SUPPLEMENTARY TRIAL OF GRUSON'S SHIELD AT SPEZIA.

WE have received the following account of the further trials at Spezia alluded to in THE ENGINEER of July 9th last.

The programme was drawn up to carry out the suggestions spoken of in our report of May 14, made with a view of testing the excellence of the Krupp projectiles which had been used in the trial, and consequently establishing the estimate which had been formed of the resisting power of the shield which had been subjected to the three blows from these projectiles. Thus, should the projectiles fired behave in such a way as to show that those previously employed were good in quality, the victory of the shield would be fully confirmed, whether it now might be found to give way or not, because it had already borne the severe ordeal laid down for it—that is the impact of three Krupp forged steel projectiles fired from the Armstrong 100-ton breech-loading gun projectiles whose excellence had been demonstrated. The programme consisted of two kinds of test. (1) Krupp 15 cm. projectiles (5·9in.) should be fired taken from a batch whose excellence had been established in the recent competition at Muggiano. This had been suggested by M. Otto Budde, Krupp's representative. If these projectiles should break up in the same way as those already fired from the 100-ton gun, the natural inference would be that there was no ground for supposing that the large projectiles were inferior in quality, at all events, the fact of their breaking up affords

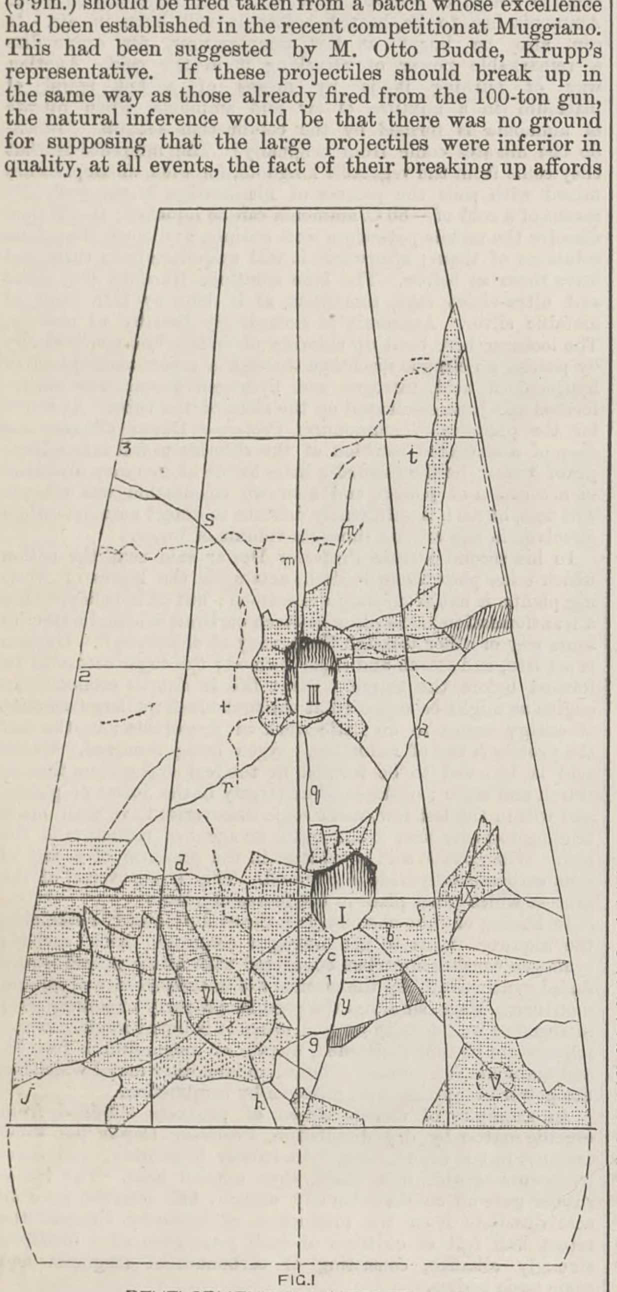


FIG. 1
DEVELOPMENT OF SURFACE

no such ground. It must be conceded that it was most reasonable that Italian officers should wish for a guarantee on this head, seeing that the difficulty of making good steel projectiles increases with the scale on which they are made to such an extent that it is desirable that those of any weight approaching 1000 kilogs., or 2200 lb., should establish their character in every possible way.

The second test was the firing of a steel projectile supplied from St. Chamond for the 100-ton breech-loading gun. This would furnish a comparison between the large projectiles made in France and Germany. Thus, supposing it were to be concluded that Krupp's large projectiles had broken up more than his small ones, or had shown an inferior fracture in any part, it would be possible to see whether the French manufacturers had been more successful on this scale.

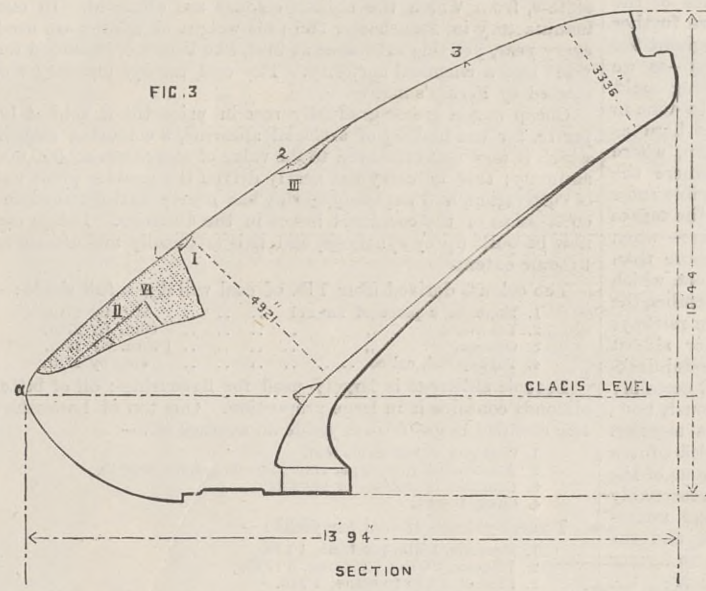
This trial, then, while it had a bearing on the resisting powers of Grüson's shield, did not touch the question of its acceptance. This had been settled at the conclusion of the trial in April. The commission for the supplementary experiments consisted of Colonel Scapparo, president, Colonel Spelta, and Captains Cabiati, Calcognini, and Zanotti. If we recollect right, Colonel Scaparro was the senior artillery officer on the commission on the April trial, and the officer who had especially pressed the necessity for a further test of Krupp's projectiles. The weight of the shield, as before given, is 87·950 kilogs. (86·56 tons). The structure had been patched up, the masonry having yielded slightly as well as the shield. The cracks in the latter were opened with steel wedges, and filled up by running in zinc.

The first firing consisted in two rounds from a 15 cm. (3·9in.) Armstrong gun, 28 calibres long, on an Albini carriage, which had been placed on the raft with a 100-ton Armstrong breech-loading gun, Lepanto type, drawn up as before at a range of 133·7 metres (438·7ft.) In both rounds with the 15 cm. gun the projectile was a Krupp hardened steel shell, made up to 36 kilogs. (79·37 lb.).

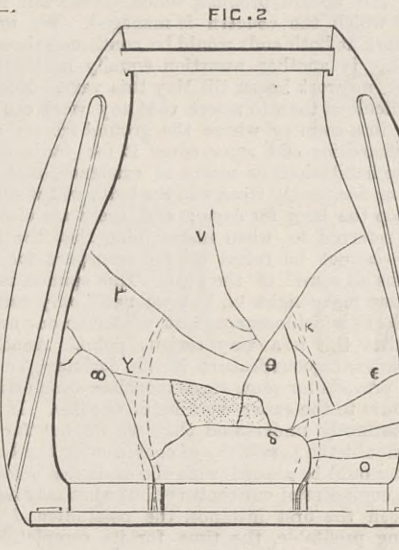
First round with 15 cm. gun (No. IV. in all).—Charge, 15 kilogs. (33·06 lb.) progressive Fossano powder (20—24 mm.); striking velocity, 500 metres (1640·45ft.); striking energy, 459 metre tons (1482·1 foot-tons). The projectile struck 13 cm. above the edge of the *avant cuirasse* (glacis plate), at 86 cm. to the right of the centre of the shield, at a striking angle of 44 deg. The projectile broke up, making a small chip in the shield.

Second round (No. V. in all).—Charge, 18 kilogs. (39·68 lb.), progressive Fossano powder (20—24 mm.); striking velocity, 564 metres (1850·43ft.); striking energy, 584 metre tons (1885·6 foot-tons). The projectile struck 23 cm. above the edge of the glacis plate and 102 cm. to the right of the centre of the shield; angle of incidence, 50 deg. 30 min. The projectile broke up, and produced about the part marked V. (Fig. 1) a chipping off the surface.

The fourth round from the 100-ton gun (Round VI. in all) was now fired. Charge, 375 kilogs. (2·2 lb.) Westphalian (cocoa powder); projectile, hardened steel, St. Chamond; calibres weight, 1000 kilogs. (2204·6 lb.); initial velocity, 539 metres; striking velocity, 535 metres (1755·3ft.); striking energy, 14,603 metre-tons (4715·4 foot-tons.) The shot was aimed high up at the point marked with a cross in Fig. 1, but the movement of the raft by the swell of the sea caused the projectile to strike close to the spot struck by the second round fired in April (see VI. on Fig. 1.) Owing to the injury the shield had suffered already, the surface was struck nearly normally—that is, at between 80 and 90 deg. The projectile broke up and dislodged portions of plate of different thickness up to 50 cm. One crack was lengthened, and some other



SECTION



INSIDE OF SHIELD

local injury effected in front (*vide* Fig. 1.) At the back were two new cracks μ and ν and also o, also a larger scale between γ and δ was detached (*vide* Fig. 2), the small fragments of which it was composed fell vertically, and would not have injured men behind the shield. A small triangular portion above α projected about 6 cm. The lower portion of the plate had given back and projected beyond the upper part about 3·5 cm. (1·4in.) along crack γ, about 6 cm. (2·4in.) along crack ϵ, and 4 cm. (1·6in.) along crack o. The left buttress or shoulder was slightly displaced. The general condition of the shield was good. In spite of the fracture of the left bearing plate or cheek, and some displacement, the shield might have borne a further attack; but there were no more available projectiles for the 100-ton gun.

The object of this programme may be said to have been attained, as far as the chief practical bearing of it for Italy is concerned. Clearly all steel hitherto known must be expected to fly in pieces against chilled iron, whether the projectile be large or small. The St. Chamond projectile, however, did not strike in such a way as to admit of a comparison of its effect with that of any of Krupp's projectiles. The comparatively small effect produced by the French shot, when striking exactly on the most injured spot in the shield, speaks well for the resisting powers of the latter, even when much cracked. We have no conclusions to add to those expressed on the April experiments. We would only emphasise what we then said on the desirability of firing at Grüson's armour in this country.

THE NORTHERN OF EUROPE RAILWAY.

THE railway which is now in course of construction in northern Europe is a very remarkable line, both on account of the engineering difficulties to be overcome and the purpose for which it is laid. It is, in brief, a line of railway from the Swedish town of Luleä, on the Baltic, north of the polar circle, to the celebrated iron deposits in Swedish Lapland, and thence to the Ofoten Fjord on the North Atlantic Ocean, whereby a direct line of communication is established between these two seas. The real object of the line is, as we have stated, to open up communication with the iron deposits referred to, a scheme which has been before the Swedish public for many years in various forms. Thus, for instance, a company formed some fifteen years ago attempted to solve the problem by canalising certain rivers flowing down to the Baltic, but without success; a sum of about half a million sterling being expended in this undertaking, and a subsequent concern suffered the same fate. There was also a proposal made to build a railway from the port of Luleä, on the Baltic, to the deposits; but this plan also fell through, as it was evident that the line must have been a financial failure, on account of the seven or eight months' winter prevailing in the north of Sweden, which would prevent all exports of ore, and almost the working of the line, during such a period. Now, however, the plan is to open up the deposits from the Swedish as well as the Norwegian side, whereby the advantage is gained of having a port open all the year round, as it is a well-known fact that the Gulf Stream keeps the fjords on the west coast of Norway open all the year. The first plan was for a railway from the Ofoten Fjord, in Norway, to the Gellivara deposits alone; but Sweden refusing the concession, as far as her territory was concerned, the promoters had to accept the inevitable, and agree to continue the line to the Baltic. There can be no doubt to any one not interested in this scheme that such a railway might have been made to pay, at all events if the prices of iron ore and iron should revive somewhat, although the distance from Ofoten to Gellivara is a little longer than the distance between the latter place and the Baltic, for this reason—that this disadvantage is fully counterbalanced by the more favourable weather conditions on the Norwegian side, an open port all the year, and lesser engineering difficulties. The total length of the railway, from the Baltic to the North Atlantic, is estimated at about 350 miles; but it would not be surprising if, when actually constructed, the line should prove considerably longer, as the parts through which it runs are wholly *terra nova* from an engineering point of view, though it is stated that the line has been surveyed. As regards the cost of the line, various estimates have been made, and none can be called trustworthy; but the cost may be near a million sterling. As an example of the engineering difficulties in Norway, it may be mentioned that the promoters estimate the cost of the 120 miles between Luleä and Gellivara to be equal to the 28 miles on the Norwegian side of the frontier. These figures are exclusive of the purchase of land and rolling stock.

Before proceeding to discuss the practicability of this railway, and whether it can become a profitable undertaking, we will give some particulars of the celebrated iron deposits in Swedish Lapland, taken from official sources.

The deposits are situated near the Norwegian frontier, in lat. 67 deg. N., the chief being those of Luosavara and Kirunavara, in the parish of Gellivara, whence their name; and of 632 samples taken by the Swedish authorities some years ago, 298 showed a contents of under 50 per cent. of pure magnetic iron, 159 between 50 and 55 per cent., 109 between 55 and 60 per cent., 45 between 60 and 65 per cent., 15 between 65 and 68 per cent., 5 between 68 and 70 per cent., and 10 more than 70 per cent. One contained as much as 74 per cent. The ores lie generally in eurite, often red in colour, and occasionally somewhat gneissic. They are marked by an exceedingly distinct striping, caused by the alternation of pure iron veins with seams of eurite or quarzite. The ores contain a large amount of phosphorus, and are, in fact, almost richer in this element than any other in Sweden, with one or two exceptions. They are consequently unsuitable for the production of the so-called steel-iron, but good enough for the production of Bessemer steel. With regard to the extent of the deposits in Swedish Lapland, it appears from the estimates of the Royal Commission dispatched thither some years ago, that the Kirunavara mountain contains down to 450ft. above the surface of the lake by which it lies about 100 millions of tons of ore, from this height down to the lake four million tons, and below about 500 tons of ore per perpendicular foot, the surface area of the mountain being estimated at three and a-half millions of square feet. The Luosavara mountain, on the other hand, is estimated to contain twenty million tons of ore down to the surface of the lake, and below it 70,000 tons per perpendicular foot. So rich are, in fact, these deposits reported to be, that it is stated that in two parishes alone 850,000 tons of ore may be broken out annually for 100 years before the level of the lake is reached. These are figures which might frighten iron manufacturers, contractors, and engineers; but there is every hope of reality proving stranger than fiction—at all events, we may safely leave the next generation to deal with the dangers of such an enormous output.

The company constructing this railway has, we learn, arranged with the owners of the Gellivara iron mountain to work the ore for not less than fifty years, at a royalty of 8d. per ton for the first 200,000 tons per annum, and at 6d. per ton above that quantity; whilst the owner of the mining rights of the Luosavara mountain has guaranteed a minimum traffic over the company's line to Ofoten of 240,000 tons the first year, 360,000 tons the second, 480,000 tons the third, and afterwards 540,000 tons per annum. These are, however, figures which should be received with great caution, as of course they are only the outcome of irresponsible "estimators." But the promoters of the line put forward another "estimate," which seems to be dangerous and misleading, respecting the yearly traffic. It is as follows:—

Estimate of Yearly Traffic.

1,000,000 tons of iron ore at 5s. per ton	£250,000
Timber and general traffic	72,800
Gross revenue	£322,800
Deducting 50 per cent. for working expenses	161,400
Estimated profit	£161,400

After providing interest at 5 per cent. on the debenture stock of the company, there remains—so the estimate says—sufficient to pay the dividend on the preference shares, and leave a surplus of £48,900 for distribution among the ordinary shareholders. This would doubtless be the case if the above figures did prove correct. For, firstly, believing, as will presently appear, that the traffic on the line cannot be sustained for more than eight months of the year, no less than 125,000 tons are to be carried per month, which is equal to nearly 5000 tons a day. With the conditions under which this railway will work this is next to impossible. But the second item is far more serious. The company puts the charge of the transport of iron ore at 5s. per ton; but how can such a charge be sustained by an article which will, after paying cost of loading, steamship freight, insurance, unloading, and duty, only fetch about 12s. per ton in German and English ports, including profits? This calculation—the basis of the estimate—being unsound, the whole falls to the ground. As an example of the prices now paid for iron ore, we may state that the exports from Central Sweden last year, whence the cost of transport, &c., is only half of that in the Far North, resulted in a loss on account of the much lower prices at which Spanish ores were offered. Still, these ores contained an average of 65 per cent. of iron, a figure which we may safely assume the million tons shipped yearly by this company will hardly exceed, taken all round. It seems to be a great fallacy on the part of the promoters of this scheme to argue that because a few of the deposits contain 70 or more per cent. of iron all the ore will have this contents, seeing that some boasts only between 50 and 60 per cent. Moreover, it is a mistake to assert that because the Gellivara ores contain 4 or 5 per cent. more iron than others they will fetch a much higher price than the latter. Recent years have disproved this, for above a certain contents the richer ores have failed to obtain a proportionately higher price.

We now come to the question of time required for the construction of this railway. The company has, by the concession, undertaken to have the line Ofoten-Luosovara ready by the beginning of 1888, and the whole line open for traffic at the end of 1891. But this must now be considered to be outside the sphere of possibilities, as although three years have elapsed since the concessions were granted, not a rail has as yet been laid on the Norwegian side, whilst in Sweden—where the work up to the present year has been confined to expropriation, erecting landing stages, &c.—the first rails could not be laid before May 3rd this year on account of ice, snow, and water, and it may be doubted whether twenty-five miles of rails will be laid down this summer. At this rate of progress it should take ten years to complete the line—a pleasant prospect for the shareholders. Last autumn we were told by the promoters that the line would be opened as far as Gellivara—120 miles—"in a few months." Up to the present, only some fifteen miles have been fulfilled of this absurd promise, which gives a fair idea of the manner in which the concern is managed. We were further told that work at both ends would be continued throughout the winter. This is another assertion equally misleading—as we have stated, no work began till May this year. Nothing could be more ridiculous than to assert that any work can be done in the winter in a country where the ground freezes as hard as asphalte, where ice and snow cover it for yards deep, where there are no habitations or means of existence, and where the thermometer frequently freezes in the bulb, whilst terrible snow storms sweep the land for days; and there are also the causes which we referred to when maintaining that the line—when completed—cannot be relied on for transport for more than eight months all round of the year. This opinion is one which the promoters make light of, but we need only remember the frightful blocks which occurred last winter on our own railways to know that this is a very serious point. Another almost equally disadvantageous feature is the darkness, or semi-darkness which prevails for some three months—which will certainly not contribute to the easier working of the line. It must, however, be distinctly understood that we do not for a moment dispute or doubt the possibility of constructing the Luleä-Ofoten line. That would be absurd with the examples before us of the skill of the engineers of our century; but what may be reasonably doubted is, in the first instance, the possibility of the undertaking being profitable, the time for its completion, and the necessity for its existence. Having dealt with the two former points, there remains only the latter. Putting aside the absurd assertions that the railway will be the means of personal intercourse and trade in a part which has justly been termed "the Far West of Sweden," a part inhabited by a few hundred poor Lapps, we come, in the first instance, to the great iron treasures and the splendid primeval forests which, it is stated, it will open up. As regards the former, it may be confidently asserted that neither iron manufacturers nor contractors or engineers desire to have more iron into a market which is already so depressed through over production, and with no prospect of improvement; whilst it is a well-known fact that the timber trade has suffered from the same disease for the last ten years. Secondly, we are told that the line will become "an international highway to Russia." Apart from the questionable advantage of such a "highway," the prospect of this becoming an accomplished fact is so far remote that it hardly will bear discussion. For, although work is to be continued this year on the Great Northern Trunk Line of Sweden towards Luleä, and ultimately the Finnish frontier, it will only progress in slow stages. The length of the line to Luleä alone is estimated at 320 miles—or about the length of the Northern of Europe Railway—the cost being put down at nearly £2,000,000—an enormous sum when it is considered that it will run through almost uninhabited parts. In fact, so little disposed is the Swedish Parliament towards the project, that it is hardly likely to be carried out in the present century. So much for the Swedish part of the "international highway." On the Finnish side of the Baltic the railway now runs to Wasa, a distance from the Swedish frontier which—for a railway—cannot be estimated at less than 700 miles, allowing for the circuit along the coast; and at present this line has as much chance of being constructed as the Channel Tunnel. It will therefore be seen what the value is of the statement made by the promoters of the Northern of Europe Railway—that this line would place Stockholm, St. Petersburg, and the interior of Russia in direct communication with the open North Atlantic Ocean all the year round. Before this will be the case, railways three times the length of the present line will have to be built. There is also another side of the question which is of great importance to England, as well as to Scandinavia, viz., the strategic value of this railway to Russia; for when it is constructed, Russia could seize it without the least opposition, and embark an army in the Ofoten Fjord in forty-eight hours. The troubles which may result to Sweden and Norway from the existence of this line are so great and incalculable that it is a matter for surprise that the Governments of those countries should have encouraged the scheme, particularly in view of its almost certain commercial failure. A point equally surprising is that the British Government should permit its accredited representative in Scandinavia officially to support it.

Finally, it is very strange that the Scandinavians themselves, who are to benefit so immensely therefrom, do not give a hearty and substantial support to the undertaking. This is far from being the case, as nearly all iron manufacturers and forest owners are against it, for they argue—and very naturally—that the opening up of these deposits and forests at present can only have one effect, viz., the complete ruin of markets already in a frightfully depressed state. However, the undertaking is one which will undoubtedly be watched attentively in this country.

The occurrence of tin in New South Wales was first made known in 1852, but it was not commercially worked until 1872, although the tin is of the best quality, and takes rank beside the Strait Settlements tin in the English market.

THE ROYAL INSTITUTION.

RECENT PROGRESS IN THE COAL TAR INDUSTRIES.

Sir Henry Roscoe, M.P., in his lecture upon the above subject, at which Sir William Bowman occupied the chair, said that Gœthe in his early years—about 1741—described a visit he paid to a "burning hill," near which he met an old philosopher engaged in collecting therefrom oils, resin, and tar; the labours of that philosopher were not successful. Times have changed since then, for now some branches of the coal tar industries may be valued at millions sterling per annum, and keep thousands of men in employment.

All organic compounds, said the speaker, may be referred to certain hydrocarbons or "skeletons;" two great classes of such compounds are known as paraffinoids and benzoids, for from these hydrocarbons they can be built up by synthesis. In rock oils is the world's largest supply of almost natural paraffinoids, but these cannot be used in the colour industries; the largest supply of the benzoid hydrocarbons may be obtained from coal, of which ten millions of tons are consumed annually in the blast furnaces of this country. Recently methods have been adopted to collect the oils from these sources, but so far the attempt to collect the benzoid hydrocarbons from such sources has been attempted but in few instances. The gasworks of the country have to be resorted to for benzoids, which might be extracted from coal in special ovens, and the coke be afterwards left for the use of the ironmasters. The coal from the same pit, but dug out at different levels, will yield slightly different oils. The paraffinoid oils are not easily oxidised; when nitric acid is poured upon petroleum spirit it scarcely alters it at all, but when nitric acid is poured into coal naphtha red fumes are given off, so the benzoid oil is more acted upon. In 1825 Faraday prepared benzene—the starting point of the benzoid hydrocarbons—and he did so in the laboratory of the Royal Institution. In 1848 large quantities of it were made for the first time, under Hofmann's direction, and the next step was the production of aniline, from which the aniline colours are obtained. In one manufactory in Manchester 500 tons weight of aniline are used every year, yet this substance at first, like benzene, remained for years but a chemical curiosity. The coal tar dye industry was started by Perkin's mauve.

Cheap wagon grease gradually rose in price till it sold at 1s. per lb. for the making of artificial alizarine, a colouring matter which is now manufactured to the value of more than £2,000,000 annually; this industry has nearly driven the madder plant out of cultivation, and naphthol scarlet has nearly extinguished the cultivation of the cochineal insect in the Canaries. Indigo can now be built up by synthesis, and it is artificially manufactured to some extent.

The colours derived from 1 lb. of coal will dye a full shade:—

1. Magenta, a piece of flannel .. .. .. 8in. by 27in.
2. Yellow, ,, ... 60in. by 27in.
3. Orange, ,, ... 1·93in. by 27in.
4. Turkey red, calico .. .. 4in. by 27in.

Benzoic aldehyde is largely used for flavouring; oil of bitter almonds contains it in large proportion. One ton of Lancashire coal distilled in gas retorts yields an average of:—

1. Coal gas, 10,000 cubic feet.
2. Ammonia liquor, 5 per cent., 20—23 gallons = 30 lb.
3. Coal tar, 12 gallons, or 139·2 lb.
4. Coke, 13 cwt.

Twelve gallons of coal tar yield:—

1. Benzene, 1·1 lb.; aniline, 1·1 lb.
2. Toluene, 0·9 lb.; toluidine, 0·77 lb.
3. Phenol, 1·5 lb.; aurine, 1·2 lb.
4. Solvent naphtha, 2·4 lb.
5. Naphthalene, 6·3 lb.; naphthol, 4·75 lb.; naphtha, yellow, 9·5 lb.
6. Creosote, 17 lb.
7. Heavy oils, 14 lb.
8. Anthracene, 0·46 lb.; alizarin, 20 per cent., 2·25 lb.
9. Pitch, 69·6 lb.

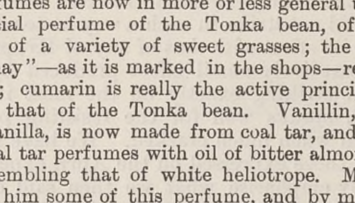
The colours derived from 1 ton of coal will dye a full shade:—

1. Magenta, 500 yards of flannel 27in. wide.
2. Naphthol yellow, 3800 27in. wide.
3. Aurin, 120 yards, 27in. wide (orange).
4. Alizarin, 225 yards, 27in. wide calico, Turkey red.

Perkin discovered mauve when he was trying to artificially manufacture alkaloid like quinine, but of late certain products have been made by chemists from coal tar derivatives, which products possess febrifuge qualities of value; one of these was discovered in 1881 by Otto Fischer, of Munich; it is not quinine, but it possesses qualities of analogous characters; one advantage is, that it does not produce upon the patient the unpleasant effects of large doses of quinine. A dose of 30 grains of it is found to lower the temperature of patients afflicted with typhus fever 3 deg. upon an average. Thallene is also a febrifuge, it has been used with some success in the treatment of yellow fever.

Coal tar perfumes are now in more or less general use, including the artificial perfume of the Tonka bean, of the sweet woodruff, and of a variety of sweet grasses; the perfume of "new mown hay"—as it is marked in the shops—really comes from coal tar; cumarin is really the active principle of this scent, and of that of the Tonka bean. Vanillin, the active principle of vanilla, is now made from coal tar, and by mixing some of the coal tar perfumes with oil of bitter almonds, a scent is obtained resembling that of white heliotrope. Mr. Rimmel had forwarded him some of this perfume, and by means of the spray distributor before them he had the pleasure of scenting the theatre of the Institution therewith. These coal tar artificial perfumes, he continued, are gradually driving out the industries of extracting the natural perfumes from the plant. About 150 tons of nitro-benzene are used annually for the perfuming of cheap soaps.

Of all the marvellous productions from coal tar, the next one bears the palm, namely, saccharine. Saccharine is a white crystalline body artificially prepared from coal tar (toluene) and possessing an intensely sweet taste. It was discovered by Dr. Fahlberg. It is not a sugar, does not produce any appreciable physiological effect on the human body; does not act as a food, but only as a flavour, and passes away unchanged. It contains carbon, oxygen, hydrogen, sulphur, and nitrogen, combined as follows:—



Its chemical name is orthobenzoyl sulphonic imide; its sweetening power is 280 times that of cane sugar.

Only within the last few months has saccharine been made in quantity, although it was discovered in 1879, and for some purposes it may prove to be of very great service. As yet it is a little too soon to say whether its consumption will prove injurious, because although it and many other hydrocarbons do not act as poisons, in long course of time those other hydrocarbons have an effect, more especially upon the liver. Large quantities of saccharine have been given to dogs, and one dog had as much of it daily as was equivalent in sweetening power to a pound of sugar, but it did him no harm. There are human diseases, during the course of which sugar must not be taken. In such cases the use of saccharine may prove to be advantageous.

Sir Henry Roscoe here sweetened some cups of tea with saccharine, and invited the listeners to come to the table and taste the same. He likewise produced some bon-bons and some Swedish punch, flavoured with orthobenzoyl sulphonic amide.

THE CHEMISTRY OF THE ALKALOIDS.

Professor James Dewar, F.R.S., in the course of three lectures upon "The Alkaloids," said that the alkaloid department was one of the most recondite of organic chemistry, and for what is known about it the world is much indebted to pharmaceutical workers. The alkaloidal bodies are easily separated, because they form compounds with acids, and in general they exert a violent physiological influence upon the system. At present chemists are very close upon making them artificially, indeed some of the simplest of them have already been built up synthetically; therefore, if the Legislature exerts itself to stop the cultivation of opium, there is no guarantee that morphia may not hereafter be made artificially. All the alkaloids contain nitrogen, probably in the form of ammonia, from which form there is reason to believe that all alkaloidal bodies are built up. Ammonia has to be heated before it will burn in air. It can also be burnt at low temperatures, for ozone has a remarkable power of attacking it in the cold. Another way of burning it is by means of a hot spiral of platinum in a mixture of air and ammonia, when nitrate of ammonia is formed by the combustion set up. Where do the nitrates come from originally? The inference is that they come from the vegetable kingdom, for when antiseptics are mixed with soils the process of nitrification is stopped. By means of a cold of − 80 C. ammonia can be liquefied; it will then dissolve the metals potassium and sodium, and form deep blue solutions of them; afterwards it will evaporate from them and leave them as before. The blue solutions transmit the violet and ultra-violet rays, somewhat as is done by thin films of metallic silver. Ammonia is exceedingly healthy to breathe. The lecturer here built up chloride of ammonium synthetically by passing an electric discharge through a mixed atmosphere of hydrochloric acid, nitrogen and hydrogen gases; the newly-formed salt then condensed on the sides of the tube. As a test for the presence of ammonium, Professor Dewar allowed one drop of a saturated solution of the chloride to fall into a large jar of water; he then added a little iodide of mercury dissolved in a solution of potash, and a brown colouration was set up. The test, he said, is sufficiently delicate to detect ammonia when dissolved in one million times its volume of water.

In his second lecture Professor Dewar said that the action which takes place when sunlight acts upon the leaves of growing plants, is not accurately understood; but it is believed that a transformation takes place between carbonic acid and water, in some way or other through the agency of chlorophyll. Oxygen is set free, and starch and sugar formed; the sugar seems to be formed before the starch. Plant life is not so economic an engine as might be supposed at the first blush; a large amount of energy seems to do little work in proportion; in the leaf the process is one of reduction, oxygen being removed. Oxalic acid is believed to be formed in the leaf at the same time as starch and sugar; oxalates occur largely in the juices of plants, and within the last few weeks some discoveries have been made tending to prove that oxalic acid is an agent of reduction in the leaf. When oxalic acid is oxidised in the presence of a salt of iron, carbonic anhydride is given off. This is a reversal of the process which takes place in the leaves of plants.

In tracing out the chemistry of the evolution of the alkaloids, the inquirer wants to get nitrogen connected with carbon; cyanogen consists of carbon connected with nitrogen, and is produced synthetically by the electric arc in the presence of air and moisture. Magnesium has the peculiar property of uniting with nitrogen as well as with oxygen, when it is burnt in air. If the magnesium be first moistened, nitrate of magnesium is formed, and ammonia is liberated. Titanium is another metal which has the power of uniting with nitrogen by combustion.

As examples of various classes of products obtained from organic matter by dry distillation, Professor Dewar put some sawdust in one retort, some india-rubber in another, and some fragments of quill in a third, then applied heat. The india-rubber gave off combustible oily matter, the sawdust gave an acid distillate from the production of ordinary vinegar, the retort half full of cuttings of quill pens gave off a distillate strongly alkaline, consisting of carbonate of magnesia and some basic bodies.

In his third and last lecture Professor Dewar said that the word "aromatic" conveys an idea to the mind of the modern chemist other than it did to the chemists of earlier times, for aromatic compounds are now recognised as derivatives of benzole. Take away an atom of hydrogen from benzole and substitute one of nitrogen, the pyridine nucleus of the alkaloids is then formed. If aniline be mixed with strong sulphuric acid and some glycerine, quinoline is formed when the mixture is heated, consequently is thus made artificially; the hydrogen in this base does not unite with nitrogen in the form of ammonia. Corrosive sublimate precipitates alkaloidal bodies as a class, and is an excellent reagent; tartaric acid dissolves the alkaloids. The deadly alkaloid brucine has a remarkable reaction with strong nitric acid, a deep red colour being produced thereby; sulphuric acid has no apparent action upon strychnine, but if bichromate of potash, an oxidising body, be also added, a fugitive violet colour is produced. All the alkaloidal bodies combine with chlorate of platinum; quinine, for instance, may be taken and acidified with a little hydrochloric acid, then upon adding a few drops of bichloride of platinum, what is called "the platinum salt of quinine" is thrown down; there is a corresponding gold salt, but that of platinum is ordinarily used for the purpose. The alkaloids have remarkable optical properties, which have been worked at by Professor Stokes, many of them being fluorescent. Quinoline exercises a powerful absorption in the ultra-violet portion of the spectrum. Messrs. Macfarlane, of Edinburgh, said the speaker, have manufactured these alkaloidal bodies for nearly half a century.

Tunnel between Denmark and Sweden.—The Swedish and Danish newspapers have for some days been discussing schemes for the construction of a tunnel between Denmark and Sweden, under the Sound. The question of a submarine way between the two countries has been raised several times, but never so seriously as now. M. A. de Rothe, the engineer, who has been for several years employed as an engineer on the Panama Canal works, in the name of a French company, has just presented to the two Governments interested a plan for cutting a tunnel between Copenhagen and Malmö, in Sweden. The tunnel would be seven and a-half miles long, in two parts, of which two miles would lie between the islands of Amak and Sattholm, and five and a-half between the latter island and the Swedish coast. The estimated cost is £1,200,000.

THE INSTITUTION OF NAVAL ARCHITECTS.

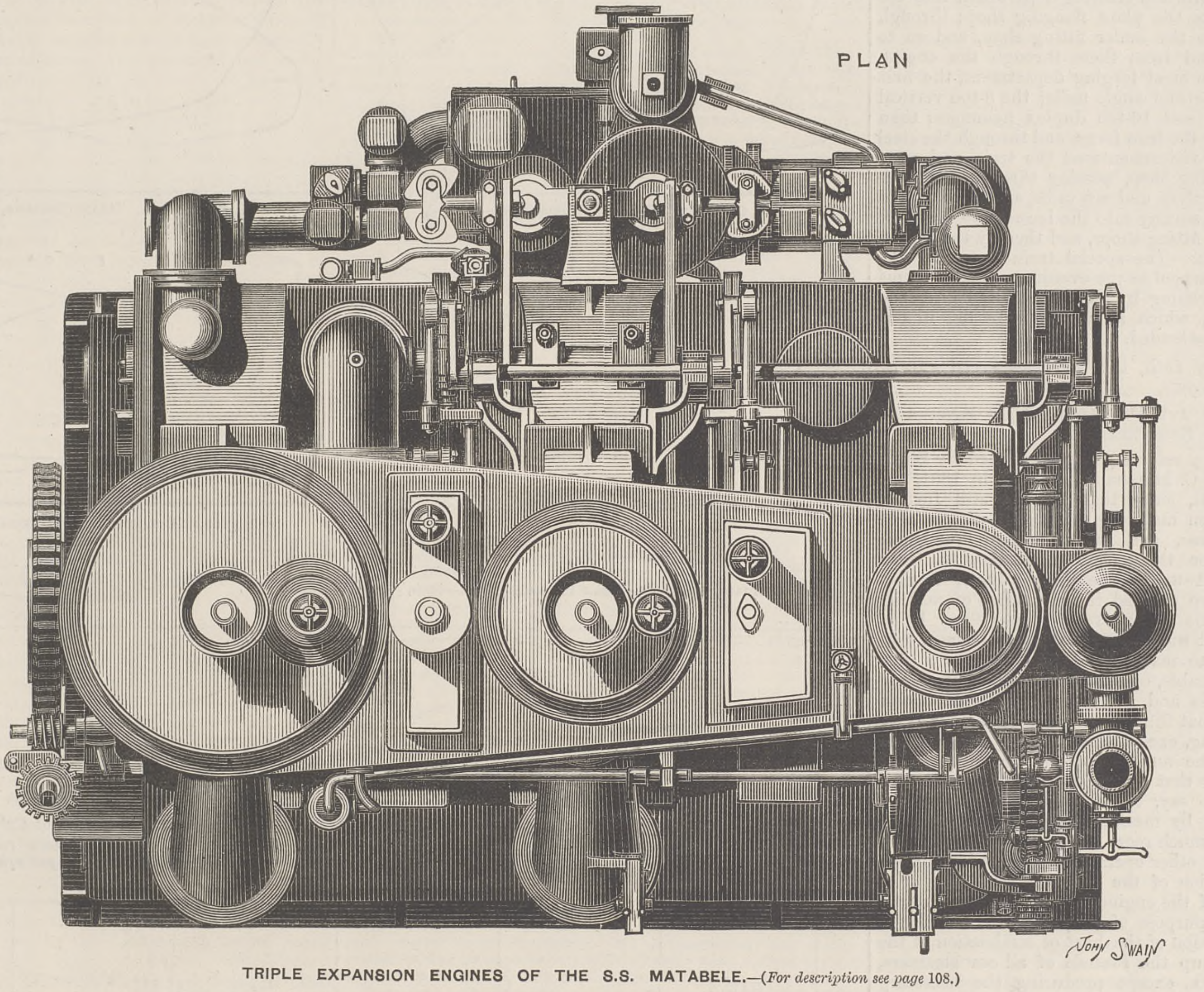
ON the morning of Wednesday, the 28th ult., the business of the meeting was resumed. The only paper read being by Professor Elgar,

NOTES UPON LOSSES AT SEA.

