THE STYRIAN EXCURSION OF THE IRON AND STEEL INSTITUTE.

The metallurgical industry of Styria and Carinthia being based upon a combination of resources in ore and fuel which is so utterly unlike anything that can be seen elsewhere, at least on nearly the same scale, it is not surprising that a large proportion of the visitors to the Vienna meeting availed themselves of the opportunity afforded to them of visiting the beautiful valleys of Mürz Mur and Vordernberg, under the able guidance of Hofrath von Tunner and his colleagues of the Leoben Academy. The arrangements for the trip were so carefully planned and admirably carried out that it would be difficult to praise them too highly. Starting from Vienna about 7.30 a.m., the party were taken by a special train on the Southern Railway across the Semmering Pass, stopping for a few minutes at the summit, to Mürzzuschlag, where the train was shunted to the Neuberg branch, and ran directly up to the works where the special process of combined Bessemer and open hearth steel refining was shown in operation, together with the rolling of a large sized steel plate intended for a locomotive frame, after which the company were with some difficulty collected, retrained —according to the new War-office phraseology—and taken back to the main line at Mürzzuschlag, where breakfast was provided by the Styrian Iron Trade, and billets for the night's lodgings at Leoben were distributed to the visitors. When these arrangements were completed, the train started for Leoben, and after a short stoppage at the town to allow the members who were desirous of visiting the coal works at Seegraben to alight—which, however, was done by few if any—proceeded to the Donawitz forges and rolling mills, where the remainder of the afternoon was spent, the train returning to Leoben just before dusk in a pouring rain. Owing to the delay in returning, an interesting feature in the programme, the visit to the Mining Academy, was necessarily omitted, only a few enterprising members having found their way there, when they were kindly shown round the collections by candle light. It is to be regretted that these collections, or more particularly that illustrating the metallurgy of iron, were not seen by members representing the great English iron-producing centres, as they might be imitated in Middlesbrough, Sheffield, and other places with advantage. After the dinner given in the evening by the Styrian iron trade, which lasted till a late hour, the company separated to reassemble at eight on Saturday morning, and proceeded to the head of the railway at Vordernberg, inspecting some of the more prominent blast furnaces on the way, including that at Trofaiach, which represents the most improved practice in charcoal smelting, whence they proceeded by carriages along the Eisenerz road to the railway at the head of the Präbichl incline, and thence by train along a wild mountain side into the open workings about the middle level of the Erzberg. Here the nature of the workings was explained, and after a short interval the blasts prepared during the morning's work were fired. After an inspection of the different points of interest, which was necessarily limited owing to the further demands made on the remaining time by the hospitality of the Alpine Montangesellschaft and the length of the return journey, and a glimpse down the lovely valley of Eisenerz, which was fortunately clear of cloud and mist, the party reluctantly returned by the same route, and passing Leoben and Bruck, turned southward to Gratz, where the long day's work terminated. From the preceding itinerary it will be seen that the works were necessarily examined in ascending order, those dealing with finished products, such as Neuberg and Donawitz, coming first in order, the blast furnaces of Vordernberg next, and, lastly, the mines. It will, however, be more convenient here to reverse the order, and consider first the central point of interest, the great Erzberg itself. This is a conical mountain mass on the watershed of the Enns and the Mur, the high road from Gratz to Steyer, which passes up the Vordernberg valley from Leoben, crossing it on the Präbichl pass, and descending the Eisenerz valley, reaches the Enns at Hieflau. The highest point above the sea-level is about 4800ft., and about 3000ft. above the town of Eisenerz. The deposit nearly follows the surface contour of the ground, so that it was formerly stated that the entire mountain was solid ore, but it is now known to be really a bedded mass included between limestones, which lie upon old schists, probably Devonian, and covered by the slaty beds of the Werfen series, which are of Triassic ages, and are enormously developed in the Tyrolese Alps. The ore is a finely grained spathic carbonate, which when unweathered contains from 40 to 42 per cent. of iron, 1 to 2 per cent. of manganese, and 2 to 3 per cent. of magnesia, with only very little lime, usually under 1 per cent. When altered by exposure to the air or infiltration of water, it changes to the so-called brown or blue ore, a rusty red limonite, averaging 54·4 per cent. of iron. This was the mineral sought by the primitive miners as being alone best suited for direct reduction in open fires, and the fissures were followed by small and tortuous levels, driven by pick and gad; the unweathered white ore, locally known as Pflinz or spangles, from the glittering facets of the spar, was abandoned as waste. In places the admixture of magnesia and lime becomes so great as to render the ore worthless, producing the triple carbonate known as ankerite, the proportion of iron being reduced to 25 per cent. and below. At the base of the deposit the ore is somewhat siliceous from the presence of small strings of quartz; but this condition is exceptional, the bulk of the produce being prominently of a basic character, and almost absolutely free from sulphur and phosphorus. The average furnace yield is 37 to 38 per cent. on the raw, and 51 to 52 on the calcined ore, the charges being usually so combined as to yield 48 per cent. on the average. The greatest real thickness of the deposit is about 500ft.; but from the change in the inclination, which is at a low angle at the base and becomes very steep at the summit, the apparent thickness is much greater, the ore in a more or less pure condition appearing under foot for nearly 2000ft. in height on the mountain side. From the configuration of the ground, the deposit was attacked at different levels by the works on opposite sides, and by an arrangement made as far back as 1524 the upper part was appropriated to the furnace proprietors or wheel masters—*Radmeister*—on the Vordernberg side, and the lower to those in the Eisenerz Valley. As far back as 1625, the rights of the latter proprietors, consisting of nineteen furnaces with their associate forges, roads, and forests, were consolidated into one adventure known as the Inneberger Hauptgewerkschaft, while the furnaces or wheel works of Vordernberg remained independent until 1828, when the mining rights of thirteen proprietors were united, but the last one did not come into the combination until 1871. Since the commencement of the present year the works in both valleys, together with the principal ore mines and furnaces of Carinthia, have become the property of the Alpine Montangesellschaft which now controls thirty-five blast furnaces.

On the Eisenerz side the workings are entirely carried on in the open in regular terraces which cover a surface of about seventy-eight acres. Twenty-six terraces, with a total height of about 1500ft., are now worked, and there is room for five more up to the Vordernberg boundary; from 500 to 600 men are employed in winter and about 1250 in summer. The transport of the ore is effected by a combination of vertical shafts or mills and horizontal railways and inclined planes, numerous large reservoirs being interposed at intervals for containing the winter supply. Near the bottom of the hill is a series of fifty-eight calcining kilns heated by wood or small coal. The calcined ore is loaded in railway trucks and drawn by horses to the Eisenerz railway station, whence it is distributed partly to the company's distant furnaces at Hieflau, Zeltweg, and Schwechat, a portion being smelted on the spot, and the remainder sold to other works. The annual production of the Eisenerz side is from 250,000 to 300,000 tons.

On the Vordernberg side of the mountain the workings lie between 3500ft. above the sea level, and the summit nearly 1500ft. higher, so that open working can only be carried on during the six summer months. Partly on this account and partly because of the thick surface covering, the method of underground working has been very largely developed. The open workings occupy about forty-five acres and the mines about twenty acres more. The system of working is by broad pillars or panels, the ore being taken away, either parallel or perpendicular to the main levels, according to the direction of the jointing of the rock. The excavated spaces are packed with waste, derived mainly from the surface workings. The ore raised during the winter is stored till the following summer, when it is picked and broken.

The transport of the ore to Vordernberg is also confined to the summer, when about 200,000 tons have to be carried, cleaned, and stored for winter use. The arrangements for this purpose are in the main the same as those originally adopted in 1830, and it speaks well for the skill with which they were laid out that they have within the last three years been adapted to the immensely increased requirements of the present time with a comparatively small additional expenditure. The principal element in this line of transportation is a railway about 3½ miles long, starting from about the middle level of the workings, and passing through the Präbichel ridge by a tunnel to the Handlalp, in the Vordernberg Valley. The ore from the upper workings is passed down by shafts, while that from below is raised to the loading place by three inclined planes, one worked by steam power, and the other two by water balances. The railway has a gradient with the load of 1 in 100, and was originally worked by horses, but in 1878 traction by locomotives was adopted. The gauge of the line is 3ft. The curves and tangents are in the ratio of 30 to 70, the average radius of the former being about 185ft., and the minimum, which, however, occurs only in two places, about 153ft. The super elevation of the outer rail varies from 1in. to 2in., according to the radius. The locomotives are tank engines, of Haswell's construction, such as were originally used for underground traction in the collieries in the Banat. They weigh 11 tons in working order, and take a train of thirty-five wagons, with a net load of 98 tons, down hill at a speed of nine miles an hour. The return journey with the empty train and engine, together about 46 tons, is run at fifteen miles an hour. The fuel consumption on the double journey is about 150 lb. of Leoben coal. Usually ten trips are made in twelve hours, and between May to August the line is worked day and night. At the end of the locomotive line the ores are discharged into a covered reservoir, where they are loaded into other wagons which perform the remainder of the journey to Vordernberg by a combination of inclined planes, passes, and railways, on a falling gradient of 1 in 110, which are worked partly by men and partly by horses, the further difference of level being about 1170ft. from the end of the railway to the upper end of the town of Vordernberg. The most interesting features in this part of the system are the inclined planes, which are about a quarter of a mile long, at an inclination of 14 deg. from the horizontal, the loaded truck being carried crosswise on a platform wagon. The load, of 9¾ tons gross, or 5½ tons net, is lowered at the uniform rate of about 430ft. per minute by an iron wire rope winding on a conical drum of 115in. maximum, and 101in. minimum radius, making seven and a-half revolutions per minute. The work due to the acceleration of the descending load in the lower part of the journey, which is equivalent to 60 or 70-horse power, is absorbed by a continuous brake, consisting of a four-armed paddle, revolving in a cistern under a head of about 5ft. of water at about six times the speed of the main drum. This arrangement, which is a reproduction on a large scale of Joules' apparatus for determining the mechanical equivalent of heat, was viewed with great interest by most of the members present. It has been at work since the year 1846, and the motion of the load is so perfectly regulated that the iron wire ropes have a working life of fifteen years, the average day's work being 300 wagons of 5½ tons lowered. At various points on the lower railways large covered reservoirs are provided for storing the ore, the winter being too severe to allow of its being left in the open. There are five of these reservoirs, the largest resembling barns or granaries, and having a total capacity of about 140,000 tons. There are also sixteen calcining kilns with a productive power of about 70,000 tons yearly. The total number of hands employed in the working and conveyance of ore varies from 750 in winter to 1100 in summer. The product, which for the present year is estimated at 212,000 tons, is entirely consumed in the blast furnaces of the Vordernberg Valley, which will be subsequently noticed.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.

By Professor Oliver Lodge.

No. VIII.

It is now time to consider the action of ordinarily coated lead plates. Sulphuric acid acts upon most salts and oxides of lead, decomposing them and forming plumbic sulphate. The peroxide escapes this action, but both the protoxide and minium are rapidly acted on when immersed in dilute sulphuric acid, without evolution of gas, but with some generation of heat. The action for litharge is simply,

$$PbO + H_2SO_4 = PbSO_4 + H_2O;$$

but, as litharge has commonly absorbed some carbonic acid from the air, a few bubbles of CO_2 are commonly evolved at the same time; no other action is perceived, and the colour of the powder hardly changes, though it does become a shade lighter. The reaction for minium is not quite so simple—it is this,

$$Pb_3O_4 + 2H_2SO_4 = 2PbSO_4 + PbO_2 + 2H_2O.$$

No adulteration of carbonate is commonly met with in minium, and accordingly no gas is evolved, but the formation of black peroxide makes itself manifest by a rapid darkening of the immersed powder. In either case, therefore, the quantity of free sulphuric acid present in the liquid is diminished, and if plenty of powder is put into the dilute acid, it will in time get reduced to plain water with no sour taste. A cell containing an excess of oxide of lead, and allowed to stand some time with the acid in before charging, cannot therefore be expected to conduct the charging current properly. When, however, oxide of lead—and especially minium—is packed pretty tightly together, it would be a very long time before its interior parts get acted upon much; for though, no doubt, the acid does soak all through it, yet as it is a very clogging substance, there will be scarcely any circulation or renewal of the acid in its interior. The coatings of an ordinary unformed Faure cell will, therefore, consist of a large amount of unaltered minium, together with a perfectly intimate mixture of peroxide and sulphate, the latter occurring more particularly at the outer face and edges.

To such a cell let a charging current be applied, and consider first what happens at the + plate. If the electromotive force available be not as high as two volts, a clogging crust of hydrated protoxide or of sulphate is formed —see Art. VII.; but if the electromotive force applied is about three volts, the hydrogen of the hydrate is removed, and a brown or puce coloured coat of PbO_2 is at once formed, thus:

$$PbH_2O_2 + O = PbO_2 + H_2O,$$

while some metallic lead is also acted on and apparently peroxidised direct.

As soon as a complete thin coat of conducting peroxide has been formed, the oxygen is liberated at its surface, and is no longer able to reach the lead beneath it, except in small quantities. It therefore is ready to oxidise anything it finds to hand, and a good deal of it in all probability oxidises the Pb_3O_4 direct into $3PbO_2$; some more acts upon the sulphate of lead present, with the help of a molecule of water, thus:

$$PbSO_4 + H_2O + O = PbO_2 + H_2SO_4$$

reproducing the sulphuric acid which was absorbed from the solution while the cell was standing idle; while another portion is apt to combine simply with itself, and to rise as gas. The quantity of oxygen which escapes under the last head depends very greatly upon the intensity of the current—that is, on the strength of the current divided by the area of the plate—and by keeping the current weak it may be reduced to a minimum. At the same time a slight escape of gas is not usually of very great moment, and it serves a useful purpose in promoting circulation in, and therefore uniformity of, the liquid.

