may not get 200 later on. The vessels would consequently have to lay up in winter while a second fleet of passenger and cargo boats took their place, these again having to lay up in summer.

Various reasons were urged on behalf of twin screws, but none, to my mind, of much practical value. It was assumed that a higher number of revolutions, and consequently greater speed was attained with two engines of 6000-horse power each than with a single 12,000-horse power engine; but it remains to be proved that the Arizona's engines can be run faster than those of the Umbria. The question of revolution is simply one of size and pitch of propeller, and wear and tear of engines. In the matter of revolution, both are therefore on an equality; but in the matter of pitch, the advantage will be to the single engines and larger screw. The long projecting shafts and supporting struts must retard the speed appreciably, while to lessen the outside length of shafting there will be a temptation to make the lines aft full, which will have a most injurious effect on the sailing qualities of the vessel. The loss and trouble caused by shaky sternposts will be as nothing compared to what will be experienced with twin screws. It would also appear that two engines of 6000-horse power each would cost more than one of 12,000-horse power, while there will be just double the number of parts to get out of order and keep in repair. Twin-screw engines will also take up more space, will require more engineers, &c., oil, &c., and cost more in repairs and renewals, while the very thought of having two such complicated engines as those of the Etruria in one ship is enough to appal any sea-going engineer.

The great argument, however, in favour of twin screws is immunity from total breakdown; but there is a fallacy in connection with this. There is nothing whatever in the fact of a shaft having a fellow on the other side to prevent its breaking, and nothing is plainer than the fact that to double the number of shafts is to double the number of broken shafts. Thus, if a fleet of single-screw boats has a broken shaft every hundredth passage, a fleet of twin-screw boats with similar sailings would have a broken shaft every fiftieth passage. It is admitted, however, that in the latter case the breakdown would be only partial; but even in that case there would be danger of the second shaft breaking through over-working, with the object of keeping time.

It is very evident that in every case shafts break through unequal strains caused by the racing and sudden stopping of the engines when the ship is pitching in heavy weather. With twin screws a new element of danger would come in, namely, the rolling of the ship causing the engines to race in addition to racing caused by pitching. With shafts placed about 25ft. apart, the rolling of the vessel would cause the screws to be raised and depressed alternately, resulting in danger to shafts, besides greater loss in speed in rough weather than is the case with single screws. If sails are set to steady the ship one screw will be raised and the other depressed, causing unequal revolutions and difficult steering. If, on the other hand, no sails are used, the vessel will roll and the screws race excessively, causing, in addition to the disadvantages before mentioned, greater discomfort to passengers.

The idea that twin screw vessels will be safer is a popular error not supported by facts. It may be pointed out that broken shafts are practically unknown in steamers whose power exceeds one-horse power per ton. The reason for this appears to be that in vessels of great power, the shaft being larger and stronger in comparison with the hull than in the case of moderate-powered vessels, is better able to withstand strains imparted by the hull when working in heavy weather. In proof of this, may be cited the City of Rome, Etruria, Umbria, Servia, Aurania, Oregon, Alaska, Arizona, America, and the eight new boats of the North German Lloyd's. Collectively these vessels have made about two thousand transatlantic passages with only one broken shaft occurring, that of the Weira a week or two ago. Thus a company might run a weekly line to America for twenty years without a breakdown with proper supervision in port.

Now, it is a singular fact that while a fleet of twin-screw boats, known as the Twin-screw Line, has been running between London and America for years, their performances have not been adduced as proof of the superiority of twin screws. If twin screws will be such a success, how is it that the performances of these boats have not been brought forward to prove it conclusively? If I am not mistaken, their usual fine-weather passages are thirteen or fourteen days, while they are not, I understand, quite free of breakdowns.

Lest I should be twitted, like the Union Liberals, with having no alternative policy, I may state my conviction that the best type of steamer for the New York passenger trade is a 6000-ton Britannic, or better still, an enlarged Adriatic, long, sharp, and powerful. Such a vessel would be 500ft. by 48ft. by 36ft. It would be a mistake to have less length or greater beam. The power should be the greatest that could be obtained by six boilers, that number of boilers not to be exceeded. 10,000-horse power could be easily obtained, which would give such a vessel an average ocean speed of 20 knots, enabling a vessel leaving Queenstown at two p.m. on Friday to reach New York the following Thursday morning. With improved engines the coal consumption should not be more than 2lb. per horse-power per hour, giving a total for the day of, say, 200 tons, or 1300 tons for the passage. This would allow of a large cargo being carried besides passengers. The accommodation for the latter should be made to adapt itself to requirements, that for the saloon varying from two to four hundred, and the steerage varying from six to twelve hundred.

LIVERPOOL.

August 25th.

SIR,—Permit me to offer my proportion of the thanks your readers owe you for your reproduction of Mr. John's valuable paper on "Atlantic Steamers," which appeared in THE ENGINEER of the 13th inst. Such an extensive repository of modern facts and of recent proportions and modes of structure as have been therein collected by such a master in the art of marine construction, cannot fail to be of the utmost value to novices like myself, who are anxious to arrive at just views upon these topics by the shortest route; and here permit me to remark that there are three main conclusions in regard to Atlantic steamers to which I have been led by my studies upon the subject. The first is, that it is vicious in principle to attempt to combine a heavy goods traffic with an express mail and passenger traffic in the same vessels. It is like putting a racer to the plough. The experience gained with torpedo-boats shows that one main element of high speed with moderate power is lightness; and how can that necessary quality be attained in a luggage or cargo vessel? My second conclusion is, that the frames and beams should be horizontal, with one or two transverse or ring frames between every two bulkheads, to which ring frames and also to the bulkheads the horizontal frames and beams would be firmly secured, while the plating of the sides and deck would be fixed to the horizontal frames and beams. In this way it seems to me that most strength would be obtained with the least materials. My third conclusion is, that the cross sections of the City of Rome, Servia, and Oregon, which are given in your pages, are quite too rectangular to be reconcileable with a small resistance. It is now, I believe, generally admitted that the main resistance of a vessel in passing through the water is the resistance of friction, which, as in a river of given velocity, varies with the hydraulic mean depth or the smallness of the wetted perimeter. The wetted perimeter of a vessel with any given area of cross section is a minimum when the outline is a semicircle; and although the keel should be kept deep to prevent rolling, and the garboard strake should be carried gradually down towards the lower part of the keel, the general outline of the cross section should be as near as possible to a semicircle, which is accordingly the form of cross section adopted in the torpedo boat built by Messrs. Thompson, and of which you have given several views at page 130. Both forms, it is clear, cannot be right for speed, and I hold that it is the semicircular section of the torpedo boat that is right, and the rectangular sections of the large Atlantic vessels are wrong.

These conclusions, whether accurate or not, are at least distinct, and I submit that it would be a great benefit to your readers if Mr. John or some other eminent authority would favour us with his judgment on the subject.

JAMES C. PAULSON.

Chiswick, W., August 23rd.

STEAM JACKETS.

SIR,—On reading over your report of the Institution of Mechanical Engineers in your issue of 20th August inst., we find that the present system of draining jackets was condemned, and very justly too. We would, however, point out that the "Lancaster" high-pressure steam trap will answer every purpose in drawing off the condensed water from engine cylinders, and this they are now doing from those belonging to the engines of Messrs. Marshall, Sons, and Co., at the Liverpool Exhibition, working at a steam pressure of 140 lb. with the most perfect success, and we have no doubt that their engineer in charge will confirm this statement. Probably many members will be attending the Exhibition, and we shall be glad if they will call at Messrs. Marshall's stand. Our stand, No. 836, is close by, and the attendant will be glad to take visitors to where the steam traps are working.

Pendleton, August 23rd.

LANCASTER AND TONGE.

SIR,—I am glad to find that the steam jacket question was discussed to a certain extent at the recent meeting of the Institution of Mechanical Engineers. There is now, and always has been, a great uncertainty as to the true value of the steam jacket, and this results, I think, from the way in which it has been used. As was pointed out by one of the speakers, there is very serious loss by condensation due to external radiation. So great is this loss, I am convinced that the jacket may do far more harm than good, and this is especially likely to be the case when the steam envelope is thin, not more than $\frac{1}{2}$in. in some cases.

In order to get the full efficiency out of the jacket, it ought, in my opinion, to be made double—that is to say, a jacket inside a jacket; this would keep the working steam, as I may call that in the jacket, warm and dry to an extent that does not obtain now.

Very many speakers and writers denounce the presence of water in jackets. Now, whether water does harm or not depends on its temperature. If the water is as hot as the steam in the boiler, or nearly as hot, so far from doing harm it will do good; and the best system of jacketting that can be adopted is to cast spiral ribs round the cylinder liner, and take water in at one end and out at the other, the water flowing round the cylinder, and then through a system of tubes heated by the waste heat from the boiler. There will then be a constant circulation of hot water maintained round the cylinder, and the whole of the condensation that now takes place in the jacket, amounting to as much, according to Mr. Halpin, as $17\frac{1}{2}$ per cent. of all the steam generated in the boiler, will be saved; the temperature of the water would be kept perfectly under control, and the whole cost would be only that of a few yards of wrought iron pipe. It seems to me very remarkable that a device so simple, so cheap, and so certain to work well has not been tried. There is no patent about it yet, and of course the principle cannot be patented; but various ways of applying the principle can be patented. I have no pecuniary interest in the matter, not being a builder of steam engines. If any of your readers would like further information I would very gladly write, with your permission, another letter on the subject, setting forth my views more clearly.

London, August 24th.

ISO THERM, C.E.

DEPRESSION IN TRADE.

SIR,—The report of Mr. J. Head's speech on the causes which lead to the depression in trade, as given in last week's ENGINEER, was interesting if only because it represented a few more of the many evils which are alleged to be the cause of trade depression. Engineers especially should require radical proof before accepting any statement however plausible or pleasant to personal interest, or which may be in conformity with commonly acknowledged rules and formulæ, which, however, may also be imperfect. I beg leave to suggest to those of your readers who take any interest in the subject to carefully read "Communal and Commercial Economy," by John Carruthers, M. Inst. C.E., published by Stanford, Charing Cross, London. They will gather from this book a great amount of information regarding the important factors to which many thinking men are turning their attention, such as the correct definitions of wealth and price, values, capital and stock, expansion and contraction of trade, cost of production, rent, Free Trade, wages, &c. These are of such importance that one cannot discuss them all in a letter, but they all tend to prove, and, I think, conclusively, that the causes of bad trade are not to be remedied by the many personal suggestions which are made by those who suffer in such departments as are affected by mono-metalism, bi-metalism, Free Trade, Fair-Trade, war and conquest, peace, taxation, trade or professional monopoly, royalties on minerals, rents, and the long list which might be given of the actions and re-actions of those personally or selfishly interested on one side or the other, in the fight of what is called the "survival of the fittest."

If it be true, as Mr. J. Head states, that the fight is to be carried on by man in the same way as we understand it is carried on by the lower animals, then the bonds of society would be broken, for it would only be just and right that each unit of society should be freed from all the artificial habits, institutions, laws, and morals which are imposed on every member of a civilised society, but from which the lower animals are free.

The remedy for bad trade is not to be found by "fighting," nor is it to be found by patching up the seamy side of any system such as the present, based upon selfish interest in any trade, profession, or "quiescent" do-nothing branch. It is to be found in "universal and free co-operation," which is distinct from unhealthy co-operation of a few workers, manufacturers, and middlemen.

The subject is simple when stripped of the selfish sophistry accumulated round it, through a long diseased commercial connection. Certain pseudo-political economists have woven theories regarding the conditions of "high times" and "low times," "progress and poverty," "wealth," &c., so that when it is necessary to touch the personal interests of any, for the common good and weal, they bring forward a few specious arguments, and point, like fetish worshippers, to Mill or Ricardo, and with powerful emphasis on names and customs, pose as defenders of truth. At the present time especially, I maintain that it is necessary, and a duty incumbent on all, to reconsider our true industrial and social condition, the only aim in such inquiry being to arrive at the present truth; for, Sir,—

"'Tis not antiquity nor author
That makes truth truth."

Washwood Heath, Birmingham.

H. KENNETH AUSTIN.

THE FLOW OF WATER IN PIPES.

SIR,—A correspondent some time since asked in your pages how much water would a pipe $1\frac{1}{2}$in. bore discharge, the pipe being 700 yards long, and 100 yards higher at one end than at the other. The question is so put that it is not quite clear whether the pipe is straight or vertically curved, and is so far incomplete. I will answer it, however, on the assumption that it is, on the whole, fairly straight.

In Neville's "Hydraulic Tables and Coefficients" will be found a table, and rules for using it, which just meets the case raised.

The pipe runs full bore; therefore its "hydraulic mean depth" will be half the radius, or $\frac{3}{8}$in. The inclination of the pipe is 1 in 7. The velocity of the water in such a pipe will be 100in. per second, no matter what the length of the pipe may be. For this velocity the discharge through a pipe $1\frac{1}{2}$in. in diameter will be, by Neville's tables, 6·136 cubic feet per minute, or, allowing 6·25 gals. to the cubic foot, 38·35 gals. very nearly.

This, it will be seen, is different from the result given by your correspondent "T." How obtained I have not the least idea.

Table VIII., which I have used, was calculated by Neville from the formula $v = 140\,(r\,s)^{\frac{1}{2}} - 11\,(r\,s)^{\frac{1}{3}}$; where v is the velocity in inches per second, s is the inclination of the pipe, and r the hydraulic mean depth = half the radius.

AQUARIUS.

London, August 24th.

MAIGNEN'S WATER-SOFTENING APPARATUS AND MATERIALS.

SIR,—In reference to the notice of my softening and filtering arrangement which appeared in your last week's issue, it should have been stated that experiments were in progress for the extended use of the system by the Southwark and Vauxhall Water Company. Should these prove successful, the works contemplated would probably take the form reported in the notice.

One of the most important points now being tested is the value of the sediment or precipitate, re-treated according to one of the writer's recent patents, for use again as softening reagent. It is expected this will reduce the cost of softening to half that of any other process in existence.

V. MAIGNEN.

London, August 25th.

THE WHITWORTH SCHOLARSHIPS.—As mentioned by our Glasgow Correspondent last week, the students of the Glasgow College of Science and Arts, under Professor Andrew Jamieson, have been very successful. For some time, when it was the practice to limit the number of awards to six successful candidates, not only did each of them get his £100 bursary over the three years, but it was possible, by a system of extra awards, for a Whitworth scholar to receive *in cumulo* as much as £800. On account of the twenty-five scholarships which are now yearly awarded to the successful candidates, there is annually paid out a sum of £3000, the most successful of the students receiving £200, eight others receiving £150 each, and the remaining sixteen getting £100 each. Out of the twenty-five scholarships awarded this year over the whole kingdom, as many as seven fall to the lot of Glasgow students. The awards for 1886 have been made as follows:—1, G. C. Humpey, engineer apprentice, Nottingham; 2, R. Holt, engineer apprentice, Liverpool; 3, R. Chorley, pattern-maker, Manchester; 4, J. H. A. M'Intyre, mechanical engineer, Glasgow; 5, W. C. Borrowman, engineer, Glasgow; 6, T. R. Murray, mechanical engineer, Galashiels—formerly Stafford; 7, J. T. Nicholson, marine engineer, Newcastle-on-Tyne; 8, G. W. Wooliscroft, engineer apprentice and student, London—formerly Crewe; 9, I. Brown, engineer, Glasgow; 10, R. Wallis, engine fitter, Newcastle-on-Tyne; 11, R. M. Ferrier, engineer, Ardrossan; 12, R. B. Creah, fitter, Crewe; 13, E. Wilson, engineer student, Leeds; 14, E. S. Padmore, engineer student, Birmingham; 15, W. H. Watkinson, engineer student, Glasgow; 16, R. Johnston, mechanical engineer, London; 17, J. M. Malcolmson, draughtsman, Woolwich; 18, H. Shoosmith, engineer apprentice, London; 19, E. Codling, engineer, Newcastle-on-Tyne; 20, C. Day, engineer apprentice, Stockport; 21, C. Hyde, engineer student, Ebbw Vale; 22, A. Etchills, draughtsman, Hyde; 23, W. Berry, draughtsman, Glasgow; 24, D. Kemp, mechanical engineer, Glasgow; 25, G. H. Follows, engineer apprentice, Manchester. All the six Glasgow men are students of the College of Science and Arts.

RAILWAY MATTERS.

The Midland Railway Company is about to lay a mile of steel sleepers on the main line north of Leeds, in the vicinity of Shipley.

The Chatham and Dover Railway Company is growing so rich that it has taken up the role of philanthropist, and has relieved the North-London Company of some of the worst stock running on any road, and is showing self-denial by using it on the Metropolitan Extension line.

The Cork and Bandon Railway Company seems to get rails very cheaply. At the meeting on August 14th, the chairman stated that they "had now laid 42½ miles of steel rail, representing 2000 tons, at a cost of £3 19s. 6d. per ton, which would be reduced to £2 per ton if they sold their old iron rails."

The cost of working the Swiss railways in 1884 was £838 per mile; of the mountain lines, £528 per mile; so that the net earnings were £225 for the mountain lines, and £527 for the other railways. The cost of the Swiss railways has been so great, however, that their net earnings were but 2·86 per cent. on their capital.

It is stated that for some years past Germany, under discouraging conditions, has enjoyed two-thirds of the import trade to the Caucasus, and it is represented as beyond a doubt that the Transcaspian Railway will tend to spread a knowledge of the "superiority of German goods over all others among the peoples of Central Asia, who have hitherto languished in ignorance thereof, and that the industry and skill of the Fatherland will be able to drive all competitors out of the field." Russian railways in the East receive a cordial greeting in Germany.

The North British Railway Company is making a trial of a carriage fitted with the electric light to run in the tunnel of the Glasgow Underground Railway. A 16-candle lamp is placed in each compartment, and by the system tried—Mr. H. S. P. Carswell's—the lamps light themselves on entering the tunnel, and go out on leaving it. It is proposed to use the electric light in the tunnels, and during the daytime only, and for this purpose the ordinary gas or oil fittings have not been interfered with, so that they can be used at night.