An attempt is made in this paper to analyse the loss of life caused by the wrecks or total losses of British merchant ships at sea during the three calendar years 1881 to 1883, and to consider in detail, as far as the necessary limits of space would permit, some of the principal causes of loss and the extent to which they operated in producing loss of ships, and of lives, at sea. A general analysis had been made of all losses for the three years named, and it had been continued for the two succeeding years 1884 and 1885, so far as steamers and iron sailing ships of and above 300 tons gross register are concerned. It is very difficult to give an abstract of this paper, because the information which it contains has already been condensed by the author as much as possible. We can do no more within the limits of space available than give the more important conclusions at which Professor Elgar has arrived. In order to show what proportion the losses of ships, and of lives, by foundering at sea bears to the total number of losses recorded in the official returns, it is necessary to take as a starting point the total number of losses from various causes in all classes of vessels that occurred during the period under consideration. The author therefore commenced by taking the whole number of total losses of ships, and of the lives lost in them, during the three calendar years 1881 to 1883. The total number of lives lost at sea and in harbours and rivers by wrecks of and casualties to British and colonial ships during the year 1881, was 3531 seamen and 596 passengers; in 1882, 2305 seamen and 151 passengers; and in 1883, 2986 seamen and 215 passengers. The figures for loss of life that are here being dealt with are confined to losses by wreck and casualty. There were also losses of life by drowning, or by accident other than drowning, where there was no wreck of, or casualty to, the ships in which they occurred. These are not included. The term "ship" applies to every description of vessel that is used in navigation, and is not propelled by oars. It includes fishing vessels, yachts, barges, and all other small craft. "Wreck" means the absolute destruction of a ship, or some form of casualty which results in her removal from the register of British ships; and "casualty" means any occurrence which, though more or less serious to the ship herself, does not result in the total loss of the ship, or in her removal from the register. Ships that are described as lost at sea include those that are lost upon any coasts all over the world—all, in fact, except those lost in rivers and harbours. At the end of the paper Professor Elgar gives a long series of tables, supplying all available particulars, save one, concerning the ships lost. The missing information concerns the engine-power of the steamships, a point on which we may have something to say at another time. Professor Elgar considered the cases of the 608 ships that foundered or were missing, and of 4036 lives that were lost in them during the three years 1881 to 1883; and as it appears that 344 of those ships were small craft under 300 tons gross register, chiefly employed in coasting trades, he left them out of account and confined attention to the more manageable remainder of 264 ships in which 3006 lives were lost. The 264 ships thus selected include all British vessels of any size or importance that have foundered at sea—all that are not below 300 tons gross register—and also the vessels from which the greatest proportion of lives are lost. Out of the total number of British and colonial ships of all sizes, amounting to 3742, that were totally lost, and 8048 lives in them, during 1881, 1882, and 1883, we thus find ourselves left with 264 foundered and missing ships registered in the United Kingdom, of and above 300 tons gross register, in which 3006 lives were lost. The 264 ships under consideration consist of 81 steamers, all of which are iron, 47 iron sailing ships, 127 wooden sailing ships, and 9 composite sailing ships. Out of the 3006 lives lost in these ships, 1295 were lost in steamers, 831 in iron sailing ships, 779 in wooden sailing ships, and 101 in composite sailing ships. Taking the 43 vessels that were lost with grain cargoes, we notice that 23 were steamers and 21 sailing ships; 9 out of the 23 steamers were laden with wheat, and 8 with barley; 15 out of the 21 sailing ships were laden with wheat, and 3 with rice; leaving only 3 sailing ships that were lost with grain cargoes other than wheat and rice. Thirty-three steamers and 53 sailing ships were laden with coal, 34 of the latter being wooden vessels. Only 6 steamers were lost laden with cargoes other than grain, coal, metal, and general. Thirty-eight timber-laden vessels were lost, and the whole of them were wooden sailing ships. Their average age was 23 years, and 27 were not classed in any register society. Thirteen ships were lost while making voyages in ballast; they were all sailing vessels, 4 being constructed of iron and 9 of wood. The 4 iron ships will be commented upon further on; but as regards the 9 wooden ones, it may now be pointed out that their average age was 24 years, and 5 were not classed in any register society. The author then considered at great length the influence of cargo on the stability of a ship, and arrived finally at the following conclusions:—(1) The shifting of cargoes is one of the chief causes of the foundering of steamers and iron sailing ships at sea, independently of mere depth of loading. (2) Dangerous shifting of grain sometimes takes place, through hasty and imperfect stowage, inefficient shifting boards, or weakly constructed end bulkheads, or through the omission to fit end bulkheads where such are required on account of the density of the cargo; and dangerous shifting of coal sometimes takes place, because it is carried in compartments that are not fitted with shifting boards. (3) Many steamers carrying grain and coal cargoes—notably the class of narrow three-decked steamers built several years ago—are vessels that have insufficient stiffness, when fully laden, to resist heeling to a dangerous angle in the event of cargo shifting or of water getting below. (4) The effect upon such vessels of the shifting of cargo and of water below is generally to hold them over at a considerable angle of inclination, but not to completely capsize them. (5) Pumping power at the bilges is often an essential condition of preventing loss in such circumstances, and of getting a vessel righted. (6) The stability of these vessels, when laden with the various cargoes they are likely to carry, should be completely determined by calculation before they are sent to sea; and clear instructions, based upon the information so obtained should be framed for the guidance of those who are responsible for their loading. Such instructions should include particulars of the empty spaces to be left in the 'tween decks, or of the weight of ballast to be carried, or both, for each class of cargo. (7) All the authentic particulars procurable of ships that have foundered and are missing, and of the circumstances and the manner in which the foundered ships were lost, should be collected and published periodically, for the information of the shipping community. (8) The losses of steamers through the shifting of cargoes seem to be chiefly among the narrow steamers of the three-decked type that were built several years ago. The steamers of that type that have recently been built have more beam and much greater stability than those formerly built, and it may be confidently hoped that the attention which has been given to this matter of late, and the improvements that have consequently been introduced into this type of vessels, will lead to a diminution of losses among them.

The discussion was opened by Mr. Martell, who complimented Professor Elgar on the valuable and carefully digested information which he had supplied—information of a quite novel character. He felt certain that the tables accompanying the paper would be read with great interest, and that very valuable deductions could be drawn from them. He agreed with the observation in the summary at the conclusion of the paper, that the stability of vessels when laden with the various cargoes they are likely to carry should be completely determined by calculation before proceeding to sea, and clear instructions based upon that information framed for the guidance of those who were responsible for their loading. Supposing that a vessel were laden with a homogeneous cargo, the captain should have placed in his hands the line of stability, particulars of the empty spaces he should leave between decks, the weight of ballast he should lay in, and other items of information which would be of the utmost value to him, and would in many cases prevent those losses which they deplored. He did not think it was creditable to the shipbuilders and shipowners of the country when they were spending such vast sums on their ships that they would not go to the little additional expense of having that information supplied.

Mr. W. H. White, said that, in the shipbuilding yards of this country, within the past seven years, there had been a vast improvement in the endeavour to place within the owner's hands the best information that could be given them as to the stability of their ships. He endeavoured for nine years to get all the information he could as to the stability of vessels. He could not get very much, while four years ago he was flooded with the information, thanks in a great measure to Lloyd's, and to the improved instruments which were then used, and with which work could be got through that it was formerly hopeless to expect could be done. It was of no use, however, to have information of this kind if shipowners would not act on it. He criticised at some length the practice of the Admiralty Courts. Experts giving evidence were always discredited, and the so-called practical man had it all his own way. He did not propose that the Board of Trade should supersede, or even interfere with, such investigations as those carried on by Mr. Rotherey and assessors, but the Board of Trade ought to be in a position to supply facts concerning any ship whose loss was made the subject of a legal inquiry, so that the Court would be in a position to act with some certainty. The assessors now employed, however able they might be as captains, did not and could not know enough about the ship lost to be able to give valuable assistance in arriving at a correct verdict. Proper legal investigations would be of much value, but the existing system was very defective in every possible respect.



TRIPLE EXPANSION ENGINES OF THE S.S. MATABELE.—(*For description see page 108.*)

Mr. West said that it should not be taken for granted that want of stability was always the cause of loss. Collision and total loss might be caused by a ship becoming derelict and then being run into by, and so sinking another vessel at night, when the derelict could not be seen. Ships, too, were lost because their coals were run out; and again, in considering the cause of loss, it should not be forgotten that a ship's freeboard augmented daily as she was at sea as her coal was burned. The date of sailing ought always to be taken into consideration, and the daily consumption of coal.

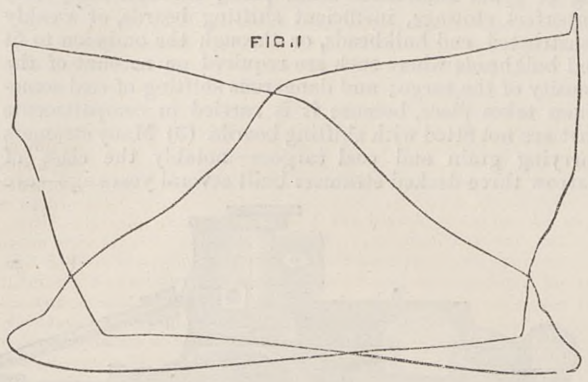
Sir T. Brassey said that going about the sea as much as he did, he frequently came across cases of ships which appeared to him to be overladen. He knew it was a delicate point. Unless the ship carried a considerable cargo it was impossible for the business of the shipowner to be remunerative. Even with the amount of cargo now carried, the business of the shipowner had been very melancholy in its results. He was bound to say he was of opinion that in many cases the cargoes carried were excessive. Anybody who had lain at anchor as long as he had in the Bosphorus, and watched the vessels coming rapidly out, must have been of opinion that not a few of them were overladen. If it were possible to obtain a recognised line of loading, he would venture to suggest that shipowners should be compensated by a reduction of the insurance charge, which now bore so heavily upon them. A considerable number of vessels were lost with their crews from the spontaneous combustion of coal cargoes. We had not yet reached perfection in the mode of carrying coal at sea. He had himself the privilege of carrying the crew of the Monkshaven off the coast of Patagonia, the coal having taken fire. There was no point to which science might be more properly directed than to providing for the safety of ships employed in carrying that description of coal which was in demand on the South-west Coast of America. Mr. Alfred Holt, shipowner of Liverpool, said he was of opinion that many ships were lost through being loaded more deeply than was desirable; but he also firmly believed that the inquiries of the Wreck Commissioner had increased the loss of life at sea. Gentlemen might laugh, but he had watched the matter himself very carefully for some time. He believed the best remedy for the offences they endeavoured to reach by the Wreck Commission was to leave them to be dealt with by the common law. As to supplying captains with scientific information, as had been suggested, he held that it would be of little use. Every captain who understood his business knew when a ship was rightly or wrongly loaded, and if they neglected old and well understood rules for loading, it was certain that scientific information would not make them more careful. Mr. Samuelson, after sharply criticising the methods of Mr. Rotherey's Courts, held that much mischief was done by shipbuilders permitting owners to dictate to them as to the kind of vessel they wanted. The shipbuilders knew what was right, and the shipowners did not. The builders ought in all cases to fix the load line. This proposition, we may add, was received with some amusement by the meeting. Mr. Withy criticised the law courts, and condemned careless loading.

After a very brief reply from Professor Elgar, a vote of thanks was passed, and the members proceeded by special train to Crewe, where they were hospitably received by Mr. Webb, and after luncheon proceeded in a special train to the Bessemer steel converting house, thence past the Siemens-Martin furnaces to the spring mill and the rail mill; through the points and crossing department into the boiler shop; then into the plate flanging shop; through the plate stores, into the boiler fitting shop, and on to the iron foundry; and from there through the engine repairing shops to the steel forging department, the first objects being the plate and angle mills; the 8-ton vertical hammer, and 30-ton and 10-ton duplex hammers; then past the tire mill into the iron forge, and through the steel foundry; after which visitors entered the train and were conveyed to the testing shop, passing through the mill-wrights' shop, joiners' shop, and saw mills, and on to the old forge, through spring smithy into the locomotive erecting, repairing, wheel, and fitting shops, and then by the special train into the station. The special train conveyed the members back to Liverpool in the evening. An At Home was given in the evening by Sir David Radcliffe, the Mayor of Liverpool, which as already reported in our columns, was largely attended.

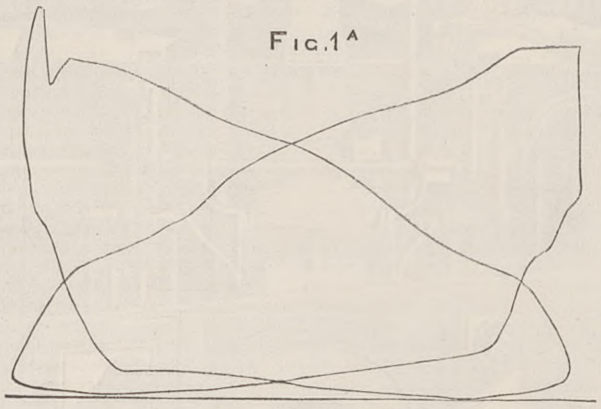
On Thursday, July 29th, the first paper read was by Mr. W. Parker, of Lloyd's,

On the Progress and Development of Marine Engineering.

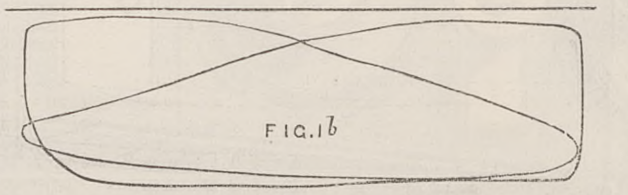
The author began by referring to papers read by Sir F. Bramwell and Mr. F. C. Marshall, the latter in 1881, and went on to say that, since that time, a still further improvement has been made by the introduction of even higher steam pressures, and of triple and quadruple expansive engines for the proper utilisation of these higher pressures; but up to the present little, if any, improvement has been effected in the method of making the steam, the marine boiler of the present day being almost exactly what it was in 1872, except, of course, that it has been possible to make it stronger than was then deemed to be practicable, owing to our having command of improved materials and appliances. It is of course difficult to foresee what the future has in store for us, or to be sure of anything, except that there is no finality in invention; but in the author's opinion there are good reasons for believing that so far as the use of steam is concerned—that is to say, the conversion of the heat of the steam into work by means of the engine itself—there is not now so much room for improvement as there appears to be in the other operations of transferring the heat of the combustion of the fuel into the steam, or of applying the work of the engine, when it has been produced, to its useful purpose of propelling the vessel. A very considerable portion of the heat of combustion of the coal still disappears up the funnels of all our steamers, doing no useful work, except producing the necessary draught—which could be produced mechanically with very much less heat, if only the funnel heat could otherwise be usefully employed; while there still remains a wide field for improvement by the production of more nearly perfect combustion of the fuel in the furnaces themselves. In regard to the economical application of the work, after it has been produced, to the propulsion of vessels, there is also room for great improvement; for according to the late Mr. Froude, the greatest authority upon this subject, only about one-half of the total power exerted by the engines is effective in propelling the vessel, the remainder being dissipated in overcoming frictional and other resistances. Advance in this direction would, he thought, be attained more from the results of direct experiment than from theoretical considerations. Already some marked improvements resulting from experiments with screw propellers have been made in some few isolated cases in which the performances of the screws first fitted were considerably below the expectations of their designers, and in these days, when such immense powers are exerted in our large and fast ocean passenger vessels, it is very probable that the cost of a few experimental screws would soon be repaid by the economy of power they would effect. It must not be inferred that because the marine boiler of the present day is practically identical in design with that of 1872, except, so far as regards strength, no attempt has been made to improve it. As a matter of fact, very many experiments in this direction have been made, and to show this he had only to mention the Rowan, the Howard, the Root, the Jordan, the Perkins, the Herreschoff, and the Turner boilers, besides others in which brick combustion chambers, brick furnaces, &c., have been used. All these forms, however, have either completely failed or have given so much trouble at sea, from their inability to fulfil the requirements incidental to oceam steaming, that none of them are likely to be repeated. Most of them were designed more with the view of enabling high steam pressures to be safely carried than with the idea of obtaining a high evaporative efficiency, and the six first-mentioned types mostly consisted of tubes or of cylindrical portions of relatively small diameter, which consequently possessed great strength, even when made of comparatively thin material. The small dimensions of the parts, however, materially assisted in rendering them unsuitable. The introduction of steel as a material for boiler plates, and the use of a stronger form of furnace than the plain cylindrical one, combined with improvements in manufacture, have now admitted of steam pressures of 150 lb. to 180 lb. per square inch being safely carried in boilers of the ordinary type, so that there will be now no incentive for engineers to design these novel types of boilers so far as strength is concerned, unless it can be shown that there is reasonable grounds for supposing that steam of still higher pressures, viz., from 250 lb. to 300 lb. per square inch, can be conveniently and economically used. Mr. Parker next sketched the history of the triple expansion engine, and, coming down to recent times, stated that during the present half-year there have been no less than forty-one sets of triple expansion engines built, as compared to sixty pairs of compound engines, and there are at present 128 sets of triple expansion engines building, as compared to seventy-one pairs of compound, independent of those building for the British and foreign Navies. For the British Royal Navy there are twenty sets being built, expected in the aggregate to indicate 130,000-horse power. As to performances, he gave some facts. Two large passenger steamers of over 4500 gross tonnage, having engines of about 6000 indicated horse-power, built of the same dimensions, from the same lines, with similar propellers, are exactly alike in every respect except so far as their machinery is concerned. One vessel is fitted with triple expansion engines, working at a pressure of 145 lb. per square inch, whilst the other vessel is fitted with ordinary compound engines, working at a pressure of 90 lb. per square inch. Both vessels are engaged in the same trade, and steam at the same rate of speed, viz., 12 knots per hour. The latter vessel on a round voyage of eighty-four days burns 1200 tons more coal than the former. The performances of two other vessels do not compare on a question of decreased consumption, but on one of enhanced carrying capacity, with an equal speed, and the same consumption of coal. The first vessel has a gross tonnage of about 2220 tons, and is, comparatively speaking, a modern type of ship. She is fitted with ordinary compound engines, working at a pressure of 90 lb. per square inch, and carries, when fully loaded, 3000 tons of cargo, including bunker coal. She steams 10 knots per hour, and burns 20 tons of coal per day. The second vessel has a gross tonnage of 2800 tons, was built last year, and fitted with triple expansion engines, working at a pressure of 150 lb. per square inch. She makes the voyage to India in the same length of time as the former vessel, burns the same amount of coal, viz., 20 tons per day, and carries 4200 tons, or 1200 tons more cargo, with the same working expenditure. The next case is that of a mail steamer, the engines of which have been converted from ordinary compound to triple expansive, the propeller not being altered. The vessel is of 3500 tons gross register. She was originally fitted, in 1871, with ordinary compound engines, working at a pressure of 60 lb. per square inch. These have been altered into triple expansion engines, and new boilers have been fitted working at 150 lb. per square inch. The vessel still maintains her original speed, and the consumption of coal has been lessened 25 per cent. In the case of another mail steamer, the engines of which have been altered in a similar manner, the decrease in consumption is 33 per cent., while the same speed is maintained. In these cases the consumption quoted includes the coals used for galley, steering engine, and other purposes, so that the economy gained in the main engines is greater than that given by these figures. In order to fully utilise the principle of expansion, it is necessary to have engines of sufficient size for the steam to fully expand into, and so relatively large engines will be, within proper limits, more economical than smaller ones doing the same amount of work. To show this the author referred to two sets of indicator diagrams taken from two engines made by two well-known engineering firms, who have each attained celebrity for the excellence of their productions; yet a comparison of the results obtained in the two cases shows a marked difference between the two engines. In each case the diagrams were taken from the engines on the trial trips. In engine No. 1, the cylinders are proportioned as 1 : 2·5 : 7·11; the boiler pressure is 150 lb. per square inch, and the mean pressure of the three cylinders reduced to the low-pressure cylinder is 25·61 lb. In engine No. 2, the cylinders are proportioned as



H.P. Cylinder. Mean Pressure, 59·56.—*Scale*, $\frac{1}{48}$.

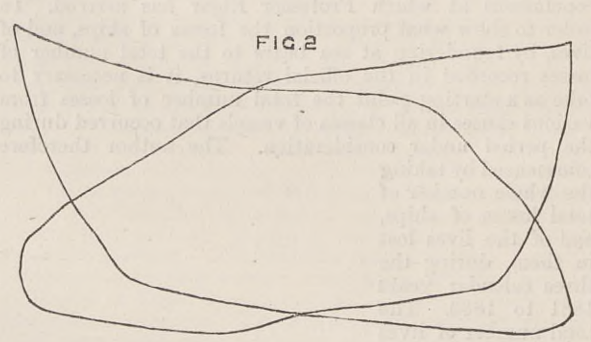


Intermediate Cylinder. Mean Pressure, 28·44.—*Scale*, $\frac{1}{24}$.

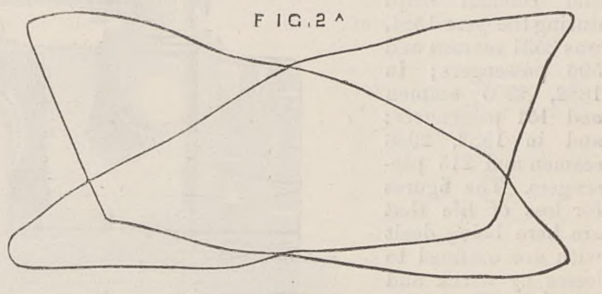


L.P. Cylinder. Mean Pressure, 8·23.—*Scale*, $\frac{1}{12}$.

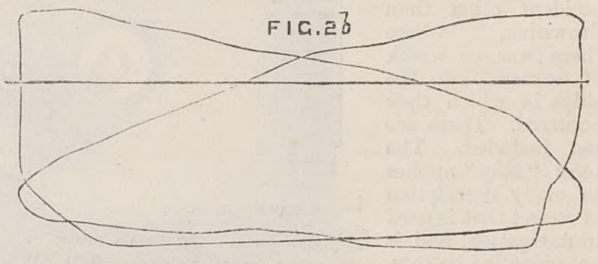
Steam Pressure, 150 *lb.* *Ratio of Cylinders:* 1 : 2·5 : 7·11.
Mean Pressure of three Cylinders reduced to Low-pressure Cylinder, 25·61 *lb. per square inch.*



H.P. Cylinder. Mean Pressure, 52·7.—*Scale*, $\frac{1}{48}$.

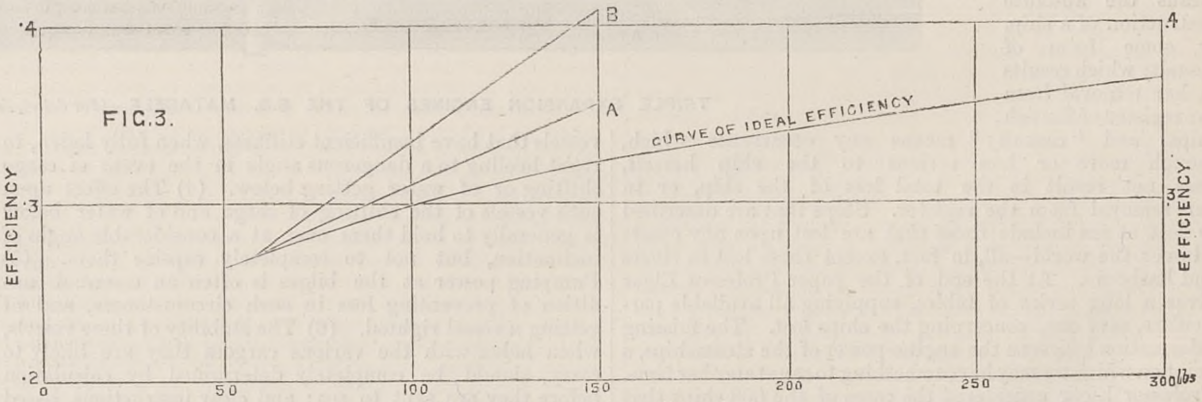


Intermediate Cylinder. Mean Pressure, 21·2.—*Scale*, $\frac{1}{24}$.



L.P. Cylinder. Mean Pressure, 11·45.—*Scale*, $\frac{1}{12}$.

Steam Pressure, 135 *lb.* *Ratio of Cylinders:* 1 : 2·5 : 5·28.
Mean Pressure of three Cylinders reduced to Low-pressure Cylinder, 32·10 *lb. per square inch.*



Steam Pressures above Atmosphere.

1 : 2·5 : 5·28, the boiler pressure is 135 lb. per square inch, and the mean pressure reduced to low-pressure cylinder is 32·10 lb. per square inch. It will be seen at once that engine No. 2 is not using the steam so expansively as engine No. 1, and in proportion to the size of low-pressure cylinders it is doing $\frac{32{\cdot}10}{25{\cdot}61}$, or 1·253 times as much work as No. 1. On measuring the amount of steam used per revolution, as shown per indicator diagrams, it will be found, however, that engine No. 2 is using 1·494 times as much weight of steam as engine No. 1, and it is only doing 1·253 times as much work, the efficiency of No. 1 engine must be $\frac{1{\cdot}494}{1{\cdot}253}$, or 1·19 times greater than that of No. 2; in other words, No. 1 engine would give 19 per cent. more power than No. 2, from the same weight of steam used. To show more clearly the effect of the internal or cylinder condensation upon the efficiency of the engine, it will perhaps be interesting to refer to Fig. 3. It is known from theoretical considerations that, supposing no practical difficulties intervened to prevent its realisation, the utmost efficiency possible with a steam engine would be represented by the difference between the temperature of the boiler steam and that of the condenser divided by the absolute temperature of the boiler steam. This ideal efficiency for steam of various pressures, assuming, as is usual, the condenser temperature to be 100 deg., is shown by the curved line in Fig. 3. It will be seen to rise slowly as the pressure increases, being ·261 at 50 lb., ·270 at 60 lb., ·298 at 100 lb., ·321 at 150 lb., ·339 at 200 lb., ·353 at 250 lb., and ·365 at 300 lb. per square inch. The actual efficiencies of steam engines, in practice, must, for several reasons, always be considerably less than these figures indicate; the principal one being the inevitable condensation in the cylinders. If, however, the various elements contributing to the reduction of the actual efficiency below its theoretically maximum amount be proportional to the work actually done in the steam engine, the form of this curve will still represent the relative efficiency of engines working with the different steam pressures. From this we see that in advancing from 60 lb. pressure to 150 lb., we ought to increase the efficiency by 19 per cent., or, what is the same thing, to effect an economy of 16 per cent. The fact that an increase of economy is actually obtained considerably above this amount, when using the triple expansion engine, shows that this engine is working under conditions more nearly approaching to those required for the maximum efficiency than the other. The spot A in Fig. 3 lying above the curve represents the height to which the efficiency has gone in starting from 60 lb., if 25 per cent. economy has been effected; while the spot B, still further above the curve, shows the similar height upon the assumption of an economy of 33 per cent. It must be remembered, however, that every addition to steam pressure increases the temperature of the steam. At 150 lb. the temperature is 366 deg. Fah., at 300 lb. it is 422 deg. When it is remembered that the boiler plates which have to transmit the heat to the water must necessarily be hotter than the steam temperature, and that steel is considered to be untrustworthy when it is at what is called the blue heat, which commences at about 470 deg. Fah., it will be evident that at a pressure of 300 lb. there will be less than half the margin between the steam temperature, and the temperature of untrustworthiness of the plates, than there is at a pressure of 150 lb. per square inch, and only one-third of the margin there is at 80 lb. pressure. Further, an increase of steam temperature will probably be felt in the working of the engine itself, as there must be some limit of temperature at which the endurance of cast iron will cease, and we may be nearer that limit than we think. He believed that our friends the locomotive engineers found a limit of this kind in their cylinders at lower pressures than we are now working at, until they changed the method of casting them. There is the further consideration that the higher pressures advance, the less margin there is to work upon in that direction, as is evidenced by the tendency to flatten itself, shown by the efficiency curve in Fig. 3. Mr. Parker concluded with some remarks on forced draught and mineral oil fuel. In every case in which oil has been successfully used up to the present time as a fuel for boilers, it is blown into the furnace and at the same time converted into a spray—or pulverised, as it is technically called—by means of a steam jet, this jet being obtained from the boiler itself. The amount of steam used for the purpose of pulverisation has never been definitely ascertained, but it is variously estimated at from 8 to 12 per cent. of the total production of steam in the boilers. Let us assume for a moment that it is 8 per cent., this will mean that for every 92 tons of water evaporated for use in the engine 8 tons of fresh water is lost, and must be supplied from the sea. If this is supplied from the main boilers, this will mean that a steamer exerting, say, 1000 I.H.P. will require about 14 tons of sea water to be put into the boilers per day. What amount of scale this would produce he would leave others to calculate, but it is evident that such a system is wholly impracticable for extended ocean steaming. It is, of course, possible to use an auxiliary boiler working at a comparatively low pressure for the purpose of feeding the oil into the furnace, but this complication is not likely to be carried out. When, however, the price of oil falls so low as to render it possible for it to compete with coal in ocean work, Mr. Parker does not doubt that it will be easy to find means to burn it, without employing steam to "pulverise" it. He believed the ultimate solution of the problem would be found in the use of compressed air, possibly of heated air, for the purpose of pulverisation.

This paper was followed by a very brief discussion, which elicited no information of much importance. It turned principally on the history of the use of high-pressures at sea, the Thetis being cited as an example of economy which had not yet been beaten; and on the tendency of furnace crowns to come down, all the speakers seemed to be agreed that the higher the pressure the greater was the tendency of deposit to adhere with stony hardness to the furnace crowns. There was no time available for discussion, because another paper—our notice of which we must reserve until next week—by Mr. W. John, manager to the Barrow Shipbuilding Company, had yet to be read, and a large number of the members who had been specially invited by Messrs. Ismay, Imray, and Co. were due at a little after 1 p.m. on board the s.s. Germanic. For the remainder of the members luncheon was provided by the Reception Committee at the Grand Hotel, and at 2.30 p.m. a visit was paid to Messrs. Cope Brothers' great tobacco works in Lord Nelson-street. Here the visitors were shown all the various processes of manufacturing tobacco and cigars of every kind. About 1000 women and 250 men are employed, and much care is taken by the proprietors to provide for the health and comfort of their employés. Later in the afternoon an official visit was paid to the Exhibition by a considerable number of the members, and at 7 p.m. the annual dinner of the Institution took place in the Institution building.

LETTERS TO THE EDITOR.

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

FORTY-KNOT SHIPS.

SIR,—The general purport of my proposal for the creation of a class of light steamers of large size, capable of maintaining a speed of 40 knots an hour, as a valuable and inexpensive reinforcement of the strength of our Navy, has been sufficiently described in my former letters to obviate the need of further explanation; but as your correspondent, Mr. Cleghorn, does not yet appear to be able to discern the practicability of such a speed, it is proper that I should expend a few remarks in the hope of resolving his difficulty. Some years ago such a speed as 40 knots in vessels of any class might reasonably have been regarded as impossible; but recent experience with torpedo boats, coupled with the acquisition of our knowledge of the law that, in vessels of whatever size, but of the same proportionate power, the larger vessels will always be considerably the faster, has so completely inverted our conceptions of the probabilities of the case that the maintenance of the persistent scepticism of our days of ignorance would now be inexcusable. If it be the case, as according to Reech's law it confessedly is, that by increasing the linear dimensions of a steamer four times, with a proportionate increase of power, we get twice the original speed, and if, further, it be the fact, as it also confessedly is, that many torpedo boats realise a speed of over 20 knots, then it is plain that we have only to enlarge one of these torpedo boats four times in every direction to get the 40 knots we require. Nobody can pretend that such an enlarged torpedo boat cannot be built, and with these points of knowledge before the public, the onus manifestly lies upon those who deny the practicability of attaining the 40 knots, to specify wherein lies the impediment to its realisation. If we accept Reech's law, then, so far as I am aware, the only objection of the least plausibility that has yet been mooted is, that whereas the strength of the working parts of engines increases simply as their sectional area, while the momentum strain put upon them by excessive speeds increases as the square of the velocity, the momentum strain at very high speeds may so far outrun the strength that some of the parts will give way. To this the simple answer is, that it is not proposed in these engines more than in any other engines to employ such excessive speeds as could lead to any such result, and in my last letter I specified several engines, which had been working for years without accident, with a considerably larger momentum strain upon them than I should be disposed to permit. I have already shown that up to such speeds as I propose to employ the effect of the inertia or momentum of the working parts will be to equalise strains, and therefore to reduce rather than to augment those which are most considerable. No doubt we have not any vessels yet working at a speed of 40 knots through the water, but we have innumerable examples of engines in all parts of the world running at this speed on railways, and it signifies nothing to an engine, so far as its strength is concerned, whether the resistance it has to surmount is situated on the land or on the sea.

The accuracy of Reech's law as a measure of the resistance of vessels has long been recognised on the Continent, and has also been conclusively demonstrated in this country by the late Mr. Froude. At page 5 of his obituary memoir given in the "Minutes of Proceedings" of the Institution of Civil Engineers for 1879-80, Part II., the following remarks will be found on this subject:—"Mr. Froude's first step in connection with his inquiries touching the resistance of ships was to enunciate the true principle of the relation of the resistance of a ship to her model—namely, that the resistance is in the proportion of the cube of a linear dimension—in other words, as her bulk—at speeds proportionate to the square root of the linear dimension. He demonstrated this mathematically, and by experiments with different sized models, some of which were nearly half a ton in displacement."

If we take a torpedo-boat as the model, then a vessel four times larger in each linear dimension will be four times the length, four times the breadth, and four times the depth; while her capacity will be 4^3, or 64 times, her displacement 64 times, and her engine power 64 times; but with these proportions her speed will be $\sqrt{4} = 2$ times greater, or if the speed of the smaller vessel be 20 knots, then that of the larger vessel will be 40 knots. In vol. xxxix. of the British Association Reports for 1869, pp. 43 to 47, and in various recent tracts and papers by Mr. Froude, ample information in regard to the accuracy and applicability of Reech's law is afforded, and to these I refer Mr. Cleghorn if he should consider further evidence necessary in verification of the doctrine I have propounded. If Reech's law be correct, it follows as a necessary consequence that by the introduction of the specified power, a speed of 40 knots will be practically obtained; and this power may be introduced without employing such a speed of engine as would jeopardise its strength and safety, or be otherwise inconvenient in any respect.

The two points, then, of the speed that will be generated in enlarged vessels by the introduction of the same proportion of power to tonnage which existed in the model, and the practicability of running engines of the necessary dimensions at the speed required to generate the power, are in reality the only questions requiring serious attention in connection with the present inquiry. "The rest is all but leather and prunella." But as Mr. Cleghorn is obviously of a different opinion, as he has raised various petty points which he may consider important, and as there may be some of your readers who participate in his incredulity, I propose to offer a few words of reply to his various objections, which I shall deal with *seriatim*:—

First, "I now ask him to justify his remark" that in the engines I propose to employ the evil of deficient strength would not be encountered.—A. The best justification is the fact that multitudes of engines have been for years at work without fracture or inconvenience in which the momentum strain upon the working parts is considerably greater than would exist in the engines I have recommended. In my engines the momentum strains would not be quite as great as the steam strains.

Secondly, "I call attention to a diagram purporting to show the combined stresses due to the steam and inertia of the reciprocating parts." This diagram is alleged to be erroneous in some respects.—A. It was stated in the letter in which this diagram was given that it was not mine, but was due to Mr. Chas. Louis Hett, who is more competent than I am to vindicate the relevancy of his own work. Whether accurate in all respects, however, or not, the law which it illustrated is obviously a law of nature, and its operation will certainly be to moderate the pressure on the crank suddenly created by throwing the steam on the piston in the case of an engine working expansively, and to surrender in the second part of the half stroke the intercepted force, so that while the total force is the same, the maximum and minimum will be so far equalised. Among those who have given most attention to the subject of fast-moving engines, Mr. Charles T. Porter, of New York, has occupied an eminent place for many years. To him Mr. Hett's diagram was submitted, and in a letter dated May 10th of the present year, while correcting an arithmetical error in Mr. Hett's computation, he says, "Mr. Hett's diagram I have stated to be correct."

Thirdly, "Looking at Mr. Hurst's proposed engine, I first remark that a stress of 87 lb. per lb. of reciprocating parts due to their inertia assumes a connecting-rod of infinite length, and that that quantity would require to be increased."—A. In reply to this same objection, noted by Mr. Porter in his examination, Mr. Hett says, "The angle of the connecting-rod was not overlooked, but for the purposes of calculation the connecting-rod was assumed to be infinitely long," as by such assumption the calculation was simplified, while the ultimate result was almost the same. The affectation of minute accuracy in such preliminary disquisitions as the present is, it seems to me, little less than absurd. It is as if one made the objection that the distance between London and Edinburgh had been given in miles instead of in feet, inches, and decimals of an inch.

Fourthly, "The weight of the reciprocating parts will not be under 6 lb. per inch of piston area, and the maximum load on the main bearings will be at least $2\frac{2}{3}$ times that due to the maximum steam load alone." "Mr. Hurst's engines will therefore be too heavy."—A. In a leading article which appeared in THE ENGINEER of June 18th, reference is made to recent investigations by Mr. Rigg regarding the inertia of the working parts of fast engines, and it is concluded, on a review of the whole matter, that the weight of the reciprocating parts of those engines "cannot well be less than 3 lb. per square inch of piston." This appeared to me to be a fair and judicious estimate of the quantity in question, and accordingly I adopted it as the basis of my computation. But Mr. Cleghorn at once doubles the quantity thus judicially arrived at without condescending to offer any explanation of his imperial assumption. If such a style of controversy be permissible, anything may be proved or anything may be confuted. But for such feats of legerdemain the engineering community has no admiration, nor will it accept Mr. Cleghorn's unsubstantiated dicta in lieu of proofs.

Fifthly, "His simple engines are to use steam of 200 lb. cut off at one-tenth. Mr. Hurst ought to have known better. His consumption of fuel will certainly not be under 4 lb. per indicated horse-power per hour."—A. I should certainly have known better than to commit the folly of recommending a species of engine which would entail so large a consumption of fuel as Mr. Cleghorn has specified, when all ordinary marine engines work with half this consumption, or less. But will any one suppose that I have done this? In my early letters I put down the consumption at 2 lb., though I believe it will not exceed $1\frac{1}{2}$ lb. But after having doubled the weight of the reciprocating parts of the machinery so easily, it will no doubt be an easy feat to Mr. Cleghorn to double or treble the weight of the coal.

Sixthly, "I would have expected in these days of triple expansion engines Mr. Hurst would have known something of their *raison d'être*."—A. I certainly do not know, as the fact is clearly otherwise, that the amount of power which is generated by a given weight of steam of a given pressure expanding through a given space depends in any measure upon the number of cylinders through which it is passed, the result being the same whether the expansion is accomplished in one or in fifty. This was long ago demonstrated by Mr. Watt when Hornblower's design of a compound engine first came out, a century ago; and I should have expected that such an elementary truth in engineering science as the immaterial character of the number of cylinders for the generation of the power would have fallen within Mr. Cleghorn's cognisance. The compound system has been several times revived, notably by Woolf; by Messrs. Simpson, of Pimlico, about forty-five years ago; in the compound engines designed by the late Mr. David Thomson for the New River Waterworks; and subsequently by Messrs. Randolph and Elder, who applied the method to steam navigation. The compound engines at the New River works were erected in competition with simple engines erected by Boulton and Watt, both having the same species of boiler, working at the same pressure. The performance of each class of engine was ascertained by careful experiments, conducted under the personal supervision of the late Mr. Joshua Field, and it was found that on the whole the best performance was got from the simple engines, and not from the compound. In my letter I did not *prescribe* the use of simple engines; but the words of my suggestion were that each screw shaft should be "driven by a triple expansion engine or by three simple engines," believing the nature of the decision upon this head to be not very material. Whatever style of engine were adopted, there would of course be adjustable expansion valves, which would cut off the steam at any point of the stroke that might be found to be most beneficial. It will be obvious that where very high initial pressures of steam and large expansion are dealt with, the same ultimate pressure is not to be expected that is due to the volume and weight; and this will be especially the case if the engine be also a fast one. During the whole course of the expansion the engine will be generating power at the expense of the heat in the steam, the temperature of which will consequently fall to a lower point than if such power were not exerted; and if the engine is a fast one the cylinder becomes virtually a non-conductor, and very little of the expended heat can be recovered from the jacket.

In regard to the strength of the hull, which is attainable by the utilisation in the deck and bottom of the large vessel of the material yielded by the numerous decks and bottoms of the small, it is proper to observe that while in all metals the tensile strength is pretty nearly constant for the same area of cut section whatever the thickness of the metal may be, the strength to resist compression follows a different law, and becomes very small when the metal is thin, whatever be the area of the cut section. We all know that a sheet of gold leaf will not stand on edge, its compression strength being insufficient to sustain its own weight; and experiments on the compression of rivetted rectangular iron tubes, of the same dimensions as one another, but of different thicknesses, show that whereas with an area of section of 1·532 square inches the crumpling weight per square inch of section was 6·786 tons, it rose to 12·015 tons per square inch of section when the area of section amounted to 7·326 square inches. It follows from this that the thick plates of the deck and bottom of the enlarged vessel will be twice as strong to resist compression per square inch of section as the thin plates of the small vessels can be; and as the compression strength is the weak place in small vessels, it also follows that the enlarged hull will be twice as strong as it would be if it inherited the special weakness of smaller vessels, arising from the thinness of their constituent plates.