I incline to think it most probable that the direct oxidation of Pb, or PbO, or Pb_3O_4, into PbO_2, is not performed until the oxygen has united with itself into ozone; for I have always found that a visible layer of oxygen bubbles is necessary before any peroxide makes its appearance, and that directly any visible gas appears some peroxide is instantly formed.

I have made special experiments to find out whether peroxide of lead requires for its formation an intensity of current above some particular limit; but I find that an exceedingly weak current is still able to form peroxide, though, of course, with extreme slowness. But its presence is unmistakeable, from the violent energy of the return current as long as the peroxide lasts. The strength of current used in charging was about a milli-ampère; the plates were clean bright lead in dilute sulphuric acid, and each plate exposed an area of about 15 square centimetres. The current was driven by two Groves, and its strength was brought down by adding resistance, not by diminishing the electromotive force. This we know is essential whenever peroxide is to be formed. The coat so formed exhibited colour of thin plates, and in about twenty minutes its colour was a greenish yellow.

Beginning then at the surface of the + plate, and spreading out gradually through the mass of stuff with which it is coated, there grows a dense formation of conducting peroxide of lead. It is mainly at the front and advancing surface of this formation that gas is liberated and further peroxide formed. But the peroxide, though conducting, is slightly porous, and a certain amount of oxygen is being liberated pretty well all through it, so that, if a cavity of unaltered minium should happen to be

left, it is not altogether, though it is very nearly, protected from peroxidising action. The minium in such a cavity would probably, however, scarcely be touched until the outer portions had all been acted on; but as soon as this has occurred, and there is nothing more outside to absorb the oxygen, then the opposition electromotive force is so much higher there than it is where there is still an absorbent left, that a good deal of the current may be diverted to the enclosed cavities, in spite of the extra resistance offered by the porous substance in which they are buried.

Now consider what is happening at the — plate. The nascent hydrogen liberated by the charging current against its surface first reduces the slight coat of rust on it, producing a clear metallic surface alloyed more or less with hydrogen gas. More hydrogen, being liberated against this surface, will either combine with itself and escape as gas, or will act on and reduce whatever oxidised substances are in intimate contact with the lead plate. If the current is too intense, some gas will certainly be evolved, but it takes a much stronger current to liberate free hydrogen from coated plates than it does to liberate free oxygen. There is, in fact, always a slight escape of oxygen, whereas it is easy to absorb every trace of hydrogen. The Pb_3O_4 thus gets reduced, first, no doubt, to Pb O, then probably to the sub-oxide Pb_2O, and finally to metallic lead. A growth of metallic lead, therefore, begins at the surface of the — plate, and spreads gradually out through the mass of oxide which coats it.

When lead is deposited in this way *from a solution*, as, for instance, from the acetate, it grows in a fantastic crystalline, or "tree," form, but when it is formed, as above, from an insoluble and closely packed powder, it forms a dense, coherent, though certainly porous, cake.

This is not the whole of the matter, however, for the coating consisted of some $Pb O_2$ and $Pb S O_4$, formed while standing in the acid, in addition to unaltered minium. The growth of metallic lead must sooner or later spread into districts occupied almost wholly by these substances, and the hydrogen will be liberated in contact with them. Now the peroxide offers no difficulty, it will naturally be reduced step by step down to metallic lead; but there is some uncertainty with regard to the sulphate. It is certainly *difficult* to reduce sulphate of lead by the action of nascent hydrogen, and if it exists in even small lumps it usually escapes action altogether. When, however, as in the present case, it is so intimately mixed with other substances which have been already reduced, that every atom of it, one may say, is in contact with a hydrogen generating surface, it is pretty certain that it does become reduced, with the re-formation of the free sulphuric acid which had been absorbed.

We observe, therefore, that during the operation of charging the cell, sulphuric acid is being generated at both the plates, so that ultimately the full strength of the solution is exactly restored; in fact it is a trifle stronger than it was, by reason of the absorption and evolution of the elements of water at the two plates. If the plates have been originally coated with a mixture of minium and sulphate of lead, mixed together with the intimacy of fire-work composition, fresh sulphuric acid is produced inside the coatings at the expense of the sulphate, in addition to that which had been absorbed on standing; the effect of this is usually to whiten, and sometimes to destroy, the cloth in which the composition is wrapped.

The sulphuric acid in any case produced or reproduced during the process of charging, is apt to sink towards the bottom of the cell by reason of its weight; and, especially if there has been no evolution of gas or thermal or other convective disturbance, it will be found that the solution near the bottom of a nearly charged cell is distinctly more acid than that near the top. The lower portion of the cell, therefore, conducts the current better than the upper portion, and accordingly it is common to find the bottom of the plates most acted on, and I have seen the composition there fully peroxidised and reduced respectively, while that near the top was as yet barely touched.

In an ideally perfect operation, however, the charging should proceed with absolute uniformity, beginning at the surface of the lead plates and gradually spreading outwards as a steadily advancing plane layer, until the free surface is reached; for in such a process the maximum of gas would be usefully absorbed, and the opposition electromotive force would be kept down as low as possible all the time. But it is next to impossible to secure this steady advance by the layer of operation; for besides the tendency to concentration of acid at the bottom of the cell, which tendency may be counteracted by agitation, the layer is very apt to protrude itself capriciously in one or more places; and wherever such a protuberance occurs it is sure to increase, because of the diminished distance between the conducting surfaces; so that a local growth of metallic lead, or of peroxide, is often found to have penetrated through the composition and to have reached the free surface, where it begins to spread out, screening off a quantity of unaltered substance behind it. The oxide so screened can ultimately be acted upon, because the screen is more or less porous, but it is a slow and wasteful process; it takes a pretty high electromotive force, and a good deal of gas is being uselessly evolved from the already completed portions while it is going on.

In order to diminish the chances of this local inequality of action, the thickness of the composition, and distance between the plates, ought to be very uniform, so that there be no thin places to offer less resistance to the current than others. Again, the edges of the plates ought in some way to be protected; for it is well known in electrolysis that the amount of deposit on the edges of a plate is greater than on the flat portions, and for the same reason the growth of the peroxide and reduced lead is pretty sure to be completed first at the edges and thence to spread over the front face, protecting the middle portions.

Finally, the liquid must not be allowed to become stagnant and of different densities. A fairly powerful charging current, by the heat it generates and the gas it evolves, automatically secures the uniformity of the liquid; though this can hardly be considered an economical mode of stirring. I am by no means sure that the plates would not do better if "formed" in a large electro-plating sort of tank, and afterwards inserted in their separate cells for use. When cells come to be made on a large, stationary, gasometer-like scale, various improvements may be introduced in the directions I am indicating, which in the small portable affairs now constructed are scarcely practicable.

Liverpool. O. J. L.

KRUPP'S MEPPEN EXPERIMENTS FOR 1882.

We have now received the official report of Krupp's trials at Meppen, of which we have only noticed hitherto the case of one experiment connected with plates, of which a cut and a few words were given in connection with the exhibition at Fishmongers' Hall.

We find from the report that the following pieces have been fired this year:—(1) and (2) Guns of 30·5 centimetres (12in.) and 15 centimetres (5·9in.) each, 35 calibres long, being examples of Krupp's new system, which is remarkable, Firstly, for the adoption of heavy charges, reaching the amount of even one and a-half the weight of a round shot of the calibre of the gun; Secondly, for the employment of specially heavy and consequently long projectiles; and thirdly, for the great length of the guns. (3) Mortar of 21 centimetres (8·3in.), resembling that fired in 1879. (4) Gun of 15 centimetres (5·9in.), with muzzle fixed by a ball joint in armour, before tried in the years 1877, 1878, and 1879. (5) Gun of 15 centimetres (5·9in.), fixed on a pivot—a long gun of 15 centimetres having replaced the gun of 8·7 centimetres (3·4in.) fired in 1879. (6) Gun of 8 centimetres (3·2in.) on spring pivot. This was employed to exhibit the reduction of pressure which with pivot guns is produced by even a very short recoil. There were present at the experiments officers representing the following Powers: Germany, Austria, Belgium, Brazil, China, Denmark, Spain, Holland, Italy, Japan, Norway, Russia, and Sweden.

The 30·5 cm. (12in.) and 15 cm. (5·9in.) long guns were fired for accuracy, velocity, and pressure on the bore. The 21 c.m. (8·3in.) mortar was fired for accuracy. The 15 cm. (5·9in.) gun—ball-and-socket pivotting muzzle—was fired for accuracy, speed, and trial of system. The 8 cm. (3·15in.) gun on spring pivot, and 15 cm. (3·9in.) gun on fixed pivot, were fired to show the action of the pivots, and armour-plate firing was carried on with the 15 cm. gun. These must be considered in turn.

The 30·5 cm. Gun (12in.) of 35 calibres in length.—In its construction this gun resembles those of the same calibre of 22 and 25 calibres in length, produced by Krupp's factory in previous years. This new gun differs from its predecessors materially only in having a bore suited to the employment of larger charges and of longer projectiles. This great length even does not give the same complete utilisation of powder as in the earlier guns. In the gun of 30·5 cm. of 22 calibres long, with a charge of 72 kg. (158·7 lb.), the proportion between the cubic contents of the bore and that of the combustion chamber was 6 to 1, while in the 35 calibre gun this proportion is normally only 4·6 to 1. In the experimental gun the combustion chamber had been prolonged, with the object of trying certain experiments, which reduced this proportion in the trials of last March 29th and 30th to that of 4·3 to 1. Now the utilisation of the powder depends much on this proportion. Thus, in earlier guns the gas has an expansion up to six times the space occupied before the shot begins to move, while the expansion only reaches 4·6 times in the new guns. Whilst in the first case each kilogramme of powder impresses on the projectile from 51 to 54 tonnes-metres of *vis viva*, only 44 tonnes-metres is attained in the second. To obtain an equal result then, a much greater quantity of powder is necessary. This, however, is only a question of expense. One very important fact should be recognised, namely, that the pressure of the gas at the muzzle is much greater when the expansion is less, consequently the gun decks of ships are liable to suffer when the turret or other guns are brought to fire along them.

This inconvenience may be partly rectified by reducing the combustion chamber, but at all times this expedient has the evil of an increase of pressure, and consequently a more rapid destructive effect on the gun. There only remains then the expedient of increase of length. To obtain in the new 30·5 cm. gun a six-fold expansion as in the old 30·5 gun of 22 calibres, it is necessary that the gun should be about 45 calibres long. Such a long gun may be placed without difficulty in an open battery, but not always in a turret or naval battery. These considerations caused the limit to be drawn at 35 calibres. The experimental gun of 30·5 cm. has the usual breech-closing fittings of Krupp guns. It is fired by self-closing tubes in an axial vent. Its principal dimensions are—calibre, 30·5 cm. (12in.); total length of gun, 10·7 m. (35ft.), that is 35 calibres; length of bore, 9·77 m. (32ft.); total weight, 49,700 kg. (48 tons 18 cwt.); number of grooves, 68; depth of grooves, 1·75 mm. (0·069in.). All the projectiles of the experimental gun of 30·5 cm. weigh 455 kg. (1003·1 lb.), and consequently vary in length. Steel armour-piercing* shell, length 3½ calibres = 1067 mm. (3ft. 6in.), bursting charge weight, 11 kg. (24¼ lb.); cast iron shell, 4 calibres = 1220 mm. (4ft.), bursting charge weight, 22 kg. (48½ lb.); steel common shell, 4½ calibres = 1372 mm. (4ft. 6in.); bursting charge weight, 49 kg. (108 lb.). Centering is effected by the metal of the projectile without a copper ring. The copper ring for rifling and check of gas is of a special form, with the object of making the base of the shell rest in the junction of powder chamber and rifled portion of bore, so as to prevent the development of scoring by the best possible obturation, as it is well known that these scoring injuries are formed and increase faster as the charge is larger. The charge is of prismatic powder channelled through and of 1·82 density. For firing the experimental gun of 30·5 cm. was placed on a carriage of 35·5 cm., which had already been used for many experiments in 1878 and 1879.

Results.—The 30·5 cm. long gun fired seventy-three rounds with varying charges and kinds of powder. The bore shows the commencement of scoring, otherwise it is almost uninjured, seeing that one can only detect enlargements of 0·1 mm. (·004in.). The results as to velocity and pressure, as well as those as to accuracy, were good. The powder known as H 3.82, made specially for this gun, proved to be the best. On March 27th with the projectile of the normal weight of 455 kg. (1003·1 lb.), with a charge of 147 kg. (324·1 lb.), an initial velocity of 526 m. (1725·8 ft.) was obtained with a pressure of 2665 atmospheres (17·5 tons) by Rodman's gauge, and of 2785 atmospheres (18·3 tons) by the crusher gauge in the powder chamber. This gives a total *vis viva* to the projectile of 6420 metre-tonnes (about 20,715 foot-tons), and *vis viva* per cm. circumference of 67 metre-tonnes (549·4 foot-tons). This amounts to 43·7 metre-tonnes per kilogramme of charge (20·64 foot-tons per lb.), or 130·5 metre kilogramme per kilogramme of weight in gun, or 423·5 foot-tons per ton of metal. On this trial a fact often noticed was very marked, namely, that the first round of each day imparted a higher initial velocity to the projectile than subsequent ones. This is attributed to the fact of the bore being clean. After the second round the velocities are uniform.