The construction of the first section of the great Pacific Railway which is to connect Buenos Ayres and Valparaiso will, the *Buenos Ayres Standard* of July 16th says, be commenced before the end of the month current, starting from Palermo Park, where it will have a junction with the Northern Railway. Mr. Clark's plans have been approved by the National Government, with some trifling alterations. The section will be sixty miles in length, and will traverse the most thickly settled districts, passing south of Luxan, not far from Mr. John Brown's estancia of La Choza, and meeting the portion of the Pacific line already made at Mercedes.

An examination of the accounts of the chief railway companies shows that the tendency is increasing on the part of passengers to travel by the cheapest class. On the London and North-Western Railway the passengers during the last six months numbered 25,148,651 and out of these 22,457,620 travelled third-class, 1,681,401 second-class, 986,592 first-class, and the remainder season ticket holders. On the Lancashire and Yorkshire the numbers were 17,139,287 third-class, 931,871 second-class, and 577,537 first-class, the season ticket holders numbering 14,448. The Midland Railway carried 13,983,734 third-class, 290,510 first-class, and 39,933 season ticket holders. In all these cases, like those of other railways, there is a large increase of the proportion of third-class passengers.

A Commission appointed in Russia for the testing of rails and tires has recently reported, after testing 107 rails and 58 tires. The results of the tests were as to rails: (1) The best rails are harder than brittle rails. Hard rails are not necessarily brittle. (2) The best rails yielded less under the first blow of the drop weight, and had greater tensile strength, on an average 92,500 lb. per square inch; their extension was less by about 19 per cent., and they had less diminution of section by 35 to 40 per cent. (3) The best rails contained more carbon and more manganese than brittle rails, and less manganese than excessively worn rails. It was further observed that a certain relation—not stated—between the manganese and carbon in the rails tested appeared advantageous, and also a relation between the silicon and phosphorus. The samples tested by the commission came from forty different roads, and had undergone most diverse experiences, with lives from a few months to ten years, and traffic varying from a few tons up to 20 million tons. The rails were of Russian, English, and French make. The Commission found very remarkable differences in the amount of silicon and phosphorus in the best as well as in the worst rails, and the proportion between these elements also varied greatly. In the best rails, however, the proportion between them did not vary much, and averaged 4 of silicon to 1 phosphorus, while in brittle rails these elements stood to each other as 3 to 2.

At the last meeting of the Mersey Railway Company, some further interesting facts were given beyond those we mentioned a fortnight ago. Since the tunnel was opened in January last the railway had carried about 2¼ million passengers, and on the Monday of last week the amount received was £200. The traffic shows an unmistakeable tendency to increase, and although the travelling during the summer months is as a rule abnormal, in this case the growth is likely to continue throughout the year, inasmuch as the tunnel under the Mersey will save people from the necessity of crossing by boat in the winter months. And another consideration is that during the fine weather many people probably prefer the open air passage, who in winter will seek the comfort and shelter of the tunnel. So satisfactory is the traffic considered that the directors have proposed and the shareholders have approved the payment of interest on the debentures. The most important arrangement made by the Board, in addition to those we previously referred to, is an agreement with the Cheshire Lines Committee, giving the Mersey Railway access to the Central Station at Liverpool. This will put them in connection with the great manufacturing districts of Lancashire and Yorkshire, and when the expected connection with the Great Northern and London and North-Western systems at Birkenhead is effected, the new railway will give direct communication between North Wales and Lancashire and Yorkshire. These extensions are expected to be completed in about another year.

A report has been published by the Board of Trade on a collision which occurred on the 17th July at Rothiemay station, on the Great North of Scotland Railway. In this case a passenger train from Keith to Aberdeen was started by mistake from Rothiemay station at about 1.25 p.m., and came into collision about twenty-one yards south of the loop points with a special train from Aberdeen to Keith. The system upon which this single line is worked cannot fail to be attended with great risk. Major Marindin says in the report:—"I am afraid that it is hopeless to expect that the company will voluntarily adopt on their single lines the train staff and ticket system of working, admitted by nearly all railway authorities to be the safest way of working a single line, and the Board of Trade has unfortunately no power to insist upon the use of this mode of working, or an equivalent, except upon new lines, where it is invariably required; but I trust that, at any rate, the starting signals which are actually in position at this station will be brought into use, for it is clear that if these signals had been in operation the station-master also must have made a mistake, and the block working between Rothiemay and Huntly must have broken down before the authority for the up train to start could have been given by the lowering of the starting signal." This gives some idea of how the line is worked. It is added:—"The points and signals at this station should be interlocked, and the working concentrated in proper frames, and the rolling stock of the company should, as soon as possible, be fitted with the continuous brake adopted on this line, for had the carriages as well as the engines in these trains been so fitted no collision would have occurred."

NOTES AND MEMORANDA.

The six healthiest places in England and Wales last week were Derby, Wolverhampton, Bristol, Blackburn, Brighton, and Hull.

Lake Huron is 250 miles in length; its greatest breadth, 190 miles; mean depth, 800ft.; elevation, 578ft.; area, 21,000 square miles.

The deaths registered during the week ending August 21st in twenty-eight great towns of England and Wales corresponded to an annual rate of 19·5 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year.

In London, 2528 births and 1420 deaths were registered last week. The annual death-rate per 1000 from all causes, which had declined from 22·0 to 18·9 in the three preceding weeks, fell to 17·9. In Greater London 3324 births and 1760 deaths were registered, corresponding to annual rates of 32·7 and 17·3 per 1000 of the population.

The *Chronique Industrielle* says the following paste will remove the rust, and not scratch the finest polished surface:—Cyanide of potassium, 15 grams; soap, 15 grams; chalk—blanc de Meudon—30 grams; water, sufficient to make a thick paste. Inasmuch as removal of rust means removal of material surrounding rust pittings, however fine, a paste for the purpose must be a grinding material.

The *Revue International de l'Electricite* says that M. Walter Hempel has discovered that an electric machine that gave under ordinary atmospheric pressure fifteen sparks per minute, gave thirty-two sparks per minute when the machine was placed in the extra pressure of one atmosphere. Is this true, and what's the cause, and how much would the machine give under, say, 10 atmospheres, and will the same effect attend dynamo machines, and many other questions come up at once?

A correspondent of an American contemporary writes that brass is capable of being tempered. He says:—"Brass, not hard by mixture, but by compression, either by rolling, hammering, wire drawing, or any other process which compresses the particles of metal, can be, and is, tempered regularly, just as easy and in the same manner as an equal sized piece of hardened steel would be tempered, viz., by heat. By placing a small piece of polished steel on the brass object to be tempered, and applying the heat so as to effect equally the brass and steel, the colour of the steel will indicate the temper of the brass, and by this process the brass may be tempered in exact proportion to every shade of colour of the steel."

Mr. Alfred E. Fletcher states, in his latest report as chief inspector under the Alkali, &c., Works Regulation Act, that in one establishment where lead rich in gold and silver is treated, he found, on testing the fume escaping from the chimney, that the value of the metals passing away in this form in a year was £3000. The larger portion of this escape is now saved by arrangements for causing the fume to settle. In a lead smelting works in Wales, a flue or culvert three miles long has been erected to give the fume an opportunity of settling, yet a considerable quantity finally passes from the top of the chimney into the air. Metallic fumes from copper, zinc, arsenic, and other works also escape. Much of this can now be prevented by electrical means, as explained by Dr. Lodge.

If v_1 and v_2 represent the velocities of two plane waves propagated in the same direction in quartz, and v'_1 and v'_2 the velocities of two plane waves propagated in the same direction in a crystal which does not possess the power of optical rotation, but which in directions perpendicular to the optic axis has the same velocity of light as quartz, then, according to a paper in the Chemical Society's *Journal*, by K. Exner, it follows from the theories of Cauchy and V. v. Lang that—$\frac{1}{2}(v_1 + v_2) = \frac{1}{2}(v'_1 + v'_2)$, that is to say, for any direction of propagation in quartz, the arithmetical mean of the two velocities of propagation is equal to the arithmetical mean of the velocities which would correspond with the same direction of propagation in a crystal without the power of optical rotation, but with the same refraction. From this may be deduced Cornu's law that in the direction of the optic axis of quartz, the arithmetical mean of the two velocities of propagation of light is equal to the velocity of propagation of the ordinary wave in directions perpendicular to the optic axis.

Mr. Mattieu Williams assisted in the experiments more than forty years ago, made by Starr, the inventor of the incandescent lamp. Starr's patent, taken out by King, is dated May 4th, 1846. At the end of a barometer tube a bulb was blown, into which a platinum wire was fused, and to one end of this a filament or stick of gas-retort carbon was fastened, the other wire being carried through the mercury, the whole tube being 33in. long. Starr tried platinum, and platino-irridium alloys, in wires and sheets, carbonised threads, cane, &c., before he hit upon gas-retort carbon. The lamp was repeatedly exhibited in action, at the town hall, and the Midland Institute in Birmingham, by Mr. Williams. The carbon filament wire or stick was 0·1in. in diameter and 0·5in. long; and the platinum wire had the same sectional area as the rod. The light was eminently and brilliantly successful; but funds were exhausted, and none concerned in it were adepts in getting up companies. Moreover, Starr was engaged in improving the magneto-electric machine then in use for electro-plating, &c., by Messrs. Elkington of Birmingham; hence the matter was not followed up.

Writing on a lubricant for brass work, Mr. H. G. Madan says:—"Many besides myself have probably been inconvenienced by the corrosive action of ordinary lubricants—lard, grease, &c.—upon brass and copper, which causes the plugs of stop-cocks to leak or get fixed in their places, and does much damage to air pump plates. Melted india-rubber answers fairly, but it has too little "body" and too much glutinosity; moreover, it does, undoubtedly, in course of time, harden into a brittle, resinous substance. Vaseline is quite without action on brass, and never hardens; but it has not sufficient tenacity and adhesiveness. A mixture of two parts by weight of vaseline—the common thick brown kind—and one part of melted india-rubber seems to combine the good qualities of both without the drawbacks of either. The india-rubber should, of course, be pure—not vulcanised—and should be cut up into shreds and melted at the lowest possible temperature in an iron cup, being constantly pressed down against the hot surface and stirred until a uniform glutinous mass is obtained. Then the proper weight of vaseline should be added, and the whole thoroughly stirred together. This may be left on an air-pump plate for at any rate a couple of years without perceptible alteration either in itself or the brass."

The death-rate for the whole United States for the last census year was 18 per 1000. Comparing it with the rates of some other countries for the year 1880, we find that in England and Wales the rate was 20·5; in the rural districts of England, 18·5; in Sweden, 18·1; in Belgium, 22·4; in the German Empire, 26·1; in Austria, 29·6; and in Italy, 30·5. The *Sanitary Engineer* says the mean annual birth-rate of the United States is 36 per 1000 of population, and the annnal increase of population from the excess of births over deaths is nearly two per cent. a year, and this is exclusive of the increase from immigration. The mean annual birth-rates of some foreign countries are as follows—viz.; England and Wales, 35·4; Sweden, 30·2; Denmark, 31·9; Belgium, 32; Austria, 39·1; German Empire, 39·3. As usual the high death-rates go with the high birth-rates. The birth rate is greater among the coloured than among the whites, but this difference is less in the rural districts than it is in the cities. Taking twenty-three counties in the South containing cities or large towns, and having an aggregate population of 588,129 whites and 586,038 coloured, we find that the birth-rates per 1000 of living population were, for the whites, 28·71, and for the coloured, 35·08; while in fifty-one Southern counties containing only very small towns, and having an aggregate population of 542,705 whites, and 591,336 coloured, the birth-rates were: white, 34·31; coloured, 39·46.

MISCELLANEA.

An unusually pretty and characteristic programme of the Queen's visit to Edinburgh the other day was executed by Messrs. T. and A. Constable, of Edinburgh, the sketches being original.

The new passenger lift at Gresham House, Old Broad-street, just erected by Messrs. Clark, Bunnett, and Co., on its first twelve days' running made 3180 journeys, carrying 11,626 passengers, at a cost of 70s., or one farthing per journey.

The British Iron Trade Association return of the make of pig iron in the United Kingdom for the half-year ended June 30th, 1886, compared with the make for the corresponding half of 1885, shows that there has been a net decrease of make in 1886 of 270,321 tons.

A Belgian journal makes the extraordinary announcement that the Chinese Government has given to an English house an order for 190,000 rifles, but has stipulated that they must be of Belgian and German manufacture. It would appear from this that the reputation of the Ordnance Department is extending to the private manufacturers.

It is stated that certain cement makers in Germany are in the habit of putting into the market what they call Portland cement, but what in reality is a mixture of *bonâ fide* Portland cement with a large quantity of ground-up blast furnace slag, together with slate, china clay, and lime. The majority of German cement makers protest against the action of these manufacturers in placing this adulterated material upon the market.

A local government inquiry was held at Newhaven, August 18th, by Mr. Thos. Codrington, C.E., to consider an application of the local board to borrow £5900 for the drainage of the town. Mr. W. H. Radford, Assoc. M. Inst. C.E., Nottingham, explained the plans, and showed the method adopted to store the sewage during high tide. The inquiry was adjourned to allow time for Mr. Radford to complete negotiations with the harbour authorities, the Board of Trade, and the War Offices.

Mr. W. Crookes, F.R.S., and Drs. Odling and Meymott Tidy have been carrying out a series of bacterological experiments with the Thames and other water, and the results so far are of great importance. The report, which will be published next month, will probably do much to allay the groundless fears which have grown up recently through sensational and alarmist microbe theories. The Thames water supplied to London last month, it may be mentioned, contained but one part of organic matter—including vegetable—in seven hundred thousand.

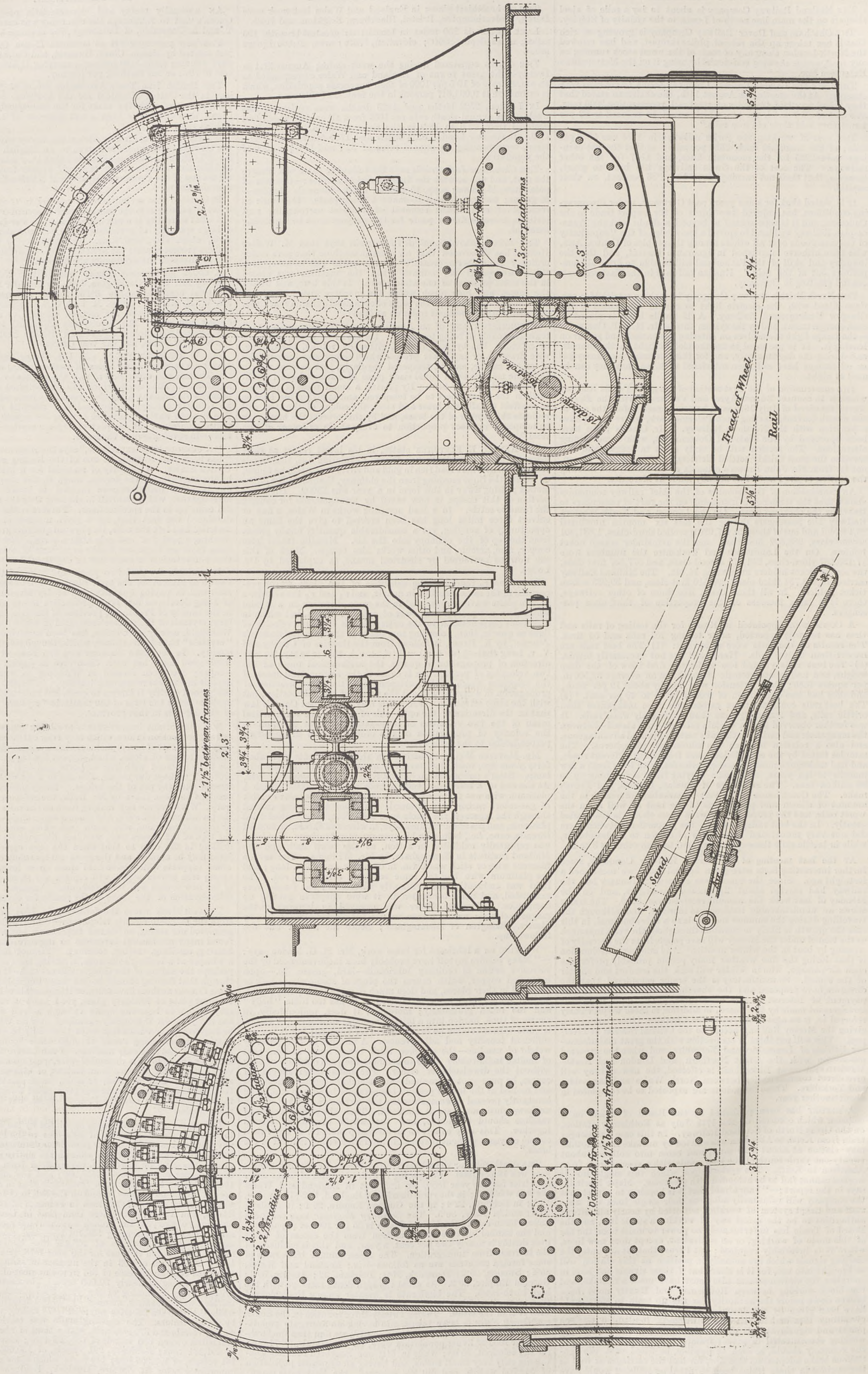
"A curious bit of experience," says the *American Manufacturer*, "has been had recently at one of the leading steel mills in the United States. A quantity of material for a bridge was rejected by the inspector of the buyers, much to the surprise of the producers. The manufacturers decided to make an independent investigation, which resulted in showing that the rejected material did come up to the specifications. Further research followed, and developed the fact that, for a given number of hours after the material had left the rolls, its physical qualities gradually changed, reaching a period of rest only after a certain time had elapsed. If these facts are borne out by the experience of others a good deal that is mysterious in steel may be explained."