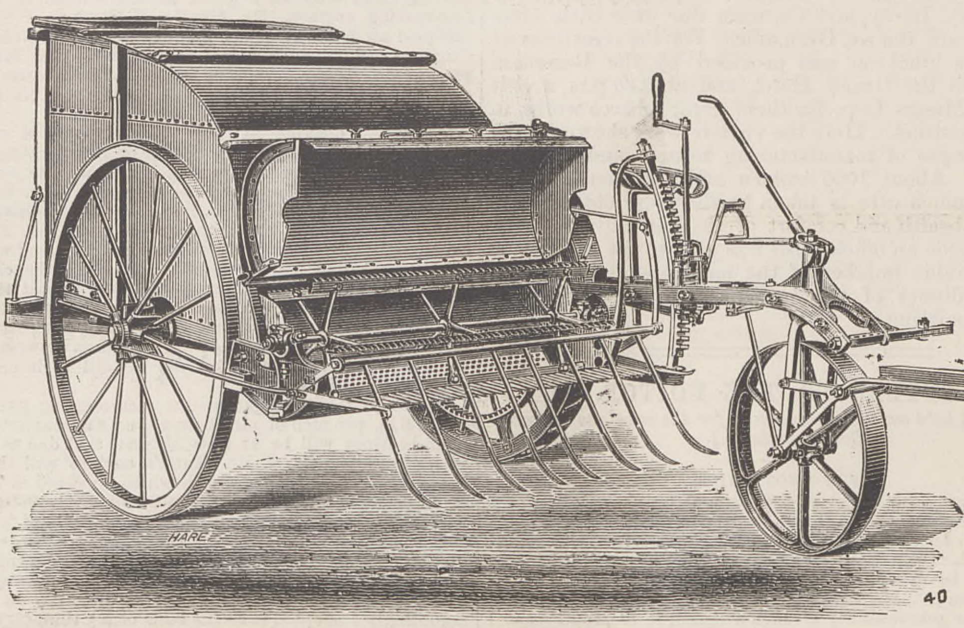
Such, then, are some of Mr. Cleghorn's most prominent contentions, and such my reply. The enterprise of establishing vessels upon the sea which shall be capable of attaining a speed of 40 knots is confessedly one which will tax to the utmost our engineering resources, but will not outrun them; and the importance of the achievement to the maintenance of our maritime ascendency and our engineering prestige is so great, that it may be hoped that a general emulation will be created among us to assist in the realisation of so beneficent a design. Mr. Mansel's thoughtful letter of June 4th is a contribution in this direction as it pointed out a want of congruity between some of my figures, and established facts in other combinations. In this discovery Mr. Mansel gave proof of his great perspicacity, for the speed and power from which my figures were deduced I afterwards found were erroneous, and the rectified figures gave a result which more nearly accorded with Mr. Mansel's estimate.

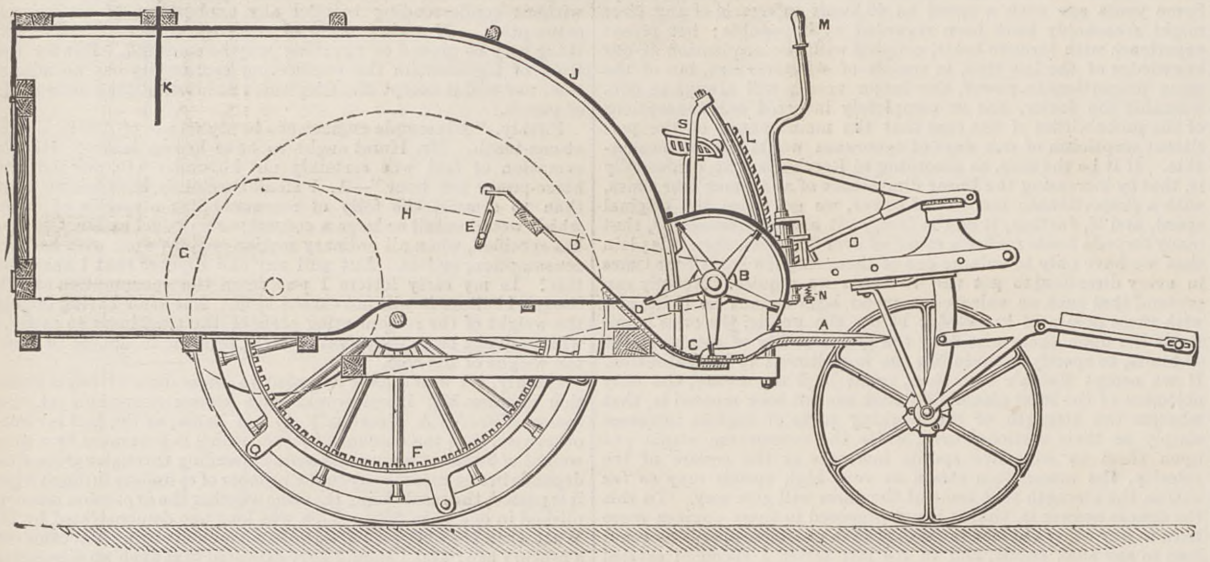
CHAS. F. HURST.

College of Practical Engineering, Chiswick, W.,
August 2nd.

AUSTRALIAN STRIPPER AND THRASHER.

MESSRS. HORNSBY AND SONS, GRANTHAM, ENGINEERS.



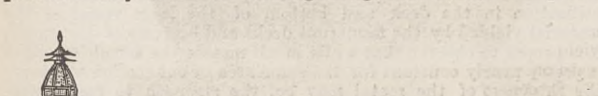


AUSTRALIAN STRIPPER AND THRASHER.

The above engravings illustrate a stripper and thrasher made for the colonial markets by Messrs. Hornsby and Sons, Grantham. From the perspective view, in which the drum cover is raised to show the drum, the general character of the machine will be gathered, while the section shows clearly the arrangement in detail. A cog ring F gears with a pinion on the spindle of the wheel G, a strap from which drives the drum B. The drum knocks the corn from the ears, which are stripped from the top of the corn by the sharp-edged fingers A as the machine is hauled across the field. The grain chiefly passes through the concave and grid C and D, the chaff and chobs being carried into the box H, from which it is afterwards taken and dressed by winnowing machines. The drum is of a very light form, the beaters being light angle iron or steel. The height of the stripping fingers may be varied by raising or lowering the front part of the machine. The board K prevents the flight of grain and chaff through the opening beyond it. The machines are attracting some attention in this country now, as possibly indicating a new departure in English harvesting.

KITTS' STREET LAMP-POSTS.

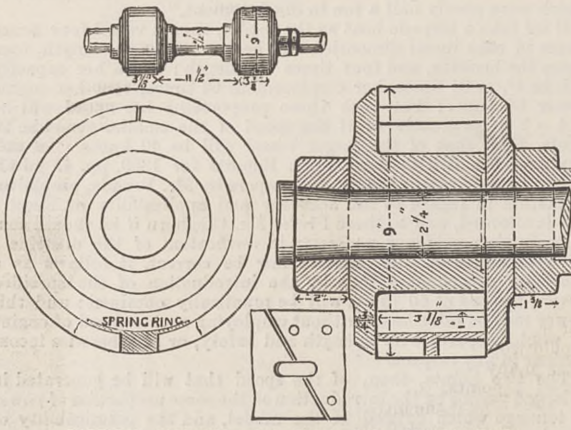
The lamp-posts illustrated by the accompanying engraving are made by Messrs. J. W. Sugg and Co., Westminster, under Mr. Kitts' patent. The object of the invention and the action of the post are easily seen from the engraving. No ladder is required



for cleaning or repairs, and it is intended by the inventor that no lighting rods should be necessary, lamplighters carrying a key which enables them to disengage the post, then light the gas, and then return the post to the vertical.

ENGINES AND BOILERS OF THE STEAMSHIP MATABELE.

While the attention of engineers is directed at the present moment so much towards increased pressure, a short description of the machinery of Messrs. John T. Rennie, Son, and Co.'s new steamer Matabele will be interesting, and we publish on pages 109 and 112 general arrangement and sectional views of the engines and boilers. The vessel was built by Messrs. Hall, Russel, and Co., of Aberdeen, under the superintendence of Messrs. Flannery and Baggallay, and was completed last December; the dimensions are 252ft. by 35ft. 3in. by 23ft., equivalent to 1570 gross registered tons. The engines are of triple expansion type, having three cylinders fore and aft of each other, of diameters 19in., 30in., and 50in. by 36in. stroke, and are driven by steam at 150 lb. pressure from two steel boilers of the single-ended type. It will be seen from the plans that the machinery compartment is very little, if any, larger than it would have been with the ordinary compound engine of equal power, as the cylinders are smaller and the boilers and stokehole shorter.

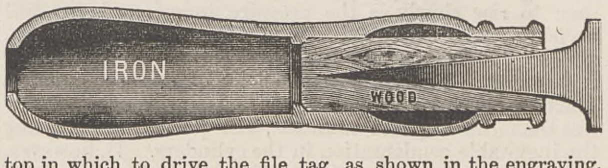


PISTON VALVES OF THE S.S. MATABELE.

The high-pressure valve is of the piston type as shown, and the pistons of all cylinders are of McLaine's patent type, which is now so generally used in triplex engines. The weight of the low-pressure slide valve is compensated by a cylinder at the upper end of the valve spindle. All three pistons are guided by tail rods; but, as the high-pressure cylinders of engines of this class are extremely long in proportion to their diameter, it is doubtful if there is any advantage in fixing tail rods, except to the intermediate and low-pressure engines, especially in view of the cooling effect of the tail rod in passing between the very high-pressure steam and the atmosphere. The starting gear is very compactly arranged, so as to be worked by hand and steam. The boilers are of Siemens-Martin steel throughout, and on account of the great thickness and pressure, have had extra attention, the edges of the shell plates being planed, and all holes drilled and rimered in place, and the plates separated and the burrs filed off before rivetting. Fox's flues are fitted, and the boiler is accessible in every part for cleaning. On the trial trip these engines indicated 811-horse power, driving the vessel nearly eleven knots, which completely fulfilled the intended conditions of her trade. The engines were tried for the lowest speed, and ran smoothly at ten revolutions a minute, the cranks just creeping over the centres; and when racing at sea, she has since shown in a marked degree the improved regularity in running produced by the three crank system, and consequent reduction in maximum strain upon the crank shaft. The Matabele has just completed a voyage to Natal and back, and the working of the machinery has been most successful, the speed being about the same as the sister-ship Dabulamanzi, fitted with ordinary compounds, but the consumption quite seven tons less per day. The boilers keep steam easily, which is one of the great secrets of economy, and the result of the ship's present running to the Cape is very satisfactory from the small consumption, and leaves no doubt as to the economy of the higher pressure engine if rightly designed. The vessel runs with a minimum of slip, the screw being fine, and the thrust upon it nearly equal at all parts of the stroke. The vacuum is well maintained at 26 in northern seas and 25 in the tropics. This is, we believe, the first triple expansion set of machinery put on a regular Cape line, but others are quickly following Messrs. Rennie's example.

WELLS' UNBREAKABLE FILE HANDLE.

To avoid the loss by breakage of wood handles, Messrs. A. C. Wells and Co., of Ogden-street, Manchester, are bringing out an iron handle made in thin annealed iron, rendering it practically everlasting. A small short wooden plug is driven into the



top in which to drive the file tag, as shown in the engraving. A hole is provided at the back of handle, so that for removing the wood a piece of iron can be inserted and the plug instantly driven out.

THE EDISON-HOPKINSON DYNAMOS AT THE INDIAN AND COLONIAL EXHIBITION.

One of the most important elements which has conduced largely to the success of the electric lighting at the Exhibition is that in place of an enormous variety of dynamos of all types, the lighting has been divided into three or four large groups, each worked by dynamos from one maker. The dynamos for the whole of the internal incandescent lighting have been supplied by the Edison and Swan Company, and are of the Edison-Hopkinson type, manufactured by Messrs. Mather and Platt, of Manchester. There are in all eight machines, but only six are at work, the remaining two being spare machines available for any work required of them. Four are the 10in. long size for an output of 105 volts, 320 ampères at 750 revolutions per minute, three of which are employed for lighting Old London, the Hong Kong Pavilion and Tea-gardens, the vestibule and the Indian Palace sections, while the fourth is run at a higher speed to give 130 volts, and is used for charging the E.P.S. accumulators. It was on machines of this size that the efficiency experiments were made which we referred to and commented upon in our issue of 5th March, 1886. We then showed that a commercial efficiency of over 93 per cent. had been attained, and the satisfactory working of the machines at the Exhibition confirms the opinion we then expressed, for good efficiency shows itself not only in economy of power, but in good lasting qualities, as power wasted is always more or less destructive. Two of the remaining machines are for an output of 55 volts and 280 ampères at a speed of 850 revolutions per minute, and are employed in lighting the Exhibition dining-rooms. One of these is the same machine which underwent the special test of three weeks' uninterrupted run, the particulars of which we also gave in our issue of 23rd January, 1886.

Trials of Seed and Manure Drills.—An international competition of sowing machines, *i.e.*, drills, is to be opened at Foggia on the 20th of October, 1886, and closed on the 30th of November. All national and foreign inventors, constructors, and agents can take part in the competition. All agents, national and foreign, taking part in the competition are considered only as representatives of the constructors, and, in case of merit, the prizes shall be awarded to the latter. To the competition are admitted machines to sow in rows and to scatter the seed, as well as those combined both to sow seed and to distribute manure. An executive commission provides everything necessary for the success of the competition. The Commission is composed of the director of the professional school at Foggia, who is also the president, of a delegate of the provincial council, of a delegate of the municipality of Foggia, of a delegate of the Chamber of Commerce and of a delegate of the Royal Economical Society of Capitanata. The prizes are as follows:—(*a*) A diploma of honour and the purchase made by the Ministry of Agriculture of five sowing machines the system of which shall obtain the first prize; (*b*) two silver medals with 200 Italian lire each; (*c*) ten prizes of 30 Italian lire each to those labourers that during the experiments shall employ themselves in driving and regulating the machines, and that shall give proof of having best learned their management. All sowing machines presented to the competition must be subjected to all the experiments prescribed by the jury both on flat and on hilly ground. All sowing machines that have already obtained a prize in other competitions are admitted, but cannot obtain a new prize, unless they present some useful alteration.

Junior Engineering Society.—On Monday, July 26th, this society visited the Royal Small Arms Factory, Enfield, by special permission of the authorities. The party were first shown the process of manufacturing the several parts of the new pattern Enfield rifle soon to be issued to the service, the manner of proving the barrels for accurate boring and sighting being particularly explained. The finished rifle apart from the stock was seen and fired with the usual test of a double charge. The various processes employed in the manufacture of the new pattern bayonet and sword, from the rough steel to the finished weapon as it leaves the polisher's hands, were then inspected, after which the visitors were conducted to the shop containing the Gardner, Gatling, and Nordenfelt machine guns, the actions of which were fully explained. The wood-working shops were next visited, and the turning of the gunstocks from walnut wood by means of Blanchard lathes was seen in course of operation, the rapidity with which the lathes performed their work attracting much attention; the time occupied for roughing out each stock being but 1 min. 40 sec. Much interest was evinced in the forging machines, one being provided with tools sufficient to work up the rough sword blade or bayonet from the steel as supplied from the manufacturer to the proper thickness, width, and length, for machining. The visitors then entered the barrel-rolling mill where the barrels are passed in the rough bar at the proper heat through a series of six horizontal rolls, after which they are ready for boring, three being rough-bored simultaneously, in which process the barrels revolve and the tool remains stationary. The finished boring takes place at other machines, the barrels are turned outside and rifled. An inspection of the 560-horse power main engine—by Fairbairn—brought the excursion to a close. For the information of any who may be desirous of joining the Society, the address of the hon. sec. is 64, Reedworth-street, Kennington, S.E.

ENGINES AND BOILERS OF THE S.S. MATABELE.

MESSRS. HALL, RUSSEL, AND CO., ABERDEEN, ENGINEERS.

(*For description see page 108.*)

FIG. 1.

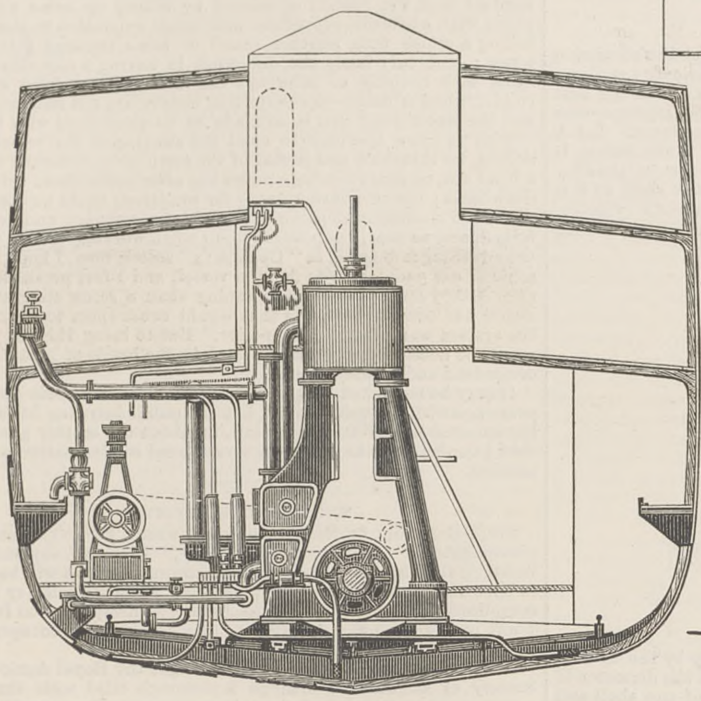


FIG. 2.

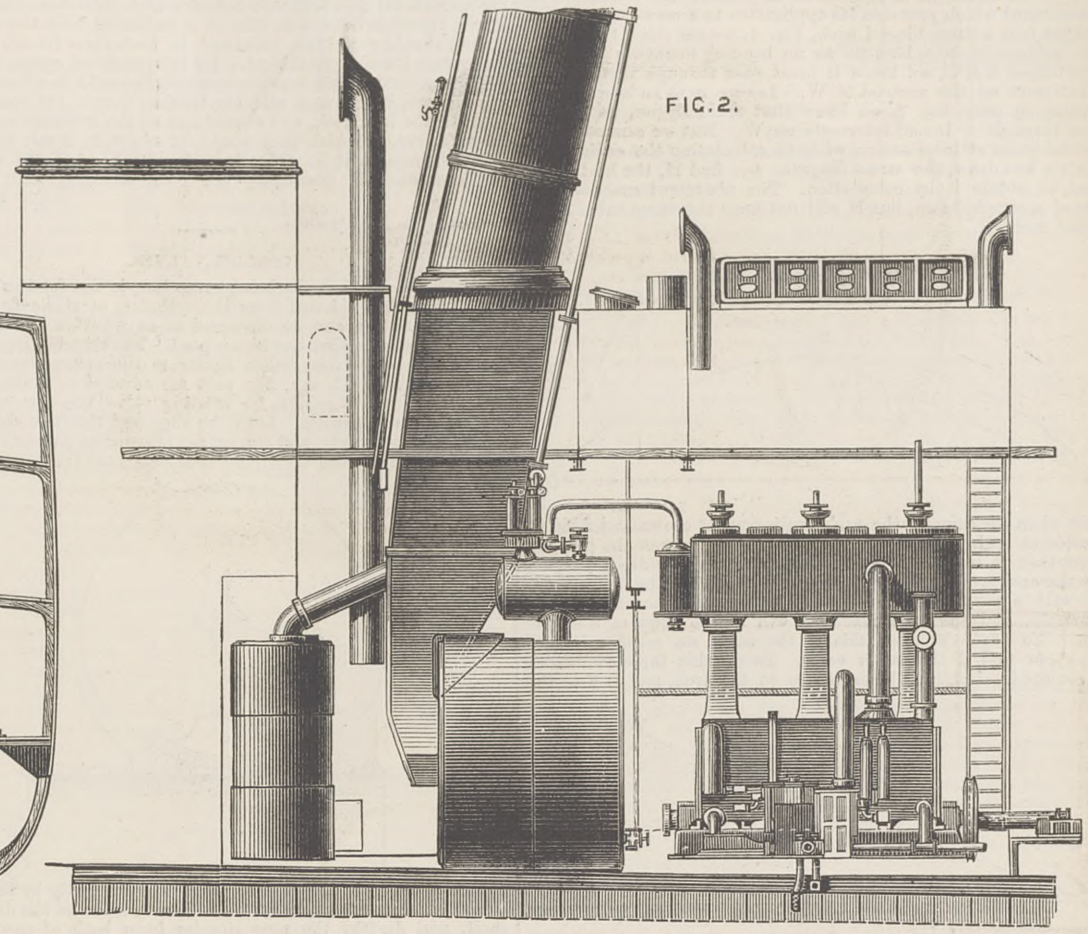


FIG. 3

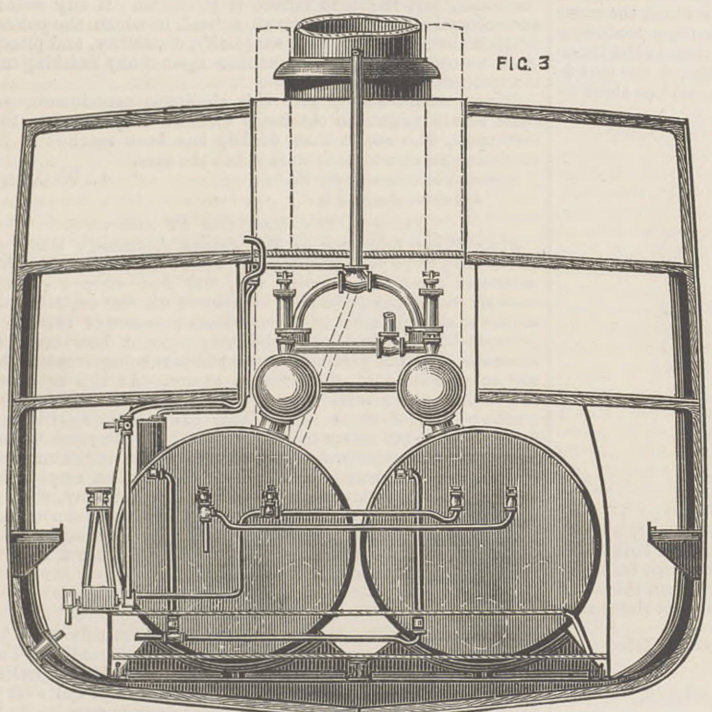


FIG. 4

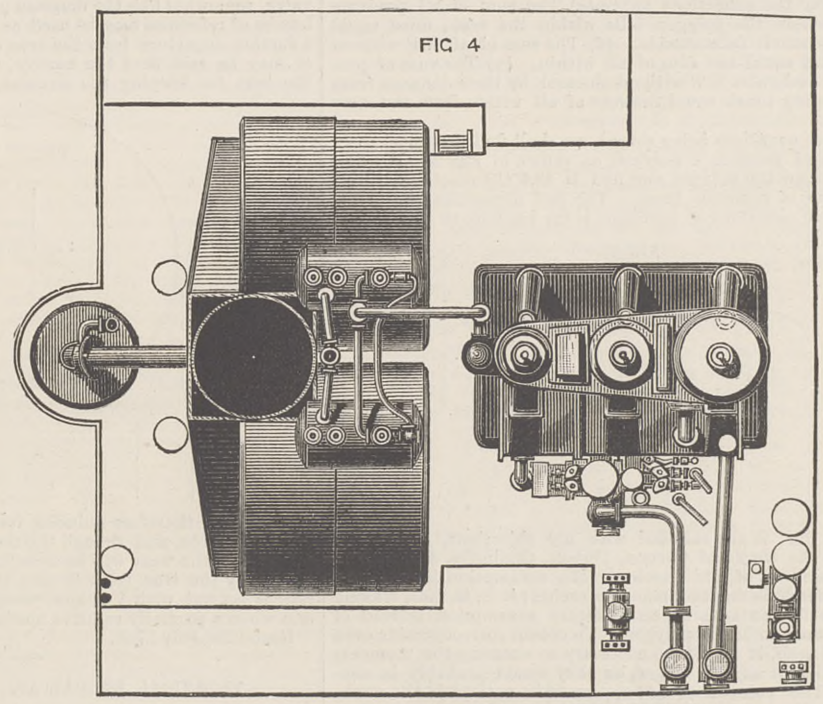
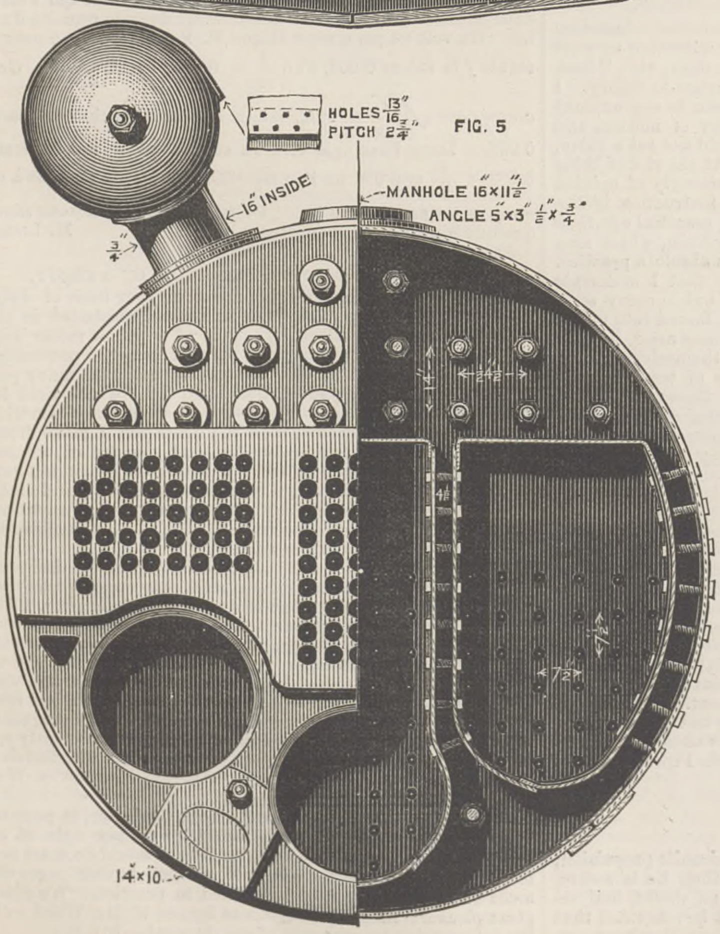


FIG. 5



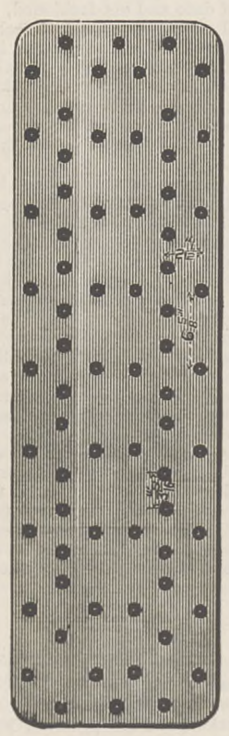
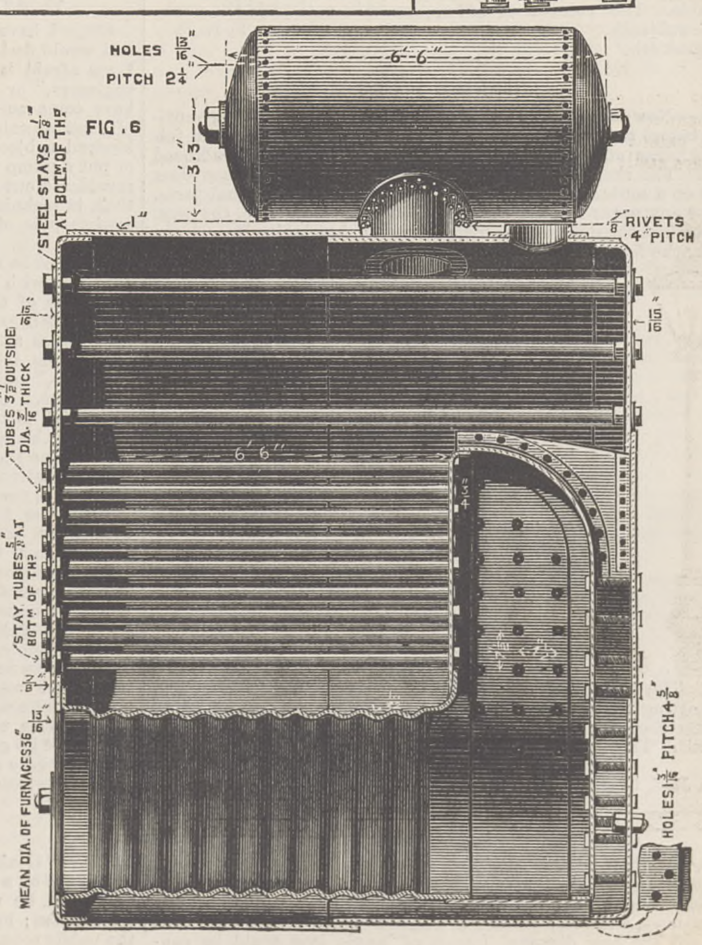


FIG. 6



LETTERS TO THE EDITOR.

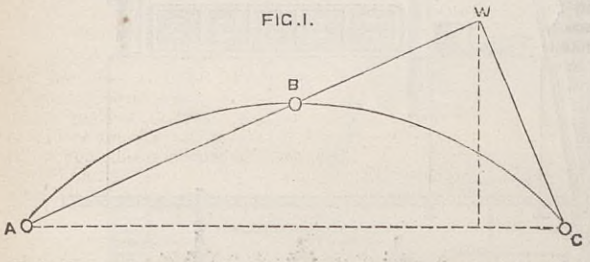
(*Continued from page* 107.)

GRAPHIC TREATMENT OF MASONRY ARCHES.

SIR,—As "A. S. H." does not accept my correction, will you permit me to define in as few words as possible the limitation to his treatment which prevents its application to a masonry arch?

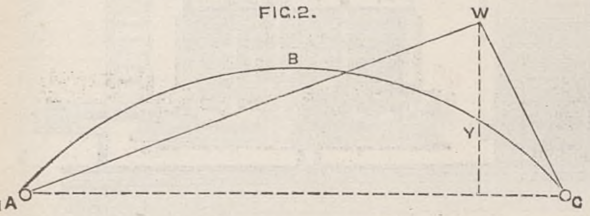
Taking first a three-hinged arch, Fig. 1, we can draw the equilibrium polygon at once, because as no bending moments can exist at the hinges A B C, we know it must pass through these points and intersect on the vertical of W. Taking next an arch hinged at springing only, Fig. 2, we know that the polygon, as before, passes through A B and intersects on W. But we cannot determine the point of intersection without calculating the ordinate y, when we can draw the stress diagram and find H, the horizontal thrust, or obtain it by calculation. The abutment reactions are those of a simple beam, but H will not have the same value as in the last case.

FIG. 1.



But when we come to the arch continuous at crown and fixed in direction at springing, Fig. 3, we know nothing about the polygon except that it intersects in the vertical of W. Indeed, judging from the analogy of a beam fixed at the ends, we should suppose that with a partial load there will be bending moments at the abutments, and that the reactions will not be those of a simple beam. To prove whether this is the case, we must calculate y_0 y_1 y_2, or find if the latter exist. To do this three conditions are required. Let D E be ordinates to the arch, and D F to the

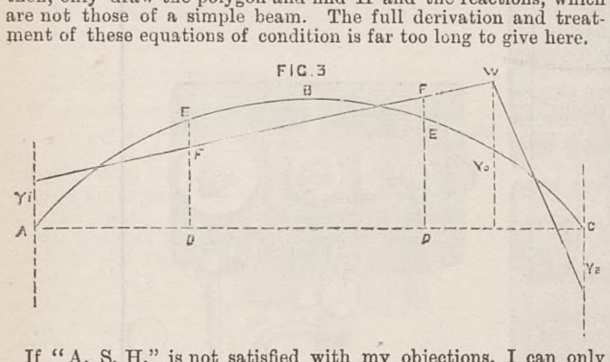
FIG. 2.



polygon, then the conditions are:—(α) The sum of all products D E, E F, where the polygon falls within the arch, must equal their sum, where it falls outside. (β) The sum of all E F without the arch must equal the sum of all within. (γ) The sum of products of all ordinates E F without the arch by their distance from either springing must equal the sum of all within from the same springing.

These three equations being solved, we shall find that most cases of partial load produce a polygon as shown in Fig. 3. We can, then, only draw the polygon and find H and the reactions, which are not those of a simple beam. The full derivation and treatment of these equations of condition is far too long to give here.

FIG. 3

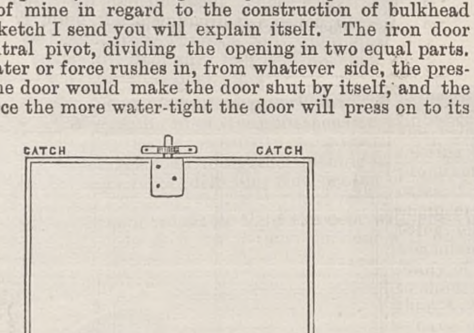


If "A. S. H." is not satisfied with my objections, I can only refer him to the works of Greene, Dubois, Chalmers, &c., for the graphic treatment of fixed arches. His assumption is one that is too often made in treating masonry arches; it is, in fact, making the polygon fit the arch by an arbitrary assumption instead of making the arch to fit the polygon. To obtain correct strains even for a hinged arch, it would be necessary to examine the moments caused by friction at the hinges, as they would probably be considerable. This point does not appear to be noticed in the works on the subject. F. E. R.

August 4th.

BULKHEAD DOORS.

SIR,—Now that the question of bulkhead doors is being ventilated before the public, I shall be glad if you will publish the following ideas of mine in regard to the construction of bulkhead doors. The sketch I send you will explain itself. The iron door opens on a central pivot, dividing the opening in two equal parts. In case any water or force rushes in, from whatever side, the pressure against the door would make the door shut by itself, and the greater the force the more water-tight the door will press on to its



sides. The rims of the doors can be lined with india-rubber, and a self-acting catch spring be put on, to work from both sides, to keep the door shut if wanted, and when the water closes the door by itself. The length A B should be wide enough to let coalmen pass. JOHN I. DE JONGH, A.M.I.C.E.

San José, Costa Rica, July 10th.

HORIZONTAL FRAMES IN SHIPS.

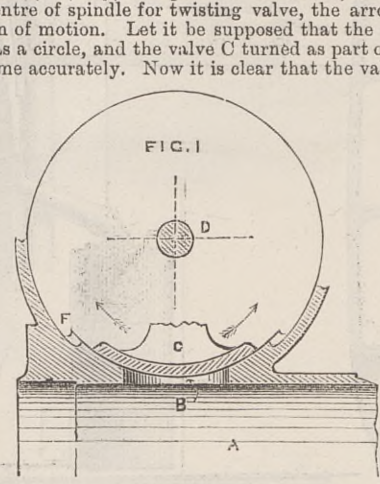
SIR,—With reference to the letter of your correspondent "Delta," diagonal iron bars such as he describes were habitually used in wooden ships. They were scored into the timbers within and without, and their effect was found to be advantageous. But I do not see how diagonal frames of angle iron could be conveniently introduced in iron vessels, nor do I think their presence would be beneficial. I admit the accuracy of "Delta's" axiom, that ships require greater strength vertically and transversely between the longitudinal frames than is given by the skin plating of the ship. But this necessary strength is imparted by the bulkheads, and by a single strong transverse frame between every two bulkheads. Supposing the vessel to have five bulkheads, which is not an unusual number, then between each two there should be a strong transverse frame in lieu of a bulkhead, and the horizontal frames should run from bulkhead to transverse frame, and from transverse frame to bulkhead. By this mode of construction the necessary vertical and transverse strength would be afforded. The deck beams, in common with the frames, should run fore and aft, beneath the iron deck, and should rest on the bulkheads and transverse frames, to which they would, of course, be firmly secured. A ship so formed will be virtually a Menai tube, and will attain the consummation of possessing the most strength with the least materials. JOHN BOURNE.

Chiswick, August 2nd.

CORLISS VALVES.

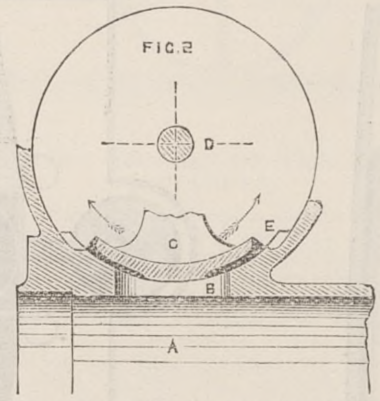
SIR,—The Corliss valve has been so long in use for the admission of steam to and exhaust from the cylinders of stationary engines, that the question can be answered as to whether it has the best form for its work that can be adopted. The sketch diagrams—not drawn to scale—given below illustrate the arrangement. Let A be the cylinder, B, say, the port for admission, C the valve, D being the centre of spindle for twisting valve, the arrows showing the direction of motion. Let it be supposed that the shell at F is bored true as a circle, and the valve C turned as part of a cylinder, to fit the same accurately. Now it is clear that the valve C having

FIG. 1



motion given to it across the port B concentrically by the spindle D and its connections, the wear will be to increase the diameter of shell, and destroy the true circular form both of the shell and valve, somewhat like the diagram given below—for which the same letters of reference may be used as before—each surface producing a further departure from the true circle in proportion to the time. It may be said that the narrow, rectangular shape of the port is the best for keeping the circular motion of the valve as short as

FIG. 2



possible, and therefore reducing its wear; but this is only a question of degree, and though the metal may be hard in both shell and valves, the wear will be as before noticed. The same tendency to destroy the true form is also in piston valves, when the outer ring is set out with V-shaped wedges and springs to fit the shells, and when a partially rotative motion is employed.

Rochdale, July 27th. THOMAS SPENCER SAWYER.

TECHNICAL EDUCATION.—"BOOK ENGINEERS."

SIR,—I have read your several articles on technical education, and would desire in this connection to call your attention to what I am afraid is a growing race in these latter days, viz., "book engineers," or those who have subordinated practice to theory. I have come across several of these lately, who can do any amount of abstruse calculation, talk glibly on the theory of motion, and kindred subjects, who, for the life of them, could not set a valve, or put a pump in order that refused to work. At the risk of being considered out of date and old-fashioned, I am strongly of opinion that, in technical education, practical technical instruction in the workshop is of far greater money-value in this practical age than the knowledge of any amount of algebraical formulæ, which may or may not be found to accord in its results with absolute practice. I do not wish it to be understood from this that I underrate the value of theoretical instruction generally; but in many engineering colleges I think that theory has been forced into undue prominence at the expense of practice. This may arise, in some cases, from the Professors or teachers being themselves "book engineers," and therefore more or less incapable of teaching anything else. Another reason, probably, why theory is in the ascendant is the scarcity of really practical engineering books. Many of the more recent books appear to have been written rather to show the learning and mathematical knowledge of the authors than to instruct younger men, who—when in business, at any rate—have not the time, and perhaps not the knowledge, to work out the more or less accurate, but certainly very intricate, formulæ with which some of these works abound. I take it that, at the present time, there is ample scope for a series of books on the different branches of engineering science, written in a plain, straightforward way, and in which we shall not have to dig down through a mass of more or less "clever" but involved verbiage to get at the grains of practical information which may or may not be found below. In my own case, I may say I have been in business now some twenty years, and have found the greater proportion of the stuff I was crammed with at college absolutely useless. In urging that practice receive at least as much attention in technical education as theory, I will conclude by asking to whom does the world owe its greatest inventions—to practical or theoretical men? I take it there can be but one answer. M. POWIS BALE.

Appold-street, E.C., August 2nd.

HYDRAULIC PROPULSION.

SIR,—"Goahead's" letter of July 23rd, on hydraulic propulsion, is perhaps of a much more interesting nature than he is aware, and could he make good his promise, would, no doubt, find remuneration; but he, being an engineer, need not be reminded that the public require a lot of convincing before they will take to an invention, and inventors are too apt generally—I speak from experience—to over-estimate the value of their ideas, and even when tried, if they fail, are inclined to say that the trial has not been fair to the invention. But I don't say this to discourage, for, with "Goahead," I believe, and have always done since Waterwitch was launched, that some such mode of propulsion would yet take front rank.

The Waterwitch, with all her faults, could nearly hold her own with a sister screw gun-vessel, and had her propelling system been arranged in a more scientific manner, so as to get rid of a lot of bends in the piping, with its attendant friction, and so utilise fully the force of the water, this, combined with suitable trim of vessel, might have caused her to do so well as to have induced the commercial world to take the matter in hand, in which case the best adaptation would have been quickly discovered, as it is not to be supposed that in Ruthven's invention the matter had reached finality. Just now, with the depression in shipping trade, it is needless to expect any company to take it up, but some of the wealthier men of the yachting world could do much for their own comfort and the benefit of science by fitting up some auxiliary yacht with hydraulic propellers and triple expansion engines, and taking a cruise with another vessel of same tonnage fitted with screw; and only fancy the difference in having a nice clean-built boat, with nothing to interrupt the flowing lines from stem to rudder when cruising—for projecting nozzles are not indispensable, and the water inlet can be so made as to close flush with bottom—with no screw aperture to spoil the steering of the vessel when sailing, no thrashing and jarring of the stern when steaming against a head sea, no shaft bearings under the after cabin floor, with their drawbacks; the circulating pump for condenser could be dispensed with, the machinery department would be compact and self-contained, and as nearly as possible silent when working. These and all the advantages detailed in "Goahead's" letter, may, I hope, induce some of our yachtsmen to fit up a vessel, and I feel persuaded that even if they did not do better running than a screw steamer, they would find other advantages that would cause them to admit that the system was practically superior. But to bring this to pass it would be necessary to place the work in the hands of a thoroughly competent and unprejudiced firm.