Special attention is called to rounds No. 1 and No. 2 of March 15th, which show very low pressures. With an initial velocity of 423·5 m. (1389 6ft.), and a projectile of 455 kg. (1003·1 lb.), the pressure is 1600 to 1700 atmospheres (10·5 to 11·2 tons); and with the initial velocity 489·3 m. (1605ft.) the pressure is 2325 atmospheres (15·25 tons). The velocities were measured at 100 m. and 1974 m. (109 and 2159 yards) from the muzzle, and on several days at 300 m. (328 yards) also. They accorded well with the results of calculation. The fact that on March 23rd the steel armour-piercing shell had at 2000 m. a less velocity than on March 23rd, in spite of its having a higher velocity at 100 m. from the muzzle, is to be attributed to the force of wind, which was 5·8 m. in one case, and 1·9 m. in the other. Too few rounds were fired to do justice to the accuracy of the gun, but enough to show that the projectiles of specially increased length carried as truly as the short ones.

On March 23rd and 29th were fired, each day, five rounds of armour-piercing shells of 3½ calibres length; and on March 27th and 29th five rounds each day, with similar projectiles 4 calibres long, against a target at a range of 2026 m. (2216 yards) with good results, the same range tables serving for the armour-piercing shell and common shell. The penetration of the 30·5 cm. gun was not tested, but of course the terms given above enable us to calculate it. Herr Krupp calculates with an initial velocity of 520 m. (1706ft.) a total stored-up work of 6276 metre-tonnes (about 20,230 foot-tons), 65·4 metre-tonnes per centimetre circumference (536·7 foot-tons per inch circumference), and 8·58 metre-tonnes per centimetre squared of cross section. This he compares with the 100-ton gun and 80-ton gun, to which he assigns the following data:—The 100-ton gun: Weight of shot, 917 kg. (2021·6 lb.); velocity, 520 m. (1706ft.); giving a total stored-up work of 12,638 metre-tonnes (40,780 foot-tons); work per centimetre squared of cross section, 7·92 metre-tonnes. The 80-ton gun: Weight of shot, 771 kg. (1700 lb); velocity, 489 m. (1604·4ft); giving a total stored-up work of 9397 metre-tonnes (30,330 foot-tons); work per centimetre squared of cross section, 7·26 metre-tonnes. Herr Krupp, on this system of calculation, assigns to the 30·5 cm. gun a greater penetrative power than either the English 100-ton or 80-ton gun, and he observes that the advantage is still more on the side of the 30·5 c.m. gun as the range increases. He also gives the actual powers of the gun against existing armour as follows:—

Name of ship.	Strongest armour.	The armour-piercing shell of the 30-5 cm. gun penetrates the armour normally	
		with a vis viva of tonnes-metres per centimetre of section.	therefore penetrates up to a range of metres.
Inflexible (English).	24in., plate upon plate, &c.	6·5	2200 (2406 yards)
Majestic, Colossus, Ajax, Agamemnon (English)	18in. compound armour	5·5	over 2500 (2734 yards)
Admiral Baudin, Formidable, Admiral Duperré (France)	21·7in. steel (probably)	8·3	200 (219 yards)
Hoche, Magenta, Marceau, Neptune (France)	17·7in. steel (probably)	6·4	2300 (2515 yards)
Caiman, Indomptable, Requin, Terrible (France)	19·7in. steel	7·3	1250 (1318 yards)
Dandolo, Duilio (Italy)	21·7in. steel	8·3	200 (219 yards)
Italia, Lepanto	29·5	10·5	Not penetrated at all

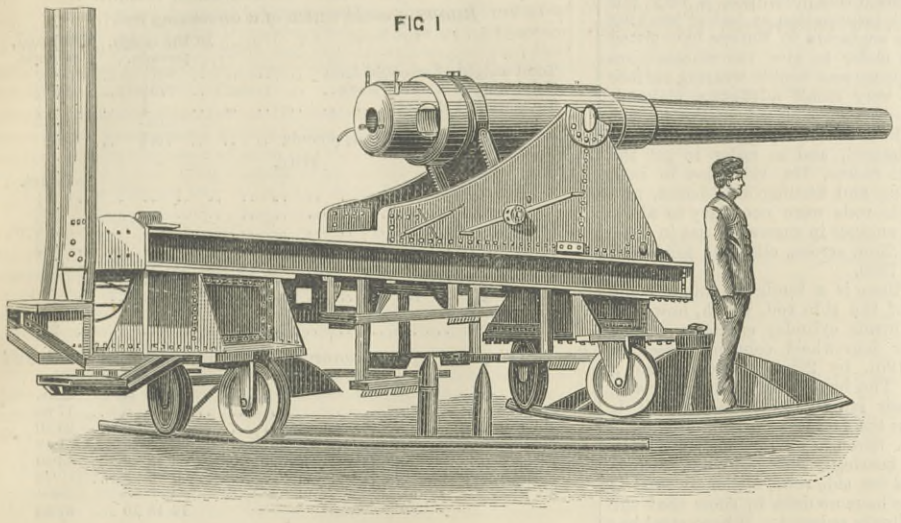
This table shows the Inflexible, Majestic, Colossus, Hoche, Majenta, &c., penetrated normally at all fighting ranges; the Caiman, &c., at short ranges; and the Admiral Baudin, Dandolo, and Duilio at the muzzle.

The 15 cm. gun of 35 calibres in length—*vide* Fig. 1—is constructed on the same principles as the 30·5 cm. gun of 35 calibres. The only difference in the construction consists in the fact that the 30·5 cm. gun is built up of more hoops than the smaller piece. The dimensions of the 15 cm. gun are as follows:—Calibre, 14·91 cm. (5·87in.); total length of gun, 5·220 m. (17ft. 0·73in.), 35 calibres; length of bore, 4·800 m. (15ft. 8·98in.), 32 calibres; weight of gun, 4750 kg. (4 tons 13½ cwt.); number of grooves, 36; depth of grooves, 1·5 mm. (0·059in.). The projectiles are all of the weight of 51 kg. (112·44 lb.), but it is of course possible to employ lighter ones if a high velocity and flat trajectory at short range is desired. The projectiles are as follows:—Armour-piercing steel shell, length 500 mm.

* "Obus de rupture,"

KRUPP'S GUN AND TARGET EXPERIMENTS AT MEPPEN.

FIG 1



HORIZONTAL SECTION
FIG. 2

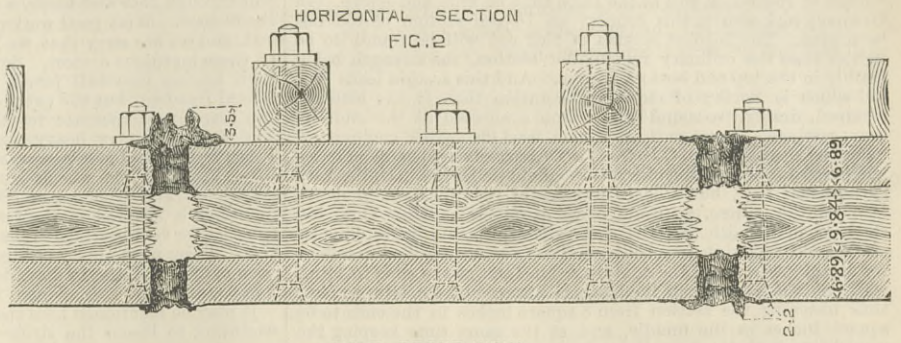


FIG. 3 FRONT VIEW

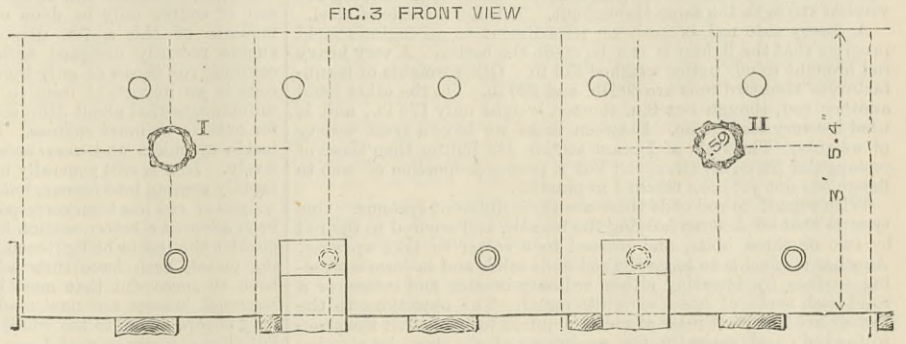
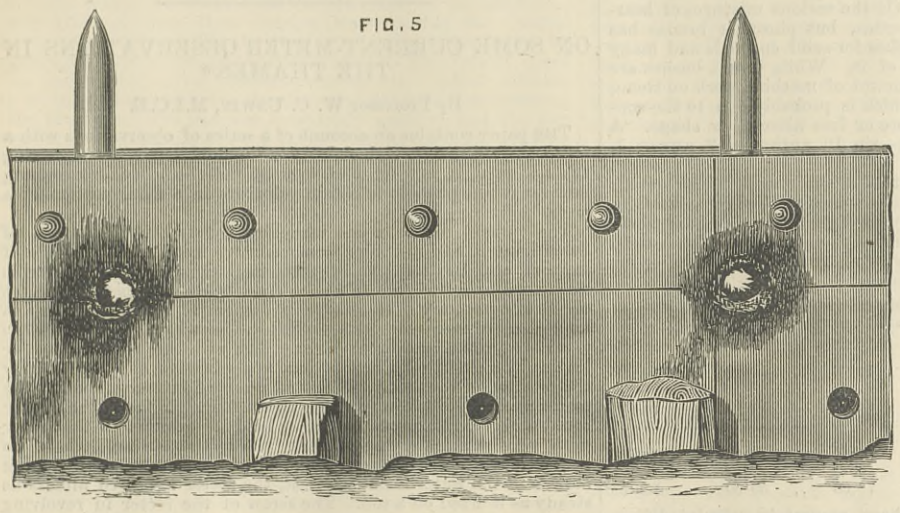


FIG. 5



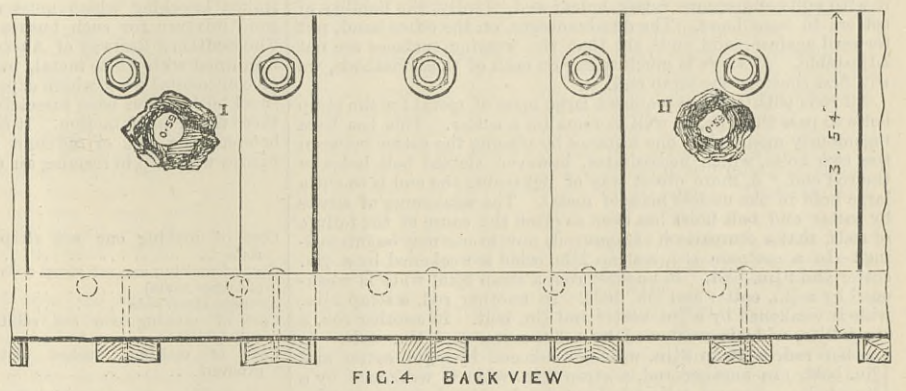


FIG. 4 BACK VIEW

FIG. 6.

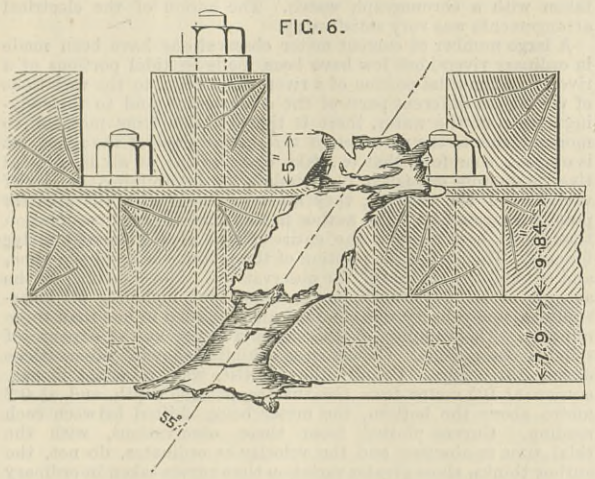
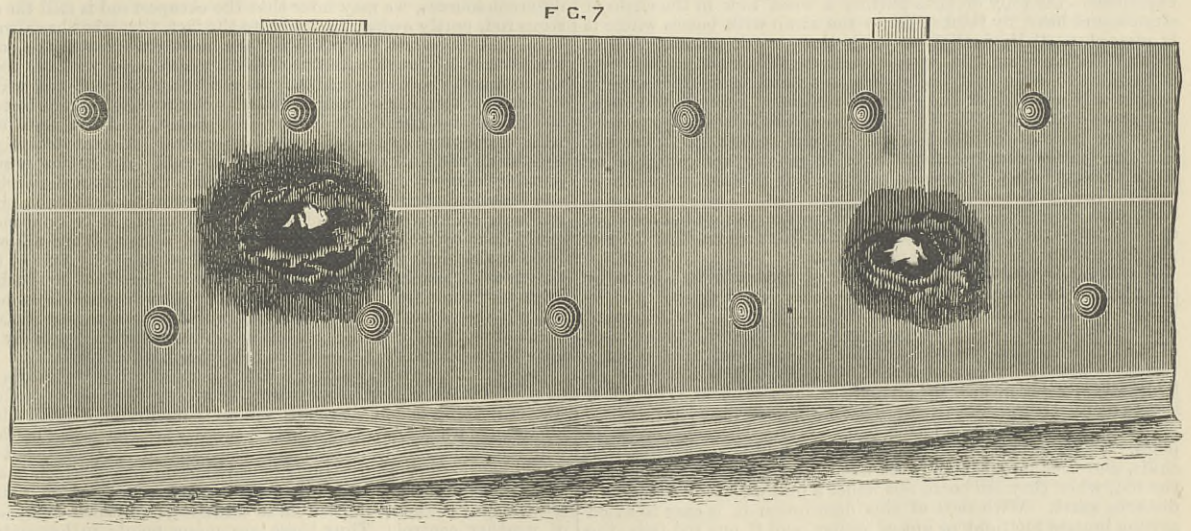


FIG. 7



(1ft. 7·68in.), or 3·35 calibres ; weight, 51 kg. (112·44 lb.); bursting charge, 1·5 kg. (3·5 lb.). Common cast iron shell, length 596 mm. (1ft. 11·57in.), or 4 calibres ; weight, 51 kg. (112·44 lb.) ; bursting charge, 3·4 kg. (7·5 lb.). Common steel shell, length 670 mm. (2ft. 2·38in.), or 4·5 calibres ; weight, 51 kg. (112·44 lb.); bursting charge, 6·2 kg. (13·7 lb.) The projectiles resemble those of the 30·5 cm. gun in form. The charges are of prismatic powder with one perforation, and of density 1·75 to 1·8. The gun was mounted on a coast carriage formerly employed with a 15 cm. gun 30 calibres long.