It is within the past two years that mica of the best quality, known as Muscovite, has been discovered in Canada in marketable sizes and in paying quantity, and to-day several deposits capable of being developed into fairly productive mines are known. Two in the county of Frontenac, province of Ontario, show well-formed, large crystals at the surface embedded in white quartz; another in Wakefield, county of Ottawa, has been uncovered, and numerous "crystals" have been exposed, which, though small, are of excellent quality. In the Lake Superior and the Lake of the Woods districts good mica has been discovered in paying quantity, and a company has been formed in Winnipeg to work an important deposit in the last-mentioned locality. In British Columbia also a fairly good quality is known to exist, but no attempt has yet been made to prove the sizes of the available "crystals" or to the extent of the deposits in that province.

Some important improvements are being made in the Niagara railway suspension bridge which may turn out to be as dangerous as they are difficult of accomplishment in an engineering way. The four massive towers of stone, which support the big cables of the bridge are to be replaced with iron supports, and it is thought now that, although perhaps dangerous, this can be done without much interference with the use of the bridge. Every precaution to avoid an accident has been taken by Mr. Buck, the engineer in charge of the work. Workmen are now making room on the sides of the towers for the preliminary ironwork, and stone is being chipped away with care by experienced men, who know just which ones to remove. On the tops of the towers men, who look like pigmies from below, are drilling in the caps so that when the time comes the hydraulic jacks may be applied and the great cables safely cradled from the stone supports which have held them up so long, and placed on strong iron towers which will replace the stone ones. The cost of the new towers will be 40,000 dols. American papers say that disintegration of the stone is the reason for changing the towers.

Though Hook wrote the following in 1664 he was a long way from the magneto-electric telephone:—"And as glasses have highly promoted our seeing, so 'tis not improbable but that there may be found many mechanical inventors to improve our other senses of hearing, smelling, tasting, touching. 'Tis not impossible to hear a whisper at a furlong's distance, it having been already done; and perhaps the nature of the thing would not make it more impossible, though that furlong should be ten times multiplied. And though some famous authors have affirmed it impossible to hear through the thinnest plate of Muscovy glass, yet I know a way by which it is easy enough to hear one speak through a wall a yard thick. It has not yet been thoroughly examined how far Otocousticons may be improved, nor what other ways there may be of quickening our hearing, or conveying sound through other bodies than the air; for that is not the only medium. I can assure the reader that I have, by the help of a distended wire, propagated the sound to a very considerable distance in an instant, or with as seemingly quick a motion as that of light, at least, incomparably swifter than that which at the same time was propagated through the air; and this not only in a straight line, or direct, but in one bended in many angles."

The report of the commission appointed by the French Chamber to inquire into the question of subsidies to the French merchant navy, states that since the law passed five years ago came into force the amount paid in the way of subsidies to native shipbuilders and owners has gone on increasing, having risen from about £150,000 the first year to upwards of £450,000; and the effect of granting these subsidies has so far been favourable that in respect to steam vessels France now comes second on the list, next to England, their tonnage being now 197,863 tons in excess of that of the United States, and 186,697 tons more than that of Germany. At the beginning of the year the French merchant navy comprised 14,327 sailing vessels, representing 536,191 tons, and manned by 76,403 sailors; and 895 steamers of 467,488 tons burden, with 18,288 sailors. Compared to those for the year 1878, these figures represent a diminution of 603 in the number of sailing vessels, while there has been an increase of 307 in the number of steamers, with a total increase of nearly 30,000 tons. The coast fisheries comprised, at the beginning of the year, 9966 vessels, of which only thirteen were steamers, manned by 470,000 fishermen and sailors; while the deep sea fisheries comprised 478 sailing vessels, manned by 10,054 sailors. The coasting trade was carried on by 2543 sailing vessels and 379 steamers, with a total of about 18,000 men. Marseilles owned 655 vessels of 685,892 tons; Havre, 344 vessels, of 491,131 tons; Bordeaux, 221 vessels, of 130,655 tons; Nantes, 161 vessels, of 103,966 tons; the ports which come next in point of importance being St. Nazaire, Dunkirk, Boulogne, Dieppe, and Rouen.



BOGIE EXPRESS ENGINE, CALEDONIAN RAILWAY.

MESSRS. NEILSON AND CO., GLASGOW, ENGINEERS.

(*For description see page 172*)

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THE ENGINEER, August 27th, 1886. PAGE

TO CORRESPONDENTS.

Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."

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

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

*** *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.*

STUDENT.—*See* THE ENGINEER, *vol. lvii., and for the "Theory of the Mechanical Refrigeration of Air," see vol. liv. See also the "Proceedings" of the Institution of Civil Engineers, vol. lxviii., the "Proceedings" of the Institution of Mechanical Engineers of* 1874, *and D. K. Clark's book of "Rules, Tables, and Data for Mechanical Engineers."*

R. G. B.—(1) *Brass or gun-metal will probably be the best for the purpose, but sticking will have to be prevented by lubrication.* (2) *There is not, we believe, any published data on the compressibility of powdery clay. A paper "On Brick Machinery and Presses" was recently read before the Institution of Civil Engineers. Some of the brick machinery makers have, no doubt, some figures on the compression and pressures necessary in dealing with clay in the dry and semi-dry state.* (3) *The mechanical action you sketch is not new.*

MEETING NEXT WEEK.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Birmingham, commencing on Wednesday.

THE ENGINEER.

AUGUST 27, 1886.

MARINE ENGINES IN THE NAVY.

JUST one week ago we called attention to the unsatisfactory policy pursued by the Admiralty in dealing with the machinery of our war ships. Too short a time has elapsed, we suppose, to admit of our statements being challenged; but even a week has been sufficient to supply strong confirmation of their accuracy. It is well known that the representative of one journal alone is permitted to be present during a trial of one of her Majesty's ships, and very many trials are made when he is not on board. Indeed, if rumour is to be trusted, he is never invited unless it is tolerably certain that things will go well. However, the truth finds its way out now and then; and the *Times* of Wednesday contains a report of the last trial of the twin screw despatch boat Phæton, 3750 tons, which is extremely instructive. The Phæton has, to say the least, been a very disappointing vessel up to the time she left the Medway. However, at length she was sent round to Portsmouth to complete her steam trials, a speed of seventeen knots being demanded. This is what the *Times* reporter says concerning her:—"The trials were made in due course, and at the end of the full-power runs, and while the engines were being driven at comparatively slow speed, it was discovered that the high-pressure cylinder cover was fractured. Subsequent investigation proved that the saddle which supported the weight of the piston had become loosened and been broken into fragments by the action of the piston. A committee, of which Captain Seymour, of the Duke of Wellington, was president, was appointed to inquire into the causes of the accident, and the chief engineer was eventually removed from the ship. The defects were made good, and bearers of an improved form introduced to diminish the grinding of the piston, which in horizontal engines is considerable. On Monday morning the Phæton again got under way at Spithead for the purpose of resuming her trial under the auspices of Mr. Robert Sennett, of the Admiralty, and members of the dockyard engineering staff. Before much progress had been made with the half-hourly observations, there was a great rush of steam from the other cylinder—the low-pressure one—accompanied by tremendous bumping. Quite a panic took place in the stokehold and engine-room, and the trial was suddenly arrested. It soon became evident that the low-pressure cylinder had been considerably more fractured than the high-pressure cylinder at the former trial, and presumably from the same cause; though this and the extent of the crack cannot be determined until the cylinder has been opened out and the lagging removed. Had the trial proved satisfactory, the Phæton would have sailed for China at once. Besides the fracture of the cylinder, it was discovered that the piston rod was broken inside the cylinder, the severance being as clean as though it had been cut with a knife. This is the first time that a case of a broken piston rod has taken place in the service. Should the examination show that the cylinder is cracked beyond remedy, the ship will be paid out of commission until a new one can be provided." Some one had to suffer, and so the chief-engineer was removed on the first occasion. We shall watch with interest to see who will now be removed. The "saddle" referred to is no doubt the slipper put into some horizontal engines to distribute the weight of the piston over a larger surface on the bottom of the cylinder. How this "became detached," it is very difficult to understand, and it remains to be seen how the low-pressure cover was fractured. The question arises—Was the piston rod which broke of steel, and did it break at a sharp corner where there was no fillet? So far as can be gathered from the very meagre information allowed to leak out, the engines are too weak for their work, their weight having been cut down as much as possible. It is stated furthermore, though not by the *Times*, that the machinery of her Majesty's ship Hero has come to grief. Perhaps some one well informed on the subject will say whether this rumour is true or not.

There is evidence that the machinery of her Majesty's ships constantly gives trouble, and that in many cases it is only after repeated attempts that ships can be made, so to speak, to drag through full-speed trials, all concerned knowing that, once through the test, they will not be submitted to another like it for years, if ever. No trouble of this kind is ever experienced in the mercantile marine; a hot bearing is the worst thing that occurs. The recurrence in ship after ship of anything more serious would not be tolerated. We have no doubt whatever that the machinery of our war ships is not what it ought to be; not because of any fault on the part of the makers, but because they have to comply with well-nigh impossible conditions laid down by the Admiralty as to weight, and space, and power. The makers take their chance that the ships will pull through their six hours' trial. If they do this, well and good. They usually do. The fact remains that the full speed power of most of our ships, as stated in parliamentary reports, is from 25 to 30 per cent. higher than that at which it is safe to work their engines; and this fact should always be taken into consideration in estimating the value of our Navy for war purposes.

JET PROPELLERS.

CERTAIN mechanical devices appear to exercise a remarkable influence on some minds, and engineers are blamed for not adopting them, in no very measured terms in some cases. It is not in any way necessary that these devices should have been invented by the men who advocate their adoption in order to secure that advocacy. The intrinsic attractions of the scheme suffice to evoke eulogy; and engineers sometimes find it very difficult to make those who believe in such devices understand that there are valid reasons standing in the way of their adoption. One such device is hydraulic propulsion. A correspondent in a recent impression suggested its immediate and extended use in yachts at all events, and we willingly published his letter because the system does no doubt lend itself very freely to adoption for a particular class of yachts, namely, those provided with auxiliary power only. But because this is the case it must not be assumed that the jet propeller is better than screw or paddle-wheel propulsion; and it is just as well before correspondence extends further that we should explain why and in what way it is not satisfactory. The arguments to be urged in favour of hydraulic propulsion are many and cogent; but it will not fail to strike our readers, we think, that all these arguments refer not to the efficiency of the system, but to its convenience. A ship with a hydraulic propeller can sail without let or hindrance; a powerful pump is provided, which will deal with an enormous leak, and so on. If all the good things which hydraulic propulsion promises could be had combined with a fair efficiency, then the days of the screw propeller and the paddle wheel would be numbered; but the efficiency of the hydraulic propeller is very low, and we hope to make the reason why it is low intelligible to readers who are ignorant of mathematics. Those who are not ignorant of them will find no difficulty in applying them to what we have to say, and arriving at similar conclusions in a different way.

Professor Greenhill has advanced in our pages a new theory of the screw propeller. As the series of papers in which he puts forward his theory is not complete, we shall not in any way criticise it; but we must point out that the view he takes is not that taken by other writers and reasoners on the subject, and in any case it will not apply to hydraulic propulsion. For these reasons we shall adhere in what we are about to advance to the propositions laid down by Professor Rankine, as the exponent of the hitherto received theory of the whole subject. When a screw or paddle-wheel is put in motion, a body of water is driven astern and the ship is driven ahead. Water, from its excessive mobility, is incapable of giving any resistance to the screw or paddle save that due to its inertia. If, for example, we conceive of the existence of a sea without any inertia, then we can readily understand that the water composing such a sea would offer no resistance to being pushed astern by paddle or screw. When a gun is fired, the weapon moves in one direction—this is called its recoil—while the shot moves in another direction. The same principle—*pace* Professor Greenhill—operates to cause the movement of a ship. The water is driven in one direction, the ship in another. Now Professor Rankine has laid down the proposition that, other things being equal, that propeller must be most efficient which sends the largest quantity of water astern at the slowest speed. This is a very important proposition, and it should be fully grasped and understood in all its bearings. The reason why of it is very simple. Returning for a moment to our gun, we see that a certain amount of work is done on it in causing it to recoil; but the whole of the work done by the powder is, other things being equal, a constant quantity. The sum of the work done on the shot and on the gun in causing their motions is equal to the energy expended by the powder, consequently the more work we do on the gun the less is available for the shot. It can be shown that if the gun weighed no more than the shot, that when the charge was ignited the gun and the shot would proceed in opposite directions at similar velocities—very much less than that which the shot would have had had the gun been held fast, and very much greater than the gun would have had if its weight were, as is usually the case, much in excess of that of the shot. In like manner part of the work of a steam engine is done in driving the ship ahead, and part in pushing the water astern. An increase in the weight of water is equivalent to an augmentation in the weight of our gun and its carriage—of all that, in short, takes part in the recoil.

But, it will be urged, it is just the same thing to drive a large body of water astern at a slow speed as a small body at a high speed. This is the favourite fallacy of the advocates of hydraulic propulsion. The turbine or centrifugal pump put into the ship drives astern through the nozzles at each side a comparatively small body of water at a very high velocity. In some early experiments we believe that a velocity of 88ft. per second, or 60 miles an hour, was maintained. A screw propeller operating with an enormously larger blade area than any pump can have, drives astern at very slow speed a vast weight of water at every revolution; therefore, unless it can be shown that the result is the same whether we use high speed and small quantities or low speed and large quantities, the case of the hydraulic propeller is hopeless. But this cannot be done. It is a fact, on the contrary, that the work wasted on the water increases in a very rapid ratio with its speed. The work stored up in the moving water is expressed in foot-pounds by the formula $\frac{W v^2}{2 g}$, where W stands for the weight of the water, and v for its velocity. But the work stored in the water must have been derived from the engine; consequently the waste of engine power augments, not in the ratio of the speed of the water, but in the ratio of the square of its speed. Thus if a screw sends 100 tons of water astern at a speed of 10ft. per second per second, the work wasted will be 156 foot-tons per second in round numbers. If a hydraulic propeller sent 10 tons astern at 100ft. per second per second, the work done on it would be 1562 foot-tons per second, or ten times as much. But the reaction effort, or thrust on the ship, would be the same in both cases. The waste of energy would, under such circumstances, be ten times as great with the hydraulic propeller as with the screw. In other words, the slip would be magnified in that proportion. Of course, it will be understood that we are not taking into account resistances, and defects proper to the screw, from which hydraulic propulsion is free; nor are we considering certain drawbacks to the efficiency of the hydraulic propeller, from which the screw is exempt; all that we are dealing with is the waste of power in the shape of work done in moving water astern, which we do not want to move, but cannot help moving. If our readers have followed us so far, they will now understand the bearing of Rankine's proposition, that that propeller is best which moves the greatest quantity of water astern at the slowest speed. The weight of water moved is one factor of the thrust, and consequently the greater that weight, other things being equal, the greater the propelling force brought to bear on the ship.

It may be urged, and with propriety, that the results obtained in practice with the jet propeller are more favourable than our reasoning would indicate as possible; but it will be seen that we have taken no notice of conditions which seriously affect the performance of a screw. There is no doubt that it puts water in motion not astern. It twists it up in a rope, so to speak. Its skin frictional resistance is very great. In a word, in comparing the hydraulic system with the normal system, we are comparing two very imperfect things together; but the fact remains, and applies up to a certain point, that the hydraulic propeller must be very inefficient, because it, of all propellers, drives the smallest quantity of water astern at the highest velocity.

There is, moreover, another and a very serious defect in the hydraulic propeller as usually made, which is that every ton of water passed through it has the velocity of the ship herself suddenly imparted to it. That is to say, the ship has to drag water with her. To illustrate our meaning, let us suppose that a canal boat passes below a stage or platform a mile long, on which are arranged a series of sacks of corn. Let it further be supposed that as the canal boat passes along the platform, at a speed of, say, five miles an hour, one sack shall be dropped into the boat and another dropped overboard continuously. It is evident that each sack, while it remains in the boat, will have a speed the same as that of the boat, though it had none before. Work consequently is done on each sack, in overcoming its inertia by imparting a velocity of five miles an hour to it, and all this work must be done by the horse towing on the bank. In like manner the hydraulic propeller boat is continually taking in tons of water, imparting her own velocity to them, and then throwing them overboard. The loss of efficiency from this source may become enormous. So great, indeed, is the resistance due to this cause that it precludes the notion of anything like high speeds being attained. We do not mean to assert that a moderate degree of efficiency may not be got from hydraulic propulsion, but it can only be had by making the quantity of water sent astern as great as possible and its velocity as small as possible. That is to say, very large nozzles must be employed. Again, provision will have to be made for sending the water through the propeller in such a way that it shall have as little as possible of the motion of the ship imparted to it. But as soon as we begin to reduce these principles to practice, it will be seen that we get something very like a paddle-wheel hung in the middle of the boat and working through an aperture in her hull, or else a screw propeller put into a tube traversing her from stem to stern.

We may sum up by saying that the hydraulic propeller is less efficient than the screw, because it does more work on the water and less on the boat; and that the boat in turn does more work on the water than does one propelled by a screw, because she has to take in thousands of tons per hour and impart to them a velocity equal to her own. Part of this work is got back again in a way sufficiently obvious, but not all. If it were all wasted the efficiency of the hydraulic propeller would be so low that nothing would be heard about it, and we certainly should not have written this article.

STEAM ENGINE BREAKDOWNS.