It may be remarked that an exhaustive trial was made some few years ago with a torpedo-vessel, but the public learnt so little about the construction of the machinery, or about the matter generally, that I don't think the system deserves total condemnation on that account. W. H.

THRASHING MACHINES.

SIR,—Referring to the article in last week's ENGINEER on "Improvements in Agricultural Machinery," I beg to say that my finishing thrashing machine—a full account of which will be found in THE ENGINEER of July 6th, 1883—is neither so heavy nor so complicated as the single-blast machines you mention; and further, I am prepared to supply my machine considerably cheaper than any now in the market.

A short time since I endeavoured to get the Royal Agricultural Society of England to arrange a thorough trial with thrashing machines, but failed to induce it to do so. If any well-known agricultural society will arrange a trial, in which the points to be decided should be efficiency, simplicity, durability, and price, I am open to compete with my machine against any finishing machine in existence.

If you would kindly give this challenge prominence, perhaps some result might be obtained, and we may be able to show foreigners, who assert that finality has been reached in English thrashing machines, that such is not the case.

Queen Victoria-street, E.C., A. W. MANTLE.
London, August 3rd.

FEED-WATER HEATERS AT NORWICH.

SIR,—With reference to Mr. James Atkinson's letter on the above subject in your issue of last week: Supposing that the temperatures given are correct, viz., 200 deg. when the engine is running empty, and 250 deg. with the work full on, Mr. Atkinson argues that there must be a mean back pressure of 18 lb. in consequence, but he does not take into account how much this is neutralised by the partial vacuum which is being created through the condensation of the exhaust steam. As this raises a very interesting point with regard to the relation which the heat bestowed on feed-water should bear towards the heat to be taken from the exhaust steam in order to produce the most economical results, I hope that you will be able to obtain indicator diagrams of this engine running with full work and when empty, in order that your readers may see what back pressure, if any, there really is, and form their own conclusions as to the most economical relations between heating the water on the one side and condensing the steam on the other. FRANK PROCTOR.

Cannon-street, London, E.C., July 29th.

SCREW PROPULSION.

MONSIEUR,—Vous avez publié dans les colonnes de votre journal un intéressant mémoire de Professeur A. G. Greenhill sur l'utilisation des propulseurs hélicoidaux. Permettez-moi de signaler à son auteur, par votre intermediaire, une légère erreur qui s'est glissée dans le numéro iii. de ce mémoire inséré dans le numéro du 9 Juillet. On voit au paragraph 31 que M. Froude a trouvé pour la constante f la valeur 0·008, d'où $\frac{f}{m} = 0{\cdot}004$, or M. A. G. Greenhill donne pour $\sqrt{\frac{f}{m}} = 0{\cdot}02$, tandis que cette racine est carrée est 0·063. Dans l'example cité au section 35 le result serait donc $0{\cdot}063 \times \frac{4}{3} = 0{\cdot}084$ au lieu de 0·03. Et les conclusions à en tirer seraient un peu differéntes. Cette rectification aurons sans doute quelque intérêt pour vos lecteurs. M. LISBONN.

Paris, 31 Juillet.

THE ELECTRIC TRANSMISSION OF ENERGY.

SIR,—In your article on this subject in your issue of July 30th, you end up by saying that, "but he has not succeeded in showing that such energy obtained by means of a prime motor requiring steam is either cheap or practical. It may be convenient and luxurious—other it is not." You call attention to many points of great importance in your article, and I have not time for this week's issue to attempt to do justice to it in these remarks; but permit me now to say this, that the quotation I make from your article would lead many to suppose that you are of opinion that electric power transmission from a steam engine is not practical and economical. This would shut out tramways and light railways. There is no system existent of working tramways and light railways so cheap as electric transmission, even though it be from a steam engine as the prime mover.

Take a system of tramways in a town worked by direct electric transmission—one steam engine station may operate many miles—there is only one set of boilers and engines to look after. The coal consumption per horse-power is far less on a large stationary steam engine than on steam tramway engines, which, in addition to their high rate of depreciation, are little coal eaters. In addition to this, instead of having a steam locomotive on the tram line weighing 7 or 8 tons, or less, the electric motor weighs only a few hundredweight, and the net weight of rolling stock—and consequent wear and tear and necessary first cost of the road—is greatly reduced per passenger carried. Here then is a vast field for electric transmission even from a steam engine. RADCLIFFE WARD.

August 4th.

[Our correspondent is, we gather from his letter, in possession of figures which show the actual working cost per mile of electric railways. The publication of these figures would do more no doubt to carry conviction to the minds of his readers than pages of argument unsupported by figures obtained in practice. We shall have great pleasure in publishing these figures if Mr. Ward will place the information he possesses at our disposal.—ED. E.]

RAILWAY MATTERS.

THE German rail works are losing heavily by the dissolution of the international rail convention and of the conventions with England and Belgium.

THE aggregate railway mileage of the world is estimated, at the end of 1884, at 290,750 miles. Not less than 60 per cent. of the whole mileage of the world is in English-speaking countries. Australia has the largest amount of railway accommodation in proportion to population.

IT is stated that the administration of the Prussian State Railway has proposed to the Russian and Austrian Junction Railways the making of mutual tariff concessions. Unless measures of an extraordinary kind are speedily taken, the iron industry of Silesia will, it is thought, be irretrievably ruined.

THE cost of the railway system of the world is estimated at £4,800,000,000. The highest expenditure was in Great Britain, where it amounted to £41,168 per mile, as compared with £24,797 in Belgium, £24,928 in France, £21,041 in Germany—State railways—£20,885 in Austria, £16,449 in Russia, and £12,650 in the United States.

THE *Railroad Gazette* remarks that no less than five explosions of hollow cast iron pistons have occurred in French workshops in the last twenty years in reheating these pistons—generally for the purpose of removing the piston rod. Investigation into the interior of a piston in use for eleven years showed the existence of a brown substance containing fatty matter, oxide of iron, peroxide of iron, and carbon. It is thought that a certain quantity of water had been forced into the cavity in service either through the iron or through imperfections in the plugs with which the original core support cavities were filled. This water in forming oxide of iron set free its hydrogen, which filled the piston cavity. The recombination of this hydrogen with the oxygen at a low red heat would produce the explosion, and it is recommended that all such pistons should be tapped before reheating.

AT present New South Wales is expending three millions annually on permanent public works. More than 23,522 miles of common roads are open, affording intercommunication with every part of the interior, and greatly facilitating the carrying of farm and other produce to the best markets. About £5,000,000 have been spent in ten years on common roads alone, and construction is still rapidly going on. Mail coaches run through every district. During the last quarter of a century more than fifty miles of public bridges have been constructed. About 5000 miles of road are metalled, 1600 miles are graded mountain passes, and the remainder, for the most part, drained and cleared, with bridges where required. There are eighty-seven public ferries, four of which are worked by steam, and the number is yearly increasing, notwithstanding that many of the most important are being replaced by iron and stone bridges. Every part of the colony is rapidly being opened up.

THE North Shore Cable Tramway, Sydney, has been opened. It is a double track, 4ft. 8½in. gauge, the materials used being iron and concrete throughout, excepting the longitudinal sleepers for rails. There are seven curves in the line, and the radii of these vary from 100ft. to 264ft. At Milson's Point terminus the rope runs round a sheave 10ft. in diameter, and along the straight portions of the line vertical sheaves 10in. in diameter are placed at intervals of 36ft. apart. On the curves horizontal pulleys carry the rope, and these are fixed from 8ft. to 16ft. apart. At the crown of all streets where there are heavy down grades large sheaves are provided. The grippers in the dummy pick up the rope at each end automatically, and no delay occurs in shunting from one line to the other. The cars will run at a speed of eight miles an hour. The ascent of the line from Milson's Point to the terminus at the Reserve is equal to about 375ft. The rolling stock at present consists of some eight dummies and a similar number of cars. Each dummy will seat twenty-one, and each car sixteen persons.

THE capital invested in the Indian railway system, with its connected steamer services, is estimated at £161,917,840. Of this sum the Government have spent directly £82,255,391. The capital outlay of guaranteed companies stands at £71,032,838, and that of the "assisted" companies at £3,808,232. Native States—the principal in this respect being Mysore and Hyderabad—are responsible for an outlay of £4,821,379 on lines within their territories. When the construction of railways in India was first mooted there were some who warned the projectors that caste prejudices would prevent the natives from using them; but it is an astonishing fact that last year Indian railways carried no fewer than 80,864,779 passengers, who paid for their fares £5,538,126. In 1884 the number of passengers was 73,815,119, and their freight was valued at £5,070,754. The chief income of most railways, however, is derived from its goods traffic, and in this respect the Indian lines yield more than double the receipts obtained from passengers. No less than 18,925,385 tons of goods were carried, the receipts from which amounted to £11,915,375. Both the tonnage transported and the returns show an increase over the figures of the previous year, which was credited with a goods traffic of 16,663,007 tons, and receipts therefrom amounting to £10,565,941.

DISTINCT progress is being made in the task of completing the network of railways designed to cover the region separating the Mersey from the Dee, from and above Birkenhead. A company, named the Wirral Railways Company, has acquired the Seacombe, Hoylake, and Deeside Railway, at a cost of £112,450—the line yielding 5 per cent. per annum—and all the rights and privileges of the Wirral Railway Company, at their actual cost. They have also secured the through line to Wales, by Connati's Quay, and the bridge over the Dee at that point will shortly be commenced by the Manchester, Sheffield, and Lincolnshire Company. Further, they have acquired all the land required for the lines from New Brighton to the present terminus of the Seacombe and Hoylake Railway, and from the Hoylake terminus to the joint station with the Mersey Tunnel Railway at Birkenhead Park. These preliminaries having been effected, the first object of the company is to connect the Hoylake and New Brighton lines with the Mersey Railway at Birkenhead, which they expect to accomplish within eighteen months. Bridges and other works have been commenced, and rapid progress is being made in several directions towards the completion of a series of lines which will be of incalculable benefit, not only to that part of Cheshire, but to Liverpool and Lancashire and the Principality across the Dee.

A BOARD of Trade report has been published on an accident which occurred, on the 26th June, near Dalmally, on the Callander and Oban Railway, when, as a special excursion train from Falkirk to Oban was running at moderate speed down an incline of 1 in 75, the eighth vehicle behind the engines left the rails towards the left side. This accident, which might have been a very serious one if the carriages had left the rails a few yards before they did, as they would then have fallen over into a stream or on to a deeply-cut road, was clearly caused by a very unusual occurrence. About six yards east of the first mark of a wheel being off the rails and breaking a chair outside the left rail, the high rail on the outside of the curve, there were distinct marks where a stone had been on this rail, crushed pieces being found on each side of it, and throughout this six yards there was the track of a wheel flange running along the top of the rail. Eastward from this point there was, for a distance of about 60 yards, marks on the sleepers and ballast outside the left rail where something had been trailing along, striking the ground at intervals, and there can be no doubt but that these marks were caused by the trailing end of the stay-rod on the left side of the brake van immediately in front of the first vehicle which left the rails, which rod was found to have become detached at the trailing end. It appears from the evidence that it is not an unusual occurrence for these and other bolts and nuts to be found loose, and looking at the serious results in this case, the company is recommended to take steps to have all such bolts properly secured by having the heads rivetted over, or in some other manner.

NOTES AND MEMORANDA.

THE increase in population in New South Wales in 1885 was 59,305, being almost equal to that of Victoria, Queensland, South Australia, West Australia, Tasmania, and New Zealand combined.

THE density of liquid atmospheric air has been found to be 0·59 at −146·6 deg. Cent., and 45 atmospheres of pressure. Calculations from the densities of liquid oxygen and nitrogen give the figure 0·6.

COPPER lodes are found in many parts of New South Wales. Some of the ores are extremely rich. The quantity of copper raised in the Colony was 5746 tons in 1885, valued at £264,920, against 1452 tons in 1872, valued at £105,888.

THE production of American pig iron in the first half of this year amounted to 2,954,209 tons—an increase of 424,844 tons. The stock in hand on July 1st was 470,421 tons, or 222,500 tons less than was in hand on the corresponding date of last year. The American Iron and Steel Association reports that this country will make more pig iron in 1886 than it has made in any previous year.

M. COLLADON suggests that the thunder-storm electricity is generated principally by friction of air and water vapour During a thunder storm, the rain-drops formed in the storm cloud descend vertically to the earth, causing a partial vacuum, which is replaced by air drawn in laterally and from upper layers. The friction caused by this movement is the principal cause of the generation of electricity.

TO get an absolutely clear solution of shellac has long been a desideratum. The *National Druggist* says it may be prepared by first making an alcoholic solution of shellac in the usual way; a little benzole is then added, and the mixture well shaken. In the course of from twenty-four to forty-eight hours the fluid will have separated into two distinct layers, an upper alcoholic stratum perfectly clear, and of a dark red colour, and under it a turbid mixture containing the impurities. The clear solution may be decanted or drawn off.

M. PALMIERI, the director of the Vesuvian Observatory, has succeeded in exhibiting the negative electricity developed when steam is condensed by cold, and positive electricity liberated when evaporation takes place. A platinum shell is placed in communication with one of the plates of a condenser. The golden leaf is separated when a piece of ice is placed in the shell, and also when it is full of water if exposed to the rays of the sun. *Nature* says the electricity has been proved positive in the first instance, and negative in the second.

A PAPER was read on the 12th ult. on the relations that exist between the geodetic and geological sciences, by M. Faye, before the Academy of Sciences. The author's remarks are intended to show that the distinction formerly drawn between these two sciences can no longer be maintained. Thus in geodesy, for example, the sum of the forces acting on the terrestrial globe cannot be considered apart from those incessantly modifying its relief. The recent objection regarding the Quatenary glaciers is specially dealt with, not from the geological standpoint, but from that of the attraction exercised by them on the seas.

AT a recent meeting of the Paris Academy of Sciences M. Boussinesq made some remarks accompanying the presentation of M. de Saint-Venant's manuscript memoir on "The Resistance of Fluids." This unpublished work, begun in 1847 and not completed till the year 1885, a short time before the author's death, embodies historical, physical, and practical considerations regarding the problem of the mutual dynamic action of a fluid and a solid, especially in the state of permanence supposed to be acquired by their movements. It comprises three parts, the first dealing with the researches of previous physicists on the impulse of fluids in motion on solid bodies encountered by them; the second showing theoretically that this impulse is connected exclusively with the "imperfection of the fluid," that is, the development of friction, which to be surmounted requires a higher pressure on the upper than on the lower surface of the submerged body; the third containing a practical calculation of the impulse experienced by a body in any indefinite fluid current.

MR. W. FOSTER, jun., of New York, has succeeded in sinking a shaft to the salt deposits of central New York. The shaft was sunk 1013ft., and the mine is perfectly dry, with the exception of a little water which drips down the shaft. A 1½in. pipe removes all the water. The salt is remarkably free from impurities for refined salt, and contains 97·84 per cent. of sodium chloride. This fairly represents the purity of a stratum 14ft. thick, which is now being mined without hindrance from any causes. Other strata of salt were found both above and below this one. The upper stratum was reached at a depth of 991ft., and was so mixed with shale as to be unprofitable. The lower stratum was reached at 1047ft., and is 50ft. in thickness, being practically clear salt. Between these two there was also a 4ft. stratum of clear salt. Thus, in all, there is, within a distance of 200ft., not far from 80ft. of solid salt at a depth of a little over 1000ft. below the surface. The shaft begins in Hamilton shale. The following is the record:—Shale, 407ft.; corniferous lime rock, 148ft.; shale, 223ft.; limestone and shale, 70ft.; shale, 102ft.; lime rock, 11ft.; shale and salt, 30ft.; first bed clear salt, 22ft.; lime rock and shale, 28ft.; second bed clear salt, 4ft.; rock, 2ft.; third bed clear salt, 58ft.

THE best wheat-growing districts in New South Wales are to be found on the table-lands, from 2000ft. to 4000ft. above the sea-level. The fine quality of the wheat grown on the Australian continent is well known, and New South Wales can claim to produce some of the best samples. The area of land in New South Wales under grain crops, and the quantity of produce obtained in 1884-85 were as follows:—Wheat, 276,250 acres, yielded 4,203,394 bushels; maize, 115,600 acres, yielded 2,989,585 bushels; barley, 7035½ acres, yielded 148,869 bushels; oats, 19,472¼ acres, yielded 425,920 bushels; rye, 1110½ acres, yielded 16,739 bushels; millet, 118½ acres, yielded 1843 bushels; sorghum and imphee, 41 acres, yielded 187 cwt. The acreage and produce of hay crops was:—Wheat, 86,584 acres, yielding 87,328 tons; barley, 2173¾ acres, yielding 2870¼ tons; oats, 121,922½ acres, yielding 149,489 tons; sown grasses, 15,966 acres, yielding 40,624½ tons. The area under green crop for cattle was:—Maize, 6771 acres; barley, 3744¼ acres; oats, 3109½ acres; rye, 933¼ acres; millet, 157¼ acres; sown grasses, 123,024 acres; sorghum and imphee, 2789½ acres. In 1885-86 there was a falling off in the yield of wheat and other cereals, in consequence of the prolonged dry season; but there is every reason for believing that the harvest of 1886-87 will be the richest yet recorded.

THE principal telescope of the new Lick Observatory is approaching completion. Mr. Lick bequeathed £140,000, with the express wish that the observatory should be equipped with the best telescope that could be manufactured. It has taken five years to have the lenses finished. They were made by a French house, cost 25,000 dols. each, and have been polished by Mr. Alvan Clarke, of Boston. They will be set in a steel tube 3ft. in diameter and 57ft. long, and have taken more than two years to polish. The observatory is situated on Mount Hamilton, in Santa Clara County, California. For the convenience of visitors a road has been made up to the observatory at a cost of £15,600. The contract for mounting the 36in. objective has been awarded by the Lick trustees to Warner and Swasey, of Cleveland, O., for 42,000 dols. The telescope is to be 57ft. long, the diameter of the tube 42in. Provisions are made by which it will be possible for the observer at the eye-end of the telescope to command all the possible motions, and these same motions can also be controlled by an observer stationed on a small balcony 20ft. above the floor. It is expected that the mounting will be completed in April, 1887, and that the glass will be brought to Mount Hamilton and put in place some time during the summer following. The total cost of the equatorial and dome will be about 164,850 dols.; the cost of the dome being 56,850 dols.; the mounting, 42,000 dols.; the visual objective, 53,000 dols.; the additional photographic lens, 13,000 dols.

MISCELLANEA.

ON the 25th ult. the completion of the 100,000th repeating military rifle was celebrated in the Arsenal at Spandau, near Berlin.

MESSRS. BARFORD AND PERKINS, Peterborough, have taken into partnership their sons, Mr. J. G. Barford and Mr. J. E. S. Perkins.

SIR T. SPENCER WELLS, Bart., has accepted the presidentship of the Sanitary Congress to be held in York, commencing September 21st.

AT the last meeting of the South Wales Institute of Engineers Mr. Archibald Wood, the President, gave some salutary advice to coalowners on economic washing, and remarked that in these days, when new motive powers were sought in electricity and in petroleum, too much caution could not be shown.

THE National Lifeboat Institution has now 292 lifeboats under its charge, and no less than 555 lives were saved last year from shipwrecks on our coast through its instrumentality. Pecuniary help is particularly needed at the present time, as, owing to the badness of trade, there has been a falling off in the receipts.

THE United States Government has authorised the building of two 6000 tons armoured ships, costing 2,500,000 dols. each, one 5000 ton swift cruiser, costing 1,500,000 dols., and one torpedo boat, all built of American steel. It also votes 3,178,046 dols. to complete the four double-turret monitors now building, the armour and materials being American, also 1,000,000 dols. to arm vessels now building, and in addition 350,000 dols. to build one dynamite-gun cruiser. These votes are spread over three years, and 3,500,000 dols. are available this year.

THE members of the Association of the Birmingham Students of the Institution of Civil Engineers on Tuesday week visited the works of the Horseley Company, Tipton, when, amongst other ironwork, a bridge for the Buenos Ayres Railway, and 6ft. diameter wrought iron pipes for the Sydney Waterworks, were inspected with much interest. After the visit a meeting was held, when Mr. E. Pritchard, M.I.C.E., was elected president, and Messrs. J. W. Gray, M.I.C.E., C. Hunt, M.I.C.E., and W. S. Till, M.I.C.E., were elected vice-presidents.

A NEW shaft is being sunk at the Channel Tunnel works, Dover. The shaft is only a few yards distant from the other pit, which communicates with the whole underground works and submarine gallery. The work is stated to be of an experimental character with regard to the formation of strata in this district, there being reason to believe from tunnelling operations which have taken place on the other side of the Channel that a mineral of valuable description may be discovered here. The shaft will be sunk to the level of the existing shaft, a depth of 160ft. Boring will then be continued about 600ft.

A NAPLES correspondent of the *Times* remarks that three years have passed since the cholera made such havoc in Naples, "and since the King and his Prime Minister declared that no time should be lost in 'disembowelling' the city, yet the projects for the most important reforms have not yet been approved and the necessary decrees await the Royal signature. A hundred times or more has the Syndic been summoned to the capital to discuss some disputed point, but assurance has now been given that these decrees will be signed on Thursday. 'Festina lente' is a good old proverb, but the 'lente' in Italy must be understood in the superlative degree."

AN official paper says:—"The demand for bricks for building purposes in New South Wales is considerably in excess of the supply. Hence brickmaking is one of the most profitabie industries in that colony. Brickmakers receive from £1 2s. 6d. to £1 10s. per 1000; bricklayers, 12s. per day. Where employed in connection with machine-made bricks, the remuneration is from 8s. to 10s. and 11s. per day. Pipemakers average from £2 10s. to £3 per week, and potters obtain about the same rate of wages. Pitmen, 7s. 6d. to 8s. 4d.; setters, 7s. 6d. to 8s.; rollers, 9s.; screeners, 7s.; burners, 10s.; kiln men, 7s.; loaders, 7s. to 8s."

THE rates of wages in the iron trades in New South Wales at latest dates were:—Turners, 1s. 2d. to 1s. 3d. per hour; engine-fitters, 1s. 2d. to 1s. 3d.; ship smiths, 1s. to 1s. 6d.; blacksmiths, 1s. 2d. to 1s. 4d.; blacksmiths' strikers, 9d. to 10d.; ironmoulders, 1s. 2d. to 1s. 6d.; pattern-makers, 1s. 3d. to 1s. 6d.; boiler-makers, 1s. 2d. to 1s. 4d.; boiler-makers' assistants, 9d. to 10¾d.; youths, 6d. to 8d.; general labourers in ironworks, 9d. to 10d.; engine drivers, 9¾d. to 1s. 4d., or £2 2s. to £2 10s. per week; furnacemen, 10d. to 1s.; dressers, 9d. to 1s. 2d.; machine men in fitting-shop, 10d. to 1s. 2d. Country blacksmiths receive from £75 to £80 per annum, with rations or board.

THERE are reasons for believing, says the *North-Western Lumberman*, that in the making of stock sizes of sash, doors and blinds, in the factories of the North-West, white pine will not much longer be the only material used. Poplar is commonly thought of as the most available substitute, and so it probably will be as long as it remains at anything like its present price; but there are other woods which may receive favour. One prominent Wisconsin manufacturer is now making doors of basswood, treating them to a priming coat of paint, and sending them out to his regular customers. They are said to give good satisfaction in every respect, and particularly in price.

GLASS bearings and bushes for loose pulleys are being made by Messrs. Powis Bale and Co. Mr. Powis Bale's description says that with the object of reducing the working friction to its lowest limit, and experimenting with various materials, he determined to try glass, and, being highly satisfied with the results in his early trials, adopted it. "The bearings are grooved or crenated in such a manner that the lubricating material is kept in circulation between the top and bottom half of the bearings; at the same time, a current of air is allowed to pass through the bearing, thus keeping it cool whilst in work." It might be expected that frictionless bearings would not need ventilation.

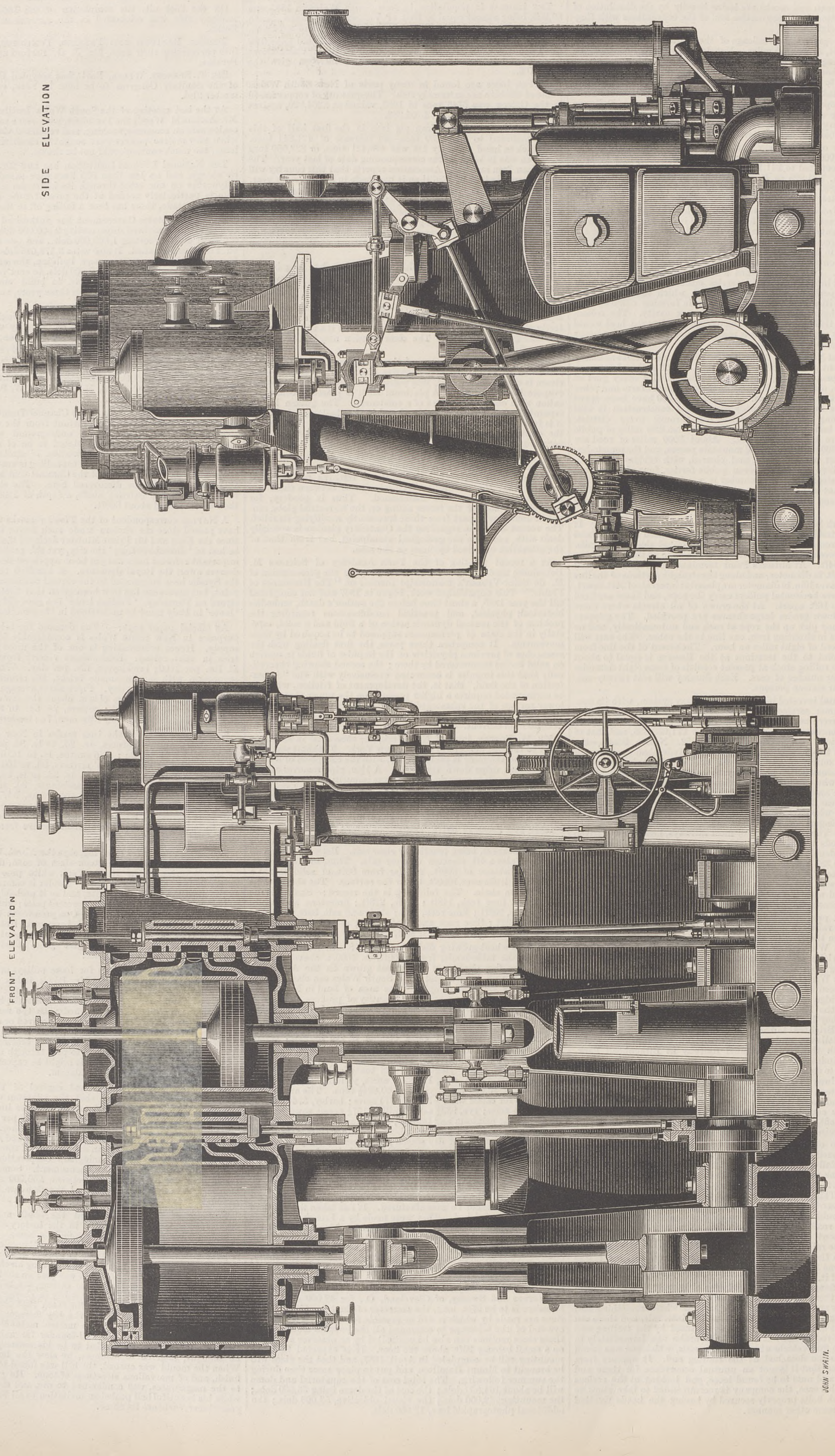
THE Committee which has had control of the Birmingham Corporation Gasworks states that the adoption of the three-lift system in the construction and erection of the immense new gas-holders lately built has effected a saving of 33 per cent., besides a great economy in space. The Committee will shortly report to the Council the total cost of the new gas-holders and other extensions just completed. Altogether an expenditure of some £2,000,000 has been sanctioned by the Birmingham Corporation upon its gas-works property from the commencement. Some time ago the works were making a profit of between £50,000 and £60,000 per annum, but now, in consequence of the decrease in the value of residuals, it is found difficult to make any profit at all.

THE city of Breslau celebrated the 500th anniversary of an occurrence which was memorable in the history of the town, and is known wherever German poetry finds a home. The bell which hangs in the southern tower of St. Mary Magdalen's church, and is named "St. Mary's bell," but is usually known as "the poor sinner's bell," rang out morning and evening on the 17th of July, to remind all who heard it that it was cast on that day 500 years ago. When all was ready for the casting, the bell-founder withdrew for a few moments, leaving a boy in charge of the furnace, warning him not to meddle with the catch that secured the seething metal in the caldron. But the boy disregarded the caution, and then terrified on seeing the molten metal beginning to flow into the mould, called to the bell-founder for help. Rushing in and seeing what he had intended to be his masterpiece ruined, as he thought, angered to madness, he slew the boy on the spot. When the mould was opened, the bell was found to be perfect in finish, and of marvellous sweetness of tone. He gave himself up to the magistrates, was condemned to die, and went to his doom while his beautiful bell pealed an invitation to all to pray for "the poor sinner," whence its name.

ENGINES OF THE S.S. MATABELE.

MESSRS. HALL, RUSSEL, AND CO., ABERDEEN, ENGINEERS.

(For description see page 108.)



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TO CORRESPONDENTS.

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MACHINES FOR MAKING STRAW BOTTLE CASINGS.

(*To the Editor of The Engineer.*)

Sir,—Can any of your readers favour me with the name of any maker of machines for the manufacture of the straw casings or envelopes which serve to protect the small glass bottles used to hold salad oil, liqueurs, &c.? I desire to purchase such a machine, and have exhausted the usual means of obtaining such information.

M.

Glasgow, July 29th.

HIGH-SPEED ENGINES.

(*To the Editor of The Engineer.*)

Sir,—As I propose to employ high-speed engines in driving a somewhat extensive electric lighting plant, I shall be much obliged to any reader of The Engineer who can tell me what proportion the brake horse-power of such engines bears to the indicated horse-power. This is an important consideration, which will go far in guiding me in making a choice. I refer now to such types of engine as, on the one hand, the Armington and Sims, and on the other, the Westinghouse, Brotherhood, and such like.

Lux.

Hartlepool, August 3rd.

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THE ENGINEER.

AUGUST 6, 1886.

GROYNES ON SHIFTING BEACHES.

There is perhaps no subject that presents greater difficulty to engineers than the designing of works to arrest the travel of shingle. If the line of that travel were always determinate—if the causes operating to produce it followed a constant rule—no such difficulty would be experienced; but in dealing with such agencies as wind and weather, no constancy can be relied upon. It would seem therefore that the engineer whose advice may be sought to stay the denudation of any part of a coast line has to consider the means for arresting the travel of shingle from whatever quarter the wind may blow. But it must be apparent from the very nature of the problem thus set that it must be wholly impossible to avert entirely the effects of a force so constantly shifting its direction of attack. We can only consider how far the maximum of beach may be accumulated during the winds most prevalent or most powerful, so as to provide a store from which the demand, which must infallibly be made when the attack comes from other quarters, may be met in a degree which will insure leaving of a residuum sufficient to guarantee safety to the coast it is desired to guard.

The experience gained during many years of struggle with the ocean around our coasts has not enabled us to pass the limit of defence above pointed out. We must always be prepared to see the accumulations of one season very materially reduced during the next. That that reduction admits of modification there can be no doubt, and the works which have of late years been constructed on the Hove and Brighton beaches seem to prove that a material step has been made in advance towards our known means for extending that power of modification. The lapse of a considerable period since these works were undertaken has sufficed to show the relative efficiency of the several systems of groyning which have successively been tried, and it is only after such a lapse that any conclusive opinion can be justly formed. As we have pointed out, the shingle which the currents may deposit during the prevalence of westerly—*i.e.*, in the case of our southern coast—offshore winds is liable to entire removal from the effects of the south-westerly gales which are so frequently experienced, and with such violence, on those shores. It is not therefore until both the best and the worst have had their chance that it is possible to ascertain from the residual effect how far measures adopted to retain the beach have served their purposed ends.

When Sir John Coode was called in to consult with Mr. Ellice-Clarke upon these works, the former authority differed from the latter as to the principle Mr. Ellice-Clarke had adopted with his groynes. These had been built at varying angles with the shore line following the set of the prevailing current up channel, and their effect had manifestly been—while securing the beach from scour on the lee-side of them—to assist the run of the sea in the removal of the shingle on their weather side. They, in fact, no longer afforded "pocketing" for the beach brought by the prevailing currents, and their intended function had become reversed. Sir John Coode appears to have somewhat compounded Mr. Ellice-Clarke's procedure in that adopted by himself, though it is possible that course was adopted only with the intention of saving the expense of entire removal of the groynes built upon the trending system we have named. But whatever may have induced the engineer to such a course, we now see that the roots of the groynes remain at their former angle, while their extension has been altered to the line of a right angle with the shore. This middle measure between the two systems of the respective engineers appears to have had rather successful results, and it may prove that the divergence of opinion, and the adoption of a composition of those systems, may have taught us a useful lesson. While Sir John Coode's changed line of extension has afforded a deeply embayed pocket for the lodgments of shingle, the lee trend of the roots has evidently done much to prevent that scour behind them which has always proved such a difficult matter to deal with in all previous practice with marine groyning. We could not fail to perceive to what a very considerable extent the varied trials experienced during the past twelve months had left a residuum of beach, and we came to the conclusion, on the occasion of a recent visit, that the engineers have now secured the certainty of a good shingle protection for the base of the fine sea-wall recently constructed at Hove. Without some such protection the best designed and best constructed of sea-walls must be always exposed to the chance, at least, of injury; and however solidly our finest breakwaters are built, it is always deemed necessary to protect them by a berm of some sort or other upon which the mass of incoming waves may be broken somewhat before striking the solid masonry and digging at its footing. In the case of the Hove wall we may now say that this provision for safety has been secured by the run over the shingle, which all waves must make before they strike the wall itself.

While we have nothing but success to record as to the Hove works, we still have to refer to the comparative failure which at present seems to attend the efforts made on the Brighton section of the foreshore. The lapse of time we have referred to has, however, developed rather a singular phase in the history of the Brighton beach. The line of this between the eastern and western extremities of the combined frontage of the two towns—parishes they might more fully be termed—assumes in a considerable degree the crescent form. While the western turn of that crescent has been subject to attacks of late years which have now been successfully guarded against, the eastern horn—whether as the result of extensive past groyning at that spot, or from occult natural causes, it is impossible to decide—has experienced a large accession to its formerly considerable amount of shingle foreshore. It is in the hollow of the crescent, deepened as this is of course by the pushing out of the artificial works on the Hove or western horn, and the extension of the beach at its eastern extremity above named, that the full action of the sea is now experienced, and we scarcely exaggerate when we say that between the West Pier and the intake of the Hove wall there is practically no beach left. It is at this point that remedial measures have to be adopted, and it is interesting to note the result of the commencement with these which has already been made. We wish we could say that any prospect is apparent of these fulfilling their intended purpose; but we see no evidence to justify us in doing so. While against each groyne there is a slight, but only a very slight deposit of beach, nearly the whole of the interval we have named is still but a run of coarse sand right up to the unprotected earth bank, upon which have been built the new ornamental gardens and band kiosk. The danger we before pointed out as threatening this site appears to us to have become greatly intensified by the increased embaying given to it by the seaward extensions named above of the extremities of the crescent. Several timber groynes have now been run out at this threatened point, but, as above remarked, they have had apparently but little effect. It would seem that the shore is now too deeply embayed to permit the current to sweep the travelling shingle within the line of their influence. It is doubtful if this difficulty can be overcome unless these groynes receive extension much more to the seaward than they at present reach. At all events, the bareness of this embayment proves that they fail to arrest any shingle within their present limits.

A trial has been made with a novel system of groyning which has in its theory received much intelligent support, viz., that of open groynes. Several of these have been erected in the wide spaces between those of a more solid character. They consist of piles driven at intervals of some 8ft. or 10ft., which are united at their heads by timber railing at a height of about 6ft. The open spaces are filled in with vertically placed iron rods spaced some 2in. apart. It is held by those who have advocated the use of this description of groyne that they would retain the larger and more solid shingle, while their open construction, permitting the free passage of the water, would prevent that breakage and heavy wash of the sea when running from an unfavourable quarter, which in the case of solid groynes does so much to remove the shingle. The action of such groynes must, however, necessarily be slow, and as yet they have secured but a trifling amount of shingle. Assuming their principle to be correct, we yet must hold that their present position offers no fair chance for its development. The increased embayment we have spoken of, and the consequent throwing more seaward of the line of travel of the passing shingle, must, we fear, militate as fully against their successful trial as it apparently does with the groynes of more solid type. But it is certain that, as adding to our knowledge of possible means for meeting the difficulty named in our opening remarks, the works commented upon possess a particular value. These works are in the hands of able engineers, and we yet hope to see their efforts result in success though it may not be attained without some considerable extension of the present design.

THE PANAMA CANAL.

If undaunted courage and bold defiance of all adverse circumstances could insure success, it might be safely assumed that the Panama Canal will be actually completed in three years' time. Upon this point M. de Lesseps has still not the slightest doubt, and on the question whether or not the canal can be carried out, he has the support of M. Rousseau, an eminent engineer, whom the French Government sent out to investigate the matter. Another element of encouragement is the fact that M. de Lesseps has within the past week completely regained the confidence of the shareholders. As against these promising influences there are still many powerful enemies to the scheme, and, worse than all, the works are stopped through the want of money. It has been said that with time, men, and money, this gigantic undertaking could certainly be carried out. Men can be had in abundance, but the time is limited by M. de Lesseps' reiterated assertions that three years will be sufficient, and the necessary money had to be subscribed. In this state of things, it is worth while to glance at the latest aspect of the subject without going far into the past history of the venture, which is now an old and familiar story. With a view to replenishing his exhausted coffers, M. de Lesseps rather more than a year ago endeavoured to raise the £24,000,000 then required by means of lottery debentures. This plan, however, involving, as it did, an Act of Parliament, gave an opening to his opponents, of which they took full advantage, defeating the Bill in the Chamber, after first causing a year's delay. In the meantime, as will be remembered, M. de Lesseps, accompanied by a number of experts and delegates, went out to Panama in order to see precisely the condition of the work—with the object, of course, of reassuring the French people. As we pointed out at the time, more than one adverse report was hurried over by some of the party; and since then numerous other reports and various pamphlets have been issued to proved that the scheme had already broken down. In face of these it was not surprising that the enemies of the canal had their own way; but at last M. de Lesseps has himself spoken out, and the project is once more in the ascendant. At a meeting of the shareholders held last week in Paris M. de Lesseps presented his report, from which we will make a few extracts, leaving them to stand upon their own merits. The report states first that the total net expenditure on the works since the beginning has been 471,000,000f., and that the amount of shares and bonds is 712,000,000f., leaving a balance of 241,000,000f., 147,000,000f. of which consist of uncalled-up instalments on shares, 13,000,000f. of such instalments on bonds, and 81,000,000f. of other assets. Much has been said from time to time about the heavy mortality among the workmen; but M. de Lesseps asserts that the death-rate last year was only 5¼ per cent., "which is not more than the average of mortality on public works in Europe." He admits, however, that among the victims have been some of the chief engineers. Having bestowed a few hard hits upon his adversaries, whom he describes as "little more than speculators," M. de Lesseps quotes a number of qualified authorities to show that traffic of at least 7,250,000 tons a year, yielding a revenue of at least 108,000,000f., may be confidently expected from the canal, and then turns his attention to the question of quantity of matter to be excavated. The first estimates, he says, put the amount at 75,000,000 cubic metres—the assumption being that there was a large quantity of granite to be removed at a cost of 1,200,000,000f.; but subsequent experience showed that the ground was by no means so difficult to work, and that instead of two perpendicular granite walls to the canal, sloping sides could be made, and that would increase the amount of excavation to 110,000,000 cubic metres. Next he explains that the programme of execution decided upon was this. A canal of 9 metres below the average sea level, bottom width of 22 metres; a direct trench open to the sky between two seas; a chamber with a flood-gate on the side of Panama; ports at Colon and Panama; a siding about midway from the extremities of the canal, and a bar at Gamboa. And then, in order to refute the contention of the opponents based upon the amount of material already excavated, he points out that the rate of extraction increases with the use of improved machinery and with the greater familiarity with the work. To illustrate this argument he mentions that at Suez, with 75,000,000 cm. to be extracted, while 25,000,000 cm. took eight years to excavate, and it was therefore predicted that twenty years would be required for the remainder, the other 50,000,000 cm. were extracted in two years. In like manner he shows that the excavation at Panama has risen from 16,000 cm. a month in 1882, to 658,000 cm. in 1885, and to 1,079,000 cm. a month during the first half of this year. From this he argues that with a monthly output of 2,000,000 cm. next year, and 3,000,000 cm. in the following years, the whole of the 110,000,000 cm. may be extracted and the canal completed by July, 1889! By a similar process of reasoning he deals with the question of cost, pointing out that the greatest expense is that of organisation, transport, and getting the machinery to work. The rest is only a matter of fuel and wages, and remarking that half the necessary effort has been made, and more than half the expense has been paid, he again points to Suez as an analogy, stating that in that case, while the first third of the excavation cost two-thirds of the total expense, the remaining two-thirds cost less than half the first 50,000,000 cm. cost. So, he contends, it will be at Panama; and his figures and arguments proved so convincing to the meeting, that the report was adopted with enthusiasm and absolute unanimity. The loan was issued a few days ago, and it now remains to be seen whether this enthusiasm will take a more substantial form, or whether it will evaporate, as was the case in regard to the Manchester Ship Canal. Whether the canal, if made, will pay, is a problem that must remain open for at least five years, M. de Lesseps' calculations notwithstanding.