The results of firing were as follows : The bore was almost without scoring marks after firing :—Highest result, charge 18 kg. (39·68 lb.) ; weight of projectile, 50·5 kg. (111·3 lb.) ; initial velocity, 556·7 m. (1826·6ft.); pressure, Rodman 2585 atmospheres (16·95 tons) ; English instrument, 2695 atmospheres (17·70 tons) ; stored-up work, 797·9 metre-tonnes (2576 foot-tons) ; work per kilogramme of powder, 44·32 metre-tonnes (143 foot-tons). The normal charge of the 15 cm. gun is 17 kg. (37·5 lb.), with which the steel armour-piercing projectile weighing 51 kg. (112·44 lb.) has an initial velocity of 538 m. (1765·1ft.). The mean pressure was about 2600 atmospheres (17·1 tons). The accuracy of the long projectiles was very good. This gun was fired against two targets of armour at a range of 150 m (164 yards) from the muzzle. One of these was for direct impact. It was made up of two wrought iron plates, each 18 cm. thick—apparently more exactly 17·5 cm. (6·89in.) *vide* Fig. 2—(7·09in.) with an intermediate layer of wood 25 cm. thick (9·84in.). Figs. 2, 3, and 4 show the construction of this target.* Krupp calculates that the 15 cm. gun requires 3·9 tonnes-metres *vis viva* per cm.² of cross section. Hence he would expect the 15 cm. shot to penetrate with work to spare. The trial showed this to be the case. On March 28th a projectile was fired with 18 kg. of powder, which passed through and struck the ground intact 1110 m. (1213·9 yards) up the range. The point was slightly set up—*vide* 5, on top of plate. On March 30th an armour-piercing shot with a charge of 17 kg. also passed through the plate. The projectile was recovered uninjured at 300 m. (328 yards) up the range. These two projectiles are depicted in Fig. 5 taken from a photograph, standing on their bases above the holes made in the plate. The second target was for impact on an angle of 55 deg. (35 deg. to the normal). It consisted of a wrought iron plate of 20 cm. (7·9in.) in thickness, a layer of wood of 25 cm. (9·8in.), and a skin of 2·5 cm. (0·98in.)—*vide* Figs 6 and 7. On striking direct the 15 cm. steel armour-piercing shot penetrated this with a *vis viva* of 2·5 tonnes per cm.² of cross section.

In oblique fire the formulæ requires a correction of $\frac{1}{\sin.^2}$ angle of incidence. An angle of 55 deg., a *vis viva* of $\frac{2{\cdot}5}{\sin.^2 55} = 2{\cdot}5 \times 1{\cdot}5 = 3{\cdot}75$ tonnes-metres per cm.² of cross section. This, then, is necessary for perforation. Hence one can reckon on perforation with the service charge giving 3·9 tonnes-metres per cm.². The target was completely penetrated, both with 18 and 17 kg. (39·7 and 37·5 lb.) charges of powder—*vide* Fig. 6; also Fig. 7, front view, the projectiles being broken up by the oblique blow. The three plates employed appeared to be of excellent quality.*

Herr Krupp observes that the great progress which brings this result before us is apparent, if one traces the development of guns of 15 cm. since the introduction of breech-loading guns. In 1864 it was impossible with a 15 cm. (5·9in.) gun to perforate a plate of 10 cm. (3·9in). ever. The gun was not strong enough, the shot not sufficiently rigid. In 1868, near Berlin, the 15 cm. gun just penetrated a 15 cm. (5·9in.) plate. At that time it was thought that at short ranges guns might perforate plates their own calibre in thickness. Now, in 1882, at Meppen, the 15 cm. gun fired directly perforated two plates, each of which is considerably more than its calibre in thickness, and, at an angle of 55 deg., a plate of the thickness of $1\frac{1}{3}$ its calibre (7·9in.). In 1868, at a short range and by direct fire, this last target was just penetrated by a 24 cm. (9·45in.) gun. Hence the 15 cm. gun possesses now $1\frac{1}{2}$ times the power of penetration of the 24 cm. gun of 1868. The ironclad ships considered impregnable at that time could not now resist the small 15 cm. calibre gun.

With 20 deg. elevation a range of 8900 m. (9624 yards) was obtained. The coast gun carriage allows of an elevation of from 27 to 28 deg., at which a range of 11,000 m. (12,030 yards) is obtained. The 15 cm. gun, then, is not only a good coast and naval gun, but a useful siege piece or gun for the defence of forts, to oblige the besieger to establish his parks at a great distance.

* In The Engineer of May 5th, 1882, a cut will be found showing a section at the place perforated, but it is given here more completely because questions may be raised as to the bolting together of the plates, &c.

* We understand that these plates were obtained from the German naval authorities, who had obtained them from England, either from Messrs. Cammell or Brown.

LOCOMOTIVE COUPLING RODS.

We give the following report of the Committee on Coupling Rods, submitted to the recent convention of Master Mechanics at Niagara Falls :—Side rods have very commonly been considered one of the necessary evils in locomotive construction since the time when the earliest engineers discovered that the tractive force of one pair of wheels was not sufficient to haul heavy trains. Efforts have been made to abolish them altogether, notably in Mr. Webb's compound locomotive, where the cylinders are arranged to work on two different axles. Also in Mr. Strong's driver coupling, which by lengthening piston rod and guide bars some 8ft. enables him to place two connecting rods to each cylinder. And the new Fontaine engine, in which the upper wheel drives two lower ones by friction; but as it is not certain that these efforts will revolutionise ordinary practice, it is important to ascertain what is the best form of side rod to adopt.

The duty of a side rod is to transmit a rotary motion from the main driving axle to other parallel axles ; to do this it must be stiff enough to transmit a thrust along its length without buckling. At high speeds it must be sufficiently strong to resist its own momentum ; it must also have ends forming good bearing surfaces. The first of these is amply satisfied by every section in use, as rods have to resist greater strains than this. As to the second, however, it is curious to notice in the history of coupling rods, the gropings of engineers after a section of rod which is at the same time light, cheap, and rigid, especially in a vertical direction. There are many rods still running of a circular section throughout; these are cheap of manufacture, but being of the same rigidity, both vertically and horizontally, they are disproportioned. This was somewhat improved upon by making rods of elliptical section, but this was too expensive for a finished rod. Again a favourite way with some builders of heavy freight engines is to make their rods thick as well as deep rectangular bars. This is when the engine is not expected to run fast.

Passing from this we find the ordinary proportion of rod to be

about 1½in. multiplied by 4in. And at the opposite extreme we have on a great many railroads a rod with the middle section of about 1¾in. multiplied by 5in., that is, four times as deep as broad. Several attempts have been made of late years to find a lighter section of rod which will at the same time be stiff and cheap. In Germany and also in this country an I-beam section of rod has been used. The finished section of this rod will be found to be lighter than the ordinary rectangular section, the strength being mainly in the top and bottom flanges. And this section leads to a rod which is worthy of more consideration than it has hitherto received, simply two round bars of iron connected at the ends by brass castings. These rods have been used on switch engines and have given satisfaction. There is a curious divergence of practice with regard to the section of rod throughout its length. Uniformity is the usual rule, but a large number of rods increase in depth towards the centre, in some cases as much as 1in. One rod thickens in breadth towards the centre ¼in., this being done by planing the rod while in a bent condition; while another excellent rod is thinned out in the middle from 1⅝in. at the ends to 1¼in., while at the same time its depth is increased from 4¼in. to 5in., thus lessening the section from 8 square inches in the ends to 6¼ square inches in the middle, and at the same time keeping the vertical strength the same throughout. This rod is made of steel.

A heavy side rod is such an impediment to an engine's rapid progress that the lighter it can be made the better. A very heavy rod brought to our notice weighed 314 lb. Other weights of manufacturers' standard rods are 302 lb. and 320 lb. On the other hand another rod, though but 9in. shorter, weighs only 170 lb., and is used for very fast traffic. Between these we have a great variety of weights. The rods of I-beam section are lighter than those of rectangular for equal strength; but a proper proportion of web to flange has not yet been reached in practice.

With regard to rod ends there are three different systems. One type is that of a strap holding the brasses, and secured to the rod by two or three bolts, and pierced by a cotter to take up wear. Another method is to forge the rod ends solid, and to form a wearing surface by inserting either ordinary brasses and cotter, or a solid bush made of brass or white metal. The objections to the former are the great mass of metal required to firmly bolt the strap to the rod; and, secondly, the weakening of the strap by piercing it with bolts and square cotter holes; and, thirdly, the liability of cotters to come loose. The disadvantages, on the other hand, put forward against solid ends are that the wearing surfaces are not adjustable. As there is much to say on each of these methods, we will first consider the strap end.

All rods with a strap require a large mass of metal for the strap bolts to pass through, as well as room for a cotter. This has been ingeniously modified in one instance by placing the cotter between the two bolts, which necessitates, however, slotted bolt holes in the rod end. A more direct way of lightening the end is to cut a large hole in the useless mass of metal. The weakening of straps by cotter and bolt holes has been so often the cause of the failure of rods, that a comparison of some rods now in use may be interesting:—In a common rod, a strap 2½in. wide is weakened by a ¾in. cotter and 9⅞in. bolt. In another rod, a strap 2⅝in. wide is weakened by a ⅞in. cotter and ⅝in. bolt. In another rod, a strap 2½in. wide is weakened by a ⅞in. cotter and ⅝in. bolt. In another rod, a strap 2½in. wide is weakened by a ¾in. cotter and 1in. bolt. In another rod, a strap 2½in. wide is weakened by a ⅞in. cotter and 1⅛in. bolt. In another rod, a strap 2¼in. wide is weakened by a 1⅛in. bolt. Several railroads have lately found—probably by experience—the folly of thus putting a weak link in the chain of strains, and have, by thickening up the strap with bosses where it is pierced, partially done away with these weak points. A ¾in. cotter hole in a strap 2½in. wide is strengthened by adding in bosses a little more than half the stolen area; and in another case by adding only one-fifth of the required additional strength in bosses. The same objection holds against solid end rods which are pierced by cotter holes to adjust brasses. In one case the weakening of the ¾in. cotter in a rod 2¼in. wide is exactly compensated by strengthening bosses on top and bottom; but in another case only half the area of the cotter hole has been added. These solid-ended rods, with bosses and a cotter, are more secure and lighter than the strap rods, but, on the other hand, builders assert that it costs more to fit these rods up than strap rods.

A still further step in the lightening of rod ends was taken by substituting solid bushes for adjustable brasses, and this method, so light, so secure, and so exact in its centres, is coming into general use. The rod end, which is generally in one piece with the rod and of steel, is bored out in a boring mill, the last tool used being a reamer of standard size, and a bush is pressed into this hole by hydraulic or other means, the pressure used being about 35 tons, and is then secured either by a taper pin passing through the joint, or by a key cast on the bush, the latter being rivetted over when in its place. These bushes, when made of white metal, are cast in iron chills, and need no machine work until after they are pressed into the rod, when they are bored out under a mill with tools a standard distance apart. With rods of this description it is easy to avoid getting brasses too tight or out of centre, and if one rod fails, the rod on any other engine can be substituted for it. It is most interesting to note what Mr. Stroudley, of the London, Brighton, and South Coast Railway, England, has to say of his ten years' experience with this class of rods. A letter from Mr. Stroudley on the subject to your committee will be found attached to this report.

The strength of cotters requires consideration, as they are a frequent source of failure; the main point is to make the cotter not only able to stand its strain without breaking, but to make it so strong that under its working strain it shall never be even deflected, as such a deflection causes a pinching and loosening of brasses. The usual breadth of cotters seems to be ¾in., though we find a ⅝in. cotter in a very neat, strong rod, and a ½in. cotter in another much-used rod, but it is unadvisable to increase this on account of weakening the strap; but its depth might in many cases be increased with advantage, *e.g.*, a light but very common section of cotter is ⅝in. by 1⅜in. in the middle, while Mr. Stroudley's cotter for a connecting rod small end measures 1in. by 3½in. in the middle. In comparing these, though the ordinary working strain on a side rod is only half that on the main rod, the former ought to be as strong, if not stronger, on account of the sudden shocks to which the main rod is not subjected. Another minor question on this subject of cotters is, whether it is a real disadvantage to place the cotters at both ends of a rod on the inside. The objection to the above-mentioned arrangement is, of course, that any closing of brasses leads to a corresponding lengthening of the centres of the brasses, unless the back of the outside brass be carefully lined up. The disadvantage, on the other hand, of placing the cotter on the outside of one end, is a heavier end and less uniformity.