Mr. Longridge's annual report for 1885, as engineer to the Engine, Boiler and Employers' Liability Insurance Company, lies before us. Mr. Longridge apologises for the delay which has occurred in its completion and issue. This delay has, he tells us, been caused by the ever increasing pressure of office work, which has left but little time for sifting the year's accumulation of papers and selecting matter suitable for publication. The report contains a great deal of interesting information, such as can be obtained nowhere else. The company, as no doubt most of our readers are aware, insures engines as well as boilers; and Mr. Longridge has therefore excellent opportunities for learning how and why engines break down. He has to record no fewer than 106 failures during 1885, while 795 occurred during the last six years. This is a very large number, and most steam users will agree with us that it might be reduced with advantage. It is very often assumed that a breakdown is always the result of carelessness on the part of the attendant, or of neglect from parsimoniousness, or other reasons, of the owner to get repairs done in good time; but Mr. Longridge's figures go to show that this is not the case. The cause of the 106 breakdowns may be thus classified: 41 per cent. were due to causes purely accidental or unascertained, 13 to old-standing defects and ordinary wear, 30 to weakness or bad design, and only 16 were attributable to the negligence of the owners or their servants. Out of the whole 106 no fewer than 24 were failures of spur gearing, and we may put these on one side as not belonging properly to engine failures. Of the rest we find that valve gear gave way frequently, and that air pumps gave still more trouble. In eleven instances the gear for driving the air pumps broke, and in twelve cases the buckets or valves failed. One "total wreck" is recorded, but the cause was not ascertained; in five instances the crank shafts broke. It will be interesting if we examine more closely a few typical examples from the many particularised by Mr. Longridge.

The excentric rod of a beam engine was broken because the engine-man had neglected to oil the slide valve. For a similar reason one of the excentric rods in a pair of horizontal compound engines was broken. In another pair of tandem engines a slide valve spindle and one rocking shaft pedestal were broken from the same cause. In a beam condensing engine the excentric rod was broken in the same way. These facts throw a good deal of light on the enormous frictional resistance of slide valves, and show how dependent they are for proper working on lubrication. This is especially the case when steam dry and of a high-pressure is used. Some of the failures recorded by Mr. Longridge are very curious. Thus, a horizontal tandem engine was broken down by a lump of hard grease; the cylinders were 23in. and 43in. diameter and 5ft. stroke; the engine made 65 revolutions per minute; the power was given off by a spur wheel 9ft. in diameter with teeth 14in. broad, and 3⅞in. pitch, both the wheel and pinion being covered by a sheet iron guard in the usual way. "The grease," says Mr. Longridge, "used for these wheels must have been very hard, or there must have been some hard substance in it, for in applying it while the engine was at work a lump was carried round with the teeth and lifted the cover off its fixing. The cover dropped upon the wheel and was torn to pieces. Both wheel and pinion were smashed, the boss of the wheel only remaining on the shaft. In connection with this breakdown it may be mentioned that one of the company's inspectors, when making his periodical inspection of another insured engine, found an indentation on one of the teeth of the spur wheel which could not be accounted for by anyone at the mill. On inquiry, he ascertained that the manager had given orders to clear all the old grease out of the wheel race and to use it over again. From this the inspector inferred—and his inference is probably correct—that a small piece of iron hidden in the grease had been carried round by the wheel until it came in contact with a tooth of the pinion, causing the indentation. As it happened, the teeth were strong enough and the clearance sufficient to allow the piece of iron, or whatever it was, to pass through without further damage. But the experiment is not one to be repeated with impunity, and it therefore seems well to mention it as a warning to mill managers and enginemen against the use of old grease from the wheel-race." In another instance there was a very thorough smash up of a condensing beam engine with a cylinder 30in. diameter and 5ft. stroke. This breakdown occurred about noon, without warning and without apparent cause. The inspector, on arriving shortly afterwards, found the beam broken in front of the main gudgeon, the connecting rod end, together with part of the connecting rod, lying at the bottom of the foundation, having carried away the floor. The other part of the rod, with the exception of a small piece which remained attached to the crank pin, was jammed across the opening in the floor. The fly wheel and driving wheel were lying in pieces at the bottom of the wheel race, even the boss of the former being broken; in fact, nothing was left on the shaft except the crank. The spring beams had broken, and the floor of the beam chamber was pulled down. The cylinder bottom was broken; no cause could be assigned. Mr. Longridge thinks it possible that the beam broke first, possibly because of water in the cylinder; but this is only an assumption. In another instance a small vertical engine was smashed by water flowing over into the cylinder from the condenser. The engine had been slowed down, but the injection cock was left full open.

We have said that a large percentage of breakdowns occurred to air pumps and their gear. Several of these were due to neglect. Of no fewer than six breakdowns Mr. Longridge says:—"All these breakdowns would have been avoided if proper care had been taken, for they all arose from defects which should have been detected by intelligent examination. Air pumps, buckets, and valves are, perhaps, more liable than any other parts to get out of order, and yet they are frequently the most neglected. When we consider the concussions to which all the fastenings and joints about an air pump are subjected every stroke, and the gritty and corrosive nature of the water in which the rods and buckets often work, it must be evident that special vigilance must be used if damage is to be prevented. The chambers in which the pumps are placed should be kept as clean as other parts of the engine-house, instead of being, as they often are, too filthy for anyone to enter without a change of clothes. They should be made accessible by permanent staircases or ladders and flooring, and should be well lighted, if possible by daylight, and if not, by gas. If this were done many of the difficulties of making a proper examination would be removed, and breakages would certainly be fewer. It is also recommended that metallic packing for buckets should be abolished. It is both a useless expense and a source of danger. A plain brass or iron bucket, about 12in. deep, when the water is free from sediment, or one with wood lagging when it is gritty, will answer every purpose; for it is not necessary that an air-pump bucket should be tight in the same sense as a piston."

Mr. Longridge very properly urges the use of proper curves and fillets in all cases where the diameter of a shaft or rod suddenly changes, and he particularly insists on this when steel is used. Indeed, it is easy to see that he is not specially enamoured of steel—Bessemer steel, at all events. He mentions one instance where a crank shaft having broken, it was replaced by one of Bessemer steel, against his advice. There was a slight change in diameter where the crank was put on. There was no fillet, the change being made abruptly. The result was that a crack commenced at the corner, and ran into the bearing, which it caused to heat, whereby the engine-man's attention was attracted, and the mischief discovered before the crank dropped off. The shaft was 5⅝in. in diameter in the journal, and 5¼in. in the crank seat, so that the shoulder was only $\frac{7}{16}$in. diameter, a quantity which might have been accepted as too small to do any harm. Mr. Longridge also gives particulars of the breakage of a crank shaft in the case of an uninsured Corliss condensing engine, with a cylinder 40in. diameter by 5ft. stroke. The main shaft was of Bessemer steel 15in. diameter in the neck, swelled to 15½in. at the end to receive the crank, which was held by a steel key after having been forced on to the shaft, probably by hydraulic pressure. The keyway in the shaft extended the full length of the swell, and was cut perfectly square in all the corners. The fracture which led to the destruction of the shaft commenced at the inner end of this keyway, and extended across the shaft, partly within the crank and partly through the neck, and on one side branched off parallel to the axis of the bearing. The final fracture appears to have taken place as the crank passed the outer centre, and when the piston was commencing its return stroke; the latter, being thus freed, was driven against the back-end cylinder cover, smashing it and also the cylinder. The engine-man was found dead near the engine-house door, having either been killed by the shock or suffocated by the steam. At the coroner's request Mr. Longridge made a report upon the accident, attributing it to intense local stress at the corner of the keyway, produced by sudden change of form in a material which, whether from initial strain set up in cooling, or from some other cause at present unknown, has proved itself unfit to bear such sudden changes. We may add here that Mr. Longridge has obtained particulars of no fewer than sixty-four breakdowns of uninsured engines. In seventeen cases the main shafts gave way, in twelve the spur gearing was smashed, and in four the engines ran away and the fly-wheels were smashed to pieces.

It is impossible to read this report without seeing that, although actual neglect or false economy brought about but a comparatively small proportion of the breakdowns recorded, the number of these would have been reduced had more vigilance been manifested. There is a considerable margin between positive neglect and supineness. An engine-man may do his duty so fairly well that it is impossible to find fault with him, while his performance is so far from perfection that it is equally impossible to praise him with justice. In the same way, while many steam owners do all that is believed to be necessary and with promptitude, they use the word "necessary" with a certain degree of latitude which leads to bad results. The very fact that the cause of a large number of breakdowns was unknown seems to us to be evidence of want of vigilance on the part of some person or persons. Take, for example, No. 21 in Mr. Longridge's list. "Beam condensing, wrought iron crank shaft broken off close to the fly-wheel boss, cause of damage not ascertained." Now, it is an almost unheard of event for a wrought iron crank shaft to break without giving evidence of weakness beforehand. We hear nothing here of a latent flaw, and it is hard to resist the conclusion that if the cap had been lifted and the crank examined with care a crack would have been discovered. Every crank shaft ought to be stripped and examined once in three months. The operation does not take long, and will go far to secure the owner of the engine against a bad accident. Of course, we are here referring only to shafts of some size, say over 5in. in diameter. Again, take the following:—"No. 8 horizontal condensing engine: Wrought iron crank shaft, crank pedestal, brass steps, two pedestal cap bolts, slide bars, eighteen cylinder cover bolts, gib and cotter for air pump connecting rod, and two air pump slide bars, connecting rod, crosshead, air pump connecting rod broken, and piston-rod bent. Cause of failure: Absence of a fillet at junction of neck to body of shaft. The square corner had started a fracture at each side of the shaft, in the line joining the centres of the shaft and crank pin. These fractures had extended through the shaft in a direction at right angles to its axis, and were within 2in. of meeting when the shaft broke. Owing to the position and direction of the fracture the neck did not heat."

It seems to be almost certain that if the shaft had been examined the fracture would have been discovered. We will not pursue this line of argument further. If breakdowns are to be avoided vigilance must be displayed in looking for premonitions of failure; and we may rest assured that steam users will best consult their own interests if they make it worth the while of their enginemen to discover and report the existence of any defect which, if not remedied, may lead up to serious consequences. We fear that only too many pursue a precisely opposite course, and discourage their men when they manifest any tendency to make what are very much miscalled "complaints."

THAMES SUBWAYS.

After nine or ten years' more or less wrangling the Metropolitan Board of Works have arrived at something like a hopeful decision on the question of constructing a tunnel or subway beneath the Thames for the benefit of the East-end and the opposite shore. Some members of the Board have deprecated and opposed the provision of any such facilities; others have disputed as to whether a tunnel, if made, should be at Blackwall or Shadwell, or some other point. Meanwhile the dwellers on either side of the lower Thames have been clamouring for some communication by which they could cross the river without having to come all the way to London Bridge, and then, having crossed, travel all the distance back along the parallel side. Hitherto their appeals and demands have been in vain, for the subway scheme was delayed; the steam ferry, which would have been a little use at any rate, speedily failed, and the additional bridge has only lately been commenced. Now, however, something is to be done. The Works Committee of the Board having investigated the question, have presented a report, in which they express the opinion that the Board should not allow another year to elapse without endeavouring to increase the transit facilities on the Thames, and advise that the Board should prepare a scheme to be submitted to Parliament next year for the formation of a subway or tunnel at Blackwall, as was suggested by the engineer to the Board in 1882. This recommendation, being put into the form of a resolution, was considered at a recent meeting of the Board, and eventually adopted by twenty-nine to ten members, after a long and rather animated discussion. Mr. Edwards, who moved the resolution, urged that the scheme would be of great advantage to the people on both sides of the river, and observed that the question of whether or not there should be another subway lower down than this must be held over until it was seen how the new Corporation bridge answered. Mr. Cook and Mr. Webster, M.P., also strongly advocated the project as one that the people had a right to have carried out. Other members preferred the Shadwell alternative, and an amendment to that effect was moved, but defeated on a division. Mr. Abbott considered both tunnels absolutely necessary; while Colonel Hughes, M.P., condemned all tunnels as the worst kind of communication that could be adopted except for railways, and advised the substitution of ferries. On the other hand, Mr. Runtz pointed out that ferries were too dependent upon tides, and mentioned that the main reason for the construction of Brooklyn Bridge was that even at New York, where the difference between high and low water was only 8ft., the use of ferry boats had been very inconvenient. In the end the proposal of the committee was accepted, and there is thus a prospect now of a definite scheme being advanced, and, if Parliament approves, carried out.

AGES OF VESSELS LOST.

The shipping register of the past month contains some facts of importance as bearing on the loss of vessels from that register. There were 166 removed from the British and Colonial registers during the past month. Not less than 55 of these were broken up. Out of the 55 there were 10 colonial wooden sailing vessels, and 1 small colonial iron steamer, built at Melbourne in 1858.

We have therefore 44 vessels belonging to the United Kingdom which were broken up; and 36 of these were wooden sailing ships, and the oldest of the 36 was a vessel built in 1811. Of the remainder of the British vessels there were 6 wooden or composite steamers, the oldest built in 1847. The 2 vessels remaining were iron steamers—one built in 1846 and of 56 net tons, and the other built at Lymington in 1868. It is thus shown that the vessels broken up were not very old, and that may be taken as an indication that the low value of new vessels is tending rather in the direction of allowing owners of old—comparatively old—vessels to replace them with new ships. There is another cause of removal which may be glanced at—that of the vessels "lost"—14 being so described. There were 10 of these colonial wooden sailing ships; three British wooden sailing ships and 1 small iron sailing ship. An interest of a different kind attaches to the statement of the vessels sold to foreigners—8 in number in the month. There were 4 of these which were colonial wooden sailing vessels, 3 British wooden sailing ships, and only 1 iron steamer. It would appear from these facts that there is a clearance of the register of some of the older wooden vessels, though at the same time more wooden vessels are being added than is generally thought to be the case. For instance, last month there were not fewer than thirty-four wooden sailing vessels added to the registry for the United Kingdom. Seven of these were not new—were built prior to the present year, that is; but the remainder were built in the present year. The ports of building were largely Yarmouth, Grimsby, Southampton, and Lowestoft, which points at once to the intention of the vessels to be employed more or less in the fishing trade. But it is clear that there is a tendency to change the merchant fleet by the removal of the old and the addition of new vessels of other forms, type, and material. Hence it may be concluded that whilst on the year as a whole there is a reduction of the tonnage of the fleet, and whilst the reduction is much more in the cargo-carrying vessels, there is also a more efficient fleet—one in which the type of vessels is newer, the speed generally greater, and there is greater adaptation to the special trade of the particular vessel.

OPENING OF THE SEVERN TUNNEL.

Another step towards rendering the Severn Tunnel available for general purposes is to be taken on Wednesday next, when it will be opened for goods and mineral traffic. We have written so frequently upon this great work during its progress that we need not now deal with the nature of the undertaking; but we may recall the fact that on September 7th last year the first trip through was made by a train bearing officials and visitors, and that on January 9th the first goods train, consisting of one engine, two vans, and fourteen trucks, carrying 150 tons of steam coal, was run through from Aberdare to Southampton docks. The journey occupied only about eleven hours, the passage through the tunnel itself taking but nineteen minutes. Both trials were deemed highly satisfactory, but there matters practically stopped, for there was still much to be done in the way of construction. The hope was that the line might be ready for general goods traffic early in the spring, but the heavy rain and floods subsequently experienced—coupled no doubt with the two mishaps previously sustained through the influx of water—made the engineers more than cautious, and on the advice of Sir John Hawkshaw the date of opening was deferred until September 1st. In the meanwhile the work has been pushed forward vigorously but with exceeding care, in order to ensure the line against further disaster. The masonry has been carried out to a high degree of solidity and firmness. Powerful and specially built pumping apparatus has been erected, and highly effective fans and other ventilating appliances have been introduced. It may therefore be assumed that when it is once opened the railway will be as workable and free from danger as engineering science can render such an enterprise. From Wednesday next a certain portion of the company's goods traffic will be accommodated, but before that service can be completed, and a passenger service established, an extension of the short line between Bristol and Pilding, where the railway enters the river part of the tunnel, has to be carried out. This will occupy a few months longer, but before the end of the year, should nothing unexpected intervene, the whole tunnel will be opened for every class of traffic.

THE MILFORD HAVEN NAVAL OPERATIONS.

It is quite impossible to read the spirited and graphic accounts of the Milford Haven attack and defence in the *Times* and *Daily News* without grasping the general features and any lessons to be learned. As we understand the case the trial was mainly one of the handling of torpedo boats and electric lights in the attack and defence of a passage imperfectly closed by a boom. The interest centred on this passage, which lay between Stack Rock and Thorn Point, across the greater part of which a boom, consisting of baulks chained together, was placed. This boom was sufficiently strong only to keep out boats. The attacking fleet anchored in water which, it must be presumed, was supposed not to be commanded by a heavy fire. Perhaps the ships had silenced all guns of sufficient range and power to fire across Sandy Haven Bay, and there were no rifled mortars with Watkins' appliances to enable them to strike the ships' decks. We are inclined to think that some supposition detracting from the power of the shore batteries is required in support of the feasibility of the operations. These chiefly consisted in the attacks on each side of torpedo boats. The general opinion seems to be that these were allowed considerable latitude on both sides as to the positions into which they ventured; this was necessary to the object in view. The operations were carried out with ability and spirit. It appears as if more was likely to be gained in experience by the shore defence than by the ships. Evidently electric lights ought to be placed lower than was formerly ordered, to illuminate water and discover boats effectually. The useful work may be nearly summed up as practice in handling torpedo boats, electric lights, range finding and searching apparatus, and machine guns.

LITERATURE.

Report on the East Anglian Earthquake of 22nd April, 1884. By Raphael Meldola, F.C.S., F.R.A.S., and W. White. London: Macmillan and Co. 1885.; 223 pp.