SIR EDWARD WATKIN OBJECTS TO THE SHIP CANAL.

Somewhat late in the day, it must be admitted, Sir Edward Watkin has been criticising and condemning the ship canal. Speaking at the last meeting of the Manchester, Sheffield, and Lincolnshire Railway Company, he vindicated that company from the charge of having—in common with other companies—opposed the canal, except so far as was necessary to protect the interests of the concern, and he was pleased to say next that personally he was in favour of an improvement in the water communication between Liverpool and Manchester. Having made that gracious concession, he denounced the canal scheme not only as a delusion, but as the worst engineered business he had known during forty years' experience. Why was it a delusion? Because, he averred, the public had been grossly deceived as to the financial part of the matter, for they had been told that Messrs. Rothschild would provide the capital at 1 per cent., whereas all they had undertaken was to lend their name, and only charge 1 per cent. upon any capital subscribed. The scheme having failed so far, would never succeed, he predicted, for the capital would never be raised. But the worthy baronet is yet more severe upon the engineering question and the effects of the canal. It seems that he has always been uneasy about the bar of the Mersey, and he holds that the first thing to do is to improve the entrance to the port of Liverpool. There is danger enough already, he observes, of the bar being silted up; but if this canal be carried out, and the channel down which the silt passes is narrowed, the bar will certainly be choked, and Liverpool as a port will be destroyed. Therefore the canal ought not to be, and never will be, executed as at present designed, and the company had better wind up the concern at once before they become further involved; that is, unless they adopt the alternative remedy for the disease which Sir Edward offers. Nothing so simple as keeping the bar well dredged will suffice. A more heroic plan must be followed, and that is to simply cut across the "Birkenhead peninsula," and in coming out in deep water on the other side obtain a second entrance to the port. This he is satisfied would effectually avert the chance of failure of access, or any other impediment to the commerce of the port. Sir Edward Watkin is a man not easily abashed or daunted, and he has a place among railway financiers, but he is not renowned as an engineer; and, at all events, the "Birkenhead Peninsula" is pretty well occupied, and the inhabitants might object to being "cut through" thus unceremoniously even if the ship canal did ultimately collapse. Meanwhile the canal company is not daunted by one failure, but is taking fresh steps, which it intends shall succeed, to raise the requisite capital. Sir Edward Watkin's denunciation was followed by a shoal of replies, and at last Mr. Daniel Adamson, chairman of the Ship Canal Company, has spoken out—and to some purpose. On the financial part of the controversy he declares, in the first place, that he never doubted Messrs. Rothschild's capacity to get the required capital; nor did the best authorities whom he consulted in Lancashire and in London. Then he says Messrs. Rothschild themselves have not lost confidence in the project, and no doubt, when the critics have done their worst and the conviction of subscribers has become more firmly established, they will, if solicited, lend their aid to secure the money required. As to the failure to obtain the capital, Mr. Adamson attributes that mainly to the fact that four days were not sufficient time to raise the money, and he explains that that condition was imposed by Messrs. Rothschild; and although he thought four months would have been a more reasonable time, he acquiesced because of their great experience. The prospectus issued he says, was the work not of Messrs. Rothschild, but of the company's directors. In reply to Sir E. Watkin's allegation that Mr. Adamson had stated that Messrs. Rothschild had undertaken to find the capital upon a commission of one per cent., he says that is entirely untrue, for no such statement was ever made by him. "I took great pains," he says, "at the first half-yearly meeting of the Manchester Ship Canal Company, held in February last, to make it clear beyond doubt to the shareholders that Messrs. Rothschild undertook only to finance this matter—to put it through their house as a financial enterprise; and as compensation for their services and experience they were to be paid a commission on the capital that they secured at the rate of one per cent. This was established by the prospectus, when they asked the public to subscribe £7,250,000, which, together with the £750,000 already subscribed in the Manchester district, made up the £8,000,000 required for the canal." Mr. Adamson then criticises in caustic terms Sir Edward Watkin's claims to engineering knowledge, his motives, and his past action in the direction of the Manchester, Sheffield, and Lincolnshire Railway, and in conclusion he says, "Although the directors of the Manchester Ship Canal Company have been disappointed, and to some extent discouraged, they are not seriously disheartened nor dismayed; and, after a thorough investigation of the prospects and chances of further Lancashire support, they hope to lay before the public such evidences of real determination that this great waterway will be carried out as to influence the outside investing public to come in and support it, not only as a necessity, but as a national undertaking that will bring the products of all nations and carry our manufactured goods to every country under the sun."

THE BUCHAREST TURRET COMPETITION.

Major Mougin has published a pamphlet in which he reviews the publication of M. Von Schütz on the Bucharest competitive trial of the Mougin and Schumann cupolas. We do not propose to discuss this review in detail because we did not so discuss M. Schütz's work, on which it is framed. The account given in The Engineer was partly based on a number of French and German publications—many obtained directly from those most interested on each side—and partly on information very frankly given by our own British officers who were present throughout the trial, and who had no reason to be prejudiced in favour of one design or the other. Both turrets, as we pointed out, embodied features specially characteristic of English armour, while as to internal fittings, there was nothing to provoke any bias that we are aware of. Major Mougin's pamphlet is ably written. It is such as might fairly be expected from the author, who naturally wishes to reply to the German reports. Without allowing ourselves to be drawn into the details of the controversy, in which Major Mougin exhibits the characteristic smartness of his nation, we would give his final summary in an abbreviated form, which is as follows:—(1) From an economical point of view it must be admitted the universal practice of putting two guns in a cupola is right. (2) Complete control and accuracy of fire is absolutely necessary. (3) The interior mechanism must be independent of, and separate from, the turret wall, so as not to suffer from the necessary deformation of the latter under fire. (4). The Schumann cupola does not satisfy any of these conditions; practically for curved and delicate forms of fire it may be considered as providing only a single gun. (5) The French cupola is a good machine, which, when perfected, fulfils all necessary conditions. Doubtless it was on this account the Bucharest Commission rejected unanimously the Schumann cupola and accepted by six votes against three the French one. These conclusions are ably expressed. We are inclined to agree generally with 1, 2, and 3, though it is amusing to find a French officer insisting as a fact on the universal adoption of two guns in each cupola without qualification, for we confess had we laid down such an axiom, we should feel that we ought to account for the universal adoption of single guns in all the fixed turrets in the French men-of-war. The question of guns in barbette towers is so nearly related to the other that we could not have ignored its treatment in an opposite sense by the designers of all the most powerful French barbette ships, ships which are held up by some authorities as the models we ought to copy absolutely. Undoubtedly Major Mougin is right, and especially so from his point of view, to insist on efficient fire from two guns. The weakest feature in the German design is the fact that the recoil of the first gun fired rotates the turret to which it is rigidly attached, and throws the fire of the second gun wildly off the mark. This forms the gist of the conclusions Nos. 1, 2, and 3, with which we agree in a great measure. Major Mougin, however, almost startles us by a drawing of a new cupola, which we think admirable. It is, as regards armour, an improvement on the German rival cupola. The form is almost identical. It is, however, made wholly of wrought iron and keyed together without bolts. The German turret armour behaved very well, with the exception of its bolts. This one has no bolts to fly. The steel face plate on the German turret became detached. Doubtless it is calculated to throw off projectiles which glance, but as it became separated from the iron foundation plate it was thought by some that wrought iron alone would have acted better. Altogether it appears as if Major Mougin had formed conclusions agreeing very nearly with those we expressed in our article of April 16th last. It is not our object to discuss how far each design retains its identity after adopting the features displayed in its rival. Krupp has carriages with recoil checked, which might be used in the German turret. In this case the French and German turrets would be very similar in all their principal features.

THE IMPROVEMENT OF THE TEES.

On Monday last, the 2nd inst., the Tees Conservancy Commissioners invited the members of the Corporations of Middlesbrough and Stockton, and of the South Stockton Local Board, together with a number of the most influential payers of dues, to accompany them in steamboats down the river Tees, in order to inspect the works in progress there. About 130 gentlemen accepted the invitation. The day was fine, and a pleasant run was made to the South Gare breakwater. There the party landed and examined that important work. It was under construction for twenty-four years, and cost £330,000. It has only been complete about a year. The extremity is circular in form and of enormous size and strength. There is a parapet all round for the protection of persons going to and fro to the lighthouse. Encircling the end of the pier enormous blocks of concrete have been deposited in a helter-skelter fashion, the object being to break the force of the waves and to prevent any displacement of the mass of slag upon which the breakwater is built. The main structure is itself composed of solid concrete, through which vertical piles pass at intervals. The light is of the dioptric kind, flashing at brief intervals. A short way back from the lighthouse is the dwelling of the light keeper and the fog-signal house. In the latter is a steam boiler and a clockwork arrangement, whereby a powerful fog-horn is sounded when needed about twice every minute. The depth of water off the end of this breakwater and on the bar, which is a little further out, is now 18ft. at low water spring tides. Thirty years ago, when the improvements were commenced, it was only from 3ft. to 4ft. At high water spring tides there is usually 33ft., and at high water neap tides 30ft. Up to Middlesbrough Docks there is at present a minimum low-water depth of 14ft., and up to Stockton about 10ft. Any increase at the latter point is for the present impeded by the works connected with the new bridge. When this is completed, dredging will be continued further up the stream, and a minimum depth of 14ft. may be eventually expected as far as there are wharves on the banks of the river. On the northern side of the estuary, exactly opposite the South Gare breakwater, may now be seen the North Gare breakwater in progress. It has not yet been carried to a point where any engineering difficulties have been met with. As soon as it is completed, the entrance to the river will be comparatively narrow, and the depth of water on the bar will be still further increased. The river within the entrance will then probably be deepened and widened, so as to make it one of the best harbours of refuge on the East coast. Already several deep-water berths have been made opposite to Port Clarence, and near the dock entrance. At these places ships of 4000 tons burden, and fully laden, may lie afloat at all times of the tide. Further inland from the fog-signal house on the South Gare breakwater, the Government are building a torpedo house and station. The object of this is to provide means of protecting the entrance of the river in time of war against the approach of an enemy by means of torpedoes. These arrangements will, however, deserve special notice when they are completed. After inspecting the works described, the party re-embarked on board the steamers and took a cruise out to sea as far as Hartlepool. Something like a scare took place a few weeks ago lest the large quantity of slag which proceeds daily to sea to be tipped at a point about three miles from the river entrance should be making a shoal at that point. Soundings were taken, and it was found that the depth at one place had diminished very considerably. Still, as at the shallowest place there was 60ft. of water left, there was evidently no ground for immediate alarm. As a precaution, however, the precise locality where tipping is permitted is now changed from time to time by order of the Commissioners' engineer, so that any undue accumulation in one place is prevented. The steamers then brought their parties back to the fifth buoy lighthouse, where the Commissioners have a large wooden building and other accommodation. A sumptuous banquet was there found ready, and the morning's work, supplemented by the sea breezes, had made the company ready for it. By good fortune it happened that the Trinity House steamer, Galatea, on a voyage round the coast, entered the river just at the same time as the other steamers, consequently Captain Ladde, who commands, and General Sir George Bourchier, who was on board, disembarked and joined the company at the fifth buoy light. The most important speech made, after the lunch, was by Mr. Fallows, chairman of the works committee. This gentleman is actually ninety years old, and yet holds perhaps the most important and responsible position amongst the Commissioners. His memories of the past history of the river were most entertaining, and his enthusiasm as to its future importance was worthy of a man one-fourth his age. The party returned to Middlesbrough at five o'clock, well pleased with the way in which the large revenue of the Commissioners was being laid out for the benefit of the trade of the river and the district.

SLIDING SCALES AND WAGES.

It is now an open secret that the coalowners of the North propose in at least one instance to endeavour to have an alteration of the sliding scale by which wages are regulated. These scales have not given that relief to the employers which it had been hoped would have been given in periods when coal was generally falling in price—whether it is because the collieries selected to ascertain the selling price from are the best of their class and command the highest price in the market, need not yet be discussed. Taking the Durham coal trade as an instance, we find that for the first three months of the present year the average realised price was close upon 5s. 4½d., and the then prevailing rate of wages was reduced by 1¼ per cent. The succeeding report of the accountants has just been published, and the price is now reported for the second quarter of the year as about 4s. 4¾d. per ton. There is no further reduction, and thus for a long period—during the current quarter—the coalowners will have no further relief, and whatever may be the fluctuations of wages in other parts of the coal-producing area, the associated coalowners of Durham will have had this year only the small reduction of 1¼ per cent., though there is no doubt that it is much less than the reductions which have been attained in the open market in coalfields such as Scotland. Thus the trade is in a measure lessened where the higher wages are maintained, and it naturally gravitates to the districts where coal is cheapest, other things being equal. If the sliding scale system is to continue it should give to the coalowners as full a reduction when times are bad as they could obtain in the open market; and it ought, on the other hand, to give to the workmen wages as full as they could otherwise obtain. Its use is simply to adjust wages to the state of trade cheaply, quickly, and without a suspension of labour. As the state of the coal trade is much worse now than it was at the beginning of the year, and as it has grown worse in the last few months to an extent sufficient to induce the coalowners of the North to apply for special relief to the railway companies, it is evident that the coalowners have not received adequate relief from the sliding scale we have instanced. Possibly it may be that the slowness of the working of the scale system may be to blame for the fact; but it remains. If that is the reason, there could be a more frequent audit than one of three months. In the allied iron trade the three months' audit has changed to one of two months, and that quicker record is now approved; but in any case the basis of the sliding scale in the coal trade will be proposed to be altered, and it is evident that if the system is to proceed, there must be an adaptation of it to the necessities of the case. No system can long retain the basis of wages above that of neighbouring districts without great harm being done to the trade, and in the end to the wages and prospects of those employed in it. In the next few months there is time to fully discuss the merits of the case and the needs of the situation; but it is apparent that the sliding scale will need to reflect the fluctuations of trade, favourable and unfavourable, if it is to continue.

THE NAVIES OF THE WORLD.

A most important Return, asked for by Lord Charles Beresford, has just been made public. The Return shows in detail the fleets of England, France, Russia, Germany, Italy, Austria, and Greece. The value of this Return depends on its accuracy and trustworthiness, and concerning these points we are not prepared to pronounce an opinion. If, for example, we take the question of speed, it will be found that the information supplied is vague, and may be misleading. For example, we are told that the speeds given are measured mile speeds; but we have no means of ascertaining under what conditions the trial was made. Most ships make many measured mile trials, and very different results are obtained. Some of these trials are made with much greater weights on board than are others, and this, of course, modifies the results materially. We shall have occasion to return to the consideration of this paper, which meanwhile we commend to the attention of our readers interested in naval matters. It can be obtained from Messrs. Hansard.

LITERATURE.

Modern Steam Engines, Described and Illustrated. By Joshua Rose, M.E. Henry Carey Baird and Co., Philadelphia; Sampson Low, Marston, Searle, and Rivington, London. 1886.

The above is but a brief epitome of a very comprehensive title-page. The book is a handsomely got up quarto, but as the margin round the letterpress is 2½in. wide at top and bottom of the page, and is more than 1½in. wide at the sides, it will be readily seen that the dimensions of the volume might easily have been reduced without detracting from its appearance or utility. There are 318 pages of letterpress and engravings, divided into twelve chapters, with a table of contents and an index. The author in his short introduction states that "the book is intended for those who desire to acquire a knowledge of the construction of modern steam engines, and to thoroughly understand the distinguishing features of each class of engines and their most important parts." The book is illustrated by 422 engravings.

In very many respects this is a thoroughly good and instructive work, and bears numerous tokens of having been written by a practical man. If we are reluctantly constrained to comment adversely on two or three things contained in it, thereby implying that it is not perfect, we only say that it is a human production. Fortunately for our own pleasure as reviewers, we have seen much to praise in it. Some of our criticism is directed, it must be borne in mind, not against Mr. Rose's book, but against certain details of American practice. First, however, for the book. The title is somewhat inexact, and therefore misleading; the volume treats chiefly of various forms of valves and valve gears, as well as certain forms of automatic cut-off governors. Certainly, the valve gear is a most important feature of a steam engine, but it is not the whole of it. The first chapter is devoted to a rudimentary description of the plainest form of direct-acting engine with a simple slide. Diagrams of its valve and excentric, with curve tables showing the proportionate areas of opening of the supply port at different points of the stroke, are added. Chapter II. treats of diagrams for designing valve motions or mechanisms, and shows very clearly in the simple examples selected the manner in which the obliquity of the connecting rod affects the relations between the respective relative positions of the crank pin and that of the piston. This is a very important point, and needs to be thoroughly comprehended by all students of the steam engine. We doubt if it is universally understood, even by engineers, as it should be. Had Mr. Rose rested content with his simple diagrams, he would have done well; but, unfortunately for the practical character of his book, he has followed in Zeuner's track, and indeed quotes and refers to him. So far as pure science goes, we do not wish to say a word against Zeuner, but he is far too mathematical and abstruse for the practical hurry and worry of business men or drawing offices in the present time. Mr. Rose in some of his diagrams for setting out laps, leads, &c., gives five circles, one of them fulfilling the double duty of representing the throw circle of the excentric to one scale, viz., full size, and also the path of the crank pin on a proportionately smaller scale. Of the other four, one is called the exhaust lap circle, another the steam lap circle, while the two others are called the valve circles for forward and backward strokes respectively. This is very confusing. In another diagram he introduces much more complication than there is even in Zeuner's, examples of whose methods he gives. Engineers now only take care that ports are large enough, and that supply and exhaust take place at the right times. With excentric gear they do not in the least want to plot out curves of port areas open at given points in the stroke; whatever they are they cannot be altered. Besides, the study of such complex diagrams demands more time and head work than a skilled chief—at least, of an English engineering department—could afford to devote to it, and they are quite above the heads of most pupils or apprentices. All that can be plotted off on Mr. Rose's elaboration of Zeuner's diagrams can be done just as well with two circles, or even semicircles, one showing the path of the crank pin and the other that of the excentric throw.

We will turn now to points of design which we in England have long since discarded, simply because they would not answer their intended purpose. One of these is the balancing of slide valves. Mr. Rose gives an illustrated description of the Buckeye engine valve. It is a rather peculiar arrangement. The main valve is hollow, and two plates, connected together by a pair of rods, work within it, being actuated by means of a spindle moving inside the tubular spindle of the main slide. The steam gets access to the ports through a cylindrical opening at either end of the main valve, and the pressure of the steam is prevented from acting to force the valve to its face by a modification of a plan often tried in this country, and found wanting—namely, a piston kept pressed on the back of the valve by a spring, and fitting a cylinder in the lid of the steam chest. This piston rests on the planed back of the valve, and no steam can act on the area covered by it. Two of these are fitted to the Buckeye valve. The contrivance never worked well in this country, because, as there is little or no motion in the piston, it speedily sticks fast, and then unequal expansion and wear soon let steam between the piston and the back of the valve; therefore no good effect is derived by using the contrivance—unless, indeed, it is taken apart, and examined and adjusted frequently. Another point of American practice, for relieving pressure of slides on their faces, is in an engine called the "Straight Line," from all the lines of the bed-plate being straight. The slide is much shallower than the usual type, and is double-ported. Two bars are put in the chest, one at each side of the port face, and exactly the same depth as the valve. The valve works between them, and over both valve and bars is laid a block or cover plate, whose margins rest on the bars and elsewhere on the back of the valve. Its face next the valve has certain recesses, and the double ports in the valves correspond with these in such a way as to give double supply and exhaust openings at the proper times. In fact, the block on the back constitutes a species of cover for the slotted valve, and the theory, of course, is that the pressure of the steam on the valve as ordinarily fitted forcing it to its face and causing so much friction, is taken instead by the cover block or plate, which, being supported on the side slips only, keeps all the faces steam-tight, but causes no friction.

The mode of piston packing adopted for this and other pistons had best be described in Mr. Rose's own words:—"The piston packing is constructed as follows: The rings are made in two sections, the lower of which is driven tightly in the grooves, and faced off even with the piston surface. The joint openings are made very narrow, and as the joint faces are horizontal"—by which Mr. Rose means that the ends are so bevelled as to be feather edged—"when in place, therefore these openings do not increase as the rings open out to compensate for the wear. The upper parts are made one-eighth of an inch larger than the bore of the cylinder, and sprung into their places, and are called 'snap' rings; and it follows that, being in two parts, the ring will conform itself much more readily and correctly to the cylinder bore than is the case when the ring has a single split." We must altogether dissent from Mr. Rose's reasoning here. His premises are incorrect, because the ring is not in two pieces. On his own showing the lower smaller part is driven in tight, so tight as to enable it to be faced—in a lathe, we presume. It is therefore in no sense part of a packing ring. The other portion of the packing is not a ring, it is only a segment, and as such, of course, it will conform to the cylinder bore; but forasmuch as that the greatest wear takes place on the lower part of the cylinder and piston, the result will be that the cylinder will have a groove worn in it answering to the fixed block, which, being of an ever reducing radius, will wear the cylinder more unevenly than it would be worn by a piston packed by a proper ring whose outside radius is always the same however much worn. Besides this, however good it might be to be able to shift the piston round a little in the cylinder from time to time, as thereby wear of ring and bore might be more equalised, in the plan described this could not be done if it is necessary to keep the block always below.

There is a number of simple and excellent diagrams, showing how to set out valves, excentrics, and their fittings, both for single valves and for separate cut-offs. Nothing can be better, and the influence of the obliquity of the connecting rod is clearly shown. Various forms of separate cut-off valves are illustrated and clearly explained. A good deal of space is devoted to the illustrations and explanations of what Mr. Rose calls "wheel governors," of which he gives a number of examples. These governors all resemble the Hartnell governor in the principle of their action, some of them acting by shifting the excentric round the crank shaft, thereby altering lead and time of cut-off; while others operate by moving a slotted excentric across the shaft, altering its throw and the travel of the slide. A portion of the book is devoted to a description and setting-out of various link motions, both for reversing motion and for cut-off expansion gear, the Porter-Allen gear being very completely described.

The latter part of the book gives general particulars of a number of types of American engines of the fixed order. Various modifications of the Corliss gear are described, condensing engines and compound engines, high speed engines, one or two forms of pumping engines, and examples of marine engines, all British types, are illustrated and in a general way described. Lack of space precludes our noticing Mr. Rose's book more fully in detail. The subject matter is clearly expressed and free from perplexing formulæ. We have already criticised the diagrams. The engravings with one or two exceptions are all excellent, as is also both paper and letterpress. The book might, as we have said above, been reduced in superficial size with advantage. The student, and even the professional engineer, will find much in it worth study.

An Introduction to the Differential and Integral Calculus, with Examples of Application to Mechanical Problems. By W. J. Millar. Blackie and Son. 1885.

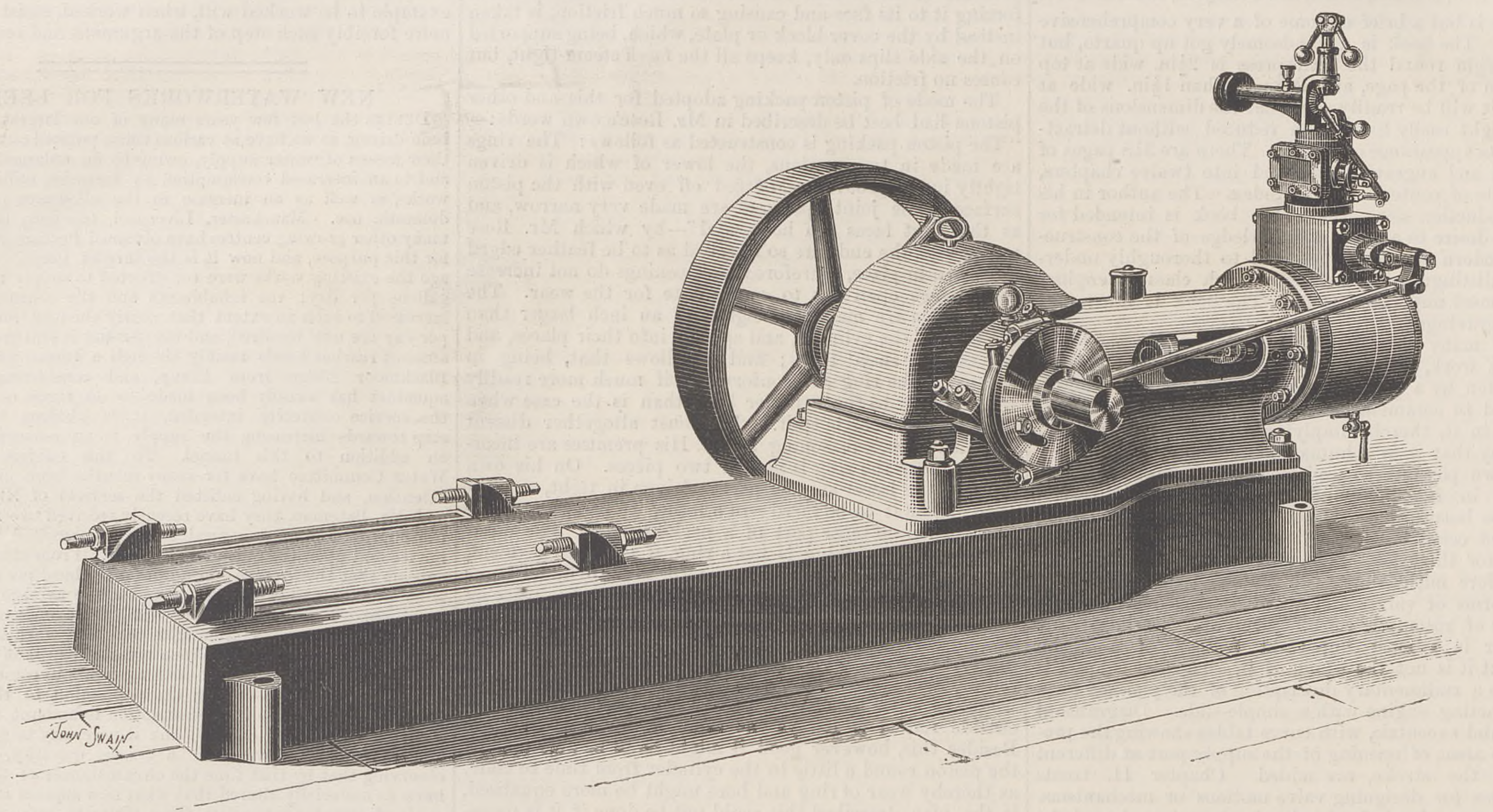
This little work is deserving of recognition from engineer students, because it embodies an effort to provide them with "an outline of the principles of the calculus" and examples of these principles similar to those likely to occur in practice. The value of such a work has long been admitted, and Price, Hall, Tate, and De Morgan wrote more especially with a practical end in view, rather than in the fashion of other, perhaps better known authors, like Todhunter, Williamson, &c., whose books are preferably written for "schools and colleges." There are large numbers of practical men who have never had the advantages of collegiate training, and therefore cannot be expected to waste their time in "getting up" the thousand-and one dodges for examination work. They require information which can be directly applied in their practice. Mr. Millar has been successful in providing a book for this purpose. It is practical from beginning to end. The rules, which like the multiplication tables in arithmetic, must be known by heart, and the nomenclature are explained by the aid of examples that are eminently practical. The method adopted is first to explain the notation and nomenclature of the subject, then to explain the rules of differentiation giving practical examples of their use. That the differential of a maximum or a minimum is equivalent to 0, is next shown and applied, concluding the first part of the book in the differential, and bringing us to the chapter on the integral calculus. One misprint may be noticed here:—10 and 5, p. 11, line 15, should be 2 and 1; and we object somewhat to reference being made to succeeding paragraphs; thus line 2, p. 13, reference to paragraph 7 is quite sufficient, without referring to paragraph 12, p 19. The chapter on integration is as simple and practical as that on differentiation. The latter half of the book is devoted to the application of the calculus to areas of surfaces, trigonometrical ratios. We would suggest as a useful addition, without adding much to the size or cost of the book, that one or two similar, but unworked examples, should be given immediately after every worked out practical example. Readers too often believe they thoroughly understand all that is said, but when put to the proof fail to obtain the wished-for result. A similar example to be worked will, when worked, assist to impress more forcibly each step of the argument and operation.

NEW WATERWORKS FOR LEEDS.

During the last few years many of our largest towns have been driven, as we have at various times pointed out, to increase their means of water supply, owing to an enlarged population and to an increased consumption by factories, mills, and other works, as well as an increase in the allowance per head for domestic use. Manchester, Liverpool, Glasgow, Oldham, and many other growing centres have obtained Parliamentary powers for this purpose, and now it is the turn of Leeds. Forty years ago the existing works were constructed to supply three million gallons per day; the inhabitants and the consumption have increased to such an extent that nearly thirteen million gallons per day are now required, and the demand is still growing. This amount reaches Leeds mainly through a tunnel passing under Blackmoor Ridge from Eccup, and considering that this aqueduct has already been made to do three or four times the service originally intended, it is obvious that a first step towards increasing the supply is an enlargement of, or an addition to this tunnel. To this subject the Leeds Water Committee have for many months been giving serious attention, and having enlisted the services of Mr. Hawkesley and Mr. Bateman, they have recently received two reports from those gentlemen upon several schemes submitted to the committee and upon the question generally. From these reports it appears that the average consumption per head per day in Leeds is at present thirty gallons, or twice the average twenty-five years ago. Thirty gallons per head these eminent engineers consider a very large allowance, and they mention that the increase in consumption has been greater than that of the population. But taking a period of thirty years to come as the basis of calculation, and assuming the population to then number 700,000, they suppose the consumption to amount to 21 million gallons a day. They do not think it necessary to provide for a longer period in advance or a greater quantity, very wisely observing that by that time the circumstances of the case may have so materially altered that what now appears to be the best mode of carrying into effect these ultimate extensions may not be advisable, or even practicable. Having visited the ground and the existing works, they state in their first report that no physical difficulties exist either to constructing a new tunnel parallel to the Blackmoor tunnel, or to enlarging that. They speak favourably of all the schemes submitted so far as adequacy and practicability are concerned—especially one by Messrs. Filliter and Rofe—but they discard them all, because none of them seems to meet in the simplest, cheapest, and in other respects the best way, the practical requirements of the case. In lieu thereof they submit a scheme of their own. "We are of opinion," they say, "that it is unnecessary to contemplate at the present time a larger supply, even to meet unforeseen contingencies, than twenty-five million gallons of water per day, and for this purpose a 6ft. tunnel, constructed under the Blackmoor Ridge, at the same inclination as the existing tunnel, will be amply sufficient. A tunnel of this size and this inclination will, indeed, pass forty million of gallons of water per day; and we are also of opinion that, including its approaches at both ends, a tunnel of this dimension may be executed for from £30,000 to £32,000, exclusive of compensation to landowners, or any special constructions which they may require." In the instructions from the committee they were desired to consider "the absolute necessity of preserving the present supply to the town intact," and upon that point, assuming quality as well as quantity to be meant, they express the opinion that it is impossible to preserve the "quality" of the water intact by any enlargement of the present tunnel by the means, and in the manner proposed. They are therefore "induced to recommend that a new tunnel, amply large enough, and quite independent of the existing one, should be constructed, and at such distance from the present one as will, in all probability, prevent any injurious percolation from either. For this purpose, and on account of the dip of the strata, they are of opinion that the new tunnel should be placed on the easterly side of the existing one, and at about 100 yards distant therefrom." Finally, they submit for consideration the question whether in the construction of a new tunnel it would not be well to make it with a smaller inclination than the present one. If this were done, and the lower or discharging end were kept at the same level as at present, it would have the advantage of drawing the water from the Eccup reservoir to a greater depth, and so increasing its available capacity. A tunnel of 6ft. clear diameter, having a fall of only 1ft. in a mile, may be relied upon to discharge upwards of twenty-five millions of gallons in twenty-four hours, and may be completed by an energetic contractor in twelve months or thereabouts. In the Loch Katrine scheme for Glasgow last year, we may incidentally mention a second aqueduct was adopted as the best means of increasing the supply. Having considered this report, the Water Committee submitted some questions to Messrs. Hawkesley and Bateman, one of which was this, upon the last point in their report:—"Whether you are aware that in recommending the construction of a tunnel with a gradient of only 1ft. in a mile, if no alteration is made in the present level at the outlet, the Corporation could only pass about 12,000,000 gallons of water per day through the existing 40in. main to the Weetwood filter beds; whereas, having regard to the present rate of consumption, which exceeds that quantity, and to the probable future requirements, it is essential, in any scheme that may be adopted, to provide for a daily supply through the 40in. main of not less than 15,000,000 gallons." To this they replied, that having been informed that the 40in. main delivered 12,000,000 gallons per day, they did not think that unless by the application of steam power at or near the existing outlet, the now alleged quantity of 12,000,000 gallons can be increased to 15,000,000 gallons without involving a considerable loss of storing ability in the Eccup reservoir. This remedy, they add, would be worse than the disease; and then in answer to the inquiry how they proposed to connect the outlet of the new tunnel with the existing 40in. main, they say it is obvious that this end can be attained by means of an additional cast iron pipe or pipes eventually capable of conveying from the outlet of the new tunnel to Leeds as much water as will complete the full quantity of 25,000,000 gallons per diem. The present 40in. pipe is stated to convey about half the stated quantity of 25,000,000 gallons; the other half must therefore be conveyed by one or more other pipes. There the matter for the present rests, but it is highly probable that at the earliest moment possible Parliament will be asked to sanction a Bill based upon Messrs. Hawkesley and Bateman's scheme.

THE LIVERPOOL EXHIBITION.—HIGH-SPEED ELECTRIC LIGHT ENGINE.

MESSRS. ROBEY AND CO., LINCOLN, ENGINEERS.

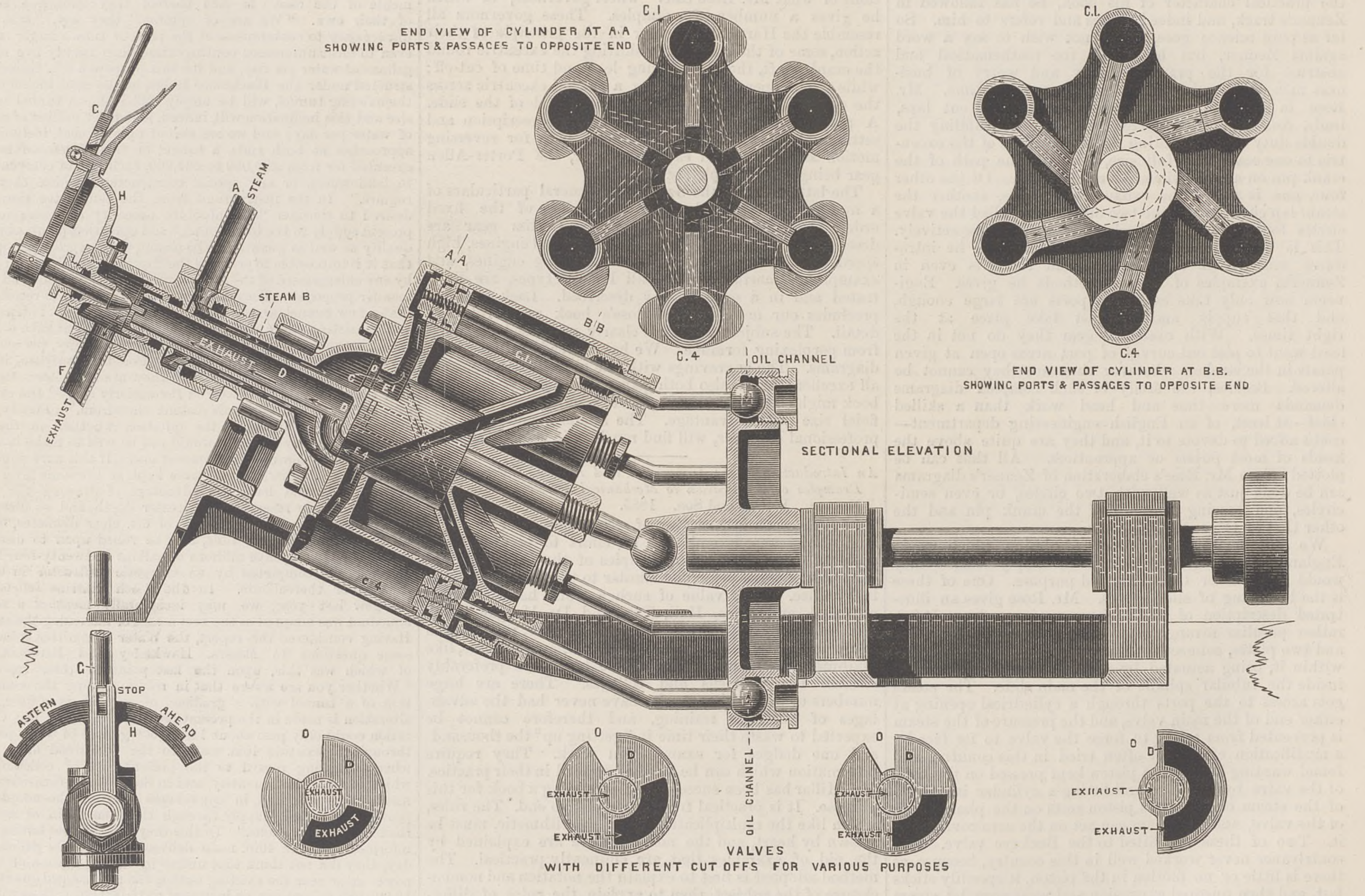


THE LIVERPOOL INTERNATIONAL EXHIBITION.

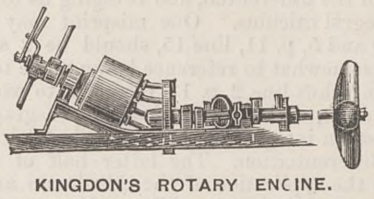
No. IV.

Messrs. Robey and Co. send an interesting collection of their well-known engines, including a horizontal engine especially intended for electric lighting, and provided with Proell's automatic expansion gear, which was fully illustrate l and described in The Engineer on August 7th and December 11th, 1885. A high-speed engine, which is illustrated at the top of this page, is intended principally for working electric light machines on board ship, but is equally suitable for any purpose where great power is required in a small space. It is designed to work with high steam pressure, and may be run at from 150 to 250 revolutions per minute, and it is well furnished with means of self-lubrication. When used for electric lighting it is mounted on a cast iron bed-plate, as shown in the drawing, one end of which carries the dynamo; the base plate is provided with lugs and adjusting screws, so that the driving belt can be tightened without stopping the machinery. Robey's compound special semi-fixed engine is too well-known to need description, and the firm have now turned their attention from agricultural to nautical matters, and exhibit a small vertical boiler and engine intended for use on board fishing smacks for hauling in nets, everything being made as simple as possible, and all the working parts are well protected.

Messrs. Simpson and Denisons, of Dartmouth, who have made the construction of small steam engines for yachts their speciality, have two exhibits, one in the main avenue and the other in the Machinery in Motion Court.