A modification of the strap and cotter, that of a screw adjustable wedge, has been neatly applied to side rods in one instance. In the place of the ordinary cotter hole, only the top half of the strap is pierced by a 1in. set screw with lock nut, which raises or lowers the wedge, the latter having a taper of 1 in 4 at the back of the brass. It would be interesting to know if these wedges, with so steep a taper, have lasted well or not. And this brings us to the subject of the right taper for cotters. The variety in use may be gathered from a dozen examples—of cotters secured by a set screw, three have a taper of about ⅝in. to 1ft., four have a taper of about ¾in., and two have a taper of about 1in. We find cotters secured by a screwed end with tapers of ⅝in. and ¾in. to 1ft. Mr. Stroudley's cotter has only ¼in. taper to 1ft. The most recent heavy freight engine on the London and North-Western Railway has only two cotters in its whole structure, these being where the piston rods are connected to the crossheads, which shows the strong feeling against the use of cotters on this railway.

A very neat cotter is a German idea, where the cotter is in two pieces placed one on each side of the road, and pressing against the flanges of the brasses; a bolt through cotters and rod holds them tight. The greatest advantage for this end seems to be that instead of piercing the rod with a slotted hole, the cotter bearings are made by simply planing a step on each side of rod. Another variety of a style very common in German designs is that of dovetailing the block into a forked end and securing it there by a light bolt through fork and block, a cotter being used as usual to close the brasses. With good workmanship this must form a very fair end, and we are sorry that we lack information as to the working of these ingenious devices. Some engineers in Europe have fitted their brasses into ball joints, in order to give the wheels more lateral freedom, but the extra expense and double wearing surface can scarcely compensate for the very small advantage claimed. The rods of a very heavy eight-wheeled coupled engine on the Paris, Lyons, and Mediterranean Railway are equipped with these ball joints. All the wheels are flanged, and in order to get the engine to traverse curves of 580ft. radius, 1in. side play in each direction is allowed in the leading and trailing axle boxes, and spherical or ball bearings in the side rods were necessary to allow this. There were ninety of these engines in successful use in 1880 with cylinders 21½in. in diameter, 20in. stroke, climbing grades of 1 in 33, and were first adopted in 1869.

It may be mentioned here that there is a tendency among some engineers to lessen the strokes of the side rod, which, however, can of course only be done on inside cylinder engines; as one instance of this a 7ft. diameter four-wheel coupled passenger engine recently designed with 19in. by 26in. cylinders has a coupling rod throw of only 18in. The breadth of bearing for side rods is an important item in their length of service, and it is unfortunate that about 3½in. seems the greatest breadth obtainable for outside cylinder engines. Mr. Stroudley's engines have both inside cylinders and very broad bearings, 4½in. and 6in. respectively. Iron is still generally used for side rods, although steel is rapidly coming into favour, but we have no data to show that the weight of rod has been correspondingly reduced. Where steel has been adopted a better section has generally also been used, which enables the rod to be lightened. Of the various mixtures of bearing metal, each have their advocates, but phosphor bronze has been so successful that most bushes for solid end rods and many sectional brasses are now made of it. White metal bushes are very cheap, owing to the small amount of machine work on them, but they sometimes work loose, which is probably due to the continued knocking which must more or less alter their shape. A good mixture for such bushes is—tin 16, antimony 2, copper 1. The Southern Railway of Austria make their bearings of wrought iron lined with white metal, but this seems one of those details of continental work where expense is not an item of consideration. Steel bushes have been successfully used for wrist pin joints where there is not much motion. It is difficult to make a fair comparison between the cost of different styles of rods, but the following figures will help in forming an opinion:—

	Material and smith work. dols.	Machine labour. dols.	Total. dols.
Cost of making one set strap rods	72·00	50·00	122·00
Cost of making one set strap rods (another style)	48·00	33·00	81·00
Average strap rods	60·00	41·50	101·50
Cost of making one set solid end (steel)	81·50	63·50	145·00
Cost of making, bushed and grooved	72·00	50·00	122·00

From these figures, which have been accurately calculated from different sources, we may infer that the cheapest rod is still the old strap rod, partly owing, no doubt, to the fact, that what has always been made is easiest made. That the next cheapest is the solid bushed end, although with fluted sides, which is, as we have seen, the best rod where standard lengths can be maintained, and which bids fair, with a little practice, to be as cheap a rod to manufacture as the common strap ended one; and, lastly, that the solid end with brasses and cotter is the most expensive. A great deal might be said on the time spent on finishing off rods. An engine is supposed by many people to be handsome when its parts are polished and its colours brilliant, and to accomplish this much valuable time has been spent and acres of emery cloth used; it is now more easily done by means of emery wheels, and some rods are allowed to go out straight from the grindstone and be painted. One of the largest railroads in England does not permit the rods to be touched after they come from the planer, but consider that a rod looks best when it shows least sign of laborious work. For a similar reason much of the bevelling of edges has been discontinued, especially in busy times when it is necessary to get out work quickly.

In conclusion we may ask, are alterations and improvements to be made by the suggestion of reason, or are we to go on in the old way of keeping to old methods, and only modifying a piece when numerous failures have proved the necessity? The latter method will, no doubt, in time eliminate the evils of weakness, but it would never show up the superfluously strong places which make an engine clumsy. On the other hand there are strains on a side rod which it is almost impossible to calculate, and which conditions of weather control. Thus there are many points in locomotive engines, even in the small subject of side rods, which will have to be modified, until some day we may have a locomotive whose parts are so admirably proportioned that no one shall be stronger or weaker than another; when every part will be able, like every perfect organism, to perform its own duty with perfect ease and safety.

The extract from Mr. Stroudley's letter is as follows:—"I enclose you tracings of my standard connecting and coupling rods. Each rod is forged out of a solid piece. We have 238 engines fitted with them, fifty are of the small size, the remainder being uniform with the drawings, but all alike in design. All of the connecting rods have been fitted up by one man, who receives them from the machines and puts in the brasses, cotters, bolts, &c., and finishes the rod entirely. The same fitter also puts up the rods under the engine and keeps the whole of them in order, no other man being employed for rod repairs. The bolt which holds the small end strap together prevents the wear by making the strap and rod quite solid, and the cotter has sufficient strength to prevent its deflecting; there is, therefore, no wear on these parts, which usually go to pieces quickly when fastened with the old-fashioned gibs. The large end is bored out and the brasses are all turned to gauge, so that at out stations the driver can remove a set of brasses and put in spare ones without the use of a file; the worn brasses are sent to head-quarters and are filled up with white metal and re-bored to be used for any other engine. In the case of side rods I have a great number that have been running since 1871-2-3 to the present time without renewal to the bushes or pins. In no case has such removal been required, except where the driver has neglected the oiling. One of the large goods engines built in these works in 1871 was in the shops when the Iron and Steel Institute visited Brighton in 1881; the side rods were as close a fit after running ten years as when new, less than $\frac{1}{16}$in. play on the pins, and they were of course sent out without any further work on them. Many of the engineers visiting the works were much struck with this durability, which is no doubt largely due to the use of case-hardened pins. We have these rods on express, tank, and goods engines, the lengths being the same in each case. The side rods are thicker in the centre than at the ends. We plane them in an ordinary planing machine, bending down the rod at one-half the required increase of thickness, and after one side is planed the iron is turned over, bent down the reverse way, and when it is finished it is symmetrical and properly curved. I may here mention that not one of these rods has broken. I place the outside crank on the same side of the axle as the inside crank. The outside throw is 10in. and the inside 12in. and 13in., according to the size of the engine. The rod ends are case-hardened and the bushes forced in and held by a pin as shown in drawing; these bushes do not get loose. In designing locomotive details I consider what is required to be done, and our present means of manufacture, instead of following old-fashioned designs which were good enough in their day, when tools and materials were very different from what they are at present. I shall feel extremely obliged if you will give me a copy of your report and some similar details of the cost of manufacture and durability of American designs.

LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.

Details of construction of a connecting rod.

	In the rough, pounds.	Finished, pounds.
Total weight of wrought iron	627	347¾
Total weight of brass work	79½	53⅜
Total weight of steel	¾	½
Total weight of rod, pounds	707¼	402

TIME.

	Hours.
Smith's time forging	15¼
Turning	56¾
Drilling	27¼
Slotting	19¾
Planing	36
Fitting	70
Moulding	1
Total	226

Summary of cost of one connecting rod (including material and labour.)

	£ s. d.	dols.
Smith's	3 13 6	17·64
Machines	5 5 5	25·30
Moulders	0 4 8	1·12
Fitters	3 10 0	16·80
Marking off	0 3 3	·78
	12 16 10	61·64

ON SOME CURRENT-METER OBSERVATIONS IN THE THAMES.*

By Professor W. C. Unwin, M.I.C.E.

The paper contains an account of a series of observations with a screw current meter, undertaken for the double purpose of testing the action of a new form of current meter and of determining how far it was possible to obtain velocities in a tidal portion of a river.

The current meter is one made by Messrs. Amsler Laffon, of Schaffhausen, and it differs from ordinary meters in the mode of support and in the use of electrical signals. The meter is suspended by a wire, which also carries below the meter a weight of 40 kilogrammes. The meter is suspended in gimbals, and is kept directed up-stream by a conical rudder which governs both its vertical and horizontal movement. The wire can be wound up or let out by a small crab, which has a graduation showing exactly the position of the meter. The first point of interest in using the meter was the directive power of the rudder. So far as the author could observe, the suspended meter held its position in the water with very satisfactory steadiness. Near the surface, where its position could be observed and where certainly the eddying motion of the water is not smallest, the meter appeared almost as steady as if fixed on a rod. The screw of the meter in revolving makes an electrical contact at every 100 rotations, and this rings a bell above water. The time of 100, 200, or 300 rotations was taken with a chronograph watch. The action of the electrical arrangements was very satisfactory.

A large number of current meter observations have been made in ordinary rivers, but few have been made in tidal portions of a river. In the tidal portion of a river, in addition to the variations of velocity at different parts of the cross section and to the eddying motion of the water, there is the variation from moment to moment, due to the variation of the surface slope of the river. It is obvious, therefore, that to make observations at all in a tidal river, numerous enough to furnish data for determining the law of variation of the velocity, they must be made with the greatest practicable rapidity. The author in this preliminary investigation thought it best to take the entire charge of the current meter himself. He shifted the position of the meter, observed the time, and entered the records of the observations. Nevertheless, on the average of six days' work, it was found that, including all interruptions, one velocity was obtained and recorded in less than three minutes. This rapidity of observation was not at the expense of reliable observation. Curves were exhibited showing observations during three tides. Usually the velocities were observed in succession at 0·5 metre from the surface, at mid depth, and at 0·2 metre above the bottom, the meter being shifted between each reading. Curves plotted from these observations, with the tidal time as abscissæ and the velocity as ordinates, do not, the author thinks, show greater variation than curves taken in ordinary rivers.

The observations were taken opposite Craven Cottage, Putney—about ten miles below the weir at Teddington—and at Westminster. They were in depths of water reaching nearly 30ft. They were intended to throw light on the velocity and volume of flow during flow and ebb, and on the relation of the flow to the amount of upland water. The author does not propose to give the calculations at present of these quantities, but it may be observed generally that the vertical velocity curve is similar to that of an ordinary river during all periods of the tide. Contrary to some other observations, within a very short period of the commencement of flow or ebb, the sub-surface velocities bear the same relation to the surface velocity as at other and later periods of the tide.

The Electric Light at Hull.—On Thursday, the 28th September, the electric lighting of some of the streets of the old town of Hull was officially inspected by the Mayor of Hull and the Lighting Committee. The party assembled in the town hall at 7 p.m. and witnessed the starting of the lights in the various rooms and passages. Six arc lights of about 1000-candle power each supplied from an SD_8 machine, and about a hundred Swan incandescent lights of 16-candle power each, worked by two SD_2 machines, are employed for lighting up the building. Later on the lights in the streets were started, comprising four 3000-candle power lights each worked by a D_7 machine, and twenty-two 300-candle power lights worked by a W_1D_7 machine in two circuits. The four strong lights are suspended from William's tubular poles about 50ft. above the roadway, and are enclosed in lanterns similar to those in use at the Royal Albert Dock. They are placed, one on the pier, the second on the Market Place, the third behind Trinity Church, and the fourth in Whitefriars Gate near the bridge over the docks. The smaller lights are on lamp-posts exactly similar to those used last year in thy city of London, and are distributed over the principal thoroughfares at about 100 yards distance from each other. The station is situated in the yard of Messrs. King and Co., South Church Side, and contains two 12-horse power compound semi-portable engines supplied by Messrs. Wallis and Steevens, of Basingstoke, each of which is capable of working the street lights alone. Suitable arrangements are also provided for measuring the currents and for interchanging the machines. The town hall is about 1000 yards distant from the station, and the two circuits of the smaller lights measure 1930 and 1700 yards respectively. The lighting was witnessed by a large crowd of people, who expressed themselves as very well satisfied with the result, and it will be continued for the next twelve months. The contract has been carried out by Messrs. Siemens, Bros., and Co., the work being done under the superintendence of Mr. F. W. W. Melhuish.

* British Association, Section G.

RAILWAY MATTERS.

It is stated that the Eastern Railway Company of France has entered into a contract with the Tommassi Company for the electric lighting of several of their trains.

It is believed that Austria, being discontented with the result of the Conference of the four Danubian States, will at once commence the construction of the Austria and the Danubian Railway, that Power claiming that she has already obtained consent of the signatory Powers to the Berlin Treaty.

Two passenger trains met at Hutchinson, Kansas, a few days ago, through a misplaced switch. The engines crashed together, wrecking the forward cars of both trains. The wreck caught fire, and both drivers and both stokers were killed and their corpses burnt. Six passengers were killed and several wounded.