This is a carefully drawn up report upon a subject which, in one respect, is most difficult to treat—namely, that in examining the numerous reports sent in by people over the area over which the earthquake was more or less sensible, said to be about 50,000 square miles, it is generally found that they are records of impressions of what the writers thought they saw and felt rather than what actually occurred. Personal peculiarities of the absolutely untrained observers vitiate almost all their accounts. Professor Meldola's report is, however, well and judiciously written, and the main items of records sent him are carefully reviewed. The book shows that earthquake physics are attracting the attention of a class of scientific men able to weigh evidence and test it by measures and physical data. Seismology, as Mallet named it, is no longer the scribbling playground of the half-informed guessing and speculating geologist, made bold by the difficulty which some years ago attended the attempt to prove that his propositions were absurd, and it is pleasant to find this report followed up by a careful digest of the evidence afforded, viewed in the light of modern scientific knowledge and of the subject. That part of the book dealing with "The Earthquake in Relation to Geological Structure," which follows the descriptive report, affords very numerous topics on which much might be said if space were at our disposal, but as it is not, we must content ourselves with a reference to only one or two. Much is said of the destruction of buildings, which is generally greatest on tertiary strata; and that differences must be expected over areas of diversified superficial formation; and in a very interesting manner Professor Meldola has drawn attention to the general agreement of observed facts with what has been pointed out by Mallet more especially, namely, that the greatest destruction will be found on those formations which, of a coherent and homogeneous nature, are yet of the semiplastic order, best fitted for receiving and transmitting wave vibrations of considerable amplitude. The London clay is an example, while the drift-sands and gravels—which, as compared with the former, have practically no elastic range—afford an example of bad transmitters, which are nevertheless more destructive as foundations than the conformable rocks. The great destruction often observable near rivers and sea margins and along junctions of different formations are considered with reference to the examples which the Essex earthquake afforded; but the examples given by previous writers, and the explanations which should be attributed to Mallet, are credited elsewhere. We have a high opinion of the energy displayed by Mr. Milne in his laborious working in seismic matters, but we must object to the statement that no writer excepting him had laid stress on the greater destructive efficiency of the wave energy near, and at free margins where the energy is dissipated by approximately free motion in one direction or set of directions. Professor Meldola has, however, evidently endeavoured to give due credit to all, and has succeeded in putting a great deal into a few pages. We can commend this book as interesting to all geologists, and especially to those who are attracted by the application of physics to one of the greatest problems in physiography.

Year-Book of the Scientific and Learned Societies of Great Britain and Ireland. Third annual issue. London: Charles Griffin and Co. 1886.

Although the year has far advanced, we may make a note on this book, for we have sometimes found it useful. It comprises the titles, address, date of foundation, and objects of the societies in the United Kingdom, and gives some information upon the recent work of each, together with lists of the papers read during the preceding year before societies engaged in fourteen different branches of science. The names of the chief officers are also given.

BOOKS RECEIVED.

Precautions to be Adopted on Introducing Electric Light. By Killingworth Hedges. London: E. and F. N. Spon. 1886.

A Course on the Stresses in Bridge and Roof Trusses, Arched Ribs, and Suspension Bridges. By W. H. Burr, C.E. Third edition. New York: J. Wiley and Sons. London: Trübner and Co. 1886.

The Railways and the Republic. By J. F. Hudson. London: Sampson Low and Co. 1886.

The Elementary Principles of Electric Lighting. By Alan A. Campbell Swinton. London: Crosby Lockwood and Co. 1886.

Cork Industrial Exhibition, 1883. Report of Executive Committee, Awards of Jurors, and Statement of Accounts. Cork: Purcell and Co. 1886.

THE MANCHESTER EXHIBITION.

With a view to the industrial and art exhibition with which Manchester intends to celebrate her Majesty's jubilee next year, considerably more than £100,000 has been guaranteed; all the details have been decided, and the contracts for the building have been signed. The scope of the Exhibition is to be this: Seven sections, viz.—I. Industrial design, as shown in textile fabrics, pottery, metal work, &c.; original drawings for manufactures of various kinds, examples of ancient fabrics and designs, and architectural designs. II. Industrial processes—textile machinery, engineering and general plant, and machinery in motion. III. Chemical and collateral industries. IV. Handicrafts—workers in brass, iron, wood, ivory, needlework, &c., illustrating ornamental work in great variety. V. Representation of Old Manchester and Salford, in which the handicraft work of Section IV. is performed; model of the Ship Canal, showing docks, locks, waterways, &c. VI. Fine Arts—paintings, engravings, sculpture, &c., produced during the Victorian era. VII. Botanical—fruits and flowers, fairy fountains, electric light, music, &c. The contract for the building has been given to Messrs. Maxwell and Luke, of Princess-street, Manchester, and the estimated cost—exclusive of Old Manchester and Salford—is £32,653. In making this estimate the contractors count upon a re-sale of materials equal to fifty per cent. of the original cost. The design proposes a building in five sections, consisting of a lofty nave and transepts, in the form of a Latin cross, with low buildings supporting it on each side. Each of these side buildings or courts is to be 30ft. wide, with a view to admitting of side exhibits and a central gangway. In Section II. there will be three sub-divisions; one for motive power, electrical machines, and machinery in motion of a hazardous description; one of machinery in motion not hazardous; and one of processes not requiring motive power, and not hazardous. The floors in the first two of these sub-sections are to be 4½ft. below the level of the rest of the flooring. Section IV. (Old Manchester) will be so arranged that the whole front of the buildings towards the Botanical Gardens will be faced by ancient buildings representing Old Manchester and Salford. Section VI.—Fine Arts, the exhibits in which will probably be worth £200,000—is to be separated from the rest of the building by fire-proof screens; and the doorways will be deeply recessed as a safeguard against fire. The music-room will also be isolated by fire screens. The whole of the framework is to be of wrought or cast iron gas and water tubing—this material being selected because of its practical value afterwards upon a re-sale, and because of the ease and rapidity with which it can be set up and taken down. The roof, however, and the dome will consist partly of glass and partly of corrugated sheet iron. The floor will consist of concrete slabs 4in. thick; and as a further protection against fire, the central portion of the building is to be divided by four 14in. brick walls from the sections on each side. It is likewise recommended that wire curtains should be provided between the brick walls, to be lowered when the building is closed, and by reason of all these measures and devices it is claimed that the risk of fire will be reduced to a minimum. The total area for the building is put at 37,305 superficial yards, which at 17s. 6d. a yard represents the estimated cost of £32,653 14s. The Exhibition is to be opened in May next.

THE INDUSTRIAL UTILISATION OF WOLFRAM AND SOME OF ITS COMPOUNDS.

Writing on this subject, Dr. G. Heppe says it is remarkable that this metal, with its many peculiar and good qualities, and its not less interesting combinations, has up to the present only found, comparatively speaking, a limited utilisation in the industrial arts and the different branches of manufacture, and therefore from time to time it cannot appear superfluous to call attention to its merits, and the useful application of some of its compounds. It was just thirty years ago last year since the metal wolfram was first added to steel, and attention drawn to it on account of the great hardness it imparted to the product. Innumerable articles have been published concerning the excellent qualities of the material, and yet very little of it is found in daily use compared to the great mass of other steel now used for such a number of purposes. The reason for this may, to some extent, be, that wolfram steel got for a time into discredit, because very often articles were brought upon the market purporting to be wolfram steel which did not contain a particle of that metal. In this manner the idea got abroad that no more wolfram steel at all was made. This, however, is by no means the case, for not long ago Dr. Heppe had the opportunity of visiting the works of Mr. Theodor Kneifch in Roswein, Saxony, where nothing else but wolfram metal and various preparations of it have been continuously manufactured for a long period, all of which have been sold regularly to the large steel works of the country. It is very probable also that another circumstance may have prevented the extended use of wolfram steel; namely, that the material was not always made of a regular quality, caused no doubt by using as a mixture with the steel or iron raw wolfram ore instead of the pure wolfram metal. In that case a regular quality in the product was not to be expected, for at one time it would contain a greater and at another a less percentage of wolfram, inasmuch as the ores vary considerably in their contents of metal, and the reduction of the latter out of them does not always take place in regular quantities. Besides this, in adding the raw ore other undesirable substances, as arsenic, phosphorus, sulphur, &c., may accompany it and mix with the iron or steel; which, of course, would thereby assume different characteristics. All these evils are at once removed by using the pure wolfram metal; it is therefore strongly recommended either only to employ this, or an iron containing a known percentage of it, when the object is to produce a steel which shall always have the same characteristics. A properly manufactured wolfram steel possesses extraordinary hardness and toughness, and costs very little more to produce than the ordinary qualities, whilst its value rises in a much higher ratio. Wolfram steel is not only peculiarly applicable to tools of every kind, as chisels, drills, turning tools and the like, for iron and steel, but to the improvement of railway materials, as rails, tires for locomotives, axles, couplings, &c.; also in the puddling process it is very valuable, inasmuch as the wrought iron produced becomes more malleable and shows a long silky fibre when broken and bent, without in the least impairing its strength or welding qualities as compared with other best sorts of iron. It is not advisable, however, to permit the percentage of wolfram in bar iron to rise above 2½ per cent., or else the iron might become too hard. On the other hand, when it is a question of steel for cutting implements, stamping dies, files, and similar tools, the percentage may rise to 7½, according to the degree of hardness required. For tires the percentage can vary from 2½ to 5; for axles, ½ to 1 p.c. Not only is an addition of wolfram applicable to puddled steel, but as is known, it can be applied with advantage to the Bessemer process; indeed, ordinary foundry pig is improved by the addition of 1½ p.c. of wolfram, and its—the pig—quality rendered thereby particularly adapted to castings which are subsequently to be annealed or made malleable. In the manufacture of wolfram steel or iron it is of the utmost importance to apply the best methods for the purpose, in order to prevent a portion of the metal from being burnt away and so being lost by oxidation. At the same time the quantity of wolfram must not be too large, or else the steel made would be too hard.

Of all the metals, iron alloys itself the best with wolfram; indeed, in all proportions up to 80 p.c. wolfram—but such high percentaged alloys are useless because they cannot be melted. This is also partly the case when alloyed with other metals, as copper, antimony, bismuth, and nickel, for 10 p.c. of wolfram is sufficient to make them unworkable. Nevertheless, very valuable alloys of wolfram with remarkable properties have been produced with a low percentage of that metal.

It may just be alluded to that wolfram steel is very applicable for steel magnets, as it retains its magnetism much longer than ordinary steel will do.

The Birmingham Exhibition.—The machinery portion of the exhibition at Bingley Hall, which was opened on Thursday in connection with the forthcoming visit to Birmingham of the British Association, promises to be a great success. Water, steam, gas, and electricity, will all be severally used in supplying motive power for the machine exhibits. Prominent among the heavy exhibits will be machinery for propelling 52ft. torpedo boats, also for propelling 28ft. cutter, and air compressing engines for charging torpedoes having a working pressure of 1500 lb. per square inch, all of which are sent by Messrs. G. E. Belliss and Co., engineers, Birmingham. Messrs. James Russell and Sons, of the Crown Tube Works, Wednesbury, contribute boiler tubes up to 15in. diameter outside, iron and steel tubes, plain, spiral, and tapered, for shipbuilding, architectural, and other purposes; hydraulic tubes of various sizes, proved from 4000 lb. to 13,000 lb. per square inch, and valves for regulating the pressure of steam from high to any lower pressure, and also a large variety of gas tubes. Electricity is being used for lighting the Bingley Hall Exhibition. The main hall is illuminated by twenty 3000-candle-power arc lamps, and incandescent lighting will employ about 220 lamps of 16-candle power each. Two compound Robey steam engines of 20 and 35-horse power respectively supply the motive power.

TOZER'S SELF-FASTENING RAILWAY CHAIR.

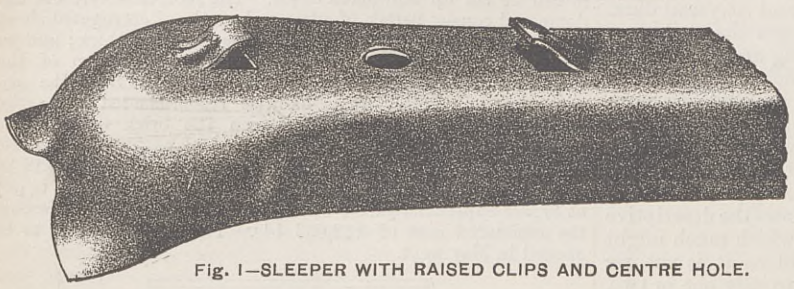


Fig. 1—SLEEPER WITH RAISED CLIPS AND CENTRE HOLE.

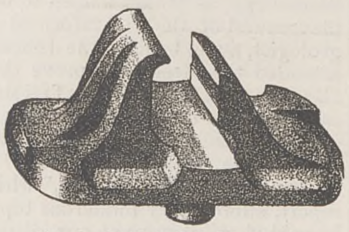


Fig. 2—SIDE VIEW OF CHAIR.

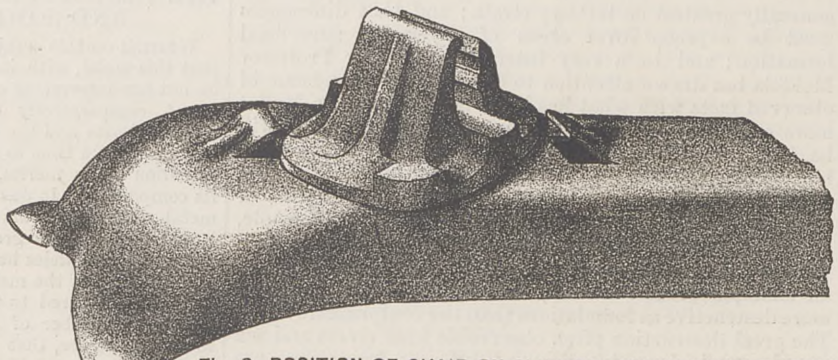
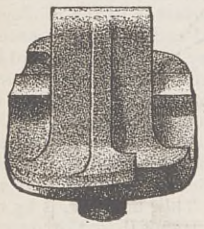


Fig. 3—POSITION OF CHAIR ON SLEEPER, READY TO BE TURNED UNDER THE CLIPS.

Fig 4



END VIEW OF CHAIR.

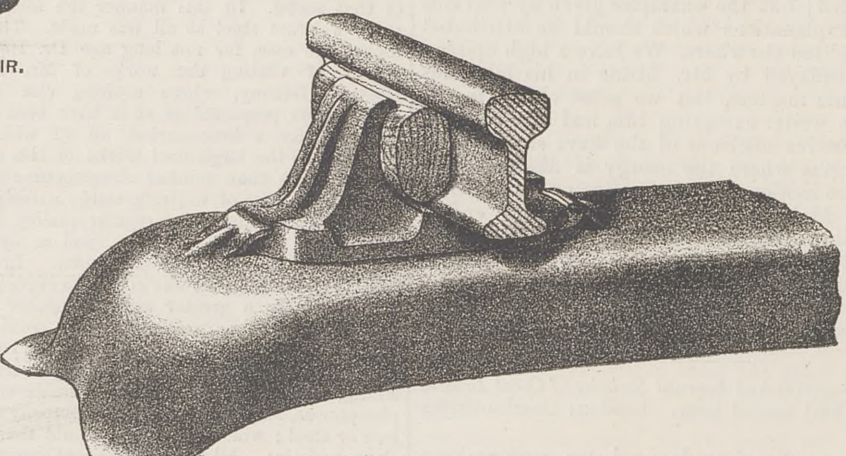


Fig. 5—CHAIR AND RAIL FIXED IN POSITION ON SLEEPER.

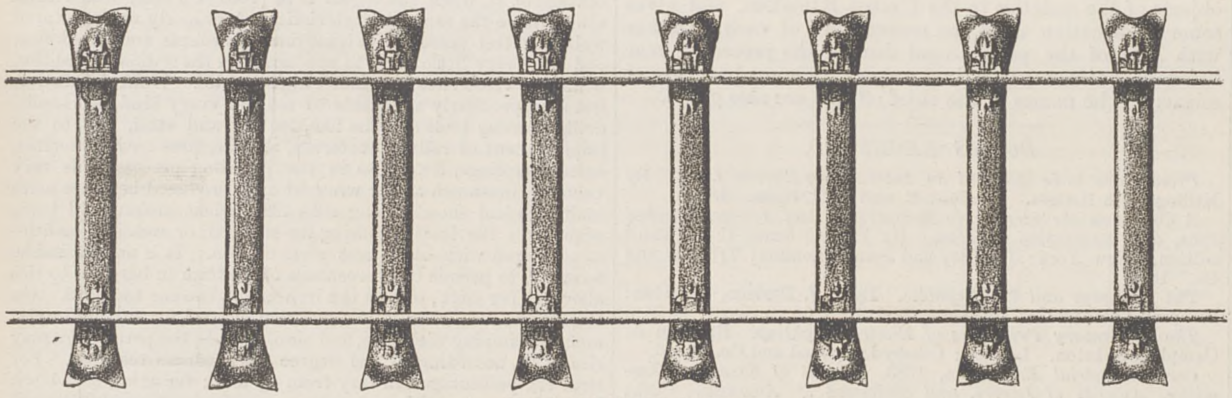


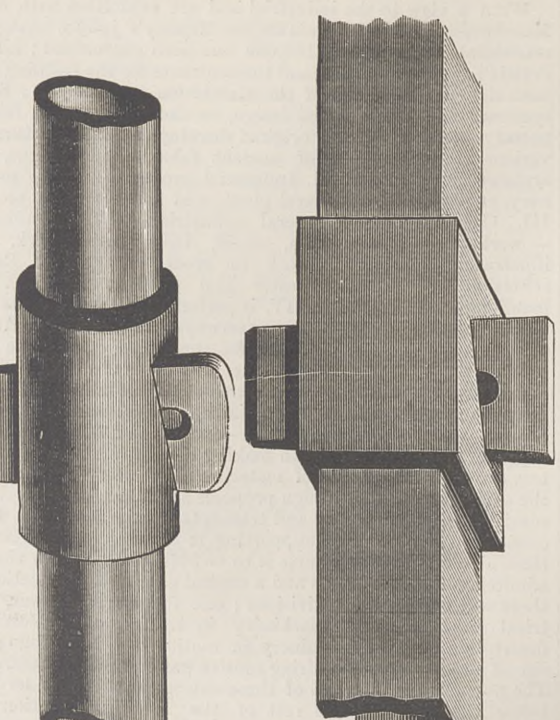
Fig. 6—PLAN OF ROAD.