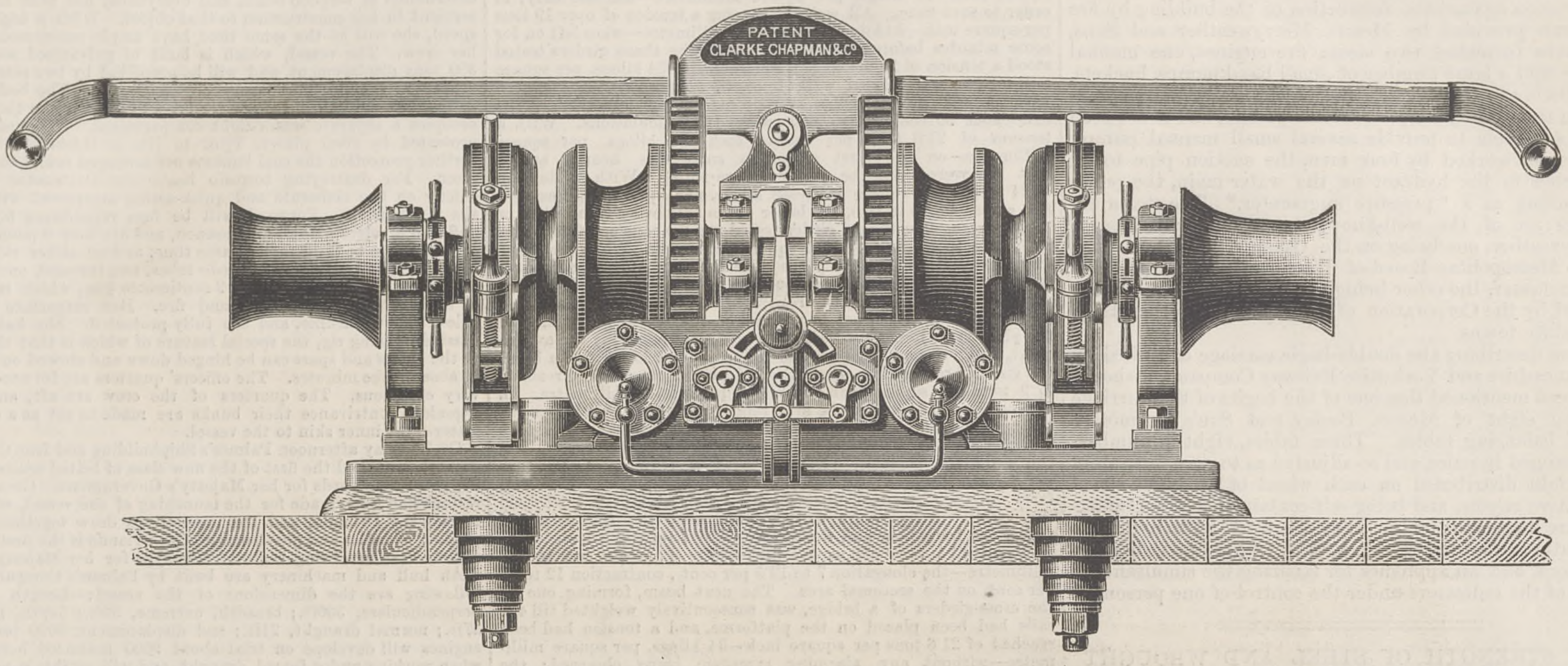
KINGDON'S ROTARY ENGINE.



KINGDON'S ROTARY ENCINE.

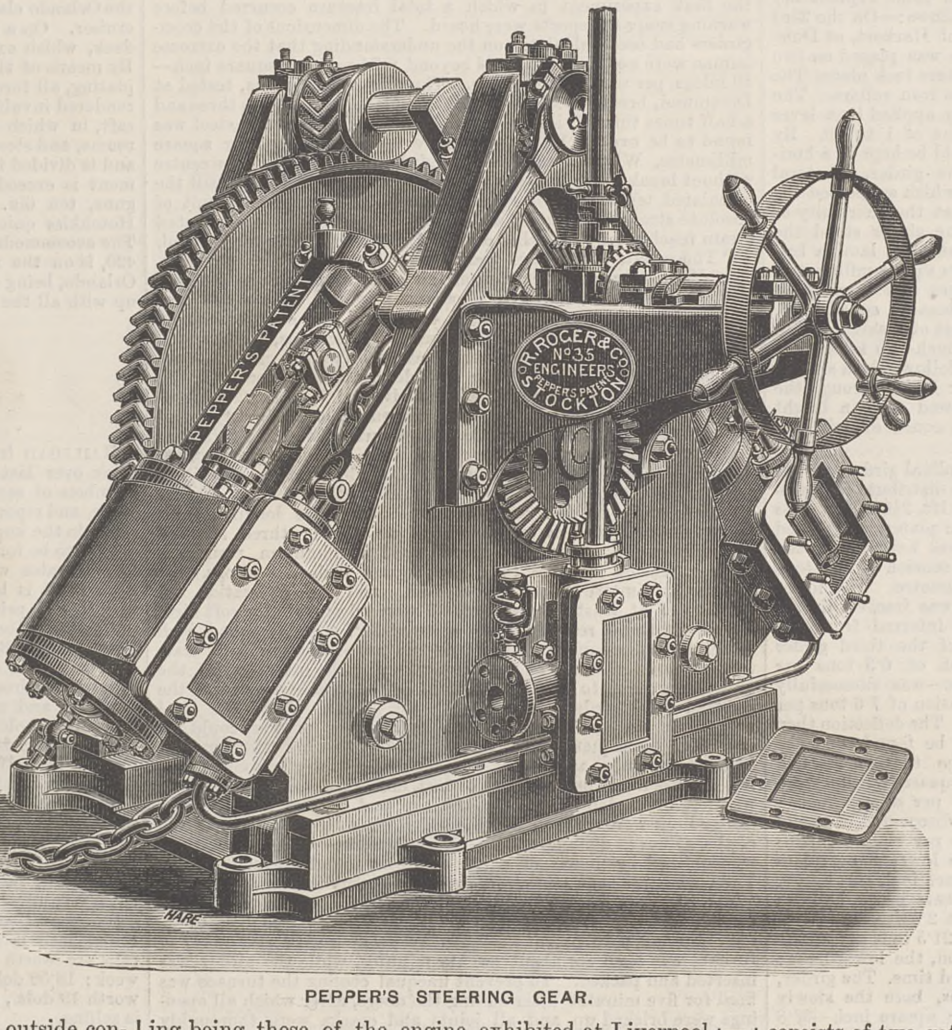
One article in the latter exhibits is certainly the curiosity of the Exhibition. It is called Kingdon's patent rotary engine, though it is not a rotary engine in the ordinary sense of the word, as the motive power is obtained by means of a reciprocating movement; still, as every part of the engine with the exception of the bed plate and bearings rotates, perhaps the name is not misapplied. The engine consists of a cylinder placed at an angle of forty-five degrees, and supported at one end by a trunnion through which the steam is admitted and exhausted, and at the other by a pivot resting on the centre of a disc. Inside the cylinder are six smaller cylinders, provided with pistons, the piston-rods of which are bent horizontally after passing through the stuffing-boxes on the cover of the large cylinder, and then attached to the disc already mentioned; the pistons are set to be at different positions, and steam being admitted, the ordinary reciprocating motion of the pistons commences, the cylinder and the disc revolve together, and the machinery set in motion. There is only one valve, and the engine can be stopped and reversed by means of it alone. Steam is admitted at A through the passage B into the chest C. It then passes through the opening O in the valve D into the port E¹, communicating with top end of

THE LIVERPOOL EXHIBITION.—MESSRS. CLARKE, CHAPMAN, AND CO.'S STEAM WINDLASS.

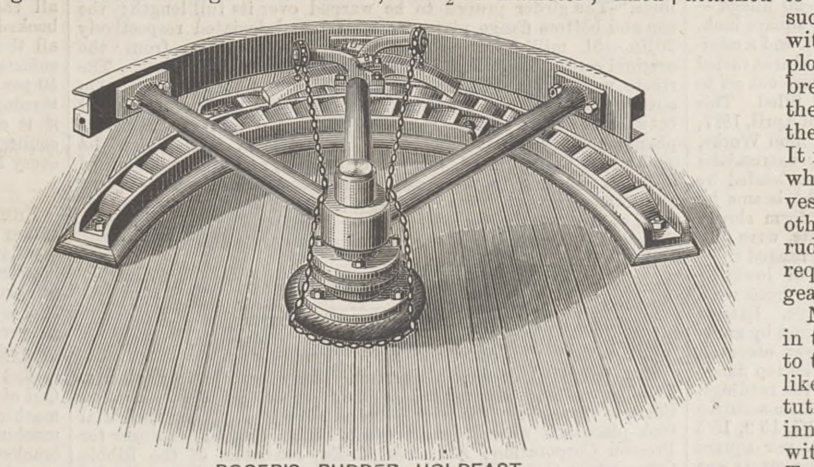


the cylinder C^1 and the bottom end of cylinder C^4, as shown by the arrows. The exhaust at the same time passes from the bottom end of the cylinder C^1 and the top end of cylinder C^4 through port E^4, then through the centre of valve D to the exhaust at F. There is only one valve in the engine, which is marked D, and it does not rotate, but is controlled by the lever G, which is held in position by means of the quadrant H. By moving this lever the engine rotates in either direction, stops and reverses with remarkable ease and rapidity. The action of this machine is extremely curious, for although the motion of the pistons in the cylinders is an ordinary reciprocating one, the entire momentum of the engine is rotary. The cylinders are not likely to become grooved in working, as the pistons have a spiral movement in one direction when travelling forward, and on the return stroke a similar motion in the other direction, the effect being that the cylinders become evenly polished by the opposite motions. Any required degree of expansion can be arranged for by the form and position of the valve, and drawings are given showing the different forms of valves. The cut-off can be varied to any extent while the engine is running. The engine is undoubtedly very compact and light, and works at a very high rate of speed with very little noise; but experience alone can prove whether this engine is an economical one or not, both as regards the consumption of steam and durability of working parts. In the main avenue these makers show a yacht's steam gig 25ft. long by 5ft. 6in. beam, carvel built, of mahogany, fitted with Kingdon's patent compound surface condensing engine, double ½ A size, with two 1½in. high-pressure and two 3½in. low-pressure cylinders, and Kingdon's patent natural draught boiler, and fitted with outside condenser, suitable for carrying on a yacht of 150 tons and upwards. The weight of this boat is 8 cwt., and the machinery, including the boiler, is only the same weight as the hull, making a total of 16 cwt. A yacht's dingey, 16ft. long and 4ft. beam, is shown, fitted with a smaller engine and boiler of the same description. A larger engine with a 4in. high-pressure and 10in. low-pressure cylinder is exhibited without a hull. These engines are all surface-condensing, the condenser being formed of solid drawn copper tubes of D section placed outside the boat, which are connected at the forward end with the exhaust pipe and at the after end with the air pump. It is stated that a vacuum of 25in. is easily obtained with these condensers. The boilers are somewhat unusual in design; they are vertical, and the diameter of the steam space is considerably greater than that of the water space, which is said to entirely prevent priming; and although it gives them a top-heavy appearance, the centre of gravity is really very low. The engines are beautifully finished, and from this cause, and their diminutive dimensions, they attract a good deal of attention. The boats are fitted with propellers on shafts having universal joints, and by means of a lever placed over the tiller and a rod working through the rudder formed of two brass plates, the screw can be lowered below the keel or raised above it in shallow water.

Messrs. Sharp, Stewart, and Co., of Manchester, have sent a bogie passenger tank locomotive, built by them for the Lancashire and Yorkshire Railway to the designs of Mr. W. Barton Wright, the locomotive superintendent of that company. This engine is of a similar type to that illustrated in the supplement of THE ENGINEER of June 11th, but the dimensions are slightly different, the following being those of the engine exhibited at Liverpool:—Inside cylinders, 17½in. diameter by 26in. stroke; leading and driving wheels, coupled, 5ft. 8in. diameter; hind end carried on bogie with wheels, 3ft. ½in. diameter; fixed wheel base, 7ft. 7in.; total wheel base, 22ft. 11in.; heating surface of fire-box, 90 square feet; and of tubes, 935·4 square feet; capacity of tanks, 910 gallons; weight, empty, 44 tons 3 cwt.; in working order, 53 tons. Fitted with the automatic vacuum brake.



PEPPER'S STEERING GEAR.



ROGER'S RUDDER HOLDFAST.

Steam winches and steam steering gear form a very prominent feature in the machinery in motion court, and prominent among them is the stand of Messrs. Clarke, Chapman, Parsons, and Co., of Gateshead-on-Tyne. The most important of their exhibits is a small steam windlass, over three hundred of which have been supplied to steam and sailing ships. The principal features of this windlass are the spring riding brakes fitted to each cable holder and a special form of friction cone used for obtaining the lifting purchase. The special advantages of these features are shown outside the building near Galloway's boilers. Here Messrs. Clarke, Chapman, Parsons, and Co. have placed one of their steam windlasses with a boiler attached under a pair of sheer legs. From the top of the sheer legs one of Martin's anchors is suspended by means of a chain attached to the windlass; while the anchor is being lowered rapidly the brake is suddenly applied, so that the momentum of the falling anchor may show the manner in which the riding springs relieve the windlass and cable of all dangerous strains when a vessel is riding at anchor in heavy weather. The Pepper diagonal steam steering gear is of a substantial and simple character, though somewhat bulky; it is readily accessible in all its parts, and is fitted with chain barrel and spur gear. A special feature of the machine, which is illustrated here, is a novel form of slide valve of a double D type, steam being admitted into one or the other chamber according to the way it is desired to run the engines. This arrangement has been found to possess many advantages over the piston valves which are troublesome to keep tight. This steering gear occupies but little space in a fore and aft direction. It is manufactured by Messrs. Robert Roger and Co., of Stockton on-Tees, who also exhibit a model of their patent rudder holdfast. As will be seen on referring to the annexed engraving, it consists of two ratchets of semicircular form bolted to the deck; two palls are attached to the quadrant on the rudder head. These pawls are held up by means of chains attached to hooks fixed to the boss of the quadrant, in such a position that they may be unhooked without any risk of accident to the person employed. In the event of the steering chains breaking, both pawl chains are unhooked, when the pawls will drop into the ratchets beneath them, and hold the rudder securely in position. It may happen that the position of the rudder when thus held is one which would throw the vessel out of her course. In this case one or other of the pawls may be lifted, allowing the rudder to move by the action of the sea in the required direction, while the other pawl being in gear, will prevent any backward movement.

Messrs. Vosper and Co., of Portsmouth, have in the main avenue a steam life cutter, as supplied to the Royal Navy. The planking of this boat, like that of the lifeboats of the Lifeboat Institution, is of mahogany, and in two thicknesses, the inner plank being diagonal, the outer fore and aft, with linen and marine glue between the planking. Teak fittings inside of double thickness form seven air-tight compartments on each side of the boat, in addition to the air-tight compartments at the bow and stern. A deck is fitted forward and a platform aft, each adapted for carrying a gun. Under all reasonable circumstances, it is claimed that this boat is unsinkable with all her machinery and gear on board. The machinery consists of a double-cylinder engine of the high-pressure type, having cylinders 4¾in. diameter, 5in. stroke, steel multitubular boiler, with oval furnace and brass tubes. The total weight of the boat and the machinery complete is said to be 3 tons 4 cwt.

Provision against the destruction of the building by fire has been provided by Messrs. Merryweather and Sons, who have furnished two steam fire engines, one manual engine, and a large number of small hand pumps, buckets, &c. Owing to the elevated site of the building, the pressure in the water mains is extremely small, and it has been found advisable to provide several small manual pumps, each to be worked by four men, the suction pipe to be connected to the hydrant on the water main, the pump thus acting as a "pressure augmenter." The steam fire engines are of the well-known types made by Messrs. Merryweather, one being on the Greenwich pattern used by the Metropolitan Board of Works and the Corporation of Manchester, the other being of the direct-acting pattern adopted by the Corporation of Liverpool and other large Lancashire towns.

When describing the double-bogie carriage exhibited by the Lancashire and Yorkshire Railway Company, it should have been mentioned that one of the bogies of this carriage rests on eight of Messrs. Pooley and Son's locomotive engine balancing tables. These tables, eight in number, are arranged in pairs, and so adjusted as to give separately the weight distributed on each wheel of an eight-wheel locomotive engine, and being self-contained, heavy foundations are dispensed with. They are fitted with hydraulic automatic indicators, giving a total maximum indication of 80 tons, and an appliance for securing the simultaneous action of the indicators under the control of one person.

THE STRENGTH OF STEEL AND WROUGHT IRON GIRDERS.[1]

The following is printed by permission, and is abstracted from a report[2] to the Dutch Minister of Public Works by Mr. W. Anderson, M.I.C.E.

"The girders experimented on were all beams with single plate webs having flanges composed of angle bars and two or more layers of plates. The paper commences with some explanatory and introductory matter, and proceeds as follows:—On the 23rd of February, 1877, in the works of the firm of Harkort, at Duisburg, Hochfeld, a rivetted longitudinal beam was placed on two supports, and weighted on the centre until rupture took place. The beam rested near its extremities on wrought iron rollers. The pressure on the centre of the top flange was applied by a lever 31ft. 2in. long, with a ratio between the arms of 1 to 29. By means of a screw at the fulcrum the lever could be kept in a horizontal position during the deflection of the girder. Lateral deflection was prevented by four angle irons which supported the horizontal flanges sideways. The scale pan at the extremity of the lever was slowly and carefully loaded; the girder stood the test well until the calculated tension in the extreme lamina had reached 12·7 tons per square inch—20 kilogs. per square millimetre. Up to that load the observed deflections were less than those calculated, but with the above strain they became equal to it. When the stress had reached the supposed limit of elasticity with a calculated tension of 15·9 tons per square inch—25 kilogs. per square millimetre—a peculiar snap was heard, followed by a similar report a second later, after which the girder broke through the middle with a loud noise. The fracture showed a clean bright metallic surface without any blemish which could explain the unexpected failure.

"On the 19th and 20th of March two longitudinal girders of the same form were tested in a similar way. To distribute the pressure more evenly, a cushion measuring 6·56ft. by 1ft. 2½in.—2 metres by 370 millimetres—made of felt, oak, and iron plates, was placed under the test load on the girder. A snap was heard when the first of these girders was loaded to a calculated tension of 15 2 tons per square inch—24 kilogs. per square millimetre. The lower flange of one of the bottom table angle bars was fractured. No exceptional brittleness or hardness could be inferred from the appearance of the fracture. The strength of the third girder proved to be even less. A calculated tension of 6·3 tons per square inch—10 kilog. per square millimetre—was successfully supported, but two reports were heard at a tension of 7·6 tons per square inch—12 kilogs. per square millimetre. The deflection then was but small; the fracture could not easily be found, and the experiment was proceeded with. When the tension reached 11·7 tons per square inch—18·5 kilogs. per square millimetre—another report was heard, and at 12·7 tons per square inch—20 kilogs. per square millimetre—a rent was discovered in one of the lower angle bars. A tension of 14·1 tons per square inch—22·2 kilogs. per square millimetre—caused the lower flange plate to tear with a report. At 17·8 tons per square inch—28 kilogs. per square millimetre—the two lower angle bars broke, and the bottom flange was ruptured in a second place at 2·62ft.—800 millimetres—distance from the first fracture. With 21·5 tons per square inch—33·9 kilogs. per square millimetre—tension, the lower flange plate and angle bars were fractured for the third time. The girder, with its lower flange broken in several places, bore the slowly augmenting load until a strain of 24 tons per square inch—37·8 kilogs. per square millimetre—had been reached, when total fracture occurred. Immediately after this parts of the broken girder near the fracture were drilled out and submitted to tests in compression and tension. These last gave satisfactory results on the whole, indicating an ultimate strength of 38 tons—60 kilogs.—to 47·6 tons—75 kilogs. per square millimetre—per square inch. The elongations amounted to a maximum of 21 per cent. and a minimum of 13·5 per cent., and the contraction of the sectional area varied between 26 and 41 per cent. Some of the rivet heads were cut off to ascertain whether the rivet-holes had been properly filled. This proved to have been the case. From the 11th to the 14th of April, 1877, three steel longitudinal beams were tested at the Union Works, near Dortmund. The beams were supported at their extremities on steel rollers resting on piers of masonry, and were loaded by dead-weights laid on a platform suspended from the beams by four rods. In order to place the weight on the platform slowly and without shaking, the rails, which served as weights, were first laid over an iron beam placed on each side, and arranged to be lifted or lowered by means of screws. The lifting or lowering never exceeded a rate of ⅜in. per minute. Four angle irons were fixed in order to prevent the platform swaying sideways. Lateral deflections of the tested beam were also guarded against by angle irons fixed vertically. The deflection in the centre was observed on the bottom flange by direct measurements, and on the top flange by means of a special apparatus designed to magnify the readings. The loading was regulated so as to cause calculated consecutive tensions in the extreme lamina of 6·3, 9·5, 11·4, 12·7, 15·2, 16·5 tons per square inch—10, 15, 18, 20, 24, 26 kilogs. per square millimetre. After this tension had been reached, the stress was increased by 1·27 ton per square inch—2 kilogs. per square millimetre—at a time, to 25·4 tons per square inch—40 kilogs. per square millimetre—after which the gradual increase was at the rate of 0·63 ton per square inch—1 kilog. per square millimetre—at a time. Up to a tension of 17·8 tons per square inch—28 kilogs. per square millimetre—the load was completely lifted off, after the deflection had been taken, by means of the screws. Above this limit the beam was totally unloaded at every 6·34 tons per square inch—10 kilogs. per square millimetre—increase only, in order to save time. All weights causing a tension of over 19 tons per square inch—30 kilogs. per square millimetre—were left on for some minutes before adding to them. The three girders tested stood a tension of 21·6 tons per square inch—34 kilogs. per square millimetre—and carried a load of 57·7 tons—58,588 kilogs.—without any unfavourable symptoms being observed. The deflections agreed pretty well with the calculations. With a tension of 21·6 tons per square inch—34 kilogs. per square millimetre—on the first girder, a snap was heard, and a rent discovered on the lower flange-plate. With a tension of 24·1 tons per square inch—38 kilogs. per square millimetre—the girder broke in two, the lower angle bars being torn in two or three places. The second girder tested stood a tension of 24·1 tons per square inch—38 kilogs. per square millimetre. When the stress had increased to 25 tons per square inch—40 kilogs. per square millimetre—the platform was found to be unevenly loaded. Before it could be lifted, previous to readjustment, a snap was heard, and a rent found in the lower angle bars on the overweighted side of the platform. Reports were heard twice after resuming the experiment, and a second fracture was found in the lower angle bars; the girder broke in two when the calculated tension had reached 27·9 tons per square inch—44 kilogs. per square millimetre. In testing the third girder, the first report was heard just before the tension of 24·1 tons per square inch—38 kilogs. per square millimetre—was reached. No fracture could be found, but the complete fracture followed with a tension of 26 tons per square inch—41 kilogs. per square millimetre. The surfaces of the fractures were those characteristic of good ductile steel. Strips were drilled from near the fractures and tested for toughness and ductility. The strength amounted to 34·9 and 43·5 tons per square inch—55 to 69 kilogs. per square millimetre—the elongation 7 to 19·5 per cent., contraction 12 to 45 per cent. on the sectional area. The next beam, forming one of the cross-girders of a bridge, was consecutively weighted till 478 rails had been placed on the platforms, and a tension had been reached of 21·6 tons per square inch—34 kilogs. per square millimetre—without any alarming symptom being observed; the actual surpassed the calculating deflection, however, to a considerable extent. As soon as the total load, amounting to 144·8 tons—147,034 kilogs.—had been imposed, and the tension had attained 22·9 tons per square inch—36 kilogs. per square millimetre—the girder broke in two with a loud report. A rent in a lower angle-bar, and a crack in the vertical web, were discovered. The rent of the web-plate showed a fine fibrous fracture. This was the first experiment in which a total fracture occurred before warning snaps or reports were heard. The dimensions of the cross-girders had been calculated on the understanding that the extreme lamina were not to be strained beyond 6·34 tons per square inch—10 kilogs. per square millimetre. The four steel girders, tested at Dortmund, broke when the calculated strain amounted to three and a-half times this tension. The ultimate strength of the steel was found to be over 38·1 tons per square inch—60 kilogs. per square millimetre. Whereas wrought iron girders bear a load in the centre without breaking or showing signs of shearing in the rivets, till the calculated tension in the extreme lamina approaches the limit of absolute strength; rivetted steel beams break when the calculated strain reaches only half that due to the direct tenacity of the steel.

"The results of the steel tests thus proved very disappointing. The different authorities on iron and steel manufacture declared that they had encountered phenomena which they could not explain, and it was determined to extend the experiments by means of some rejected girders of larger dimensions, which could be cheaply obtained. These were made of soft steel, of hard steel, and of wrought iron, and it was also determined to ascertain the difference between girders bolted and rivetted together. Accordingly the following beams were experimented on:—Twenty longitudinal girders intended for the bridge across the river Waal at Nymegen. The component parts of three of these girders were annealed before rivetting, while two of the girders were not rivetted but bolted. Three cross-girders, three rivetted girders of hard steel of the same dimensions as the longitudinals; three rivetted girders of soft steel as above; three rivetted iron girders as above. For hard steel a minimum resistance against tension of 47·6 tons per square inch—75 kilogs. per square millimetre—was prescribed, and an elongation on fracture of at least 14 per cent. The requirements for soft steel were a maximum resistance to tension of 31·7 tons per square inch—50 kilogs. per square millimetre—and an elongation with fracture of not less than 25 per cent. During the investigation the question arose as to whether it would be practicable to anneal the rivetted steel girders without injuring them. From the steel manufacturers in Westphalia no satisfactory answer could be obtained; consequently an investigation into this important matter became necessary, and one of the pieces of a girder broken in testing was used. It had a length of 13ft. 6in.—4128 millimetres—and was not much deformed. On the top and bottom flange plates centre lines were marked, and the width was measured on each side of these lines at distances 10in.—25 centimetres—apart. All rivets were proved by means of a hammer and found perfectly tight. The girder was then laid on its side in a roomy annealing furnace, which had been heated for thirty-six hours, and was considered to have attained a temperature of 1112 deg. Fah.—600 deg. Cent. Care was taken to prevent sagging by packing with stones. The furnace was open for about twenty minutes, while the girder was inserted and packed. To prevent unequal cooling the furnace was fired for five minutes after closing the doors, after which all openings were bricked up, and all joints and cracks were thoroughly luted with clay. These operations occupied forty-five minutes. The girder was left for sixty hours in the furnace, and was by that time completely cooled. It was then taken out and laid on the supports, on which it had rested during the marking of the centre lines. The girder proved to be warped over its full length; the top and bottom flange plates were bent, and deviated respectively 20⅛in.—51 millimetres—and 5⅞in.—16 millimetres—from the original centre line. The web was buckled in several places. The rivets were again tested by the hammer and found tight. On cutting off one of the rivet-heads a slight layer of dust was found between the plate and the rivet-head. With other rivet-heads this phenomenon was not observed. The red lead, with which the girder had been painted, was partly burned, and partly remained in flakes adhering to the metal. The deformations were so great and numerous that it was considered as demonstrated that, even if fixed or strutted during annealing no satisfactory results could be expected. The results of the investigations are collected in tables, and represented graphically.

(*To be continued.*)

[1] "Proceedings' Institution of Civil Engineers.

[2] The original appeared in the Tijdschrift van het Koninklijk Instituut van Ingenieurs, 12th February, 1884, and contains ten plates besides numerous tables. The MS. of Mr. Siccama's complete translation, with all the plates, diagrams, and tables, are in the library of the Institution.

LAUNCHES AND TRIAL TRIPS.

The powerful dredger Gilbertson, lately launched by Messrs. Fleming and Ferguson, of Paisley, has now been set to work cutting the new channel for the river Ribble at Preston. The official trial took place last week in the presence of Mr. Garlick, engineer for Preston Corporation; Alderman Bibby, chairman of the Ribble Committee; Councillor Atherton, vice-chairman; and a number of other gentlemen connected with the Corporation of Preston. The material she has to cut is very stiff boulder clay, but with her powerful machinery has no trouble in dealing with it. She filled a 350-ton barge in twenty minutes, and the representatives of the corporation who were on board expressed themselves highly satisfied with the manner in which she did her work and with the several parts of the machinery throughout the vessel.

Messrs. James and George Thompson have launched from their building yard on the Clyde a torpedo cruiser, named the Destructor, designed and built by them for the Spanish Government. The vessel is the first example of a new type of war ships, and in her design are several noteworthy features. The special function the cruiser is meant to discharge in naval warfare is the capture and destruction of torpedo boats, and everything has been made subservient in her construction to that object. With a high rate of speed, she will at the same time have ample accommodation for her crew. The vessel, which is built of galvanised steel, is of 350 tons displacement, and will be propelled by two sets of triple expansion engines in separate compartments. The boilers, four in number, are of the locomotive type, and each, like the engines, occupies a separate water-tight compartment. The machinery is protected by steel plates, 1¾in. to ¾in. in thickness, and as a further protection the coal bunkers are arranged round the engine-room. For destroying torpedo boats the Destructor will rely chiefly on the elaborate and quick-acting armament with which she is furnished. Forward will be four rapid-firing 6-pounders and two revolving Hotchkiss cannon, and aft four 6-pounders, all of which can be fired at the same time, and on either side of the ship. She will carry five torpedo tubes, two forward, one aft, and one on each broadside, and a 9-centimetre gun, which is capable of an almost complete all-round fire. Her magazines are well below the water-line, and are fully protected. She has a three-masted cruising rig, the special feature of which is that the whole of the masts and spars can be hinged down and stowed on the deck in about three minutes. The officers' quarters are forward and are very capacious. The quarters of the crew are aft, and by an ingenious contrivance their bunks are made to act as a complete water-tight inner skin to the vessel.

On Tuesday afternoon Palmer's Shipbuilding and Iron Company, Jarrow, launched the first of the new class of belted cruisers building in private yards for her Majesty's Government. Great preparations had been made for the launching of the vessel, which was named the Orlando, and the proceedings drew together a large number of ladies and gentlemen. The Orlando is the first of seven vessels that are being built of this type for her Majesty's Navy. Both hull and machinery are built by Palmer's Company. The following are the dimensions of the vessel:—Length between perpendiculars, 300ft.; breadth, extreme, 56ft.; depth, moulded, 37ft.; normal draught, 21ft.; and displacement, 5000 tons. The engines will develope on trial about 9000 indicated horse-power when working under forced draught, and will maintain a speed of 19 knots. The Orlando, with the other belted cruisers, are quite a new departure in war-ship design, and while superior to anything of this class of war-vessel afloat in point of speed, are much more heavily armed, and have much more defensive power than the Mersey class, which approach them nearest from a constructive point of view, the chief difference consisting of a belt of armour at the water-line, which is fitted in the Orlando class, and from which they derive the name of belted cruiser. On a level with the top of the belt there is a protective deck, which extends throughout the whole length of the vessel. By means of the armour belt amidships and the protective deck plating, all fore and aft the whole of the vessel under this deck is rendered invulnerable to shot and shell, and forms an unsinkable raft, in which are placed the engines, boilers, magazines, shell-rooms, and steering gear. The hull is built of Siemens-Martin steel, and is divided into over 100 water-tight compartments. The armament is exceedingly powerful, and consists of two 9·2in. 22-ton guns, ten 6in. 5-ton guns, six 6-pounder and ten 3-pounder Hotchkiss quick-firing guns, and numerous boat and field guns. The accommodation of the officers and men, numbering altogether 420, is on the main deck. There are two sets of engines to the Orlando, being a twin screw vessel. The vessel is throughout fitted up with all the latest and most complete improvements.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, July 24th.

Railroad traffic and earnings exhibit a further increase this week over last week, and against the same week last year. The members of several railroad companies have met during the past week, and reports that have been given out serve to stimulate confidence in the improving condition of railway securities and traffic. A pool is to be formed among the Southern railroads, and meanwhile freight rates will be firmly maintained. A large amount of railroad stock is being bought on foreign account, and offerings are liberal, and prices good. The Reading Railway troubles are still on hand, without any prospect of immediate settlement. The Pennsylvania Railroad Company is looking for a New England line that will give it a Boston terminus. Reports from twenty-three Western railroads just published show a large increase in traffic receipts, and smaller lines are gaining in business, with the prospect of holding the improvement throughout the autumn trade.

The lumber markets, both East and West, are well supplied with lumber from Western and Southern markets, and prices remain firm under the heavy building and railroad demand.

The iron trade has not improved of late, and inquiries are rather slight, especially for merchant bar, sheet, and plate iron. Crude iron is very dull, and is selling at 16, 17, and 18 dols. for forge, two and one foundry. Between three and four millions of dollars will be invested in blast furnace plants within the next twelve months. Manufactured iron is very firm, owing to the summer suspension of mills. The demand for architectural and bridge iron is sufficient to keep all mills on double turn. Steel rails are worth 35 dols.; 5000-ton contracts have been placed this week; 18·50 dols. is offered for foreign tee-rails. Bessemer pig is worth 19 dols., and in moderate demand. Very little Scotch iron is selling.

There is a general resumption of industrial activity throughout all the Western States. The textile mills are in many cases running double turn in Philadelphia, and through the State of New Jersey. There is a very urgent demand for carpetings, cloth, and all the medium grades of dry goods. Large orders have been booked within ten days for passenger, freight, and coal cars, and all the larger manufacturing companies will, by August 1st, have sufficient business to run them into October. Prices are from 5 to 10 per cent. below last year. The Pennsylvania Steel Company is turning out 1000 tons per day, and could readily double its sales if it could supply rails. The trade movement throughout the country is very strong, and encouraging indications are apparent on every hand.

The latest quotations of builders' wages in the Sydney building trades were:—Carpenters and joiners, 9s. to 11s. 6d. per day, standard price 10s. per day; stonemasons' labourers, 8s. to 9s.; plasterers, 11s.; plasterers' labourers, 9s.; bricklayers, 11s. to 12s.; bricklayers' labourers, 8s. to 9s.; painters, 9s. to 10s.; plumbers, 10s. to 10s. 6d.; gasfitters, 10s. to 10s. 6d.; sawmill hands, 9d. to 1s. per hour.

Hand v. Machine Cut Files.—An interesting series of tests in regard to machine *versus* hand-cut files has just been concluded. Out of twenty-four files tested, and which were cut on one side by machine and the other by hand, ten resulted in favour of the machine-cut sides, eight in favour of the hand cut, five were bracketted equal, one fell soft and was rejected. The result is therefore practically in favour of machine-cut files. The class of files selected were bastards, second cuts, and smooth—the three great classes of large files. The tests prove that in the smooth files hand cutting is superior. Eight specimens of each class of file were sent out; of the eight smooth files four were in favour of hand cutting, two in favour of machine cutting, one equal, and the eighth was the soft file, which was not counted. This latter result comprises the policy of many of the machine houses who cut their smooth files by hand instead of by machine. The tests are of special interest to engineering establishments.

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

(*From our own Correspondent.*)

The ironmasters' meetings in Wolverhampton yesterday, and in Birmingham this—Thursday—afternoon were influenced in their character by the prevalence of the August Bank Holidays. Many of the works did not begin the week until Tuesday night, and others not until Wednesday night, and at a few establishments the machinery will not be set going this week at all. The orders on the books do not as yet show much work ahead, since buyers continue to mostly order from hand to mouth. The aggregate of business arriving is, however, in a few departments considerable, and a better tone generally prevails. The sheet makers are receiving increased specifications alike for shipment and for country consumption, and a few works are quite busy and are prepared to engage additional hands. Strong makers quote £6 2s. 6d. to £6 5s. for sheets of 24 w.g., and £7 2s. 6d. to £7 5s. for 27 w.g. Sheets of 20 w.g. are quoted £5 17s. 6d. to £6 2s. 6d. by the same manufacturers. If prices could be got up the present condition of demand would not leave much room for complaint.

Specifications were to-day reported by the galvanisers to be arriving more briskly for corrugated sheets. The demand continues mainly on account of Australia, New Zealand, the River Plate, and some other parts of South America, in addition to country orders. Considerable Indian specifications are going about the market, but many makers allow them to pass, since the price often attached is 3s. 6d. per ton below quotations. Strong firms are quoting £9 17s. 6d. to £10 2s. 6d. for 24 gauge f.o.b. Mersey, and £10 to £10 5s. for lots of 10 tons and upwards f.o.b. Thames.

A steadily growing sale is found in this district for Bessemer, basic, and mild steel in the form of blooms, billets, tin-bars, and other partially manufactured shapes. The chief buyers are the makers of thin sheets for stamping and working-up purposes, tin-plates, merchant sheets, hoops, and small rounds. The steel is being imported particularly from South Wales and the North of England, deliveries being made, wherever possible, by sea and inland waterways. The metal generally gives every satisfaction, and enables a much more economical production, of best sheets in particular, than was formerly possible when hematite pigs had to be purchased, and the labour of the puddler employed. These importations of steel in a large measure account for the lessened business doing in hematite pigs and Staffordshire and Shropshire all-mine pigs. North of England and Welsh blooms and billets are selling at £4 7s. 6d. delivered, of 2in. sizes and above, while Staffordshire basic steel blooms and billets are quoted £4 10s. to £4 15s. per ton.

Orders for angles, tees, and other engineering sections of iron, together with plates, are still passing by local ironmasters in large numbers and are being placed in the North of England. Tank sheets, for example, are being purchased by Staffordshire brokers from Northern ironmasters at £5 5s. per ton delivered in the Thames, which is some 15s. per ton below local ironmasters' prices. Belgian ironmasters continue to find a market for their rolled iron joists in this district notwithstanding the advances in manufacture which the Northern ironmakers have made. In a building now going up in Birmingham some 150 tons of rolled joists are required, mainly of the sizes 5in. by 12in., and the people who have the work in hand anticipate being able to place the order with Belgian representatives, at something less than £5 per ton delivered Birmingham. North of England masters are at a disadvantage when soliciting the custom of Staffordshire and Midland buyers by reason of the long distance inland carriage.

Merchant sections of iron, as bars, hoops, strips, and the like, are in only moderate demand, either for export or country trade, but brighter anticipations are this week indulged. A more hopeful feeling is beginning to make itself manifest regarding the export trade, and as August and September are often two of the best months of the year for shipments, an improvement is looked for before long. Marked iron is unchanged from the quarter-day price based on £7. Second-class bars are abundant at £6, and common at £4 15s. to £5.

The continued steady revival in the United States iron trade was discussed in some circles on 'Change to-day, Thursday, as a very gratifying indication. It is conceded that American revivals are not likely to bring so much advantage to English iron and steel works as aforetime they did. Still, it is felt that to some extent our works must be directly advantaged, both by the receipt of orders from America and by some lessened competition.

The demand for native pig iron is not at present improving, and deliveries from the furnaces are being made only slowly. The importations of Midland pigs continue to take the cream of the demand. Staffordshire all-mine pigs are quoted 55s. to 57s. 6d. nominal, while Shropshire makers are freely offering their make at 50s. to 52s. 6d. Cold-blast pigs are 75s. to 80s.; common foundry, 30s. to 32s. 6d.; and part-mines, 37s. 6d. to 42s. 6d. Midland pig prices do not show much alteration. Northampton sorts are quoted on the open market 33s. to 34s. at station, and Derbyshire sorts 34s. to 35s., while Lincolnshires keep at 38s. In actual sales, however, particularly for cash against delivery, lower prices are being accepted.

Considerable sales in lots of 500 and 1000 tons are still going on in Midland pigs for speculative purposes, and buyers cannot be far "out" in their calculations. Prices must certainly rise before long. The South Staffordshire pig firm who are doing most are Messrs. A. Hickman and Son, Spring Vale Furnaces. This firm are blowing all their four furnaces, and are turning out about 6000 tons a month. They report this week that their make is going away steadily, but that an advance in prices is greatly needed.

Scrap iron is low in price, and it is difficult to do business with any margin of profit. For Welsh sheet shearings sellers ask 42s. per ton delivered here—a figure upon which buyers ask for a sensible concession.