A plan of the proposed underground railway from King's-cross to Charing-cross, and the Victoria Railway Station, Pimlico, has been lodged with the Metropolitan Board of Works, and the Board requested to express its views as to the carrying of the railway beneath the surface of the new street about to be made by the Board between Tottenham Court-road and Trafalgar-square. The request was referred to the committee for consideration and report.

On Saturday evening last a serious collision of an alarming character occurred on the London and North-Western Railway at Crewe, fourteen passengers being injured, some very seriously. It appears that an excursion train from London to various seaside resorts in the North arrived at Crewe Station, and drew up in the west bay for the purpose of allowing passengers to change. As some of them were getting out a train from Nantwich, due at the same time, ran rapidly into the bay occupied by the excursion carriages, the force of the collision being very severe.

Shortly before four o'clock on the afternoon of the 22nd ult., as the Midland train from London was entering the Central Station, the Liverpool *Weekly Post* says, the vacuum brake by some means failed to act, and the train ran at a high rate of speed to the end of the arrival platform, coming into violent collision with an empty van which was standing against the buffers attached to the platform. The van was completely wrecked, and the two buffers and their supports were forced out of position, carrying with them several flags and a portion of the foundation of the main platform. The ornamental ironwork dividing this platform from the "dock" was also broken.

A new railway, extending the Great Northern system to Leicester, has been opened for traffic just forty years after the opening of the first piece of railway work from Leicester to Swannington, which proved the beginning of the Midland system. On that occasion George Stephenson was present with his engine, the Comet, and the passengers were carried in open trucks, with seats across. While going through the tunnel the chimney of the Comet was knocked down, having come into contact with the roof. On emerging it was necessary to stop to enable the passengers to alight and wash their faces in a brook. The opening ceremony the other day was not similarly attended. The station buildings at Leicester are of a most substantial character, the cost being over £80,000.

The Kinzua Viaduct, on the extension of the Bradford branch of the New York, Lake Erie, and Western Railway, is said to be the highest in the world. It spans a deep ravine, at the bottom of which flows the Kinzua creek, in McKean county, Pennsylvania, three miles from Alton, the present terminus of the Bradford branch. The structure is 2052ft. long between abutments, and 302ft. high from the surface of the ground to the base of the rail, and consists of continuous lattice girders supported on twenty iron towers, formed by columns strongly connected together by bracing. These towers have a uniform length at top and bottom of 38ft. 6in., a width at top of 10ft., and at the bottom the width varies with the height, the two highest towers having a width at their bases of 102ft. 9in., the width of the towers at their bases being uniformly one-third of their height from the top of the masonry on which they rest to the underside of the girders. There are twenty clear spans of 61ft. and one of 62ft. in length.

French official statistics give the total length of working railways in Europe on December 31st, 1880, as 168,419 kilos., and on December 31st, 1881, as 172,372 kilos., the total increase in 1881 being thus 3953 kilos., or 2·35 per cent. of the extent worked in the end of 1880. France shows the greatest increase, viz., 1411 kilos., or 38·45 per cent. in the total increase. Looking at the absolute development of the system of each country, without taking into account the proportion relatively to the surface, it appears that the European States rank as follows, with regard to importance of railway systems :—Germany, 34,314 kilos.; Great Britain and Ireland, 29,232 kilos.; France, 27,585 kilos.; Russia and Finland, 23,529 kilos.; Austria-Hungary, 19,126 kilos. Then follow in order, but with railway systems the most important of which is under 10,000 kilos. :—Italy, Spain, Sweden and Norway, Belgium, Holland and Luxembourg, Switzerland, Denmark, Roumania, Turkey, Bulgaria, and Roumelia, Portugal, and lastly Greece, which has only 10 kilos. of railway.

Decisive action is being taken in Holland so as to prevent the recurrence of accidents, such as we often chronicle in this country, as due in their effects to the want of a good automatic brake. A Royal decree has been issued which will come into force in May, 1883, with the commencement of the summer service of trains on the railways. Article No. 84 of the General Regulations is thereby superseded by the following order, viz. :—"For express trains running at a greater speed than 60 kilometres—37½ miles—per hour the engines, tenders, carriages, and vans must be provided with automatic continuous brakes of a system prescribed or approved of by the Minister of Public Works." Similarly "automatic brakes of such prescribed or approved system will have to be fitted to the engines, tenders, carriages and vans of those passenger trains which do not run at a greater speed than 60 kilometres—37½ miles—per hour, as the Minister of Public Works may order." This is no permissive decree, but makes it absolutely necessary to provide all trains with a good brake, as should be done in this country.

A piece of railway was opened on the island of Reunion, in the Indian Ocean, in February, between St. Louis, St. Denis, and St. Benoit, along the coast. The construction of the line has presented great difficulties, owing to the steep and rugged nature of the ground, formed by the accumulated lava, and to the violence of the torrents crossed. The beds of these torrents are dry during the greater part of the year, but when a cyclone passes over the island enormous masses of water rush down, and the slope is such, a correspondent of the *Times* says, that the velocity of the stream is often more than 100ft. per second. Huge blocks of rock are carried down with tremendous force, and the streams accumulate at their mouths in a single freshet thousands of tons of sand and gravel. On the 21st of January, 1881, one of these floods in the River des Galets carried away the scaffolding of a metallic bridge that was being erected. The railway is nearly 80 miles long, and it traverses three large rivers—those named du Mât, des Galets, and de St. Etienne ; three secondary rivers, des Roches, des Pluies, and de St. Denis ; and a number of torrents, over which viaducts of metal and masonry, of a bold type, have been thrown. The greatest difficulty consisted in traversing what is known in Reunion as la Montagne or la Falaise, which is a series of enormous masses of lava occupying the seven miles between St. Denis and Possession, and having an abrupt descent of 200 to 300 metres to the sea. This long wall is incessantly broken by the waves. There has hitherto been merely a footpath along its base, often made impassable by the sea and torrents, but for the railway a tunnel has been bored in the basalt, about 10,281 metres in length, or nearly as long as those of the St. Gothard and Mont Cenis. This has been accomplished in thirty months by the skill of MM. Lavallez and Molinos. The opening of the railway, and also shortly of a harbour, is expected to cause a large accession of prosperity to the colony.

NOTES AND MEMORANDA.

The quantity of gas used in London last year, according to the analysis of the London gas companies' accounts, prepared by Mr. John Field, was, in round numbers, 20,230,000,000 cubic feet—which is equal to a bulk of one mile square by 726ft. high, and its cost to the public was £2,911,000.

At the Tynemouth Exhibition we observe that Mr. Ralph H. Tweddell has attached to his portable rivetting machines Swan's incandescent lamps, the electrical conductor being carried alongside the copper tubing, conveying the hydraulic pressures to the machines. Under the bottom of a ship, the keel rivetter is shown doing its work, and the movements of this machine can now be plainly seen. This interesting and novel application of the electric light can be applied at any point capable of being reached by the machines.

In a paper read before the Academy of Sciences, Paris, on marsh fevers, by M. d'Abbadie, the author says that immunity from such fevers in bad Ethiopian regions is often secured by sulphur fumigations on the naked body. In Sicily the workmen in sulphur mines on low ground suffer much less from intermittent fever than the rest of the population. In Greece—M. Fouqué has shown—a once flourishing town of 40,000 inhabitants, Zephyria, has been almost utterly depopulated through marsh fever ; and its decadence has corresponded to a transference of sulphur mining operations to the east, so that the sulphur emanations are prevented by a mountain mass from reaching the site of the town.

In a paper read before the British Association, by Mr. W. Sugg, on "Gas Burners," the author said : "One point of great importance in the construction of a gas burner is, that the gas should not be heated until it arrives at the point of ignition. The body of the chamber below the point of ignition must, therefore, be made of material which is a bad conductor of heat, so as not only to prevent the undue expansion of the gas before it arrives at the point of ignition, but also to maintain the heat in the flame. Sir Frederick Bramwell pointed out, some time since, that the important point in the proper combustion of gas is not so much to keep the gas cool as to keep the flame hot ; and a non-conducting gas chamber performs both these important functions."

In a paper entitled, "Study on the *régime* of the Maritime Loire," read before the Paris Academy of Sciences, by M. Bouquet de la Grye, the author says that between Nantes and Saint Nazaire there is deposited annually about 590,000 cubic metres of sand and mud. The volume of the channel has diminished about 56,000 cubic metres annually for sixty years. The outer bar of the river has risen 0·70m. since 1864, and will probably rise more, presenting a danger for large vessels coming to Saint Nazaire. The author indicates means of bringing the river back to its former constitution, such as replanting, covering slopes with turf, and he suggests a plan for carrying off quickly into the sea the 40 million cubic metres that have been deposited during the last sixty years.

The following device for keeping open the channel of the Columbia river, now seriously obstructed by sand bars, is described in the *Scientific American* :—The promoter's theory was that the current was strong enough to carry off the sand if it were properly stirred up. Mr. Prescott, manager of the Oregon Railway and Navigation Company, felt sufficient interest in the experiment to offer the use of the company's steam collier Walla Walla in making it. The steamer was moored on the bar, bow up-stream, the stern at the lower edge of the bar, and loaded so that the keel touched the bottom. In eighteen hours' actual work a channel, 1000ft. long and 100ft. wide, was deepened from a maximum of 18ft. to from 22ft. to 24ft. The steamer is now completing and straightening the channel on the whole length of the bar.

The Registrar-General's weekly return shows that the annual rate of mortality last week in twenty-eight of the largest English towns averaged 20·6 per 1000 of their aggregate population, which is estimated as 8,469,571 persons in the middle of this year. The six healthiest places were Derby, Bristol, Nottingham, Sheffield, Norwich, and Portsmouth. In London 2538 births and 1449 deaths were registered. Allowing for increase of population, the births were 22 below, whereas the deaths exceeded by 75, the average numbers in the corresponding week of the last ten years. The annual death-rate from all causes, which had been 17·0 and 19·4 per 1000 in the two preceding weeks, rose again to 19·4 last week. During the 13 weeks ended last Saturday the death-rate averaged only 18·6 per 1000, against 20·7 and 20·5 in the corresponding periods of 1880 and 1881.

The range of the changes of level in the rivers of Russia in Europe has become, since 1876, the subject of accurate measurements, and M. Tillo has just published in the Russian Nautical Review (*Morskoy Sbornik*) an interesting paper on this subject, being the result of measurements made at eighty different places. The highest range is reached by the Oka at Kaluga, the difference between the highest and lowest levels being as much as 45ft.; the average range for the same river from its source to its mouth being 32·2ft.; the average for the Volga from its source to its mouth is 33·6ft., 30·1ft. for the Kama, 25·2ft. for the Duna, and 23·1ft. for the Don. For all other rivers the range is less than 20ft. Of course this range diminishes very much towards the mouth of each river ; but still it reaches 12ft. for the Volga at Astrakhan, and 9ft. for the Duna at Riga. The highest range observed in the lakes of Northern Russia was only 2·1ft. A map prepared, *Nature* says, by M. Tillo, shows the distribution of hydrometrical stations on Russian rivers, their numbers having been increased in 1880 to 341 stations.

For cleaning old and soiled engravings, Mr. W. Brooks, writing in the *Journal of Photography*, recommends the use of Holme's ozone bleach. The strength he prefers is one part of ozone bleach to ten of water, well shaken up before pouring into a dish. He immerses the engraving in the solution, face upward, avoiding bubbles. The only caution to be observed is that when the engraving is sodden with water it is somewhat rotten ; so the less it is handled the better. Sometimes, if the engraving be only slightly stained, half an hour is quite sufficient, but when quite brown he has left them in for as long as four hours. After all the stains are removed, and the paper has regained its pure whiteness, pour the solution out of the dish into a bottle, as this can be used over and over again, until it becomes discoloured ; then fill up the dish with water, changing frequently for about two hours, or, better still, place it in running water. When sufficiently washed it can be taken out and blotted off and then hung up to dry, and when perfectly dry, iron on the back with a warm flat-iron ; but care must be taken not to have it too hot.

A paper on the "Extraction of Selenium from a Waste Product of the Alkali Manufacture," by P. Kienlen, has appeared in the "Chem. Cent. Blatt." According to the *Journal* of the Society of Chemical Industry, the author finds that the deposit which occurs in the muriatic acid condensers of alkali works contains a large quantity of selenium, derived from the pyrites used in making the sulphuric acid. In a Glover acid of 1·6 specific gravity, he found 28·3 mgrms. selenium per litre, and in a second sample of specific gravity 1·53, 34·2 mgrms. It distils with the first portions of the muriatic acid. A sample of the latter of specific gravity 1·16 yielded 25 mgrms. per litre. The percentage of selenium in the deposit varies between 41 and 45. The following process of extraction is recommended. The substance is suspended in water and treated with a stream of chlorine. Selenium tetrachloride is formed and decomposed by the water into selenious acid, a portion of which is oxidised to selenic aeid. The liquid is filtered and boiled with excess of hydrochloric acid. On addition of acid sodium sulphite, the selenium is precipitated in the form of deep red flocks, which are aggregated on passing steam, into spongy masses of a steel grey colour, which are then dried and fused.

MISCELLANEA.

It is reported that considerable damage was caused to the new harbour works at Carrickfergus during the gale of Sunday.

The street lighting on the large scale by electricity in New York has already greatly increased the consumption of gas. The quantity of light in houses and shops which was previously sufficient no longer satisfies.

There are already thirty electric light companies in England, with a capital of over £6,000,000. The number in France is less, but the capital represented is nearly as great. There are over fifty companies in America, and the capital is considerably over £10,000,000. A contemporary remarks that the average dividend is not known.