TOZER AND SON'S SELF-FASTENING RAILWAY CHAIR FOR STEEL SLEEPERS.

The simplest thing is always the last conceived by inventors of mechanical apparatus or plant. The substitution of metal sleepers in the place of wood has set engineers and others at work to ascertain the most economical and at the same time the most simple and efficient means of attaching or supporting the rails on chairs or otherwise to the sleepers, and hundreds of ingenious methods have been devised, but most have been too costly, too numerous in parts, or not satisfactory for the proposed work. Permanent way should have as few parts or attachments as possible, and Messrs. Tozer and Son seem entitled to claim to have accomplished this. They employ the ordinary cast iron chair and key, and fasten it to a steel sleeper, at a cost less than usual, as they entirely avoid the expense and disadvantages of all loose pieces. Our engravings show how this is accomplished. The sleeper itself is constructed with stiff spring clips, pressed out of the material of the sleeper itself, as shown most clearly in Fig. 1, and a round hole is at the same time punched to receive a short stud projection cast on the chair. The ends of the chair are made with bevel and slightly taper edges, and by placing the chair as shown in Fig. 3, it is readily pulled into the position shown in Fig. 5 by means of a lever. Stops are cast on the chair so that it cannot be turned too far. The spring clips, whilst possessing great holding-down power—much in excess of spikes and trenails—are sufficiently elastic to retain their firm grip of the chair, which, when turned into its position under the clips and the rail keyed up, becomes self-fastened, and cannot possibly move either way. The advantages claimed by the inventors are numerous; but a metallic permanent way that uses the cast iron chair and has absolutely no loose fastenings, needs no commendation by claims, and we need only mention that the address of Messrs. Tozer and Son is 18, Abingdon-street, Westminster.

GREEN'S POINT AND SIGNAL-ROD COUPLINGS.

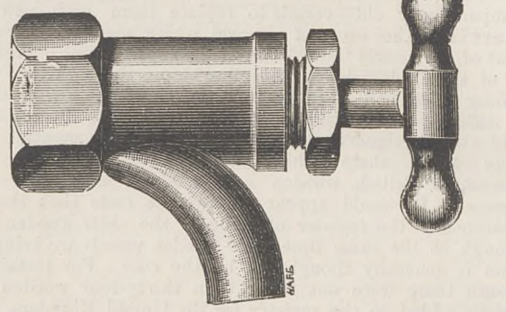
A new form of coupling for the ends of the tubular rods by which signals and points are worked, is being made by several tube and steel manufacturers under the patent of Mr. W. Green, of Croft House, Hyde, Manchester. It will be gathered from the engravings herewith, that the ends of the rods, whether circular tubes or of channel section, are slotted with a half slot in an angular direction. The two ends of two rods being placed in a coupling socket similarly slotted angularly, and a key driven in,



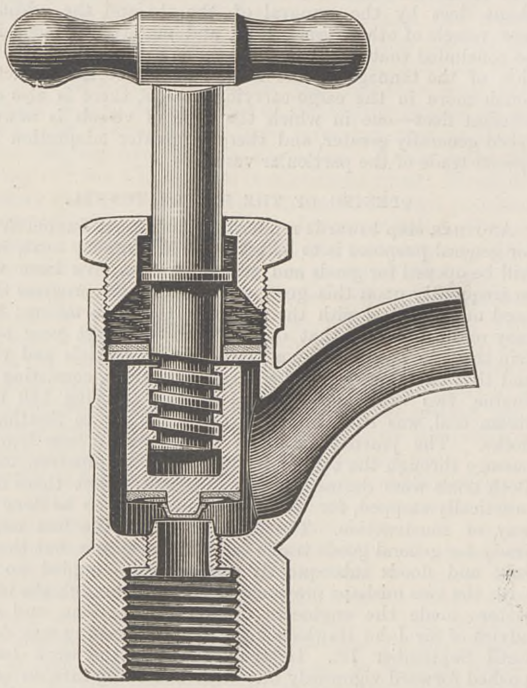
the whole are held together firmly although the slots in the rod ends are open. The joint is a very simple one, and will commend itself to railway men.

LAMBERT'S NEW HIGH PRESSURE WATER TAP.

The water cock or valve illustrated by the accompanying engravings is a new and economical high pressure valve, made by Messrs. Thos. Lambert and Sons, Short-street, Lambeth. The cocks are of cast iron, with very small gun-metal seatings, so that while they are very strong and efficient they are not



tempting to those of poorer neighbourhoods, who hold confused ideas as to property rights. When closed no water remains in them, so that frost will not affect them. The construction of the cock is clearly seen from our sectional engraving. The valve screws up against a brass bush, and is itself guided by two



side wings not seen, and is worked by a strong square thread screw. The arrangement is very simple and good.

HARRISON'S LATHE CARRIER.

The lathe dog or carrier illustrated by the accompanying engraving is just one of those simple things that are the best and handiest, and that make a man marvel at the profundity of the sleep that could have kept him from making the same thing long ago. The carrier is made by Mr. Harrison, of Abergavenny, and is for nine jobs out of ten much handier than the ordinary

carrier, and will in many cases save a good deal of time. It is made of malleable iron with hardened pointed set screw, with a square head, not a cheese head with a tommy hole as shown. Judging by the grip obtainable with a sample sent us, we should think that it is quite as firm as with the ordinary carrier, which often makes it necessary to remove the work from the lathe when it would otherwise be unnecessary. The convenience of the new one is obvious.

BOGIE ENGINE, CALEDONIAN RAILWAY.

We complete this week by the engraving on p. 168, our illustrations of the fine locomotive exhibited at Glasgow by Messrs. Neilson and Co., Hyde Park Locomotive Works, Glasgow. Our illustration gives two end views, two sections, and an elevation of the motion plate, &c. Beneath this last is an enlarged view of the sand pipe, through which a small quantity of clean sharp sand is blown, right under the tread of the driving wheel, by a jet of compressed air from the Westinghouse reservoir.

New Dock Works in Fife.—Recent years have entirely changed the position of the Fife seaboard with regard to dock accommodation. A few years ago only vessels of a comparatively small tonnage could load even at Burntisland, but now the largest steamers enter thore almost at all stages of the tide. About the same time as Burntisland went in for its new harbour scheme a tidy little dock was constructed at Wemyss by Mrs. Wemyss, of Wemyss Castle, and there, in meeting the demand of a smaller class of vessels, chiefly foreigners and coasters, a very fair trade is carried on. Only a few miles further east the coast, however —where the Firth forms a quiet sheltering bay—at Methil, also on the Wemyss estate, large dock works are at present in course of construction. Repeated attempts have been made to make new harbours and dock works at Kirkcaldy, and had the bill succeeded to form a new railway *viâ* Dunfermline to Alloa, presumably in conjunction with the Caledonian Railway system, these works would, in all likelihood, have been commenced ere now. Several plans for new dock and harbour works at Kirkcaldy have been obtained, the latest only quite recently by several public-spirited gentlemen—local manufacturers, colliery proprietors, and others—who, at their own expense, engaged Sir John Coode, C.E., to report upon the subject, but the matter is for the present shelved,

AMERICAN NOTES.

(From our own Correspondent.)

New York, Aug. 14th.

Congress has authorised the construction of two cruising ironclads, each of which will carry four 10in. guns in turrets, and four or six 6in. guns on deck. Proposals are to be invited from every American shipbuilder, and other persons who can satisfy the Secretary that they possess the facilities to do the work. Four vessels in all are to be constructed. Besides this a dynamite gun cruiser is to be built at New York, which will be 230ft. long, 26ft. beam, 7½ft. draught, 3200-horse power, with a guaranteed speed of 24 knots per hour. The vessel is to cost 350,000 dols. The four cruisers authorised by Act of Congress, March 3rd, 1885, will cost 5,000,000 dols., which in addition to the recent expenditures authorised will make a total expenditure of 16,000,000 dols., all of which, it is expected will impart considerable activity to shipbuilding.

In the Navy Appropriation Act approved March 3rd, 1885, provision is made for strengthening the navy "by additional vessels of the best and most modern design, having the highest attainable speed," and for this purpose the sum of 1,895,000 dols. has already been appropriated. Plans for these vessels are completed and advertisements for proposals will shortly be issued by the Secretary of the Navy. The Act requires the construction of two cruisers of not less than 3000 tons nor more than 5000 tons displacement, each to cost exclusive of armament not exceeding 1,100,000 dols.; one heavily armed gunboat of about 1600 tons dispacement, to cost exclusive of armament not more than 520,000 dols.; one light gunboat of about 800 tons, to cost not more than 275,000 dols. According to the plans adopted for these four vessels one cruiser will be 4000 tons and have 8500-horse power, the other will be 3750 tons and have 8000-horse power. The heavily armed gunboat will be 1700 tons with 3500-horse power, and the light gunboat will be 870 tons with 1000-horse power. This gives an aggregate of 10,300 tons displacement and 21,000-horse power. In the construction of the hulls of these four vessels 4500 tons of steel will be consumed and the machinery will require 3000 tons of various metals. They will be armed with twenty-eight 6in. guns. The entire cost of these vessels ready for sea will be nearly, if not quite, 5,000,000 dols.

The Act to increase the naval establishment which was passed at the last session of Congress is the most important step taken since the close of the war to rebuild the navy. As a measure looking to the national defence and the maintenance of the national power it is one of the highest importance. At the same time its practical relations to the iron and steel industries of the country, and the numerous industrial branches that revolve with them, cannot fail to make the Act in question one of peculiar interest alike to wage earner and capitalist. An analysis of the Act shows that approximately it involves the expenditure of 16,000,000 dols. and the consumption of 30,000 tons of the best quality of American metals. This will prove a welcome announcement to American manufacturers and mechanics. The Act provides: First, for the construction of two sea-going double-bottomed armoured vessels of 6000 tons displacement, designed for a speed of at least 16 knots per hour, and with engines having all necessary appliances for working under forced draught. These two vessels will each possess 8500-horse power, and the cost of each will be 2,500,000 dols. exclusive of armament. Secondly, one protected double-bottomed cruiser of 4000 tons displacement, designed to have the highest practical speed and furnished with the best type of modern engines, with the necessary appliances for working under forced draught. This vessel's machinery will have 10,000-horse power, and she will cost 1,500,000 dols. without her armament. Thirdly, one first-class torpedo boat to cost not more than 100,000 dols.

This much has been done towards supplying new ships for the navy. Omitting the torpedo boat, we have here three armoured vessels aggregating 16,000 tons displacement, with an aggregate of 27,000-horse power, the construction of which excluding armament will involve an expenditure of 6,500,000 dols., and which will consume 10,000 tons of American steel in their hulls and armour and about 5000 additional tons of American metals in the machinery. The Act provides that the double-bottomed cruiser shall have not less than 3500 tons or more than 4000 tons displacement, the maximum of cost exclusive of armament to be 1,500,000 dols. In the foregoing description of the vessels the displacement of the cruiser is put at 4000 tons, it being understood that these figures have been decided upon by the Secretary of the Navy.

NEW COMPANIES.

The following companies have just been registered:—

John Fowler and Co. (Leeds) Limited.

This is the conversion to a company of the business of John Fowler and Co., engineers, millwrights, &c., of the Steam Plough Works, Leeds. It was registered on the 13th inst. with a capital of £680,000, in £10 shares, 50,000 of which are £5 per cent. preference shares, and 18,000 are ordinary shares; 20,000 preference shares credited as fully-paid up, and 18,000 ordinary shares credited as paid up to the extent of £5 per share, will be issued to founders of the company. The subscribers are:—

	Shares.
*Robert Fowler, 6, Lombard-street, engineer	1
*David Greig, Headingley, Leeds, engineer	1
*R. W. Eddison, Leeds, engineer	1
*R. Wigram, Headingley, Leeds, engineer	1
J. Gurney Fowler, Woodford, Essex, accountant	1
A. Fowler, 6, Lombard-street, engineer	1
W. McIntosh, 6, Lombard-street, engineer	1

The first four subscribers are appointed directors; qualification, 500 shares.

Gandy Belt Manufacturing Company, Limited.

This is the conversion to a company of the business of belting manufacturer carried on by Maurice Gandy, of Liverpool and London. It was registered on the 17th inst. with a capital of £10,000, in £1 shares, with the following as first subscribers:—

	Shares.
T. P. Richards, 3 and 5, Salthouse-lane, Liverpool, engineer	1
A. Robertson, Mersey-street, Liverpool, engineer	1
R. D. Robertson, 30, Mersey-street, Liverpool, engineer	1
T. Wilson, 31, Wapping, Liverpool, oil merchant	1
S. T. Stephenson, Hopwood-street, Liverpool, oakum manufacturer	1
W. Chadburn, 11, Waterloo-road, Liverpool, ship telegraph manufacturer	1
W. S. Stephenson, Blundellsands, merchant	1

The direction of the company is vested in Mr. Maurice Gandy, who is appointed manager.

Knitting Machine Alliance, Limited.

This company proposes to carry on business as manufacturing engineers, and as manufacturers of, and dealers in, yarns, hosiery, and all kinds of looped, netted, felted, and textile fabrics. An unregistered agreement of the 5th inst. between Harold Digby Hassell Charlton and Theophilus Watten Thompson, of which no particulars are given in the registered documents, will be adopted. The company was incorporated on the 12th inst. with a capital of £100,000, in £1 shares. The subscribers are:—

	Shares.
William Wild, 104, Westbourne-terrace	1
*J. Holroyd, Hulme, Manchester, manufacturer	1
*J. E. Carver, 10, St. George's-avenue, manufacturer	1
H. H. D. Charlton, The Grove, Dulwich	1
T. W. Thompson, Grove Park, Chiswick	1
J. W. Vivian, 37, Sudbourne-road, Brixton, commercial traveller	1
W. Blake, 13, Annandale-road, Greenwich, engineer	1

The number of directors is not to exceed seven; qualification, 250 shares; the first are Messrs. Saul Isaac, Robert Boyd, Wilson Burgess, Arthur Goldthorpe, J. E. Carver, and J. Holroyd; remuneration, £1000 per annum.

Hyatt's Crystalline Glass Company, Limited.

This company was registered on the 12th inst. with a capital of £15,000, in £1 shares, to carry out a contract of the 11th inst. with Septimus Hedges, for the purchase of an invention for improvements in the treatment of vitreous and glazed surfaces for decorative purposes. The subscribers are:—

	Shares.
C. F. Fox, 2, Whitefriars-street, editor	1
H. Clark Lewis, Tynemouth-road, Tottenham	1
T. T. Curtis, 17, Triangle, Ruby-street, Old Kent-road, cashier	1
E. Fowler, 73, Elsley-road, Lavender-hill, clerk	1
A. Taylor, Windsor-road, Upton	1
H. A. Barrow, Whitton, Hounslow, publisher	1
W. B. Woosman, 34, Faraday-street, Walworth, clerk	1

The number of directors is not to be less than two nor more than five; qualification, five shares; the first are Messrs. Septimus Hedges and Alexander Hamilton Synge, who are to receive £50 per annum each, and such further sum not exceeding £200 per annum each as may be available out of profits after payment of 5 per cent. per annum dividend.

Aberdare Merthyr Colliery Company, Limited.

This company was registered on the 16th inst. with a capital of £25,000, in £100 shares, to acquire and work the Aberdare Merthyr Steam Coal Colliery, situate in South Wales. The subscribers are:—

	Shares.
G. E Wood, 30, Coal Exchange, ship and coal owner	1
C. Hambro, M.P., Blandford	1
W. B. Hawkins, 39, Lombard-street, iron merchant	1
H. C. Smith, Hay's Wharf, Southwark, wharfinger	1
J. H. Johnson, 23, Billiter-street, corn factor	1
R. Heriot, 70, Old Broad street, merchant	1
W. T. Rees, M.E., Aberdare	1

The number of directors is not to be less than three nor more than seven; qualification, five shares or £500 stock; the first will be appointed at the first general meeting, when the remuneration will also be determined, the subscribers acting *ad interim*.

Alderman, Johnson, and Co., Limited.

This company was registered on the 14th inst. with a capital of 20,000, in £1 shares (with power to issue mortgage debenture bonds not exceeding £10,000 at one period), to carry on business as manufacturers of invalid couches, chairs, and carriages, together with cabinet-making in all branches. An unregistered agreement of the 10th inst. between John Alderman and John Johnson of the one part, and William Oakshatt (for the company) of the other part, is adopted. The subscribers are:—

	Shares.
C. Johnson, 87, New Oxford-street, mica merchant	1
J. Johnson, 87, New Oxford-street, merchant	1
C. H. Oakshatt, 87, New Oxford-street, carriage maker	1
B. Cubitt, 85, New Oxford-street, merchant tailor	1
H. Arnold, 22, Castle-road, N.W., salesman	1
A. Collingridge, Paris, chemist	1
J. Alderman, 16, Soho-square, invalid carriage maker	1

The number of directors is not to be less than three nor more than seven; qualification, fifty shares; the subscribers are to appoint the first; remuneration, 10s. 6d. to each director for every attendance, to be doubled when 10 per cent. per annum is paid to shareholders.

Miles.—An English mile is 1760 yards, an Irish mile is 2240 yards, a Scotch mile is 1984 yards, a Prussian mile is 8238 yards, an Italian mile is 1093 yards, a Swedish mile is 11,703 yards, a Swiss mile is 8548 yards, a Dutch mile is 8101 yards, a Chinese mile is 609 yards, a Russian verst is 1167 yards.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Alfred Waters, fleet engineer, to the Pembroke, for service in Reserve; James Edmunds, staff engineer, to the Neptune; Joseph Monk, chief engineer, to the Forth; Richard J. P. Jones, engineer, to the Pembroke, additional, for charge of torpedo boats; William J. Andrew, engineer, to the Jumna; William F. Pamphlett, engineer, to the Asia, additional.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

17th August, 1886.