The South Staffordshire Mines Drainage Commissioners were informed on Wednesday by Mr. Edward Terry, the mining engineer who has just carried out the splendid feat of tapping the main Bilston underground pound of water, with the result of the work up to the present. The magnificent Bradley engine is kept fully employed in pumping the water through the three bore-holes, and the effect on the pound has already become apparent in the water having sunk at some of the hitherto submerged collieries 15ft. 7in., at others 11ft., at others 9ft. 5in., and various lesser depths. The flood at the highest point the water now stands in the district is 177ft. deep, and at the lowest point the depth is 99ft. 6in. The chairman, Mr. Walter Bassano, was loud in his praises of the benefits which would accrue from the accomplishment of the work, and in his expressions of the debt of gratitude under which Mr. Terry had laid the mineowners. Mr. Terry had, he said, been entrusted with the responsibility of the most important mining engineering operation ever undertaken in this country.

The directors of the Sandwell Park Colliery Company will, at the annual meeting, recommend the payment of a dividend of 4 per cent. per annum.

The Metropolitan Railway Carriage and Wagon Company will, it is believed, declare a dividend for the past half-year at the rate of £5 per cent. per annum. Five per cent. per annum on the ordinary and 6 per cent. on the preference capital are the dividends declared by the directors of the Birmingham Railway Carriage and Wagon Company for the past half-year.

The three railway companies serving South Staffordshire—the London and North-Western, the Great Western, and the Midland—have just intimated to the Wolverhampton Chamber of Commerce that they cannot see their way to apply the recently reduced rates upon the carriage of finished iron to London and Liverpool to lots of less than ten tons. The information has this week occasioned much complaint among the Staffordshire ironmasters. The Great Western Railway also refused to make any alteration in their parcel rates. They intimate that the advisability of placing Wolverhampton within the 100 mile radius of London would be considered, but the letter containing the intelligence was thought by the Chamber to be unsatisfactory.

An intimation has been received by the Wolverhampton Chamber of Commerce from the Foreign-office that the Roumanian Government had determined to impose heavier duties on certain classes of articles, but at the same time to make a reduction on such as were imported chiefly from Great Britain. The Chamber express satisfaction at this concession, and suggest that nails, on which an increase is to be made, should be placed in the same category as screws, which are subject to a reduction.

The agitation in the chain trade has advanced to the extent of the men's resolving to come out on strike in the event of the masters declining to increase their wages. At the meeting at which this decision was arrived at the men were encouraged in their action with the statement that some of the employers are inclined to make the desired concession.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—As regards the general trade of this district there is still no improvement to report; there seems, however, to be a growing belief that prices have at last got to the lowest point, which may possibly be some indication of a turn for the better. If the fact that makers both of pig and manufactured iron have for a considerable time been selling at an actual loss can be taken as a guarantee that prices cannot get any lower, buyers who have orders to give out would of course have little hesitation in placing them, but they have so frequently found to their cost that they have been misled when apparently the lowest possible prices have tempted them into anything like speculative transactions, that an excessive cautiousness in buying beyond actual hand-to-mouth requirements has kept business down to the narrowest possible limits. That this is in any way being broken through may be taken in some sense as a more healthy sign; it is, however, not in what may be termed the ordinary run of trade that there is more doing, but outside sales of considerable weight are being made to consumers, and where users of iron have actual requirements to cover there is a disposition to buy for forward delivery rather than take further risk of the market. It is, however, only in exceptional cases that users of iron have actual requirements of such weight that they are not already covered by iron they have still to come in, and although there may be the feeling that prices are not likely to get any lower, it will require a considerable accession of new business to give any appreciable impetus to trade. That makers themselves do not view the future very hopefully may be gathered from the fact that preparations are being made for blowing out or damping down a number of furnaces in the district, but the least check in the long-continued downward current is not to be neglected or lost sight of in the present cheerless condition of trade.

The Manchester iron market on Tuesday was only moderately attended, and again brought forward only a very slow business. Apart from one or two outside transactions already referred to, there was very little doing. For the ordinary local and district brands coming into this market inquiries were very few and small in weight; whilst prices were quite as low as ever, some of the district brands being still offered by low sellers at 33s. 6d. to 34s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities delivered equal to Manchester, although for local makers of pig iron 3s., and for one or two of the district brands 2s., per ton above these figures is nominally quoted. In outside brands the firm tone maintained for warrants has little or no effect upon the price of makers' iron, which can be bought at quite as low figures as ever; and there is still a good deal of underselling, both in Scotch and Middlesborough iron.

As regards hematites, judged by the low prices which sellers in some instances are still prepared to accept, there would not seem to be much real response to the firmer tone which is so much talked of in the market, and 50s. 6d. to 51s., less $2\frac{1}{2}$, delivered here, still represents the average price for good foundry qualities where sales of any weight are made. Makers, however, in some instances are taking a decidedly less yielding attitude towards buyers; and the considerably reduced output, coupled with the increased shipments during the present year, can scarcely fail to have a stiffening effect upon the market.

In the manufactured iron trade, so far as inland requirements are concerned, there is no real improvement to report, and the slightly increased shipping business doing in hoops and sheets has not resulted in any better prices being obtainable, the basis of quoted rates for delivery equal to Manchester remaining at about £4 17s. 6d. for bars, £5 7s. 6d. for hoops, and about £6 10s. per ton for sheets, plates are in firm demand for bridge and girder work, but prices are cut up by the excessively low figures at which North makes are offered in the market, ordinary crown Middlesbrough plates being delivered here at under £5 per ton.

In the general condition of the engineering trades there is still no improvement to report. Perhaps where there are orders to give out there is not quite so much hesitation in placing them, as prices are cast so excessively low that further holding back could scarcely result in any more favourable terms being obtained; but the weight of work coming forward continues very small, and it is only here and there that works can be said to be at all well employed.

Messrs. Goodbrand and Holland, of Manchester, have just completed an improved continuous speed indicator, which has been patented by Mr. Norman Macbeth, of Bolton. The object of this apparatus is to record automatically the variation of speed and the stopping and startings of steam engines or machines in which revolving shafts are used. One special feature of this recorder is that provision is made for multiplying the variations of the ordinary pencil drawing on the diagram in the case of very steady running engines, or for diminishing in the case of engines which run very steadily. In ordinary use the rise or fall of the pencil drawing on the diagram is approximately one-sixteenth of an inch for a variation of 1 per cent. of the speed that the engine or shaft should be running, and the recorder is arranged to take the place of an ordinary engine-house clock, where it can be fixed under lock and key, so that it cannot be tampered with by the attendant.

At the annual meeting of the Iron Trades Employers' Association, held at Liverpool, in addition to the adoption of the annual report, of which a summary was given last week, the further business transacted included the election of the following gentlemen as the General Committee of Management for the year 1886-7: Messrs. C. J. Copeland, Barrow-in-Furness; J. Farrar, Barnsley; J. Cole, Bradford; J. L. Stothert, Bristol; J. Wade, Halifax; G. W. Tomlinson, Huddersfield; P. D. Holmes and A. E. Seaton, Hull; R. L. Hattersley, Keighley, J. Craven, D. Greig, and E. J. H. Kitson, Leeds; E. Death, Leicester; A. Bowker, J. Laird, and H. Shield, Liverpool and Birkenhead; J. Field, C. N. Moberley, and G. Waller, London; B. A. Dobson, R. Peacock, M.P., and H. Wren, Manchester; W. Boyd, J. Price, and Percy Westmacott, Newcastle-on-Tyne; J. Cropper, Nottingham; Geo. Clark, J. Dickenson, and J. H. Irwin, Sunderland; and G. Rhodes, Wakefield. On the motion of the president, Mr. C. D. Holmes, seconded by Mr. W. Boyd, of Newcastle-on-Tyne, the following resolution was also passed unanimously:—"That the best thanks of the members of this Association be given to Mr. John Robinson for the pains taken by him in preparing and giving evidence, on behalf of its members, before the Select Committee appointed by the Legislature during the past session to inquire into the operation of the Employers' Liability Act, 1880; and for his continued labours in regard to the important question of securing an Act of Parliament for amending and making clear the existing law in regard to the rating of machinery used for industrial purposes; and that it is the earnest hope of this meeting that he may long continue his important services in the interests of the Association, and of the employers in the iron and engineering trades of the country generally."

In the condition of the coal trade of this district there is still little or no change to report. For all descriptions of fuel the demand continues extremely dull, and with pits not working more than an average of three to four days a week, supplies are considerably in excess of requirements. Pit prices remain at about 8s. to 8s. 6d. per ton for best coals, 6s. 6d. to 7s. for seconds, 4s. 9d. to 5s. 3d. for common coals, 4s. 3d. to 4s. 9d. for burgy, 3s. 9d. to 4s. 3d. best slack, and 2s. 6d. to 3s. for common sorts; but although colliery proprietors are steady in maintaining their quoted rates, it can scarcely be said the market is so firm that buyers who are in a position to give out orders in anything like quantities for prompt delivery are unable to obtain concessions.

Two powerful steam fire engines have been built by Messrs. Merryweather and Sons, of London, for the Manchester Corporation fire brigade. These engines are a modification of the well-known Greenwich pattern, in which several improvements have been introduced, and they may be said to be of the newest type. One special feature of the engines is their lightness of construction, the loaded weight being only 58 cwt., and between the two engines there is only a difference of 14 lb. in weight. Each engine is capable of delivering 750 gallons per minute, and in a series of trials which they were put through in the Albert-square opposite the Town Hall to test the height and distance to which a stream of water could be thrown, very satisfactory results were obtained. It required eleven minutes after lighting the fires to get steam up to the working pressure of 100 lb. to the square inch, and under the direction of Mr. Superintendent Tozer experiments as to distances were then made. The results obtained from each engine were as pretty near equal as possible, but a strong breeze which was blowing caused a loss of quite 25 per cent. when the jets had to be worked against the wind. The greatest distance the water was projected in a horizontal line with the wind was 200ft., and against the wind 150ft. This was through a $1\frac{3}{8}$in. coupled jet receiving a supply simultaneously from two hose pipes. From the No. 1 engine the water from two $\frac{3}{4}$in. jets was thrown horizontally, a distance of 118ft.; four $\frac{3}{4}$in. jets, 108ft.; one $1\frac{3}{8}$in. jet, 200ft.; one $1\frac{1}{2}$in. jet, 184ft. No. 2 engine, two $\frac{3}{4}$in. jets, 116ft.; four $\frac{3}{4}$in. jets, 120ft.; one $1\frac{3}{8}$in. jet, 150ft.; one $1\frac{1}{2}$in. jet, 159ft. The difference in some of the results is accounted for by the fact that there was blowing at the time a high wind, which interfered materially with all the tests that were made. To gauge what height the water would reach, hose pipes had been attached to the front of the Town Hall, as far as the platform over the clock; and from this point the water, by the force generated by the engine below, was discharged from a hose on the platform above the clock to within a few feet of the ball on the top of the tower, a total height from the ground of over 286ft. The general opinion was that the engines—which, I may add, have been built from drawings executed in the Surveyor's Office of the Water Department—were a great improvement on the old pattern, being easier to start, more powerful, and more under control.

Barrow.—There is a steady but quiet trade in hematite qualities of pig iron, and the business done in the earlier part of this week was restricted, owing to the observance of Bank Holiday and the temporary cessation of communication between buyers and sellers. As a matter of fact, however, brief lulls in the demand do not materially influence the trade of the district, industrially speaking, because sales are always made well forward, and makers have generally two to three months' contracts booked forward. There is not much trade in forge or foundry iron, but a large consumption of Bessemer steel is noticed, and as the causes of this demand are likely to be maintained, so is the make of this kind of iron likely to be kept up to the present rate of production which at present may be noted at three-fifths of the actual capabilities of the district. From the Cumberland district reports are to hand of a very dull and very unsatisfactory condition of affairs, particularly in the iron ore trade. Many mines have been closed and others are only being partially worked. Employment is therefore scarce, and a large number of miners has emigrated to America and elsewhere. The condition of things which affects the iron ore trade, also influences for the worse the pig iron trade generally. The output is very poor, and makers have not so many orders on hand as was the case some time ago. The condition of affairs industrially and commercially in Furness is dull and depressed, but not to so marked an extent as in Cumberland, and there is a larger per cent. of furnaces in blast, and a consequent greater proportionate output. There is no overlooking the fact, however, that the stocks of iron in hand at some of the works in the district are very heavy, but in other cases large producers have practically no stocks at all, and it is noteworthy that where stocks are fewest the largest orders for forward delivery are held. Prices remain steady at 41s. 6d. to 42s. 6d. per ton net at makers' works for prompt delivery. There is a poor trade in steel except in heavy goods, and makers are not so well off for orders in this respect as they have been. There is also a quiet trade in the lighter articles of steel produced in the district. The shipbuilding trade is also extremely dull, and builders have fewer orders in hand than at any previous time. Engineers are busy on marine work, but not many new orders are coming in. The iron ore trade is quiet. Coal and coke steady. The Barrow Tramways have now been completely opened; the section to Ramsden Dock station over the new High Level Bridge was last week inspected and passed by Inspector Hutchinson. There are now about eight miles of tramways open in the borough, and six steam tram cars are running at intervals of about twenty minutes in all directions along the principal thoroughfares.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The severity of the competition in the rail trade may be judged from the fact that a well-known local firm recently tendered for a considerable contract, and being desirous of obtaining it, put their figures at cost price exactly. Though they did not leave themselves one farthing of profit, they were informed that their quotation was 15s. per ton above the market. At these rates inland production of steel rails becomes impracticable. Several firms on the coast find the struggle for work so keen they can scarcely obtain orders to keep their men anything like fairly employed. It looks as if we were rapidly nearing a time when people who want steel rails will not go through the formality of soliciting tenders, but simply send on their work with the price attached. That is to say, they will dictate terms to the makers.

The wagon companies, which are now issuing their reports, appear to have had a better half-year than was anticipated.

The Cutlers' Company has elected as its Master Cutler for their forthcoming year, which commences on the first Tuesday in September—the traditional date of the Cutler's Feast—Mr. George Francis Lockwood, of the firm of Messrs. Lockwood Brothers, steel manufacturers, Arundel-street; Mr. James Dixon, silver plate manufacturer, Cornish Works, was elected Senior Warden; and Mr. Frank Mappin, J.P., steel and file manufacturer, of Messrs. Thomas Turton and Sons, Limited, Sheaf Works, Junior Warden. Five new members have been added to the company—Mr. Burridge, J.P., Mr. Alexander Wilson, J.P., Mr. John Marshall, Mr. Wm. Lockwood, and Mr. J. C. Wing.

The Midland Institute of Mining Engineers met at their offices, Barnsley, last week, when the following appointments were made:—President, Mr. A. M. Chambers, J.P.; vice-presidents, Mr. C. E. Rhodes, Mr. W. E. Garforth, Mr. G. J. Kell; council, Mr. J. Gerrard, Mr. E. Bainbridge, Mr. G. B. Walker, Mr. J. F. Thompson, Mr. J. Nevin, Mr. A. B. Southall, Mr. C. E. Jeffcock, and Mr. A. Lupton; Mr. Joseph Mitchell was re-elected treasurer and secretary. At the dinner, which followed the meeting, the Master Cutler of Sheffield—Mr. Charles Belk—proposed the toast of "The Institute." He pointed out that the mining engineer was the husbandman below the surface. His skill was brought to bear to ameliorate the condition of the thousands whose lives were spent in an occupation that contained in itself many elements of danger, and to enable them to cope with the constantly changing means by which the mining industries of this country were carried on. After all, commerce was a sheet anchor to this country, and in looking to commerce they must look largely to coal and iron.

The Yorkshire Agricultural Society is holding its forty-eighth annual meeting at Sheffield this week, when the largest amount ever offered in prizes—£2260—is being competed for. The implements and machinery-in-motion are exhibited by 163 firms, a total which has only been once eclipsed—at Leeds in 1879, when the exhibitors numbered 209. Among the exhibitors, Messrs. Newton, Chambers, and Co., of the Thorncliffe Ironworks, have a stand 150ft. long, displaying no fewer than 348 of their specialities, with a particularly interesting and comprehensive selection of appliances for cooking. The show promises to be a great financial success; greater even then in 1874, when the Society last visited Sheffield. Then the attendance "beat the record," and has never been reached by any other town.

Mr. F. T. Mappin, M.P., who has had a baronetcy conferred upon him by the Queen, is one of our most respected townspeople and clear-headed business men. He is the head of the firm of Messrs. Thomas Turton and Sons, Sheaf Works, steel file and spring works. He has been Mayor and Master-Cutler of Sheffield, and is now a member of the Town Trust, a burgh and West Riding magistrate, a director of the Midland Railway Company and of the Bridgwater Navigation Company, and chairman of the Sheffield Gas Company. He has largely contributed to many local institutions of Sheffield and district.

Messrs. Joseph Rodgers and Sons, the well-known cutlery manufacturers of Sheffield, have just succeeded in tracing and stopping another infringement of their trade mark. The action was against a Ballarat firm, "to restrain the defendants from infringing the plaintiffs' trade mark and name, and from selling any cutlery other than the plaintiffs' having any words resembling the plaintiffs' trade name or trade mark stamped thereon, or having the words, 'Joseph Rodgers and Co.' or 'Joseph Rogers and Co., Sheffield,' stamped thereon; and also for delivery to the plaintiffs of all cutlery in the defendant's possession so stamped." The plaintiffs also asked for the delivery to them of the invoices of these, and an account of the profits made by the infringement of the plaintiff trade name or trade mark, together with the names of the persons from whom the cutlery had been purchased and to whom it had been sold. After the writ had been issued the defendants consented to a judgment being entered against them, and to pay the plaintiffs' costs as between solicitor and client. Application was made that judgment should be entered for the plaintiffs on this consent with costs, in accordance with the claim of the plaintiffs. The defendants had stated that they obtained the goods from a firm in Melbourne. His honour directed judgment to be entered for the plaintiffs in accordance with the terms of the consent.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was but a poor attendance at the iron market held at Middlesbrough on Tuesday last, and little business was done. It cannot be said, however, that things were worse than on the previous Tuesday. Sellers are not pressing iron on the market to the same extent that they lately were, and prices are fairly well maintained. Merchants continue to ask 29s. 3d. per ton for No. 3 g.m.b., for delivery to the end of the present month. Some consumers are prepared to pay that figure, but the majority do not offer more than 29s. 1½d., and a few will not entertain anything higher than 29s. per ton. The quotation usually given by makers is 29s. 6d. per ton for No. 3, but there are two or three firms who are willing to take 3d. per ton less for small lots. The stocks of forge iron are very heavy, and will probably increase materially by the end of the month, as the approaching Stockton races will certainly interfere with the consumption at the finished ironworks. The current price is 28s. 3d. per ton, but some sales have been made at 28s.

There are no transactions to report in warrants. Their value is nominally 29s. 6d. per ton.

The stock of Cleveland pig iron held by Messrs. Connal and Co. on July 31st was 272,552 tons, being an increase for the month of 15,933 tons. At Glasgow on the same date there was 796,727 tons, being an increase of 15,654 tons.

The finished iron trade seems to be gradually getting worse, both as regards volume and price. Makers quote £4 7s. 6d. for ship-plates, £4 10s. for common bars, and £4 5s. for angle iron, all free on trucks at makers' works, less 2½ per cent. discount; but good specifications can sometimes be placed at even lower rates.

The shipping returns for July have just been issued. They show that 60,831 tons of pig iron left the Tees in July as against 63,916 tons in June, and 67,413 in July, 1885. The principal items were as follows:—To Scotland, 23,080 tons; to Germany, 8041 tons; to Wales, 5035 tons; to France, 4670 tons; to Russia, 4375 tons; to Holland, 3120 tons; to Newcastle, 2330 tons; and to Sweden and Norway, 2845 tons. The manufactured iron and steel shipped amounted to 33,545 tons, as against 34,386 tons during June. The chief customers were India, which took 11,542 tons; Argentine Republic, 2681 tons; Wales, 1955 tons; and Italy, 1874 tons.

The accountants to the Durham Coalowners' Association have issued their certificates for the months of April, May, and June. The net average selling price of coal appears to have been 4s. 4·79d. per ton. The existing rate of wages will not be altered thereby.

The North-Eastern Railway Company has just issued its annual report. The dividend announced, which is only at the rate of 4½ per cent., is disappointing.

Another instance of the futility of artificial combinations of producers and distributors to force more for their services out of the public than they can obtain according to the natural law of supply and demand, has just been afforded by the failure of the combination to maintain shipping freights for Baltic ports. A meeting of shipowners was held on the 31st ult. at the Three Indian Kings Hotel, Newcastle on-Tyne, at which Mr. George Renwick presided. Mr. McCarthy moved, "That the combination hitherto existing should now be abolished." The chairman seconded the motion, saying that there was no doubt that the attempt that they had made had been utterly unsuccessful. He attributed this to failure to act up to the general understanding by several owners who had signed it. Only that morning he had learned that two of them had agreed with a merchant for a rate of freight which they had attempted to keep secret, but which on being divulged was found not to be in accordance with the arrangement. He considered that to sign an agreement and then break it was not what was to be expected from honourable men, and it was useless to attempt to maintain a combination composed of other elements. The resolution, on being put to the meeting, was carried unanimously. Only seven gentlemen, including the chairman, were present, and therefore it is pretty clear that anything like cohesion among the members of the combination was, as usual, conspicuous by its absence.

The trade in Cumberland hematite ore seems to be extremely depressed at the present time. In the Cleator Moor, Frizington, and Egremont districts a more complete stagnation prevails than has ever been previously known. The Carron Iron Company has given a fortnight's notice to its men to terminate their engagements. The Crossfield Iron Company is working only half time, and the mines of Mr. Stirling, which are amongst the most extensive in the district, are about to be put on short time. The Eskett mines have been closed, and those belonging to Messrs. C. Cammell and Co. have also ceased working, a large number of men being thrown out of work at this mine alone. Inasmuch as the hematite pig iron and steel trades which utilise these ores are not so depressed as the iron trade, it would seem that this adversity which has befallen the hematite ore trade is not so much due to the lack of demand as to the competition of Spanish ore, large quantities of which are now being imported. On equal terms, Cumberland ore being somewhat richer and equally pure, ought certainly to gain a preference over Spanish ore. But the terms are not equal. The wages in Cumberland are much higher, and the hours of working much shorter, than in the north of Spain. Again, the railway carriage is dearer per ton per mile in Cumberland than in Spain, and finally, the royalties are preposterously high. Consequently, notwithstanding the cost of sea freight, Spanish ore appears now able to compete successfully with Cumberland ore on its own ground. Of course, the only thing to do is to let the mines stand until the three above-named elements of cost come down to the Spanish level. It is strange that the parties interested should be so foolish as to resist the inevitable until they are starved into it; yet that is the process which seems to have commenced in Cumberland, and to be likely to go on to the end.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE tone of the Scotch pig iron market this week has been rather less satisfactory. Business was suspended on Monday in the iron exchange in consequence of the Bank Holiday; and although the market resumed at steady rates, there has only been a small business, and the quotations have since evinced a tendency to give way. The amount of the past week's shipments, while about equal to the average of what has been usual this season, was rather disappointing, as there was some expectations that they might now take a decided start. They were 7510 tons as compared with 11,120 tons in the preceding week, and 7598 tons in the corresponding week of 1885. The demand is reported to be somewhat more brisk for America, but the impression is that the extended requirements there will be met with hematite rather than with ordinary pig iron. For hematite pigs there has indeed been an improved inquiry, and the prices have exhibited a slight improvement in the course of the past week. Stocks of ordinary pigs are still on the increase, and the week's addition to the quantities in Messrs. Connal and Co's Glasgow stores amounts to 3500 tons. There are eighty-five furnaces in blast in Scotland, as compared with ninety-two at the same date last year.

Business was done in the warrant market on Friday at 39s. 1½d. cash. There was no market on Monday. On Tuesday forenoon transactions occurred at 39s. 1½d. to 39s. 2d., and 39s. 1½d. cash; the afternoon prices being 39s. 1d. to 39s. ½d. cash. Business was done on Wednesday from 39s. 2d. to 39s. ½d. cash. To-day—Thursday—the market was flat at 39s. 2d. to 39s. 1½d. cash, the latter being the closing quotation.

The values of the special brand of makers' pig iron are not quite so firm as they were a week ago. Indeed, merchants are prepared to sell at easier rates. Free on board at Glasgow, Gartsherrie, No. 1, is quoted at 43s. per ton; No. 3, 40s. 6d.; Coltness, 46s. and 42s. 6d.; Langloan, 42s. 6d. and 41s.; Summerlee, 45s. and 41s.; Calder, 45s. 6d. and 40s. 6d.; Carnbroe, 40s. 6d. and 39s.; Clyde, 42s. 6d. and 39s. 6d.; Monkland, 40s. and 36s.; Govan, at Broomielaw, 40s. and 36s.; Shotts, at Leith, 43s. 6d. and 43s.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 42s. and 39s.; Eglinton, 39s. 6d. and 36s.; Dalmellington, 40s. and 37s. 6d.

The malleable iron trade continues in a depressed condition, only some of the works having sufficient orders to keep them fully employed. In the steel trade there is rather more doing, but certain masters complain of a scarcity of fresh orders.

In the past month there was launched from Clyde shipyards eighteen vessels with an aggregate tonnage of 17,700 tons, against 10,210 tons in July, 1885. For the seven months the tonnage put into the water has been 100,298, as compared with 108,635 tons in the corresponding period of last year. The number of vessels now on the stocks is 59, with an estimated gross tonnage of 95,000, compared with 67 vessels of 110,000 tons at the end of July, 1885.

There has been a good demand for coals for shipment in the past week, and owing to the frequent idle days of the colliers, and the wages agitation, merchants have occasionally found it difficult to get their orders implemented, and coalmasters have been holding for firmer rates, although no general advance in prices has been established. The past week's shipments of coals embraced 25,026 tons at Glasgow, 2158 at Greenock, 2440 at Irvine, 4251 at Troon, 2866 at Leith, 11,687 at Grangemouth, and 20,000 tons at Burntisland.

The miners of the East and West of Scotland, particularly the latter, have been in a state of ferment since last report. The men have been thoroughly aroused by the reduction of 6d. per day in their wages which was carried out last month, and many years have passed since their meetings were so largely attended or the men appeared so determined in their opposition. In the Lanarkshire colliery districts they have made a demand for an increase of 1s. a day, and they are doing everything in their power to bring pressure to bear upon the masters. Were the colliers possessed of union funds and able to hold out for a little time, it is now believed that they would succeed in their purpose. As it is, they are ill circumstanced for a strike. But in many places they resolutely adhering to the reduced output, which they have been taught to regard as a means of bettering their position. Its only effect hitherto has been to send orders to the Tyne and elsewhere which might have been dealt with at Scotch ports but for a scarcity of supplies.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

A MOVEMENT is on foot to start a Boiler Insurance Society for Wales, and judging from the promoters, all men of considerable influence, it promises well. Of course, this would affect existing insurance companies materially, as most boilers are insured.

A leading engineer connected with an important foundry states that an effort will be made to foster engine and boiler work in the principality in opposition to Leeds and Manchester. The finest steel is being made in Wales, the best ship plates at Landore, and excellent engines and general work at Treherbert Foundry and at Newport. Now he says the idea is to go on the line of barter. "We undertake supplying collieries with boilers, engines, repairing shafts, &c., and do so more expeditiously, being on the spot, and we take a considerable percentage in coal."

It is evident that "hard times" are awakening the faculties; utilisation is the order of the day, and is shown everywhere in the neighbourhood of the great steel works. The only places where it is less visible is at collieries. Probably the serious straits now overtaking the Welsh coal trade will prompt to coke ovens and bi-products, colours, and saccharine.

I visited a large part of the iron and coal district a few days ago, including Swansea. The contrast between Cardiff and Swansea was forcibly shown. Cardiff is almost dependent upon its steam coal trade, and that last week fell to 100,000 tons. Swansea, on the other hand, is favoured with a crowd of industries. No less than thirteen metals are turned out there, and its copper works are usually busy. Landore, with its famous Siemens steel plates, is active, the tin-plate trade is brisk, patent fuel improving. Even in coal shipments the Swansea total last week was close upon 30,000 tons.

The tin-plate business is fairly maintained, and prices for best brands are the same as last week. I note, however, that inferiors are not quite so firm. Common cokes in some cases have been sold as low as 13s. 4½d., but a good brand still fetches 14s., though I hear of quotations at 13s. 9d. The healthy character of the trade is shown by the preparations making to start some of the stopped works, such as Kidwelly, which was announced last week as getting ready.

Bessemer steels are the most in demand; coke wasters fetch 12s. 6d. Shipments last week to America alone amounted to 7000 tons. The quantity brought from works consisted of 40,000 boxes, and the stocks were reduced fully 7000 tons. In the face of this, rumours are afloat that prices must go lower. If so, it is contrary to the notions of Jeremy Bentham. Slackness in make this week is due to Bank Holiday.

The coal trade generally is quiet, and but for the certain loss that would accrue from closing a colliery a number would follow the example at Deep Duffryn, which is all but closed. Deep Duffryn was one of the first collieries taken by Mr. Nixon, and where most of his inventive faculty has been brought into operation. It has been carried on with remarkable immunity from disaster, and has been one of the great feeders of navy coal for a quarter of a century.

I hear that the Albion, the latest new colliery, has struck a good seam.

At Harris's Navigation, 6000 tons per week are now being worked. One day last week 1300 tons came to bank. These are the bright lights amidst gloom, for, generally speaking, the coal trade could scarcely be worse.

On Tuesday an explosion occurred in a Norwegian barque at Cardiff loading Dowlais coal for Buenos Ayres. Several men were burnt, but the vessel was not much injured. It is attributed to a sailor having brought a candle light in contact with gas in the hold. An explosion in one of the Dowlais collieries also occurred this week, injuring several men.

The steel works are quieter than one likes to see. Swansea sent away 240 tons steel plates coastwise, and from the rail works of Glamorganshire and those supplying Newport some consignments to Natal, Gothenberg, and Warberg, amounting to 2000 tons, complete the total.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE market for iron continues in an unsatisfactory condition in all districts. There are twenty-seven furnaces still in blast in Upper Silesia. Since the smaller works have had to succumb a struggle for the survival of the fittest has sprung up between the well-funded works; but let this end how it may, the victors even must pay heavily for it. Only one or two rolling mills are working to a profit at all, but they still keep in activity to work up the few orders they do receive. Plates command the best sale. Forge pig costs M. 41 to 42; bars, M. 92·5 to 95; plates, M. 135 to 145 p.m.t. at works. The boiler, bridge, and roof builders are pretty well engaged, and foundries have momentarily plenty of work on hand at low prices. In Rheinland-Westphalia business is not so good as in Silesia, and prices remain nominally as last quoted. The number of works which can show any profit on their output is becoming every week less and less. 500 men were discharged last week from one works at Dortmund, 300 from the "Union" Iron and Steel Works, and 200 from another, which has entirely come to grief. If this state of things goes on this next half-year as it did the last, numbers more works will have to give up the struggle than was then the case. When mortgages are foreclosed, or otherwise more funds are required, it is exceedingly difficult to raise them, as the public are not disposed to risk their money a second time. Ores are difficult of sale. Pig iron only changes hands in a hand-to-mouth fashion. Bars the same, and only plates seem to be slightly in the ascendant, and therefore maintain their price better than other sorts. Thin sheets are in no great request. Wire rods are in a depressed state, as the export becomes smaller and smaller in volume. The steelworks complain loudly, and as the Belgian Convention has come to an end there will now be this as well as the English competition to contend with—that is to say, if foreigners are to be allowed to compete here in the future, for the question has been asked in some quarters whether the Railway Minister will ratify the tender of the Darlington Company for the 600 tons of rails at Altona. There is no better outlook for the wagon or machine works to report. The Railway Administration has again reduced the freight and charges on ores from the mines to the works, and on coal and coke to the iron mines, in the interest of the mine-owners. This is very acceptable to the latter, no doubt; but as the railways have not yet paid the guaranteed dividend promised when the State took them over, some one will have to make up the difference, and pay for this preference shown to the mining interest, and, as usual, it can only be the ever-suffering general taxpayer. The proposition to revive the coal combination again for five years, from January, 1887, has fallen through. Zinc is pretty firm at Breslau; coke, M. 278 to 280, according to brand; sheets, M. 340 to 345 for thick, for thinner M. 5 to 10 higher; oxide, M. 320 to 345 p.m.t., according to quality. The news from France is encouraging, for prices have gone up, and keep up, too. Building girders are now 140f., without disposition to sell at the figure, as it is expected they will shortly rise to 150f. Bars stand at 130f. on the average, and shortly it is hoped to form a combination of the whole of the rolling-mill masters in the country. It looks as if the Belgian convention had seen its last days. Complaints are rife of some of the works having broken faith and sold under the statutory price, as they could not withstand the German competition. The Cockerill Company has launched out into South Russia, where it proposes erecting steel works at Kamerstoi, and a shipbuilding yard at Nikolajeft. The six groups of blast furnaces, Rheinland-Westphalia, Silesia, Saxony, Province of Saxony, Brandenburg-Hannover-Brunswick, Bavaria-Wurtemberg-Luxemburg, Hessia-Nassau, Saar-District-Lorraine, produced, according to official returns, in the month of April, 1886, 289,421 m.t., divided as follows:—Rheinl.-Westph., 34 works, 61,573 t.; Silesia, 12 w., 24,161 t.; Saxony, 2 w., 31 t.; Province Saxony, 1 w., 370 t.; Bavaria, &c., 9 w., 17,552 t.; Saar and Lorraine, 6 w., 33,612 t.; together, 64 w., 137,299 t. of forge pig and spiegeleisen. Province Saxony, &c., 12 w., 33,141 t.; Silesia, 2 w., 2355 t.; Saxony, 1 w., 900 t.; Bavaria, &c., 1 w., 1700 t.; together, 16 w., 38,096 t. of Bessemer pig. Rheinl.-Westph., 9 w., 40,072 t.; Silesia, 3 w., 3105 t.; Province Saxony, 1 w., 8147 t.; Bavaria, &c., 2 w., 12,569 t.; Saar, &c., 3 w., 14,621 t.; together, 18 w., 78,514 t. basic pig. Rheinl-Westph., 10 w., 11,866 t.; Silesia, 9 w., 3460 t.; Saxony, 2 w., 436 t.; Province Saxony, 1 w., 850 t.; Bavaria, &c., 9 w., 12,842 t.; Saar district, &c., 3 w., 6088 t.; together, 35,512 t. of foundry pig and castings from the blast furnace. 1800 tons metric have to be added to the 289,421 as estimated, for returns not sent in up to date, making 291,221 t. for the month. In the second quarter of this year there were raised in the Westphalian basin 6,487,431 t. of coal, against 6,721,355 t. in the same quarter last year, or 3·4 per cent. less for this year. In the same quarter of this year 98,553 persons were employed in the mines, against 101,156 in the corresponding quarter of last year.

Since the new line of steamers has been opened hence to the East, and two or three sea-going vessels have been ordered in the North of Germany, the press has never ceased to remind its readers what alarm this great development of commerce is causing in shipowning and shipbuilding circles in England, because of its being likely to militate against their interests. On perusing these announcements, to one acquainted with the actual situation, three things come up in his mind for reflection. Firstly, he asks himself where this great increase of goods to be carried is to come from, and what is to be its character? Secondly, he remarks that England surely must have wasted her many millions, and cannot require her wet and dry docks, warehouses, staithes, cranes, and all the other arrangements to facilitate her commerce, if, thirdly, Germany is going to carry on all this talked-of expansion of trade without such accommodation, which she certainly does not at present possess. It would therefore appear that, for the present at least, the parties concerned in England need be under no such great fear as is here represented.

THE ENGINEERING TRADES' REPORT.

The following is from the half-yearly report of Messrs. Matheson and Grant:—"General depression and low prices continue to prevail in almost all the manufacturing trades, and this at a time when money is abundant and capitalists are seeking investment. The great fall in values is attributed to various causes, especially to the scarcity of gold and the demonitisation of silver, causing and acting upon a superabundance and consequent low prices of all kinds of produce. To engineers, and trades depending on them, progress is essential, for the mere replacement of the wear and tear of the world does not provide sufficient employment, and new enterprises are necessary. Fortunately there is hardly any kind of undertaking in which money can be invested that does not, directly or indirectly, require the aid of the mechanical trades, and as capital cannot be kept idle, a revival will not much longer be postponed. There are already signs of improvement in the greater courage of investors, which may be expected to take effect when the present political crisis is over, and the latest Board of Trade returns show an appreciable advance. In the protectionist countries of the Continent there are the same complaints as in Great Britain, and in many cases without the same alleviations. In Germany there is the severest competition, production is being curtailed, and manufacturing companies are ceasing to pay dividends. In France the condition of affairs is even worse, for while the long hours and low wages of the workmen allow no scope for saving in the cost of labour as is possible here, the high prices of all necessaries of life, caused by protective and *octroi* duties, render the workmen miserable and discontented. In the United States some of the staple trades, notably those connected with railway material, have slightly improved, but the peculiar tariff arrangements of the country almost entirely prevent an export trade, and consequently retard the development of manufactures which would otherwise take place.

"*Coal* of all kinds, both for metallurgical and steam purposes, has fallen in value, but with the present rates of royalties and wages, further reduction seems impossible.

"*Iron.*—The continued fall in the prices of iron can only be remedied by the voluntary or forced reduction of output, but no common agreement or equitable system of doing this seems possible. The stocks of pig iron continue to increase both at Middlesbrough and Glasgow, and a financial collapse of some of the holders may be looked for. The fall in the value of rolled iron is greater than the saving in cost by the cheapness of materials and wages, although in the latter respect the sliding scale arrangement admits of an adjustment wanting in other trades. In the desire to bring expenditure into accord with current prices, there is a falling off of quality in some of the cheaper kinds of iron which cannot but cause harm in the foreign markets of this country.

"*Steel.*—Amidst the further general fall in values during the last six months, steel has moved faster than iron, and the due proportion between the two is not yet established. The combination among the English and the continental rail makers, which last year prevented prices falling below £4 10s. per ton, came to an end early in the spring, and at a few of the best situated works, with the latest appliances, steel rails have been sold at less than £4 per ton. As the present rates, with freight and duty added, only exceed the United States current prices by about one dollar, a resumption of shipments to America is not improbable, especially as the rail mills there are well employed at firm prices. The output of steel plates and bars has been considerable, the falling off in shipbuilding having been met more largely than heretofore by the increasing demand for bridges. The producing capacity is, however, still in excess, and the keen competition confirms the fact that the cost of production is primarily governed by the advantages arising from geographical position. Cumberland, Algeria, Spain, and Elba are practically the only sources of supply for the non-phosphoric hematites suitable for Bessemer steel, and the prices of these ores at English works near the ports of arrival are so low as to reduce greatly the advantages which the basic process promised to afford for utilising ordinary English ores. Mild steel, equal to a strain of 26 tons per inch, as made by the basic plan, is trustworthy, and admirably suited for boilers and other purposes; but where harder qualities equal to strains above 28 tons are preferred for ships and bridges, the ordinary Bessemer steel has the advantage. The manufacture of steel in Spain and Italy is extending.

"*Steel and iron shipbuilding.*—The statistics of this trade show a tonnage launched during the last twelve months less than half that of 1883, with a corresponding effect on the many subsidiary trades, but there is no branch of engineering in which this country is better prepared to maintain its supremacy, and a slight improvement in freights, which will come as the prices of produce improve, will cause an increased demand for steamers as well as for the large steel and iron sailing vessels which are remunerative in certain trades. The builders of torpedo boats have been very busy, and the naval armaments of this and other nations are likely to afford increased employment to private builders here.

"*Steel and iron bridges.*—There has been no curtailment in the quantity of work produced, but with the growing facilities of manufacture, a given tonnage occupies less time than formerly, and competition has brought down prices lower even than the cheapness of material and fuel would justify. The low price of steel and the advantages it affords, both in manufacture and strength, are rapidly increasing its adoption instead of iron, for though at present it is only in bridges over 100ft. span that the saving in weight allows a total cost as low in steel as in iron, yet even for small steel spans of equal weight to iron, an extra expense of five to seven per cent. is well bestowed to obtain thirty per cent. greater strength. At home there is a paucity of new railways and other public works, but bridges, roofs and buildings for maintaining, widening, and extending existing lines are affording considerable employment. For export the best customers for this branch of engineering are India, the Colonies, and South America. In Australia the encouragement by protective duties of local bridge making is still popular, but for some time to come this will still allow the importation by local contractors of partly finished work, rather than the complete manufacture in the Colony. American bridge builders who are not now busy at home, are competing in Canada and Australia by buying bridges cheaply here and utilising their experience as erectors, to contract cheaply for the work completely erected on the site.