The rumour that the German Government had now begun to devote serious attention to the project for the construction of a canal connecting the North Sea with the Baltic is said to be without foundation. Since the report on the subject by Lieutenant-Colonel Vogel von Falkenstein, the Government has taken no steps in the matter.

The Gas Committee of the Manchester Corporation are about to hand over to the Improvement Committee of the city, to be devoted to city improvements, the sum of £52,000. This amount, with the exception of £8530 withdrawn from the reserve fund, represents the profits upon the making of gas for the city during the year ended June 24th, 1882.

The prospectus of a company with the title "The Caledonian Steel and Iron Company, Limited," has just been issued. The capital is £250,000 in £10 shares. A satisfactory Board of Directors has been obtained. The company is being formed to work the Thomas-Gilchrist process in Scotland. The company will purchase the Wishaw blast furnaces with the coal and ironstone property appertaining to them.

The second International Electrical Conference is to be opened in Paris on the 15th of this month, a subsidy of 90,000f. having been granted by the French Government towards that object. The principal aims of the Conference are to make experiments with a view to determining electric units, to fix upon methods of observation for atmospheric electricity, to gather statistics relating to lightning conductors, and to fix a definite standard of light.

Silver medals, the highest awards made, have been given at the North-East Coast—Tynemouth—Exhibition, to the Durham-Churchill governor and to Mr. Maurice Gandy's patent belting. Messrs. Douglas and Grant, engineers, of Kirkcaldy, N.B., have gained a first prize and silver medal at the North-East Coast Exhibition for their exhibit of one of Lightfoot's patent dry air refrigerators in operation in connection with cold storage chamber. A silver medal has also been awarded to Messrs. Priestman Bros. for their patent dredger, excavator, and elevator.

The four-masted steamer Werra, built by Messrs. John Elder and Co., of Govan, for the North German Lloyd, for their mail service between Bremen, Southampton, and New York, made her official trial trip on the Clyde on the 29th ult. The Werra is a screw steamer of 5109 tons gross burden, 2856 net register tons. She is 450ft. long over all, 46ft. broad, and 36ft. 6in. deep. Her engines are constructed on the same model as those of the Orient steamer Austral ; the contract indicated horse-power was 5600, but on her trial trip it reached as high as 6700. The contract stipulated for a speed of 16 knots on a consumption of coal not exceeding 1936 lb. per indicated horse-power per hour, but when running the measured mile the mean speed was 17·225 knots an hour.

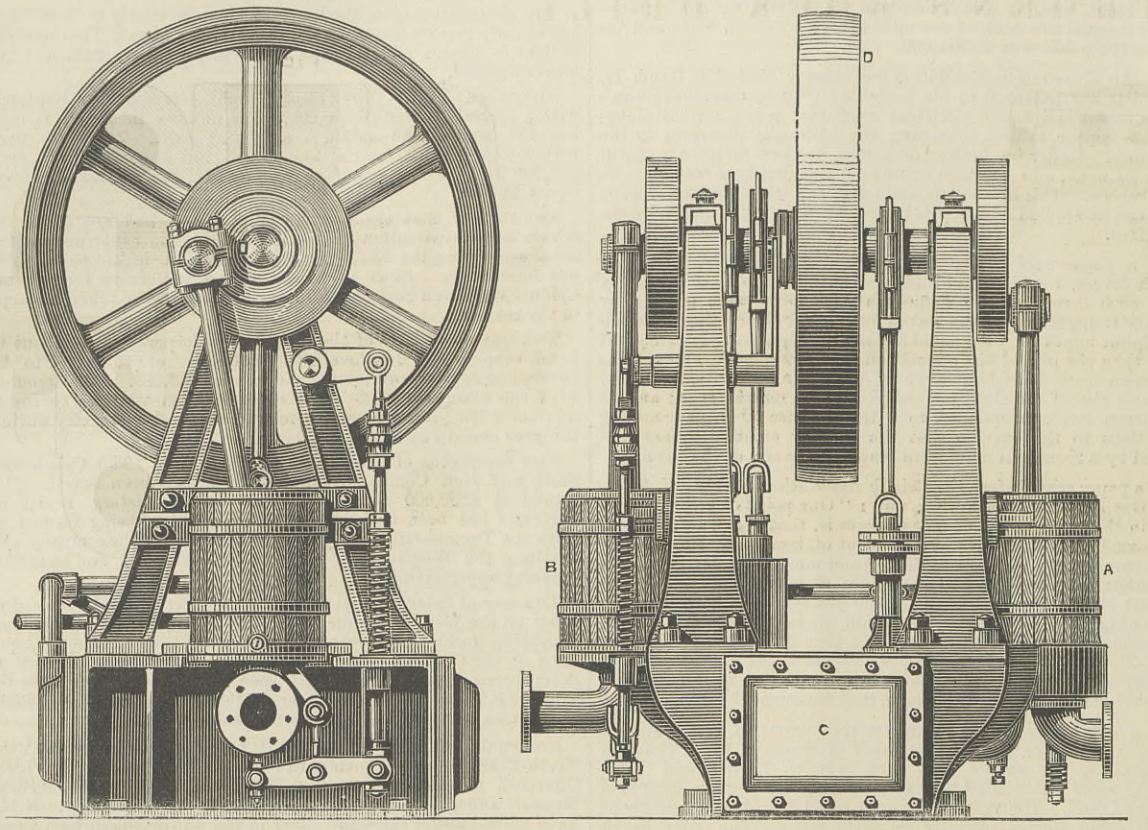
An interesting experiment took place at the opening of the present session of the London Hospital Medical College on Monday evening, when a *conversazione* was given to a large company. By the permission of Mr. W. S. Gilbert and the United Telephone Company, the Anatomical Theatre was placed in telephonic communication with the Savoy Theatre, and many of the audience heard distinctly the opera, "Patience," by the telephone. The electric light used on the occasion was also a great success, Mr. Crookes' incandescent lamps being adopted for the first time at a public exhibition, supplied by a Gülcher low tension dynamo machine, the fittings being made by Messrs. Defries and Sons. The room, though crowded, remained perfectly cool.

On Saturday Colonel Yolland, R.E., accompanied by Mr. Strong, solicitor to the Board of Trade, made an official inspection of the Channel tunnel works. They were accompanied by Mr. Brady and Mr. E. Cumming Madden, a Berlin correspondent of one of the London daily newspapers, and Mr. W. Lawford, C.E., the latter two gentlemen attending at the special invitation of Sir Edwin Watkin. Since the last visit of Colonel Yolland no progress whatever was found to have been made with the heading. The *Times*, in speaking of this inspection, somewhat curiously remarks that "while the party was in the tunnel several pieces of the chalk through which the heading is being driven were secured for Count von Moltke and members of the German military staff, who are in favour of and take great interest in the scheme."

Last week the Shipbuilding and Engineering Works Company, De Maas, Limited, launched from their yard at Delfshaven, Holland, a screw steamer named Monica, built to the order of the Crofton Shipping Company, Limited, Hull. The vessel, to be engaged in the Baltic and Black Sea trade, has the following dimensions :—Length, 212ft.; beam, 30ft.; depth of hold, 14ft.; displacement, 1720 tons ; carrying capacity, 1100 tons on a mean draught of 13ft. 3in.; gross tonnage, 923 ; net tonnage, 546 ; four water ballast tanks, 210 tons ; three hatchways—aft, 29ft. 4in. by 16ft.; middle, 25ft. 8in. by 16ft.; fore, 16ft. 6in. by 16ft. She is schooner rigged, with topgallant forecastle, long bridge amidships, raised quarterdeck and half poop for captain's cabin, fitted with three steam winches and Harfield's patent windlass. The engines—compound—are supplied by the builders of the vessel, and have cylinders 27in. and 50in. diameter with 33in. stroke, with surface condenser, air, and circulating pumps. The boiler—16ft. 3in. diameter—supplies steam to a working pressure of 85-horse power. The vessel has been built according to Lloyd's rules for the 100 A1 class, and has been surveyed during her construction by Captain J. C. Thompson, who will command her. This is the first steamer, we believe, that has been built and engined in Holland to the order of an English firm. In the event of heavy leakages there are no less than nine steam pumps which can be used.

A very large flour mill was inaugurated in Holbeck, Leeds, by the Leeds Industrial Co-operative Society. The mill previously belonging to the society was burned in October, 1881, and after an examination of the various new systems of milling the mill now nearly completed was commenced. The mill comprises a brick grain warehouse 130ft. long, 53ft. wide, and 66ft. high, with four concrete floors 8in. thick, the warehouse being capable of holding 6000 tons. The wagon loads of grain entering the warehouse are discharged into large bins, whence it is raised by elevators capable of raising 100 quarters per hour, and at once passed through separators. In a line with this warehouse is the corn mill proper. It has a frontage of 93ft., and a depth of 91ft. into the yard. This building is also of brick, and is five stories high, 500 square yards being allowed for each floor and 670 square yards for the basement. It is divided into two sections—a stone mill and a roller mill, so that the two processes may be carried on separately or combinedly. The system adopted is half-high grinding, the wheat passing through stones and rollers of different sized corrugations into centrifugals and purifiers until it reaches the final stage and is ready for delivery. The mill will, when complete, grind 1500 sacks of corn a week, and is so planned that even 2500 sacks may be ground by an extension of the fifty-four hours of labour now usual. The machinery and fittings are on the Hungarian system, by Messrs. John Fiechter and Sons, of Liverpool. Exclusive of the value of the trade stock on the Holbeck estate, £17,000 has been expended on new machinery and £16,800 on buildings.

HALL'S PATENT COLD DRY AIR MACHINE.



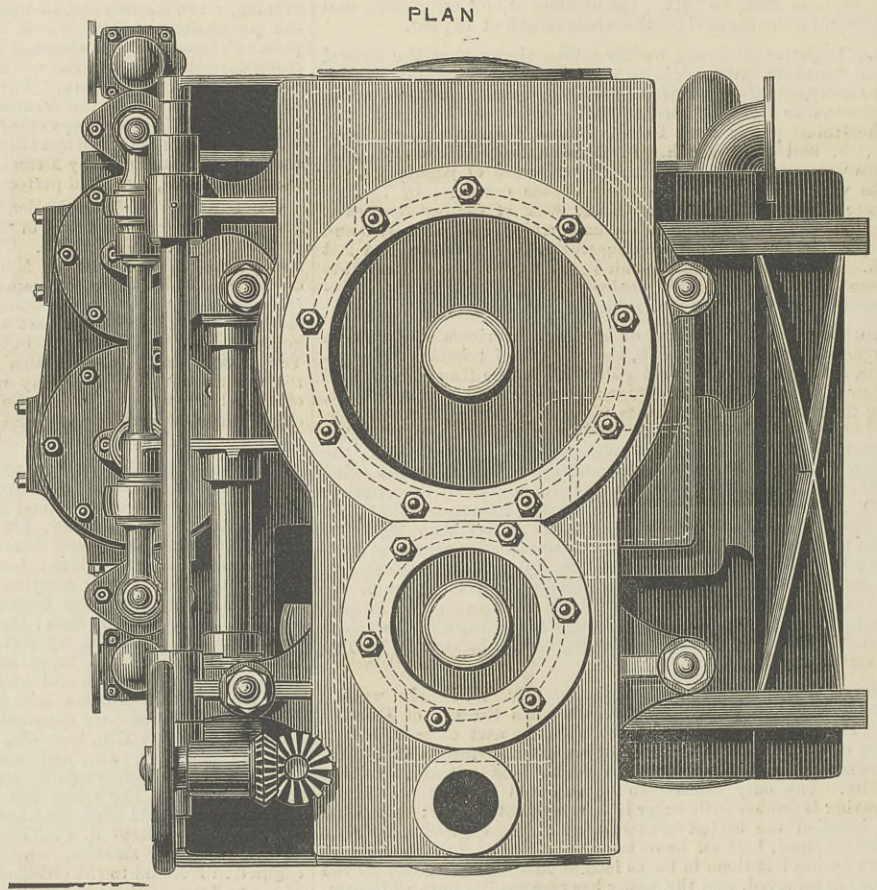
We illustrate above a new pattern of cold air machine, manufactured by Messrs. Hall, of Dartford, who are already well known in connection with appliances of this kind. This machine is arranged to be driven by a belt either from any existing power or from a gas engine, which can also be utilised otherwise when not required for working the refrigerator. One of these machines was at work during this summer in connection with a suitable refrigerating chamber, preserving about 12 tons of butter, which, when removed at the end of two months, was found to be in perfect condition in every way, and remained so during the usual time for ordinary consumption.

This is the smallest size machine of this kind that has yet been made, and delivers about 2000 cubic feet of cold air per hour at a temperature of 35 deg. Fah. below zero. A 3½-horse power gas engine is of amply sufficient power for driving. Owing to the small space which it occupies, and the ease with which it can be attended to, it is specially adapted for the requirements of butchers, fishmongers, poulterers, &c. In the illustration A is the compressing cylinder, C the cooling box, B the air expanding cylinder, D the driving wheel. When preferred a steam cylinder can be added for driving, and the wheel D omitted.

HARKER'S COMPOUND LAUNCH ENGINE.

We give herewith a plan of the launch engine made by Mr. Harker, of Stockton-on-Tees, two elevations of which appeared in our last impression, p. 234. It will be remembered that the cylinder, valve chests, &c., are all cast in one piece. The cylinders are 7in. and 12in. diameter with a stroke of 12in. The hand wheel is for reversing below, but a prolongation of the vertical mitre wheel shaft rises through the deck, and so puts the engine directly under control of the steersman if need be. The engine is massively made, but it is intended to run at high velocity. The air and circulating pumps, it may be well to explain, communicate with the condenser through the base plate, the circulating water passing under the after crank shaft bearing and keeping it quite cool—an arrangement which is excellent, and, so far as we are aware, quite new.