10,504. Compounding Steam Engines, J. A. Thompson, London.
10,505. Safety Attachment for Taps, H. J. Gibson and W. Buck, London.
10,506. Moulds for Foundry Purposes, H. Tabor, London.
10,507. Shoe-brushing Machines, &c., L. T. Jones, London.
10,508. Automatic Electric Liquid Level Indicator, J. J. Ghegan, London.
10,509. Regenerative Gas Lamps, C. M. Lungren, London.
10,510. Fastening of Buttons for Boots, W. Frost, Worcester.
10,511. Wheel Toys, F. R. Baker, Birmingham.
10,512. Devices for the Withdrawal of Aerated Liquids from Bottles, E. S. Shepherd, London.
10,513. Fire-clay Urinals, A. F. Morrison and M. Ingram, Cornbrook.
10,514. Mathematical Instruments, &c., W. Bridge, Worcestershire.
10,515. Native Rubber Block Cutting Machines, W. Coulter, Manchester.
10,516. Stretching Trousers, E. Farmer, Smethwick.
10,517. Cutting Coal, &c., J. W. Jones and R. S. Harrison, Northumberland.
10,518. Production of Evaporated Milk, A. H. Reed.—*(R. Ellin, United States.)*
10,519. Machine for Renovating Feathers, O. L. Williams and A. Conacher, London.
10,520. Locks for Leather Bags, H. Sanders, Walsall.
10,521. Protecting Bottles, L. F. Lesieur, London.
10,522. Type Setting Machines, W. P. Thompson.—*(J. L. McMillan, United States.)*
10,523. Type Distributing Machines, W. P. Thompson.—*(J. L. McMillan, United States.)*
10,524. Wardrobe, G. Denis, Liverpool.
10,525. Casting Type Bars, A. J. Boult.—*(O. Mergenthaler, United States.)*
10,526. Knob Attachments, W. I. Alvord, London.
10,527. Knob Attachments, W. I. Alvord, London.
10,528. Knob Attachments, W. I. Alvord, London.
10,529. Knob Attachments, W. I. Alvord, London.
10,530. Water Closets, A. J. Boult.—*(B. Havanagh, United States.)*
10,531. Construction of Houses, A. J. Boult.—*(A. Aubrée, Bordeaux.)*
10,532. Railway Carriage Couplings, G. L. Walton, London.
10,533. Bills of Fare, W. Mill, London.
10,534. Twisted Loop Stitch Pocket Sewing Machine, T. S. James, London.
10,535. Compound Crank, T. S. James, London.
10,536. Electric Battery Excitant, E. D. Kendall, London.
10,537. Wire Straining Machine, J. Reid, London.
10,538. Car Springs, C. T. Schoen, London.
10,539. Manufacture of Boots and Shoes, H. Law, London.
10,540. Fire-lighter, P. Comte, A. Desaubeau, and E. Delarue, London.
10,541. Driving Sewing, &c., Machines, C. Crastin, London.
10,542. Dyeing Textile Fibres, T. Holliday, London.
10,543. Swinging or Self-levelling Berths, P. M. Justice.—*(A. P. Bickmore and E. B. Pendleton, United States.)*
10,544. Tiles, H. J. Haddan.—*(H. Deschamps, France.)*
10,545. Preparing Fibres, A. Mitscherlich, London.
10,546. Valves for the Outlets of Baths, J. H. Bean, London.
10,547. Slide Valve Mechanism for Steam Engines, E. P. Alexander.—*(C. Schmid, United States.)*
10,548. Railways, Engines, and Carriages, N. P. Davison, London.
10,549. Non-condensing Steam Engines and Valves, M. H. Robinson, London.
10,550. Machines for Coiling Wire, W. R. Lake.—*(J. E. Gailey and G. W. Percy, United States.)*
10,551. Signalling Apparatus, G. W. Brown, London.
10,552. Separating Liquids of Different Densities, W. R. Lake.—*(J. Evans and D. H. Burrell, United States.)*
10,553. Axles for Railways, &c., W. R. Lake.—*(J. Bourne, jun., United States.)*
10,554. Preventing the Slamming of Doors, W. R. Lake.—*(C. H. Shaw, United States.)*
10,555. Tell-tale for use in Factories, &c., F. C. Stanton, London.
10,556. Rock-drilling Machines, W. R. Lake.—*(E. Moreau, United States.)*
10,557. Attachments for Sewing Machines, F. Cree, jun., and L. F. Marsh, London.

18th August, 1886.

10,558. Printing Music with a Revolver instead of Engraved Plates, G. Becker and D. Monnier, Germany.
10,559. Flying Engine, J. K. Smythies, Great Bentley.
10,560. Facilitating the Raising of Carriage Heads, H. Weatherhill, Manchester.
10,561. Obviating the Defacement of Buildings, &c., W. H. Fogg, Leeds.
10,562. Ships' Berths, W. P. Hoskins, Birmingham.
10,563. Locking Ladders together for Fire Brigade, &c. Purposes, T. Hunt and W. King, Manchester.
10,564. Fastening Envelopes, &c., with Gum, W. C. Owston, Wentbridge.
10,565. Preventing Lids falling off Tea-pots, G. H. Tomlinson, Shelton.
10,566. Insulators for Mechanical Telephones, C. H. Martin, Middlesbrough.
10,567. Manufacture of Confections, J. P. Wright, York.
10,568. New Advertising Medium, H. Cochrane, Dublin.
10,569. Sealing Electric Batteries, C. H. L. Clarke, Manchester.
10,570. Sectional Metal Tips for Boots, &c., W. Freeman, Leicester.
10,571. Bush for the Tap Holes of Glass Filters, P. P. Kipping and F. H. Judson, London.
10,572. Safety Screws, W. G. Hills and T. C. Menke, Birmingham.
10,573. Fasteners for Windows, J. Rankin and W. W. Palmer, Skipton-in-Craven.
10,574. Manufacture of Glass, A. Drummond, Glasgow.
10,575. Lathes, W. W. Hulse, London.
10,576. Measuring Gauges, W. F. Jackson, Sheffield.
10,577. Fare Checking Apparatus, A. W. Richardson, London.
10,578. Rollers Employed in Spinning, &c., Machinery, G. Ryder and W. Longworth, London.
10,579. Temporarily Stopping Holes in Ships, &c., W. W. Popplewell.—*(C. H. S. Schultz, Germany.)*
10,580. Ammunition, D. Johnson and W. D. Borland, London.
10,581. Galvanic Battery, E. M. Gardner.—*(T. L. Kauffer, United States.)*
10,582. Nuts for Bolts, A. J. Le Blanc, London.
10,583. Fixing Belts or Rings to Projectiles, A. J. Le Blanc, London.
10,584. Collar for Horses, &c., C. J. M. Gardner and J. Prosser, London.
10,585. Materials for Lining and Trimming Hats, B. Ware, Luton.
10,586. Warp Machine, J. R. Hancock and W. Dexter, London.
10,587. Fire-arms, L. Armanni, London.
10,588. Looms for Weaving, J. Dodd, Manchester.
10,589. Portable Saws, W. F. Stanley, South Norwood.
10,590. Tobacco Pipes, J. M. B. Baker, London.
10,591. Buttons, W. R. Comings, London.
10,592. Salting Animals, W. R. Comings, London.
10,593. Metal Stencil Plates, F. Sarjant, London.
10,594. Obtaining Alloys of Aluminium with Copper, J. Clark, London.
10,595. Desiccating Wood, A. Flamache and E. Picard, London.
10,596. Fuel Economising, &c., Apparatus, W. J. Williamson, Deptford.
10,597. Fixing Tubes in Steam Generators, H. J. Haddan.—*(I. Lecoq, France.)*
10,598. Lock, H. J. Haddan.—*(L. Baleguyier and Co., France.)*
10,599. Isolating Valves for Steam Pipes, J. Dewrance.—*(C. Pinel, France.)*
10,600. Electric Furnaces, J. E. Rogerson, J. G. Statter, and J. S. Stevenson, London.
10,601. Administering Anæsthetics in Dental and Surgical Operations, W. G. Jones, London.
10,602. Crushing Apparatus, A., A., and H. Binet, London.
10,603. Ventilating Apparatus, W. R. Lake.—*(B. Holbrook and H. N. Mann, United States.)*
10,604. Sewing Machines, F. Ewers, London.
10,605. Extracting Aluminium from its Chlorides, W. R. Lake.—*(Count R. de Montgelas, United States.)*
10,606. Extracting Aluminium from its Chlorides, W. R. Lake.—*(Count R. de Montgelas, United States.)*
10,607. Electro-deposition of Aluminium, W. R. Lake.—*(Count R. de Montgelas, United States.)*
10,608. Ships' Winches and Windlasses, T. Thompson, Newcastle-upon-Tyne.
10,609. Attaching Metallic Pens to the Outside of Boxes, &c., W. E. Wiley, Birmingham.
10,610. Safety Picture Hanger, A. Graves, London.
10,611. Converging Firing at Sea, J. A. C. de Latouche, Paris.
10,612. Securing Knobs on Doors, J. F. Nuttall, Manchester.
10,613. Metal for Water Taps, J. Shaw, Huddersfield.
10,614. Ladies' Puff-boxes, H. Levetus, Birmingham.
10,615. Printing upon Calico, &c., J. M. Hampson, Manchester.
10,616. Steering Gear for Boats, J. Coulson, Buckie, N.B.
10,617. Change or Drop Shuttle-box Looms, E. J. Scott and A. Wadsworth, Halifax.
10,618. Breaking Coke, J. Smithers and R. Thomas, Kingston-on-Thames.
10,619. Short Circuiting Devices, G. A. Mason, London.
10,620. Automatically Administrating an Electric Current, W. S. Oliver, London.
10,621. Registering Machines, W. S. Oliver, London.
10,622. Ejector for Dental or other Purposes, J. C. Plunkett, London.
10,623. Cleansing Tobacco Pipes, H. Cullabine, Sheffield.
10,624. Unstopping Tobacco Pipes, H. Cullabine, Sheffield.
10,625. Lock Girder Tiles, J. D. Denny, Llangollen.
10,626. Ejecting Granular Material, J. Farmer, Glasgow.
10,627. Button-hole Sewing Machines, H. W. Pollock, Glasgow.
10,628. Fastening Objects to Iron, C. B. Axt, London.
10,629. Wheels for Railway and other Vehicles, E. Dearden, London.
10,630. Electric Fire Alarms, R. M. Somers, Leeds.
10,631. Bricks, J. Mobberley and H. Perry, Birmingham.
10,632. Adjustable Brackets, A. M. Hart, Plumstead Common.
10,633. Toothed Rolled Fencing Wire, J. Schmidt, London.
10,634. Marking Ball Programmes, F. W. Powell, London.
10,635. Advertising Envelope, H. J. Haddan.—*(Count C. de Bruc, Duke of Busignano, Italy.)*
10,636. Waxing Paper, H. J. Haddan.—*(G. E. Raymond, U.S.)*
10,637. Metal Roller, J. K. Oldfield, Leeds.
10,638. Sewing Machines, C. F. Gardner.—*(The American Novelty Shoe Company, U.S.)*
10,639. Self-closing Faucets, E. Boyes and W. J. Shepherd, London.
10,640. Lock-joint Metallic Tubes, W. Allman, London.

20th August, 1886.

10,641. Feeding Melting Furnaces, D. Rylands, B. Stoner, and R. Potter, Barnsley.
10,642. Trigger Safety Bolt for Small-arms, W. Lockyer, Enfield.
10,643. Slicing Vegetables, G. H. Dingwall, London.
10,644. Electrodes for Secondary Batteries, A. Millar, Glasgow.
10,645. Aerated Beverages, A. E. H. Loze, Liverpool.
10,646. Belting for Transmitting Power, F. Fleming, Halifax.
10,647. Pistons for Steam Engines, A. MacLaine, Belfast.
10,648. Hydraulic Steering and Starting Engine Valves, C. Stout, Liverpool.
10,649. Ropes, Cables, &c., H. Cheesman, Hartlepool.
10,650. Tramway Brakes, W. H. Blakeney, Dundee.
10,651. Wheels and Axles for Vehicles, W. Malam, Manchester.
10,652. Self-locking Safety Burglar Proof Coal Cellar Plate, H. L. Provis, Cardiff.
10,653. Gathering Fruit from Trees, J. M. Carr, Mitcheldean.
10,654. Retaining Neckties, &c., in Position, W. S. Clark and W. H. Withington, Manchester.
10,655. Gas Heating Apparatus, S. S. Bromhead.—*(H. C. Gambier, France.)*
10,656. Spade and Shovel Blades, W. Bell, Sheffield.
10,657. Revolving Slide Valve and Face, J. Leitch, London.
10,658. Outlets for Sinks, &c., W. H. Withington, Manchester.
10,659. Transparent Flexible Material, F. H. Froedman, Dublin.
10,660. Packing, Storing, and Examining Eggs, J. C. Pool, Birmingham.
10,661. Stop Brake for Light Vehicles, J. Dove, Glasgow.
10,662. Displaying Maps, &c., C. H. Cope, Wiggington Park, near Tamworth.
10,663. Furnace Grates, J. Rankin, Glasgow.
10,664. Letter Rack, J. Blakey, Halifax.
10,665. Direct-acting Steam Pumps, C. J. and J. J. Croft, Merton.
10,666. Rotary Motors, W. L. Wise.—*(V. Popp, France.)*
10,667. Guard against Newly-painted Lamp-posts or Pillars, J. Gibson and G. Beaumont, London.
10,668. Protective Devices for Riders of Horses, &c., W. Kennedy, London.
10,669. Feeding and other Bottles, J. E. Kusenberg and H. Lamprecht, London.
10,670. Iron Girders for Building, E. Edwards.—*(C. F. F. Stendtner, Germany.)*
10,671. Lamps for Burning Light or Volatile Oils, J. Hinks, London.
10,672. Treads and Risers of Stairs, W. McGill, London.
10,673. Preventing Noise in Working Gas-engines, J. B. Payne, London.
10,674. Steam and other Engines, J. C. Peache, Thames Ditton.
10,675. Burners, The Patent Argand Gas and Oil Burners Company and R. T. Strangman, London.
10,676. Holding Rings in Position to be Removed by the Riders of Roundabouts, &c., W. Reynolds, jun., London.
10,677. Fittings of Baths, J. Hill, London.
10,678. Folding Sheets of Paper for Books, O. Imray.—*(E. T. Hazeltine, United States.)*
10,679. Breech-loading Fire-arms, T. Perkes, London.

10,680. Completing Electric Circuits, P. Everitt, London.
10,681. Caps, &c., P. P. Everitt, London.
10,682. Water and other Closets, &c., P. Everitt, London.
10,683. Checking Workmen's Time, &c., P. Everitt, London.
10 684. Muzzles for Dogs, &c., F. A. Egleton and S. Osborne, London.
10,685. Automatic Regulator for the Warp Beams of Looms for Weaving, G. F. Redfern.—(*M. Bossu, fils, M. Jung, and H. Carbon, France.*)
10,686. Eyeletting and Rivetting Machines, H. S. Maxim, London.
10,687. Knitting Machines, W. R. Lake.—(*C. Grosz and E. Popp, Austria.*)
10,688. Stopper, &c., for Ships' and other Ropes, R. J. Smith, London.
10,689. Grinding Mills, A. M. Clark.—(*H. W. Cutler, United States.*)
10,690. Pianofortes, T. J. Brinsmead, London.
10,691. Stairs or Stair-cases, Stollwerck and Stollwerck, London.
10,692. Fire-arms, &c., W. R. Lake.—(*La Société L. Joalland et Cie., France.*)
10,693. Artificial Stone, C. Drake, London.
10,694. Horseshoes, &c., T. D. Richardson, London.
10,695. Sulphurated Hydrocarbons, E. Jacobsen, London.
10,696. Working Engine-room Telegraphs, &c., T. F. Smith, C. Simpson, and T. Lockerbie, London.

21st August, 1886.

10,697. Cleaning Gold, &c., G. J. and G. J. T. J. Parfitt, Bristol.
10,698. Non-regenerative Gas Lighting, T. Thorp, Whitefield.
10,699. Watch Protector, G. W. Pridmore and S. Hands, Birmingham.
10,700. Cold-packed Pipe Joints, A. N. Rankin, London.
10,701. Ventilators for the Prevention of Down-draught, H. Sutcliffe, Halifax.
10,702. Steam Printing Stove for Potters, T. Shore, Hanley.
10,703. Furnaces for Treating Materials Infected with Disease, E. Sergeant, Bolton.
10,704. Mixing Apparatus for Liquids, S. S. Bromhead.—(*L. Stauffert, France.*)
10,705. Simplifying of Grab Dredgers, S. C. Harris, London.
10,706. Combined Soap Stick and Shaving Brush, J. Smith, London.
10,707. Metallic Sleepers, &c., for Railways, H. Walker and R. Woodward, Sheffield.
10,708. Bending Iron or Steel Plates, J. T. Eltringham, London.
10,709. Scutching Flax, &c., W. S. Johnston, Liverpool.
10,710. Locking Gear for Points on Railways, B. Dudley, Liverpool.
10,711. Fastening for Laces for Boots, &c., C. L. Wray, Liverpool.
10,712. Check or Back-pressure Valves, T. Aston, Birmingham.
10,713. Lighting Street, &c., Gas Lamps Automatically, J. J. Butcher, Newcastle-upon-Tyne.
10,714. Cotton-winding Machine, T. Phillips, Aberdare.
10,715. Perfect Insulation of Electrical Conductors, H. Furse and H. Thomlinson, London.
10,716. Embroidering Machines, W. E. Gedge.—(*E. Cornely, France.*)
10,717. Lighting Gas Burners, A. A. Lister, London.
10,718. Dyeing Combed Wool in Bobbins, L., J., and A. Harmel, London.
10,719. Fastening for Chains, &c., Z. Z. Barber, London.
10,720. Electro Propulsive Apparatus, W. H. Alcester, London.
10,721. Fomenting Feet of Horses, F. Seabrook, London.
10,722. Charging Liquids with Carbonic Acid Gas, F. Foster, London.
10,723. Stoves, H. Ramsden, London.
10,724. Telephone Transmitters, P. Rabbidge, London.
10,725. Removable Shields for Furniture, T. Simpson, London.
10,726. Controlling Swings, W. Reynolds, jun., and P. Everitt, London.
10,727. Indicating Distances at Railway Stations, G. F. Redfern.—(*Chabrol, fils, Thiers.*)
10,728. Cigar Lights, &c., G. A. Sweetser, London.
10,729. Match-boxes, W. R. Lake.—(*A. Widestrōm, Sweden.*)
10,730. Fillets for Decorative Purposes, E. A. Brinkmann, London.
10,731. Projectiles for Fire-arms, W. R. Lake.—(*C. Haas, Austria.*)

23rd August, 1886.