"Mechanical engineers and ironfounders are not very busy, but there are numerous exceptions among the makers of specialities. To compensate for the dulness in the railway, shipbuilding, chemical and agricultural trades, makers of arsenal plant have been well employed; there is a considerable development in mining enterprise; there are important improvements in ice-making and refrigerating apparatus; and the modern systems of milling machinery introduced in Germany and America are receiving more attention here. This country still takes the lead in the designing and manufacture of machine tools and metallurgical plant, in both of which ingenious novelties are continually being brought out, and these, besides the usual export to markets open to Great Britain, continue to be sent also to continental countries and the United States, where high protective duties shut out general manufactures. The treatment of mineral oils, and the use of such oils and gases for fuel and other purposes, are greatly extending and are likely to develope new industries. Wrought-iron lap-welded tubes of large diameter, hitherto more generally used in America than here, are being extensively made for oil pipe lines, and will probably be required in larger quantities for the oil mining districts opening up in various parts of the world. Electric lighting, improved and simplified by experience, is taking its proper place, and under fairer legislative regulations than formerly, will command more capital and afford employment to numerous mechanical trades.

"*Locomotives and rolling stock.*—Locomotive makers, who during the last few years have escaped the extreme depression of the other trades, but who are now completing the contracts given out during the last year, seem, in the scant prospects of new work, to be approaching the worst condition of 1879, which was then only relieved by the stoppage of some of the factories. The regular maintenance of the Indian and Colonial railways, and what is ordered for the home lines, do not together afford employment for all the factories in Great Britain, and when, as at present, there is a lull in the demand for new or extended railways, the lessened output tells severely on the possible balance of profit for the manufacturer. On the Continent there is the same condition of affairs, and some of the works are closing for want of orders. The leading firms of carriage and wagon builders have been fairly busy during the last year, though at moderate prices, but the lessened orders from abroad, the growing tendency of the English railway companies to make their own rolling stock, and the competition of these same railways in keeping up the rates of wages, together tell severely on the private firms.

"*Agricultural engineers.*—Manufacturers who are entirely dependent on this one branch of trade complain bitterly of the state of affairs, which has been growing steadily worse since 1880. Not only have prices as printed in lists fallen greatly, but the competition to secure a share of the diminished business reduces still further the net results. The cheapened costs of all materials of manufacture somewhat lessens the loss from low selling prices, but nothing can compensate for the greatly reduced output due to the want of money among agriculturists, and considerably also to the depression in the Australian colonies.

"In conclusion, it must be remembered that prosperity or depression are not to be measured merely by the rise and fall of prices, but by that margin of profit between cost and receipts which remains to all concerned. The present loss from reduced values is diluted by being spread over a wide area, and manufacturers are largely compensated for the low selling prices of their goods by the cheapness of all they buy. There is not yet, however, that accord between the two which is necessary to sound trading, for such preferential charges as rent, mining royalties, wages and railway carriage rates remain almost constant, and some equitable adjustment of them is essential if this country is to hold its own with Germany and other competing nations. There is no country where mining royalties are so high as in Great Britain; wages remain high, while all that a workman buys is greatly cheapened, and the rates of railway carriage to and from the ports afford a direct bounty to the foreign manufacturer. The recent investigations of the Commission on Trade will, it is hoped, tend to a reduction of these burdens. The outlets for the engineering trades are numerous. In India the growth of railways and their traffic will lead to still further extensions and to minor enterprises of various kinds; the Colonies, at present depressed by low prices of produce, drought and other causes, are likely to show an increasing demand for ironwork and machinery, while the recent discovery of gold in Western Australia and the proposed extension of railways there will open out the large dormant resources of that sparsely populated colony. China, though for the moment more intent on naval armaments and warlike munitions than on railways, will certainly in the near future obtain from this country railway, mining, and manufacturing appliances, while the neighbouring country of Upper Burmah now under British guidance may be expected to still sooner develope its wonderful natural resources. If peace be maintained a general and steady improvement may be anticipated.

NEW COMPANIES.

The following companies have just been registered:—

Great Eastern Steamship (Exhibition and Entertainment) Company, Limited.

This company proposes to enter into an agreement, dated 26th ult., with the London Traders, Limited, for the purchase of the Great Eastern steamship, her tackle, apparel, and furniture; and to utilise her for exhibition, entertainment, advertisements, sale of refreshments, or other like purposes. It was registered on the 26th ult. with a capital of £100,000, in £1 shares, with the following as first subscribers:—

	Shares.
A. Cutler, 83, Shenley-road, Camberwell, clerk	1
W. Jackman, 16, Metropolitan-buildings, Albert-street, E., clerk	1
J. Clegge, 72, Cambridge-street, Camberwell, shorthand writer	1
M. Lilly, 1, Barnsbury-square, N., clerk	1
W. Dalton, 1, Choumert-grove, Peckham, commission agent	1
C. Marquison, Chadwick-road, Peckham, coffee dealer	1
A. O. Curry, 6, Crewys-road, S.E., parliamentary agent	1

The number of directors is not to be less than three nor more than seven; qualification, 100 shares; the first are the Earl of Belfast, Captain David R. Comyn, R.N.R., Messrs. Shackleton, Hallett, and William Holland; the remuneration of the board will be at the rate of £200 per annum for the chairman, and £100 per annum for each director; the board will be further entitled to divide £50 for each £1 per cent. of net profits in excess of £10 per cent. per annum.

Baldwin, Son, and Co., Limited.

This is the conversion to a company of the business of Baldwin, Son, and Co., of Southport, ironfounders and manufacturers of articles made of cast and wrought iron. It was registered on the 23rd ult. with a capital of £50,000, in £10 shares, with the following as first subscribers:—

	Shares.
E. Baldwin, Stourport, Worcester, ironfounder	1
A. Baldwin, Wilden House, Stourport, ironfounder	1
E. A. Baldwin, The Ferns, Stourport, ironfounder	1
E. H. Carter, 33, Waterloo-street, Birmingham, chartered accountant	1
D. Roome, Ladywood, Birmingham, clerk	1
T. Cooke, Aston, Birmingham, law stationer	1
W. J. Gilliver, King's Heath, Worcester, cashier	1

The number of directors is not to be less than two nor more than eight; the subscribers are to appoint the first; the company in general meeting will determine remuneration.

Chubut Company, Limited.

This company was registered on the 27th ult. with a capital of £105,000, in 1050 shares of £100 each, to construct public works of all kinds, including railways, tramways, docks, canals, gas and water, electric light, telephonic, telegraphic, and power-supply works, in the Argentine Republic, or elsewhere. The subscribers are:—

	Shares.
Thomas Best, 17, James-street, Liverpool, merchant	1
Arthur Isaacson, 14, Water-street, Liverpool, merchant	1
A. Pilkington Bell, C.E., 14, Cook-street, Liverpool	1
H. Pothick, Weston-super-Mare, merchant	1
E. Percy Bates, 3, New Quay, Liverpool, merchant	1
W. Tod, 7, Tithebarn-street, Liverpool, stockbroker	1
W. Rodger, 17, James-street, Liverpool, merchant	1
R. Huxham, 81, Gracechurch-street, merchant	1

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

F. Williams, Limited.

This company was registered on the 22nd ult. with a capital of £10,000, in £1 shares, to carry on business as manufacturing chemists, mechanical, gas, and electrical engineers, and metallurgists. The subscribers are:—

	Shares.
C. T. D. Crews, 33, Throgmorton-street, stockbroker	1250
August Lichtenstadt, 33, Throgmorton-street, stockbroker	1250
G. J. Poston, 10, Throgmorton-avenue, stock dealer	100
T. H. Bellis, 6, Jeffrey's-square, merchant	100
F. de la Fontaine Williams, 6, Jeffrey's-square, merchant	4799
J. M. Hume, 6, Jeffrey's-square, secretary to a company	1
C. H. Felling, 14, Throgmorton-street, broker	2500

Most of the regulations of Table A of the Companies' Act, 1862, apply.

South Wales and Liverpool Steamship Company, Limited.

Registered on the 27th ult. with a capital of £45,000, in £50 shares, to purchase and work the steamers Llanelly, Burry, Fawn, and Orpheus. The subscribers are:—

	Shares.
Francis Johnston, 21, Water-street, Liverpool, shipowner	1
G. M. Ferran, Chapel-street, Liverpool, cotton broker	1
A. G. Smith, Chapel-street, Liverpool, cotton broker	1
D. Evans, Llanelly, corn merchant	1
J. R. Wright, Gowerton, near Swansea, steel manufacturer	1
J. Buckley, Llanelly, brewer	1
H. Child Buckley, M.D., Llanelly	1

The firm of Robert Gilchrist and Co., of Liverpool, are the first managers and secretaries, and Mr. D. A. Williams Baile, of Llanelly, is appointed joint manager at that port, and agent in South Wales.

Monk Bridge Iron and Steel Company, Limited.

This is the conversion of the partnership firm of the Monk Bridge Iron Company, of Leeds, into a joint-stock company, composed of members of the firm and other persons associated with them. It was registered on the 28th ult. with a capital of £250,000, in £100 shares. The subscribers are:—

	Shares.
*James Kitson, Gledhow Hall, Leeds, ironmaster	1
*E. A. Jeffreys, Gipton Lodge, Leeds, ironmaster	1
*F. J. Kitson, Burnley-hill, Leeds, engineer	1
J. H. Kitson, Elmes Hall, Leeds, engineer	1
A. E. Kitson, Gledhow Hall, Leeds	1
W. Bagshawe, 31, Virginia-road, Leeds, manager	1
E. H. Jeffreys, 1, Victoria-mansions, Westminster, engineer	1

The number of directors is not to be less than three nor more than five; qualification, fifty shares; remuneration, £2500 per annum, unless otherwise determined by the company in general meeting. The first three subscribers are appointed directors.

Patents, Designs, and Trade Marks Defence Association, Limited.

This company was registered on the 24th ult. with a capital of £5000, in 50 shares of £100 each, to form and dispense a fund for obtaining for subscribers legal and other advice for the protection of patents, trade marks, copyright, and other similar privileges. The subscribers are:—

	Shares.
*John Davis, 59, Chancery-lane, solicitor	1
*J. Giles, 28, Craven-street, architect	1
R. Varty, 9, Leadenhall-street, merchant	1
W. S. Johnson, 60, St. Martin's-lane, Charing-cross	1
F. Phillips, North Finchley, consulting engineer and patent agent	5
E. M. Daniel, Goldsmith-buildings, Temple, barrister	1
*E. R. Cummins, 38, Gracechurch-street, merchant	1

The number of directors is not to be less than three nor more than five; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

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.

27th July, 1886.

9649. Folding Camp Bedsteads, J. Pope and W. T. Bumpstead, London.
9650. Manufacture of Rolled Grass, J. Armstrong, London.
9651. Movable Weirs, S. Harrison, Ripon.
9652. Photographic Negatives, T. Turner, jun., Yorkshire.
9653. Nailing Machines used for Boots, &c., S. W. Robinson, Paris.
9654. Railway Crossing, W. T. Shannon, London.
9655. Portable Photographic Cameras, H. J. Allison.—(*C. P. Stirn, United States.*)
9656. Oscillating Steam Valves, G. H. Duthie and W. W. Barcus, London.
9657. Bicycles, F. F. Giles, Kidderminster.
9658. Fire-lighters, W. Welsh, Portsmouth.
9659. Tennis, Rackets, &c., Bats, G. T. Warwick, Birmingham.
9660. Lubricating Gas-engines, A. Bradshaw, Halifax.
9661. Raising Salt from the Mine, C. E. Moncrieff, Belfast.
9662. Knitting Machines, W. Westmoreland, Nottingham.
9663. Making Sand Moulds for Casting Metals, M. R. Moore, London.
9664. Making Sand Moulds for Casting Metals, M. R. Moore, London.
9665. Equilibrium Steam and Water Taps, J. Allmark, Middleton.
9666. Ring Spinning and Doubling Frames, H. Wuchner, P. Müller, and F. Hessling, Manchester.
9667. Manufacture of Cardboard, &c., Boxes, J. A. McWhinnie, Manchester.
9668. Funnel and Measures Combined, A. W. Foster and L. Oxford, Nantwich.
9669. Keeping Open and Cleaning Perforations in Zinc or Steel, J. Beal, R. Wigfull, and T. D. Wigfull, Sheffield.
9670. Washers for Locking Nuts to Screw Bolts, T. Jacobs and G. R. Cook, Sheffield.
9671. Fastening Piles to the Ground, E. Websky, C. F. Hartmann, C. Wiesen, and B. Hartmann, London.
9672. Waterproof, &c., Garments, B. J. B. Mills.—(*J. J. Byers, United States.*)
9673. Sights for Umbrellas, J. C. Lindsay, London.
9674. Applying Electricity to Hair Brushes, &c., H. P. Truefitt, London.
9675. Decoration of Furniture, R. Ward, London.
9676. Compound High and Low-pressure Double-acting Gas Governor, W. Pottor, London.
9677. Turning and Shaping Machines, J. Strachan, Glasgow.
9678. Artificial Teeth, J. J. R. Patrick, London.
9679. Inkstand, W. J. Downes.—(*M. Bösl, Hungary.*)
9680. Pocket Sewing Machines, T. S. James, London.
9681. Horse-shoes, J. E. Bingham, Walla-Walla, U.S.
9682. Horse-shoes, J. E. Bingham, Walla-Walla, U.S.
9683. Clutches for Electric Lamps, C. B. Noble and R. D. Noble, London.
9684. Bottle Stoppers, E. L. Lloyd and C. C. Jolly, London.
9685. Machines for Bending or Bevelling Angle, &c., Bars, R. E. Davis and J. Primrose, London.
9686. Drying Ovens for Drying Tea, &c., C. P. N. Martin, London.
9687. Cigarette Case or Holder, J. Strick, Swansea.
9688. Boxes for Matches, C. Lund, London.
9689. Belts and Straps, R. Cheetham and D. B. Myers, London.
9690. Preserves for Making Milk Puddings, &c., I. Grün, London.
9691. Applying Hydraulic Power, H. Riddell, London.
9692. Fireworks, J. Pain, London.
9693. Condensers, P. A. Newton.—(*W. Craig, United States.*)
9694. Luminant of Incandescence Electric Lamps, T. Mace.—(*The Vitrite and Luminoid Company, United States.*)
9695. Luminant of Electric Lamps, T. Mace.—(*The Vitrite and Luminoid Company, United States.*)
9696. Luminant of Electric Lamps, T. Mace.—(*The Vitrite and Luminoid Company, United States.*)
9697. Driving Sewing Machines, G. F. Beutner and A. A. Lateulère, London.
9698. Washers for Armour-plate Bolts, W. Eyre, London.
9699. Physical Strength Testing Machine, J. and R. Foot, London.
9700. Annealing Copper and its Alloys, H. J. Haddan.—(*L. Fleury, France.*)
9701. Roasting Apparatus for Coffee, &c., A. Spinner, London.
9702. Nails for Boots and Shoes, H. H. Lake.—(*F. F. Raymond, U.S.*)
9703. Semaphore Signals, H. H. Lake.—(*V. Spicer and J. Schreuder, U.S.*)
9704. Steam Boilers and their Engines, G. Becker, London.
9705. Cartridge Cases for Fire-arms, A. J. Boult.—(*G. W. Morse, U.S.*)
9706. Traction Wheels, W. A. Loud, Liverpool.
9707. Telephones and Telephonic Systems, W. C. Lockwood, Liverpool.
9708. Making and Breaking Circuit for a Dynamo Charging Accumulator, A. B. Holmes and J. C. Vaudrey, Liverpool.
9709. Couplings for Rolling Stock, A. J. Boult.—(*J. H. Hayes, U.S.*)
9710. Car Movers, C. L. Barnhart, London.
9711. Cupolas and Blast Furnaces, A. J. Boult.—(*E. Hamélius, France.*)
9712. Food made from the Kernels of Almonds, &c., E. R. and W. C. Allen, London.
9713. Tap Valves, &c., A. J. Boult.—(*M. G. Gillette and L. King, U.S.*)

9714. Nailing Machines for Boots and Shoes, H. H. Lake.—(*A. Eppler and E. B. Seaver, U.S.*)

28th July, 1886.

9715. Castors for Furniture, &c., S. Holgate, Liverpool.
9716. Treatment of Diphtheria, C. A. Buehl.—(*F. Bloebaum, Germany.*)
9717. Horseshoes, W. E. Carmont, Manchester.
9718. Furniture Castors, I. Chorlton and G. L. Scott, Manchester.
9719. Stringing Lawn Tennis and other Racquets, I. T. Townsend, Coventry.
9720. Blind Rack Pulley, S. J. J. and M. E. Rooke and G. Price, Birmingham.
9721. Effecting the Grip and Release of Conical and other Chucks whilst in Motion, F. Butterfield, London.
9722. Actuating Conical Chucks of Lathes, &c., F. Butterfield, London.
9723. Beading Articles of Hollow-ware, &c., F. Ryland, Birmingham.
9724. Water Taps, W. Patterson, Durham.
9725. Excentric Lifter, W. Lawson, Preston.
9726. India-rubber and Gutta-percha Articles, C. Tully, Newcastle-on-Tyne.
9727. Gas Caloric Motive Engines, E. and H. Crowe, Middlesbrough-on-Tees.
9728. Slicing and Grating Cocoa-nut, L. Collier, Rochdale.
9729. Colouring of Marble, &c., Composed of Calcium Carbonate, T. Bayley, Birmingham.
9730. Scaffolding, &c., for Painting, J. Siemers, London.
9731. Clog Irons, G. Percy, London.
9732. Vehicular Skates, A. G. Meeze and R. N. Laurie, Redhill.
9733. Heating and Cooling Fluids, A. G. Meeze, Redhill.
9734. Purification of Pig Iron, A. G. Meeze, Redhill.
9735. Tricycle, J. Key, Birmingham.
9736. Date Indicator or Calendars, J. J. Raggett, Birmingham.
9737. Regulating the Flow of Oxygen and Hydrogen, &c., Gases, A. Brin, London.
9738. Preserving Milk, A. Brin, London.
9739. Mechanical Telephone Indicators, W. C. Muir and H. A. Mavor, Glasgow.
9740. Electric Lighting Appliances, J. Munro and L. Balbi, Croydon.
9741. Electric Flash Signalling, E. S. Bruce, London.
9742. Musical Boxes, F. E. P. Ehrlich, London.
9743. Crinolines, J. Y. Johnson.—(*C. Rumpff and Farbenfabriken vorm. Bayer and Co., Germany.*)
9744. Rabbeting Cardboard, F. T. Pillivant, London.
9745. Signalling Railway Trains, W. R. Holyoake, London.
9746. Working Railway Points and Signals, W. Smith, London.
9747. Spinning Fibrous Materials, E. W. Wrigley and R. Patterson, London.
9748. Opening and Closing Fanlights, H. Whiteley, Halifax.
9749. Clearing Railway Tunnels of Smoke, H. J. Spooner, London.
9750. Closing Railway Carriage Windows, J. C. Taite and T. W. Carlton, London.
9751. Indicating the Speed of Motors, J. Y. Johnson.—(*E. Lambinet, France.*)
9752. Domestic Grinding Apparatus, L. Phillott, London.
9753. Motors, J. Bureau and H. Héndlé, London.
9754. Producing a Bluish Black Colour, L. Schad, London.
9755. Atmospheric Gas Burner, O. Imray.—(*C. Auer von Welsbach, Austria.*)
9756. Stands for Photographic Cameras, H. H. Lake. (*G. McLaughlin, United States.*)
9757. Electric Meters, S. Pitt.—(*J. J. A. Aubert, Switzerland.*)

29th July, 1886.

9758. Controlling Gas Supply, T. Fletcher and A. Clare, Manchester.
9759. Filter Presses, E. Jones and A. Beech, Longport.
9760. Blind Racks, A. E. Wynn, Ilkley.
9761. Mules for Spinning, S. Hall, London.
9762. One-wheeled Safety Unicycle, C. and J. Clark, West Hartlepool.
9763. Bell for Velocipedes, &c., H. Lucas, Birmingham.
9764. Lamp for Velocipedes, &c., H. Lucas, Birmingham.
9765. Lathes, J. P. Binns, Halifax.
9766. Foot and other Hollow Playing Balls, P. A. Martin, Birmingham.
9767. Fasteners for Gloves, &c., S. R. Barnett, Birmingham.
9768. Invalid Bedsteads, C. Latimer, Birmingham.
9769. Regulating the Distance between the Carbons of Electric Arc Lamps, G. A. Grindle, London.
9770. Copper-plates and Electrotypes, A. F. Wenger, London.
9771. Tables of Leather-dressing, &c., Machines, J. Vassie, Glasgow.
9772. Cleats for Ships' Hatches, &c., J. H. Bell and W. Rockliffe, Monkwearmouth.
9773. Jointing Endless Belts of Leather, T. Wheelhouse, Halifax.
9774. Tilting Casks and Barrels, W. Ellison and J. J. Winder, Liverpool.
9775. Propelling Vessels, G. Chapman, Glasgow.
9776. Dyeing Slivers of Woollen, &c., Substances, E. and G. E. Sutcliffe, Halifax.
9777. Dyeing Slivers of Silk, E. and G. E. Sutcliffe, Halifax.
9778. Ventilating Drains and Buildings, A. E. Black, Inverness.
9779. Anchor, F. J. White.—(*J. O. Morrison, Nova Scotia.*)
9780. Holding and Releasing the Leaves of Books, &c., J. Blakey and J. M. Porter, Leeds.
9781. Neckties, &c., A. G. Speight, London.
9782. Wheels, A. Dickinson, Birmingham.
9783. Obtaining Artificial Draught under the Grates of Furnaces, N. Evans, Liverpool.
9784. Fastenings for Rails and Sleepers, H. Rumsey and J. E. Hopkinson, London.
9785. Heating Steam Boiler Furnaces, S. Smithson, Bradford.
9786. Supplying Steam to Engines, J. D. Churchill, London.
9787. Filtering Liquids, P. D. and M. J. Bywater, London.
9788. Photographic Shutter, A. Phillips, London.
9789. Railway Carriage Coupling, W. J. Penn and F. J. Ryan, London.
9790. Trunk Handles, A. M. Clark.—(*J. E. Dollier, France.*)
9791. Sewing Machine, A. F. Wileman, London.
9792. Confectionery Shaping Machines, G. C. Snyder, London.
9793. Glass Globes for Incandescent Electric Lamps, H. Lea, London.
9794. Hoisting Ashes from the Stokeholes of Ships, T. Loudon, London.
9795. Sights for Ordnance, C. A. McEvoy, London.
9796. Mowing Machines, W. J. and C. T. Burgess, London.
9797. Fastening for Revolving Shutters, W. Hammond and J. Turner, London.
9798. Lenses, H. Defries, London.
9799. Hydraulic Elevators, C. H. McEuen.—(*N. Selfe, New South Wales.*)
9800. Self-adjusting Machine for Cleaning Knives, W. Hewett, London.
9801. Forming Handles for Umbrellas, W. Dangerfield and J. F. Ferrabee, London.
9802. Bait Hook for Fishermen, &c., I. K. Rogers, London.
9803. Clipping Lace, J. H. Johnson.—(*The Willcox and Gibbs Sewing Machine Company, United States.*)
9804. Hydrate and Salts of Baryta and Strontia, The Tyne Alkali Company and T. Gibb, London.
9805. Carbonising Filaments for Electric Lamps, W. Maxwell, London.
9806. Obtaining Compounds of Metal for Illuminating Purposes, C. A. von Welsbach, London.
9807. Automatic Governor for Marine Engines, D. Ragg, London.
9808. Portable Furnace, W. P. Thompson.—(*H. Wellington, United States.*)
9809. Fastening for Gloves, B. Bradford, Liverpool.
9810. Baths, J. B. French, United States.
9811. Dynamo-electric Machines, F. E. Elmore, London.

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9812. Knitting Machines, J. A. Claringburn, London.
9813. India-rubber Tobacco Pouches, C. Moseley, Manchester.
9814. Locks for Railway, &c., Doors, F. Jones and J. S. Foster, Bloxwich.
9815. Hardening, &c., Steel Wire, J. Pinder and B. Woodcock, Bradford.
9816. Use and Application of Materials such as Cutch, &c., M. Hilton, Prestwich.
9817. Protecting and Running Electric-light, &c., W. C. Mountain, London.
9818. A New Game, T. S. Greenway, Wolverhampton.
9819. Artificial Manufacture of Coal, F. V. Hadlow, Parkhurst.
9820. Separating Stones, &c., fron Grain and Seeds, E. Scholes, Manchester.
9821. Producing Patterns upon Pile Fabrics, J. Brown, Manchester.
9822. Pen Dips and Holders, J. T. Green, and W. Rockliffe, Sunderland.
9823. Shedding Motion for Looms, J. Horrocks and E. Horrocks, Bradford.
9824. Machine for Mitreing Boards, &c., A. Muir, Glasgow.
9825. Spring Dollie, S. Davey, Birmingham.
9826. Chair or Stool, C. Chatfield, London.
9827. Hat, &c., Hook, F. A. Harrison, Birmingham.
9828. Ships' Berths, F. H. Street and C. Ellis, London.
9829. Window Fastener, J. D. Tucker, London.
9830. Shuttles for Looms, J. Mounsey, London.
9831. Securing the Exclusion of Air from Casks, &c., R. W. Beard London.
9832. Attaching Railway Chairs to Wooden Sleepers, W. Davison, London.
9833. Effecting the more Efficient Employment of Gaseous Fuel in Driving Motive-power Engines, C. S. Bailey, London.
9834. Packing for Stuffing-boxes, D. Wulff and J. Tweedy, London.
9835. Primary Batteries, O. March, London.
9836. Preparation for Medicinal, &c., Purposes, R. C. Scott, Liverpool.
9837. Cigar and Cigarette Cases, H. Allday, London.
9838. Filters, E. C. Allam, London.
9839. Stove and Fittings for Drying, &c., Tea-leaves, R. M. Ritchie, Glasgow.
9840. Fire-proof Starch and Paint, G. Harrison, London.
9841. Portable Fire-escapes, L. Engelke, London.
9842. Starting Compound Engines, F. J. Burrell, London.
9843. Permanent Way of Railways, H. White, London.
9844. Instrument for Measuring Angles, G. P. Evelyn, London.
9845. Fuel-feeding Apparatus, P. A. Newton.—(*Messrs. C. H. Peters and Co. Germany.*)
9846. Transmitting Instruments, A. M. Clark.—(*L. Maiche, France.*)
9847. Treatment of Sewage, T. H. Cobley, London.
9848. Ornamenting, &c., the Edges of Curtains, C. J. Cox, London.
9849. Forging by Rollers Conoidal Projectiles, &c., C. Fairbairn and M. Wells, London.
9850. Forging Screws by Rollers, C. Fairbairn and M. Wells, London.
9851. Piston Rods, A. Collmann, London.
9852. Tags for Laces, H. E. C. Way, London.
9853. Electrical Conductors for Telegraphic Uses, E. Fox, London.
9854. Telephonic Apparatus, D. Boyd and S. Williams, London.
9855. Shuttles, Bobbins, &c., H. H. Lake.—(*L. Stone, United States.*)
9856. Pocket Sewing Machines, J. C. Cottam and A. D. Moll, London.
9857. Pocket Sewing Machines, J. C. Cottam and A. D. Moll, London.
9858. Pocket Sewing Machines, J. C. Cottam and A. D. Moll, London.

31st July, 1886.

9859. Intercepting Gullies and Grease Traps, H. Dean, London.
9860. Drain and Ventilating Traps, H. Dean, London.
9861. Propelling Ships, &c., J. Darbyshire, Longton.
9862. Metallic Doors, &c., for Dust Shoots, J. G. Stidder, London.
9863. Case for Needles, &c., J. Cottrill, Birmingham.
9864. Opening the Patent Stopper Bottles, A. F. Smith, Hailsham.
9865. Preservation of Butter, &c., in Packages, J. McKenzie, Cork.
9866. Petroleum and other Explosive Engines, H. A. Stuart, Bletchley.
9867. Extracting Paraffine from Petroleum Distillate, J. T. King.—(*C. Vose, United States.*)
9868. Hoeing Cutter, J. Park, Peterhead, N.B.
9869. Window Blinding, C. E. Fessant, Rochdale.
9870. Grain Binders, W. P. Thompson.—(*C. H. McCormick, jun., United States.*)
9871. Separating Chaff, &c., from Grain or Seeds, W. Rowlandson, Liverpool.
9872. Carts for the Conveyance of Refuse, J. W. Wood, Liverpool.
9873. Induction Coils, W. J. Muller, London.
9874. Colouring upon Celluloid and Analogous Products, A. M. Clark.—(*La Compagnie Française du Celluloid, France.*)
9875. Air-tight Appliances for Ships, &c., W. J. N. Neale, Perry Barr.
9876. Mechanical Toy, I. Greenbury, Glasgow.
9877. Vaporisers and Inhalers, I. Greenbury, G'asgow.
9878. Watch Glasses and Cases, J. Brodie, Leeds.
9879. Washing Machines, G. K. Bell, Liverpool.
9880. Picking Straps, W. Atherton, Halifax.
9881. Fastener for Window Sashes, &c., H. Johnson and T. Bessant, Birmingham.
9882. Carriage Doors and Windows, W. Kneen, Barrow-in-Furnace.
9883. New Game, W. H. Ryves, London.
9884. Frictional Couplings and Clutches, J. M. Coon, Manchester.
9885. Machinery for Grinding, &c., Paper, R. Kron, London.
9886. Coating Glass as a Support for Photographic Emulsions, J. W. T. Cadett, London.
9887. Fastening the Extremities of Spiral Metallic Springs, H. Spühl, London.
9888. Metallic Bedsteads, &c., C. W. Torr, London.
9889. Gas Lamps for Supplying Heated Air to the Burners, A. Bermbach, London.
9890. Moving Spanner, J. Brawn, Birmingham.
9891. Manipulating Pots for Shaving, A. Pohlman, Halifax.
9892. Adjustable Folding Easy Chairs, T. Opel, London.
9893. Advertising, F. Bosshardt.—(*G. Nöel, France.*)
9894. Salamander Fire-bars, T. Lineker, Nottingham.
9895. Retaining Catches for Doors, G. H. Rayner, London.
9896. Nails or Spikes, T. W. Smith, London.
9897. Lock Bolt and Nut, F. W. Keen, London.
9898. Locking Nuts on Bolts, S. de la G. Williams, London.
9899. Attaching Broom Handles, L. Bradshaw, London.
9900. Cistern Ball Valves, J. Alexander, London.
9901. Sewing Machines, W. P. Keeson, London.
9902. Novel Twist Lace Fabric, E. Cope, Nottingham.
9903. Twist Lace Fabric, E. Cope, Nottingham.

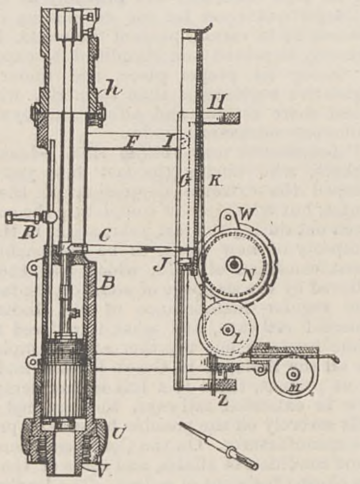
SELECTED AMERICAN PATENTS.

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

343,291. Steam Engine Indicator, *Charles W. Barnaby, Salem, Ohio.—Filed October 29th*, 1883.

Claim.—(1) The combination of a motor-cylinder, frame parts connected therewith, a paper carrier supported thereby, a piston within the motor cylinder, a pencil in connection with said piston, and a coupling attached to the frame parts at a point between the motor cylinder and the pencil lever, and adapted for coupling the instrument to an engine, substantially as and for the purpose set forth. (2) In a steam engine indicator, the combination of a paper carrier, an oscillating pencil lever, a sliding pencil holder fitted to the end of the pencil lever, a spring adapted to push the pencil and pencil holder outward, and a stop adapted to limit the outward projection of the pencil when in use, substantially as and for the purpose set forth. (3) In a steam engine indicator, the combination of a segmental or concave tablet adapted to receive a sheet of paper, and curved flexible paper-clips disposed across the curve of the tablet and secured at one end to the tablet and provided with latchments at the other end, and adapted to press the paper against the tablet, substantially as and for the purpose set forth. (4) In a steam engine indicator, the combination of a moving paper carrier, a rotary spring-axle

343,291.

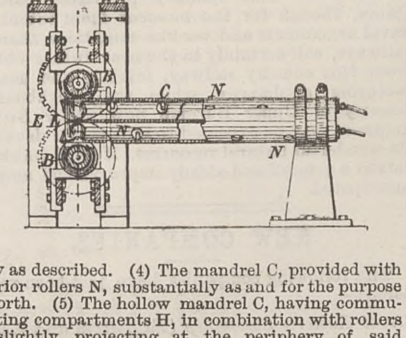


fitted to be revolved as the paper carrier moves in one direction, and to be revolved in the other direction by the recoil of the spring, a drum fitted to revolve on an axle, and provided with notches in its periphery, by means of which the drum may be revolved by the operator's grasping finger motions, a spring coiled within the drum and attached to the axle and drum, and a detent pawl engaging said notches and adapted to prevent the reverse rotation of the drum, substantially as and for the purpose set forth. (5) In a steam engine indicator, the combination of a moving paper carrier, a rotary spring axle fitted to be revolved in one direction by the paper carrier, two winding drums provided with peripheral notches, by means of which the drums may be separately revolved by the operator's finger grasp, detents engaging said notches and adapted to prevent the reverse rotation of the drum, and a separate spring coiled within each drum, and each spring secured to its drum and both springs to the axle, substantially as and for the purpose set forth. (6) In a steam engine indicator, the combination of an oscillating motor cylinder, an oscillating piston therein, an oscillating pencil lever connected with the piston, a tubular body or frame projecting upward from the cylinder and slotted for the play of the pencil lever, frame arms, projecting at right angles from such frame or body, and paper-carrier mechanisms supported by such arms, substantially as and for the purpose set forth. (7) In a steam engine indicator, the combination of a body piece, paper-carrier supports connected thereto, a changeable tubular extension below the body piece, a motor cylinder secured to such extension, a torsion spring reaching upward from the motor cylinder through the body, a removable extension piece attached above the body around the spring, and a retaining block for the spring, adapted to seat in the top of said upper extension piece or in the top of the body at the foot of said extension piece, substantially as and for the purposes set forth. (8) In a steam engine indicator the combination of an oscillating motor cylinder, a tubular body portion projecting axially therefrom, a torsion-spring reaching upward from the motor-cylinder within the body portion and a block firmly but adjustably secured to the spring and adapted to slide within said body portion, substantlally as and for the purpose set forth.

343,325. Machine for Rolling Tubes, *Edgar Little, Philadelphia, Pa.—Filed February 11th*, 1886.

Claim.—(1) The mandrel C, in combination with the rolls B, each of the latter having bevel-gearing attached thereto, all of said gearing meshing together, substantially as and for the purpose set forth. (2) In a rolling mill, a hollow mandrel having a diaphragm with a port therein, substantially as and for the purpose set forth. (3) Hollow or chambered rolls B, the hollow shaft E, bearings B^1, with bores a a^1, the shaft E^1, with groove b and bore c, the bearing B^2, with bore d, and bearings B^3, with the discharge bore e, substan-

343,325

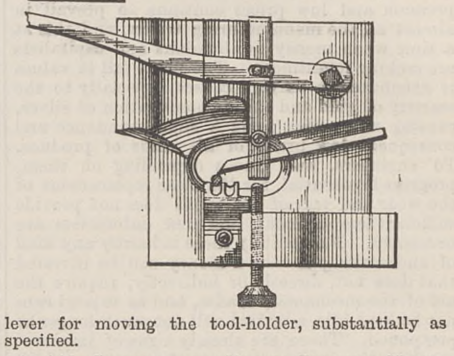


tially as described. (4) The mandrel C, provided with exterior rollers N, substantially as and for the purpose set forth. (5) The hollow mandrel C, having communicating compartments H, in combination with rollers L, slightly projecting at the periphery of said mandrel, rolls B, and rollers N, substantially as described.

343,443. Beading Attachment for Lathes, *Newton A. Dickinson, Chester, Conn.—Filed February 11th*, 1886.

Claim.—The combination, with the grooved bed-plate provided with the backing die I and the gauge screw, of the tool-holder having the slot and set screw, and the tool provided with patterns extending throughout its entire length, and the pivotted hand-

343,443.

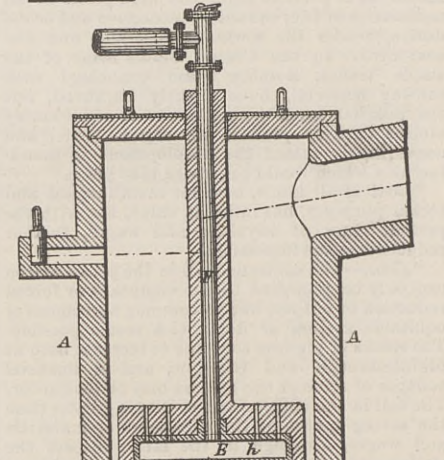


lever for moving the tool-holder, substantially as specified.

343,448. Converter for Making Bessemer Metal, *Henry L. Gantt, Baltimore, Md.—Filed November 20th*, 1885.

Claim.—(1) A stationary converter, combined with an unattached removable tuyere-box corresponding in horizontal dimensions with the interior of said converter at bottom, said tuyere-box being provided with a conduit blast pipe and in its top with a series of tuyere or jet holes for the discharge of the air jets in a vertical direction. (2) A stationary converter A, combined with a tuyere-box E, adapted to fit the interior of said converter at its bottom, and provided with upwardly-directed tuyere holes e, distributed

343,448.

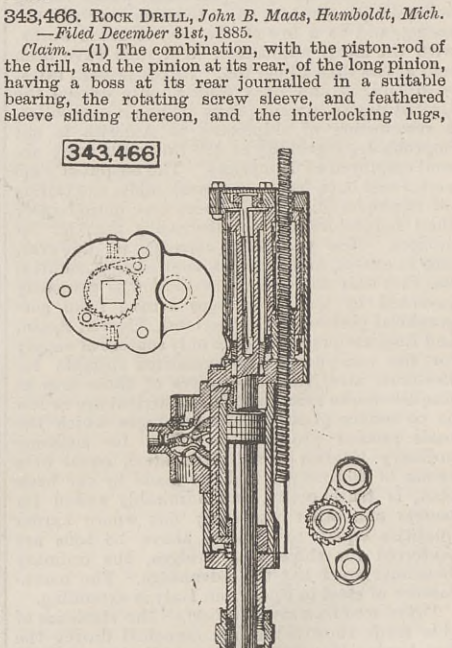


over all the cover of said box, and a blast pipe F inserted at the centre of said box, the whole being weighted sufficiently to cause it to sink into and to the bottom of the molten metal in said converter. (3) The flat-topped tuyere-box E, corresponding in diameter with the internal diameter of the converter at its bottom, provided with tuyere holes e, distributed over its cover, a hole h in its bottom, and an induction blast pipe F, substantially as and for the purpose set forth.

343,466. Rock Drill, *John B. Maas, Humboldt, Mich.—Filed December 31st*, 1885.

Claim.—(1) The combination, with the piston-rod of the drill, and the pinion at its rear, of the long pinion, having a boss at its rear journalled in a suitable bearing, the rotating screw sleeve, and feathered sleeve sliding thereon, and the interlocking lugs,

343,466



whereby the feed devices may be automatically worked or worked by hand to advance the drill to its work, substantially as specified. (2) The combination, with the piston-rod bored longitudinally at its rear, of the screw boss therein, the screw and controlling ratchet and pawls at its rear end, and the long pinion and feed mechanism, substantially as specified.

343,459. Combined Latch and Lock, *Albert A Kellogg, Clinton, Mo.—Filed April 26th*, 1886.

Claim.—The combination of the case having the recess C, the shoulder I, and the slot H, with the weighted pivotted arm E, the bolt connected thereto

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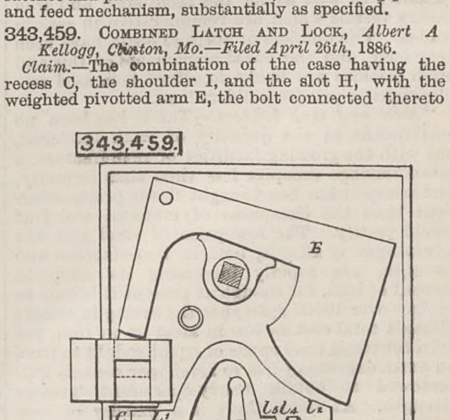

the yoke for tripping the weighted arm and withdrawing the bolt, and the tumbler having the arm l^1 to enter the recess C, the notches l^4 and l^5, for engaging the shoulder I, and the stud l^3, extending through the slot H, substantially as described.