10,732. Carriage and other Lamps, C. Peters, Manchester.
10,733. Bearings and Bushes for Machinery, C. Bennett, Sheffield.
10,734. Hat Brushes, L. Chapman, London.
10,735. Rocking Furnace Bars, L. Hopcraft, London.
10,736. Fresh Application of a Substance to Replace a certain Metal, S. Lord and J. Henderson, Wakefield.
10,737. Automatic Feed Paste Box, W. Cooper and J. Cordingley, Manchester.
10,738. Fastener for Cuffs, &c., F. R. Baker, Birmingham.
10,739. Stair Rod Eyes, F. R. Baker, Birmingham.
10,740. Artificial Manufacture of Coal so as to render it Smokeless, F. V. Hadlow, Buxted.
10,741. Protection of Life and Property caused by Boiler Explosions, R. Jones, Hanley.
10,742. Safety Box or Case, A. W. Rooke.—(*W. G. Parry, South America.*)
10,743. Friction Driving Apparatus for Lathes, A. Yates, Halifax.
10,744. Decimal Gauges, T. Duggan, E. Marshall, and G. Phillips, Birmingham.
10,745. Air Purifying Machine, J. Short, West Hartlepool.
10,746. Cutting Plush, &c., F. Robinson, Leeds.
10,747. Looms for Weaving Plush, &c., F. Robinson, Leeds.
10,748. Brakes for Coaches, &c., F. Hughes, Cheltenham.
10,749. Revolving Handle for Running Out Delivery Hose for Fire Engines, &c., G. Ivey, Burnham.
10,750. Magazine Small Arms and in Ammunition therefor, J. MacNaughton, Glasgow.
10,751. Brake Shoes or Slippers for Lorries, &c., J. S. Donaldson, Glasgow.
10,752. Brakes for Railway Carriages, &c., W. Jones, Glasgow.
10,753. Separating Funnels, &c., R. Schneider, Berlin.
10,754. Boots and Shoes, M. L. Lion and F. Cutlan, Wellingbrough.
10,755. Fining Ales by Machinery, J. Ansell and Sons, Birmingham.
19,756. Mortice Locks with Barrel Key, A. Johansen, Christiania.
10,757. Mills for Hulling, &c., J. Simpson.—(*J. S. Simpson and G. F. Simpson, United States.*)
10,758. Suspended Chairs for Obviating Seasickness, W. P. Thompson.—(*D. Valli, Italy.*)
10,759. Trusses for Hernia, E. Chadwick, W. Riley, and J. Wilding, London.
10,760. Corks for Corking Bottles, F. Flack, London.
10,761. Syphon for Storing Beer, F. Heyman, London.
10,762. Gas, &c., Lamps, H. J. Haddan.—(*A. Jahnke, Germany.*)
10,763. Making Cigarettes, E. A. Durand, London.
10,764. Hat Measure, L. E. Elkan, London.
10,765. Secondary Generators, W. Lowrie and C. J. Hall, London.
10,766. Displaying Advertisements, &c., J. St. Clair, London.
10,767. Marine Engines, J. A. Foottit, London.
10,768. Garden Syringe, L. Clifford, Barnes.
10,769. Wash Bowl Apparatus, E. W. Harding, London.
10,770. Photographic Printing Machines, J. Urie, sen., and J. Urie, jun., Glasgow.
10,771. Guards for Harness for Lessening Jerks to Horses, P. Jensen.—(*J. T. B. Sidén, Sweden.*)
10,772. Substitute for Coffee, W. R. Lake.—(*M. A. B. Mount, United States.*)
10,773. Taps and Dies for forming Screw Threads, S. C. Modzelewski, London.

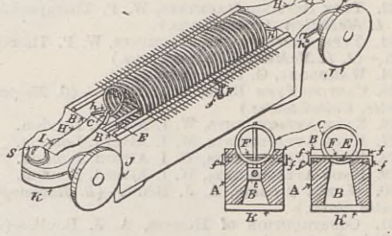
SELECTED AMERICAN PATENTS.

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

343,801. Expansion Comb for Warping, Beaming, and Other Machines, *Thomas C. Entwistle, Lowell, Mass.—Filed February* 1st, 1886.

Claim.—(1) The combination of a straight bar slotted through vertically nearly from end to end and provided in its upper surface with a longitudinal rounded groove opening into said vertical slot, a spring laid in said groove, a rod placed within said spring and extending through the same and having its ends secured to said bar within said groove beyond the ends of said slot, brackets secured to the ends of said bar provided with horizontal slits, drums turning in said brackets, screws turning in said brackets to contract said slits to hold said drums from turning, ribbons or straps secured to said drums and to the ends of said spring, and means, substantially as described, of preventing the movement of the middle of said spring, as and for the purpose specified. (2)

343,801

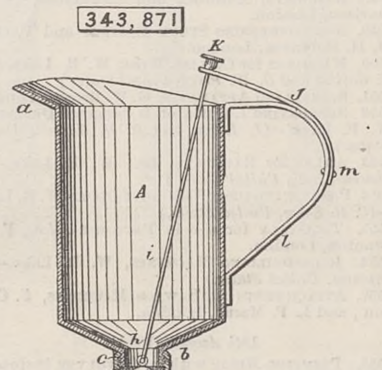


The combination of a straight bar slotted through vertically nearly from end to end, and provided in its upper surface with a longitudinal rounded groove opening into said vertical slot, a spring laid in said groove, a rod placed within said spring and extending through the same and having its ends secured to said bar within said groove beyond the ends of said slot, brackets secured to the ends of said bar provided with horizontal slits, drums turning in said brackets, screws turning in said brackets to contract said slits to hold said drums from turning, ribbons or straps secured to said drums and to the ends of said spring, and a wire or rod placed between the middle coils of said spring and secured to said bar, as and for the purpose specified.

343,871. Funnel, *Harmannus Van Kammen, Grandville, Mich.—Filed January* 20*th*, 1886.

Claim.—(1) An improved measure consisting of the vessel A, provided with the handle *l*, the conical apertured bottom *b*, and nipple *c*, having a valve seat *f*, the spring *j*, secured to the handle, the rod *i*, having its upper end secured to the spring, and the ball valve *g*, attached to the lower end of the said rod, substantially as herein shown and described. (2) As an improved article of manufacture, the measure A,

343, 871

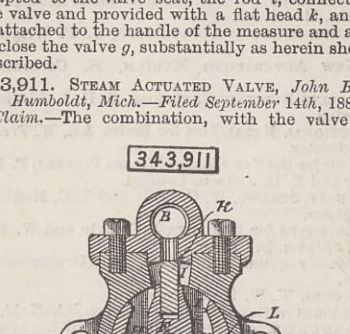


having the centrally apertured conical bottom *b*, an externally threaded nipple *c*, attached thereto, the internally threaded tapering tube *d*, having the shoulder *e*, the yielding valve seat *f*, the ball valve *g*, adapted to the valve seat, the rod *i*, connected with the valve and provided with a flat head *k*, and spring *j*, attached to the handle of the measure and arranged to close the valve *g*, substantially as herein shown and described.

343,911. Steam Actuated Valve, *John B. Maas, Humboldt, Mich.—Filed September* 14*th*, 1885.

Claim.—The combination, with the valve having

343,911

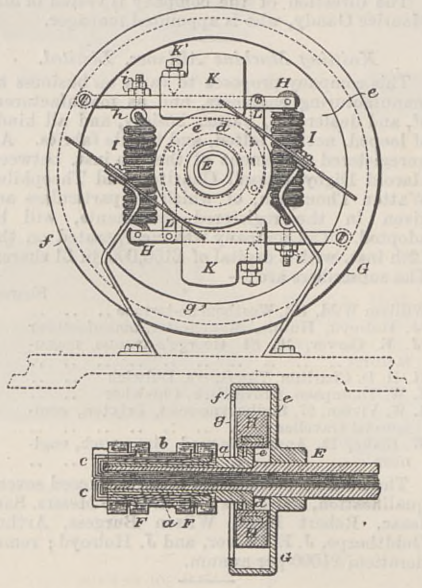


suitable induction and eduction ports and ports leading to the steam cylinder and relief ports, of the valve having corresponding ports, and the radial tongue working in a recess in the valve casing, whereby the valve is operated by the pressure of steam after its initial movement, substantially as specified.

343,886. Governor for Electro-magnetic Motors, *Chas. F. Brush, Cleveland, Ohio.—Filed December* 28*th*, 1885.

Claim.—(1) In an electric motor, the combination, with a commutator, of a centrifugal governor for automatically adjusting the commutator segments or sleeve for regulating the speed of the motor, substantially as set forth. (2) In an electric motor, the combination, with a commutator, of a centrifugal governor for automatically imparting rotary adjustment to the commutator segments or sleeve for regulating the speed of the motor, substantially as set forth. (3) In an electric motor, the combination, with a commutator sleeve loosely mounted on the armature shaft, of a centrifugal governor for automatically adjusting the commutator segments or sleeve for regulating the speed of the motor, substantially as set forth. (4) In an electric motor, the combination,

343,886

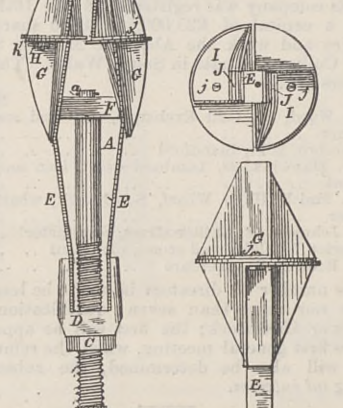


with an adjustable commutator, of a centrifugal governor mounted on the armature shaft, and adapted to regulate the speed of the motor by its automatic adjustment of the position of the commutator segments or sleeve, substantially as set forth. (5) In an electric motor, the combination, with an adjustable commutator sleeve or commutator segments, of a centrifugal governor connected with the commutator sleeve, and constructed and arranged to automatically impart rotary adjustment to the commutator sleeve in the direction opposite to that of the rotation of the armature shaft when the speed of the motor falls below a predetermined rate, and to move the commutator sleeve in the same direction as the rotation of the armature shaft when the speed of the motor exceeds a predetermined rate, substantially as set forth.

343,998. Boiler Tube Cleaner, *William H. Keep, Cal.—Filed October* 26*th*, 1885.

Claim.—The combination, with the stem A, provided with threads of the coupling B, the nuts C, the bifurcated nut D, the spreader F, and the pin *a*, the nut D being provided with the spring jaws E, embracing the spreader F, and having attached at their heads the lower scrapers G, having the heads *h*, and the

343,998

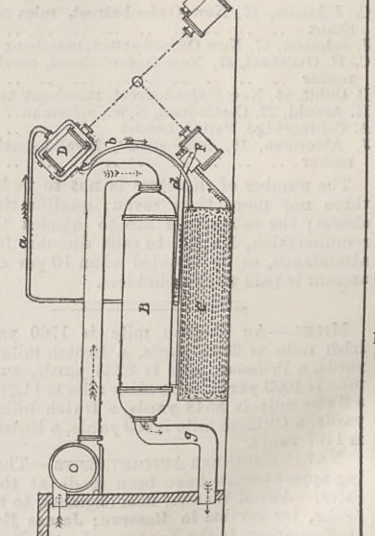


upper scrapers J, having the bases *j*, said scrapers being also secured by bolts H to the flange sections I, having a centre slot, permitting the passage of the spreader F, all constructed and arranged as and for the purposes set forth.

344,006. Refrigerator, *Cassius C. Palmer, New York, N. Y.—Filed March* 9*th*, 1885.

Claim.—(1) The process of cooling the air of a chill room, consisting of forcing the air of the chill room in

344,006

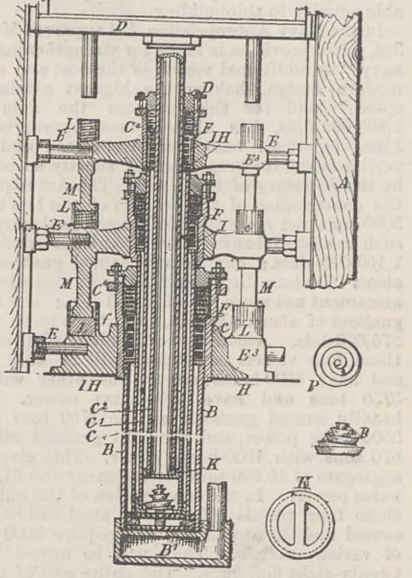


contact with surfaces made cold by contact with a second body of confined air, which is repeatedly compressed, cooled, and expanded, substantially as described. (2) The refrigerator B, containing two air passages separated by metallic divisions, the chill room, the air compressing cylinder D, the condenser or cooler C, the expanding cylinder F, the pipe *g* connecting one of the passages in the refrigerator with the chill room, the pipe *d*, connecting the other passage in the refrigerator with the cylinder F, and the pipes *a* and *b*, all combined substantially as described.

344,038. Telescoping Hydraulic Elevator, *Abraham Fitts, Worcester, Mass.—Filed February* 25*th*, 1886.

Claim.—(1) The combination, in a hydraulic elevator with outer and inner telescoping tubes or column sections, of the foot projection K, the head or stuffing box casing C^4, having the chamber c^5 with offsets *f* and *h*, the movable annular plates F and H, respectively supported on said offsets, a spring of coiled rectangular metal disposed within the chamber c^5 and confined between said plates, and the packing rings confined between the plate F and follower D^2, substantially as set forth. (2) The combination, with the hydraulic elevating mechanism or telescoping sections provided with guide arms or brackets E, of the springs L and standards M, substantially as set forth. (3) In

344,038.

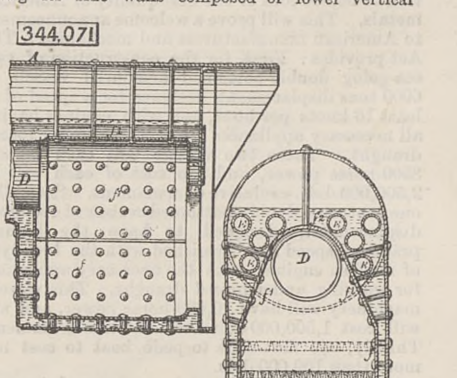


combination with the cylinders or telescoping column sections in a hydraulic elevator, the conically coiled volute spring P, the adjacent coils in which are arranged to close together as a disc, one coil against another, in the manner described, whereby said spring is adapted to act as a valve for closing the water passage, while it checks the momentum of the descending section, as hereinbefore set forth. (4) The combination substantially as described, of the elevator car, the telescoping tubular sections C C′ C^2, and the cylinder B, of the conically coiled spring and valve device P, the foot plates K, having projecting rims, the annular plates F and H, and the springs I, for the purposes set forth.

344 071. Steam Boiler, *Robert W. Aitken, Buffalo, N. Y.—Filed September* 1*st*, 1885.

Claim.—In a steam boiler, the combination, with the direct flue D and return flues E, of a fire-box having its side walls composed of lower vertical

344,071

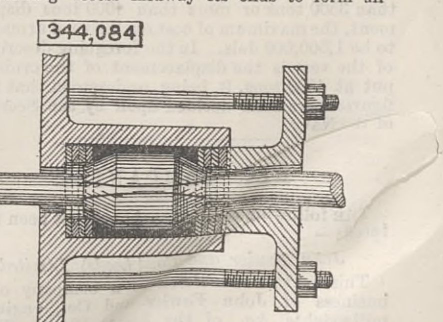


portions *f*, and upper converging portions *f′*, and having a crown sheet f^2, made concentric with the direct flue D, substantially as set forth.

344,084. Metallic Packing, *John B. Deeds, Terre Haute, Ind.—Filed October* 26*th*, 1885.

Claim.—The combination, in a stuffing box, of an annular packing made in longitudinal sections having in inclined meeting edges, each section having a corresponding recess midway its ends to form an

344,084

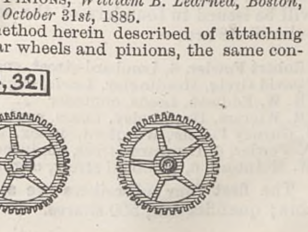


annular chamber around the rod and each end bevelled to form a double conical ended annulus, elastic rings at each end of the packiing and bearing on its conical ends, and a follower to compress said rings, as and for the purpose set forth.

344,321. Method of Attaching Hubs to Gear Wheels and Pinions, *William B. Learned, Boston, Mass.—Filed October* 31*st*, 1885.

Claim.—The method herein described of attaching hubs to small gear wheels and pinions, the same con-

344,321



sisting in forming in the wheel centre an orifice with one or more indentations in the margin thereof, and upsetting or expanding the hub in said orifice until it enters said indentations, as set forth.