PLAN



THE HIGHGATE HILL CABLE TRAMWAY.

Many of our readers will be interested to learn that at last a new tramway company is introducing into this country the Hallidie cable system of drawing tram cars, and by that means altogether superseding the employment of horses or steam locomotives for the work. The Steep Grade Tramway and Works Company will commence its operations with a new line running from the Holloway-road terminus of the London Street and North Metropolitan Tramways, whence a double line will be laid up Highgate-hill east, until near Fairrest House; here a single line will be extended to the Southwood-road terminus, near the historic Highgate "Gate House."

The system was devised for the purpose of propelling tramway cars by means of endless steel wire cables, actuated by a steam engine or other motor fixed at either end, or at any intermediate point of the line, as convenience or necessity may dictate. A tube of sufficient capacity to contain at proper intervals of distance grooved sheaves—on or under which the cable may travel—is placed beneath the surface of the street and between the rails.

The tube is provided with an opening or slit on the upper side running along its entire length, and sufficiently wide to admit of the passage of a steel shank or coulter down through, but not wide enough to admit the wheel tire of the smallest carriage, the extreme width of the opening being only three-quarters of an inch.

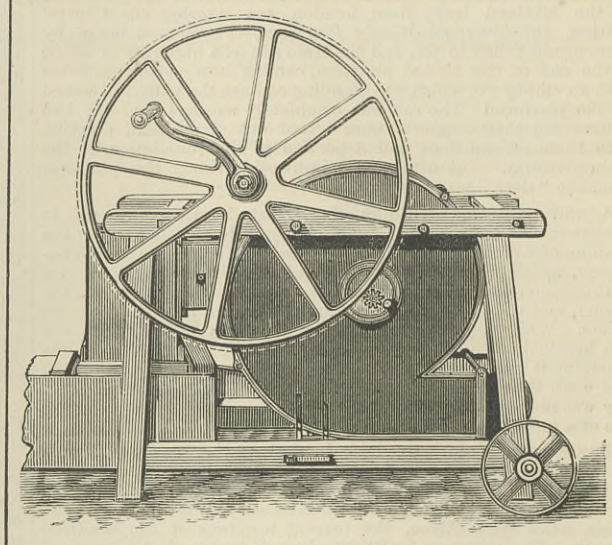
For each track one tube is employed, and it is furnished with two sets of sheaves, and contains both parts of the travelling cable, which would run therein in opposite directions. At a suitable place, and connected by the necessary gear to the steam or other engine, are mounted grip pulleys, by which the power is transmitted to an endless cable to set it in motion. The slit in the tube is made on one side of the vertical centre line, and not vertically over the rope or sheaves, in order to prevent street refuse falling therein. In the event of double sheaves being required in the tube, a like effect is produced by placing each sheave on either side of the slit, which in such case is placed in the centre. Upper sheaves are not required where the line runs fairly true between two given points, but when the grade varies considerably, upper sheaves are necessary as well as lower sheaves, in order to keep the line of rope parallel with the axis of the tube. In such cases the cable travels over the lower sheaves and under the upper sheaves, sufficient space being left between them to permit the foot of the gripping attachment to pass uninterruptedly. The gripping attachment, by the means of which the motion of the cable is transmitted to the car, consists of an iron frame fastened to the bottom of the "car" or to a "dummy." It is furnished at its upper end with a hand-wheel and nut fitted to a hollow screw, which reaches from the frame to the bottom of the car or dummy, to which it is secured. At the lower end of this screw is attached a steel shank which has a dovetailed groove in its length; a slide works therein actuated by means of a nut and hand-wheel working in a screw at the upper end of the slide. The lower end of the slide is furnished with a wedged piece, which actuates two horizontal slides at right angles to main slide that works in the shank of the large hollow screw. The steel shank is 5in. wide by §in. thick, so that the longitudinal slit in the tube is not more than ¾in. or ⅞in. at the utmost in width. Curves are as easily overcome as grades by the simple application of special rollers. There is no reason why this system should not be as successful in England as it is in America, for we have long used it in a less complete form in our coal mines, and a glance at the general figures will show the working expenditure of the various tramway systems. Horse tramways are worked generally at an expense of 75 to 85 per cent. of the earnings, steam traction at about 60 per cent., whilst the cable works in several cases at about 30 per cent.

According to the paper recently read before the Institute of Mechanical Engineers in Leeds by Mr. Davey, the cost of haulage by endless wire rope in mines is, including every cost, 2·9d. per ton per mile, or by means of a tail rope 1·87d. per ton per mile, and this is done under the conditions of wear and tear which generally obtain in a mine. This economical working strongly commends the system, which may be said to distribute energy in a way unattainable by any other method of tramway traction. This is shown by its success on the Chicago tramways, which are almost wholly level, and on those of San Francisco, which have a steepness exceeding the maximum grade over which a locomotive can propel itself.

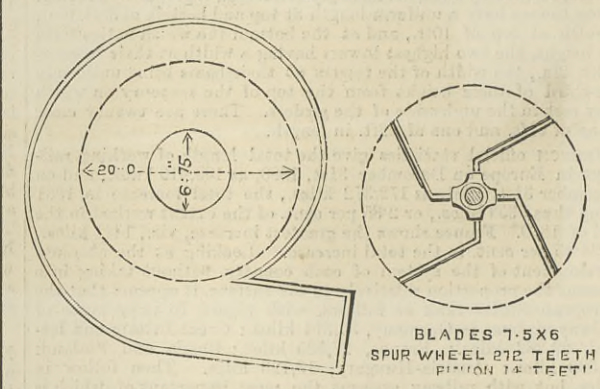
Mr. James Cleminson, M. Inst. C.E., is the engineer-in-chief of this line, and we look forward with much interest to its early opening.

FANS AT READING.

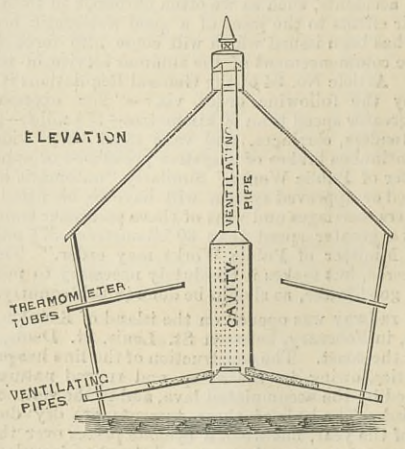
The accompanying illustrations show some of the apparatus not yet illustrated in our columns. The fan here shown is that made by Mr. E. Pratt, of Uxbridge, and exhibited outside the



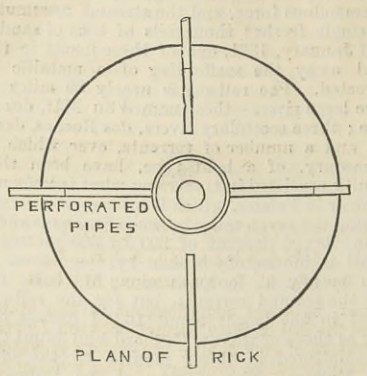
hay meadows, but not entered in the Society's catalogue. The hand-wheel had 272 cogs and the pinion fourteen cogs, and the fan thus makes 776 revolutions per minute with 40 revolutions



of the hand-wheel. The fan case was 6·5in. wide inside, and the wood tube to the rick was 6·5in. by 7in. The engravings show the form of the fan and the arrangement. Mr. Pratt also showed the same fan driven by a strap, and the whole arranged with a small horse gear on one frame.



The application of an exhaust ventilator exhibited by Messrs. C. Kite and Co. is shown in the annexed diagrams. To this we



have previously referred, and it is commented upon in the judges' report on the trials, which we published in our impression of the 22nd ult.

HATHORN'S ROCK DRILL.

FIG. 1.

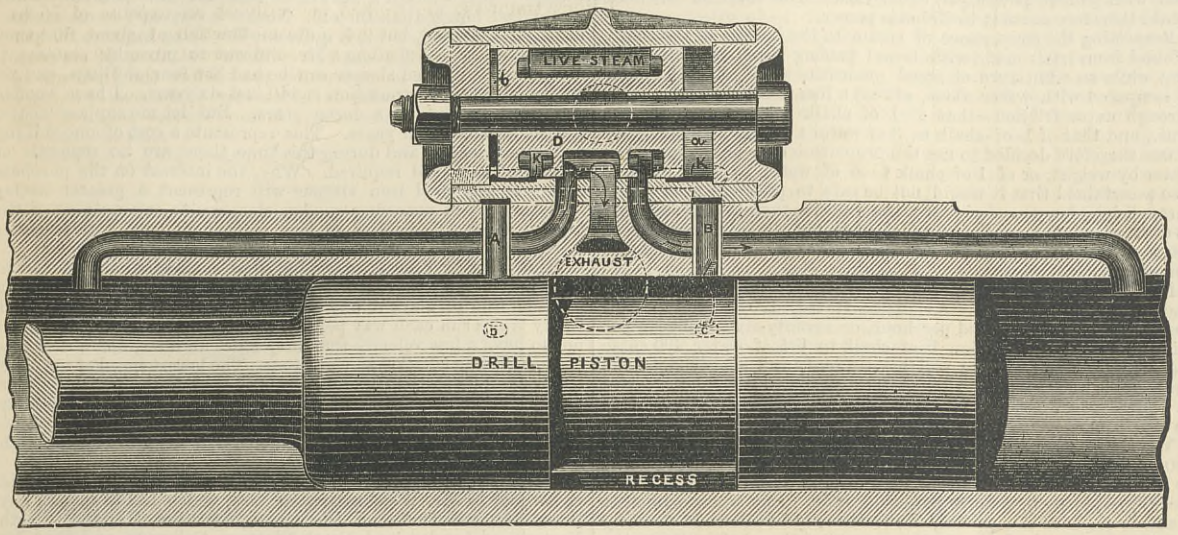
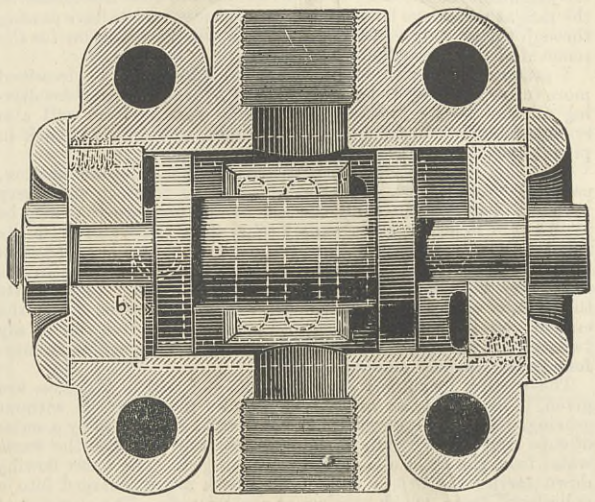


FIG. 2



SECTIONAL PLAN

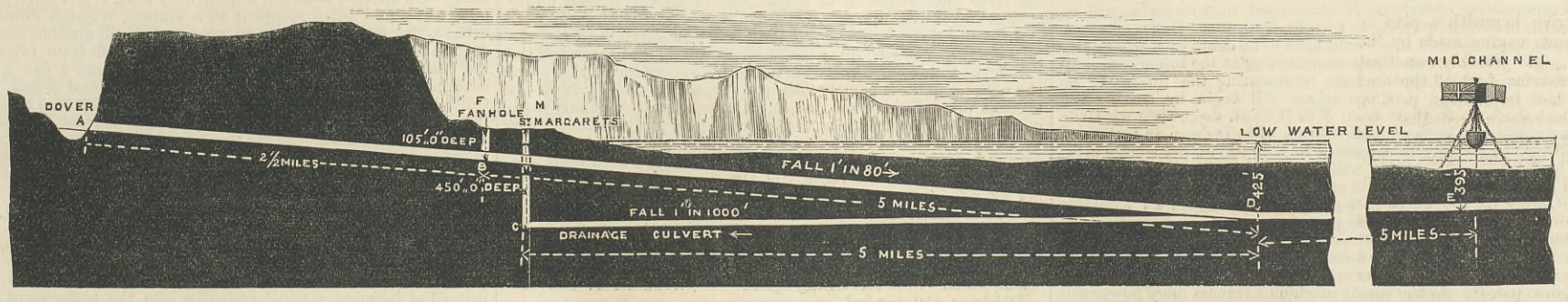
In our issue of August 4th, in the course of our remarks on the exhibition at the Alexandra Palace, we mentioned a peculiar valve motion which operates the rock drill shown by Messrs. Hathorn and Co., of 22, Charing-cross, S.W. We give above a section and sectional plan of this invention, and we think that a study of its principle will repay our readers. The valve itself is marked D, and is a little D valve with a turned face carried in a boss between two pistons, all being cast together and sliding on a spindle with a feather to prevent its turning off the ports. The spindle is the bolt that holds the two caps on the end of the valve-box, which is bored to suit the piston valve, and has an inlet for steam on either side in the centre. Thus the space over the little D valve and between its two pistons is always full of live steam, and any movement of the valve to one side admits steam to a port in the usual manner. There being a certain amount of movement for the valve, it follows that when it is in the central position over the ports there is a space at either end between the cover of the box and the piston part of the valve. These spaces are marked *a* and *b* respectively. A vertical slotted hole is drilled into each of these clearance spaces, and a passage is made by drilled holes from it—as may be seen on the sectional plan—into the interior of the cylinder itself by two little tubes A and B carried through the steam passages. The forward tube A thus communicates with the rear space *a*, and the rear tube B with forward space *b*. Parallel with these tubes two small holes *c* and *d* are drilled from the interior of the steam cylinder into a chamber communicating with the free exhaust hole—see Fig. 1.

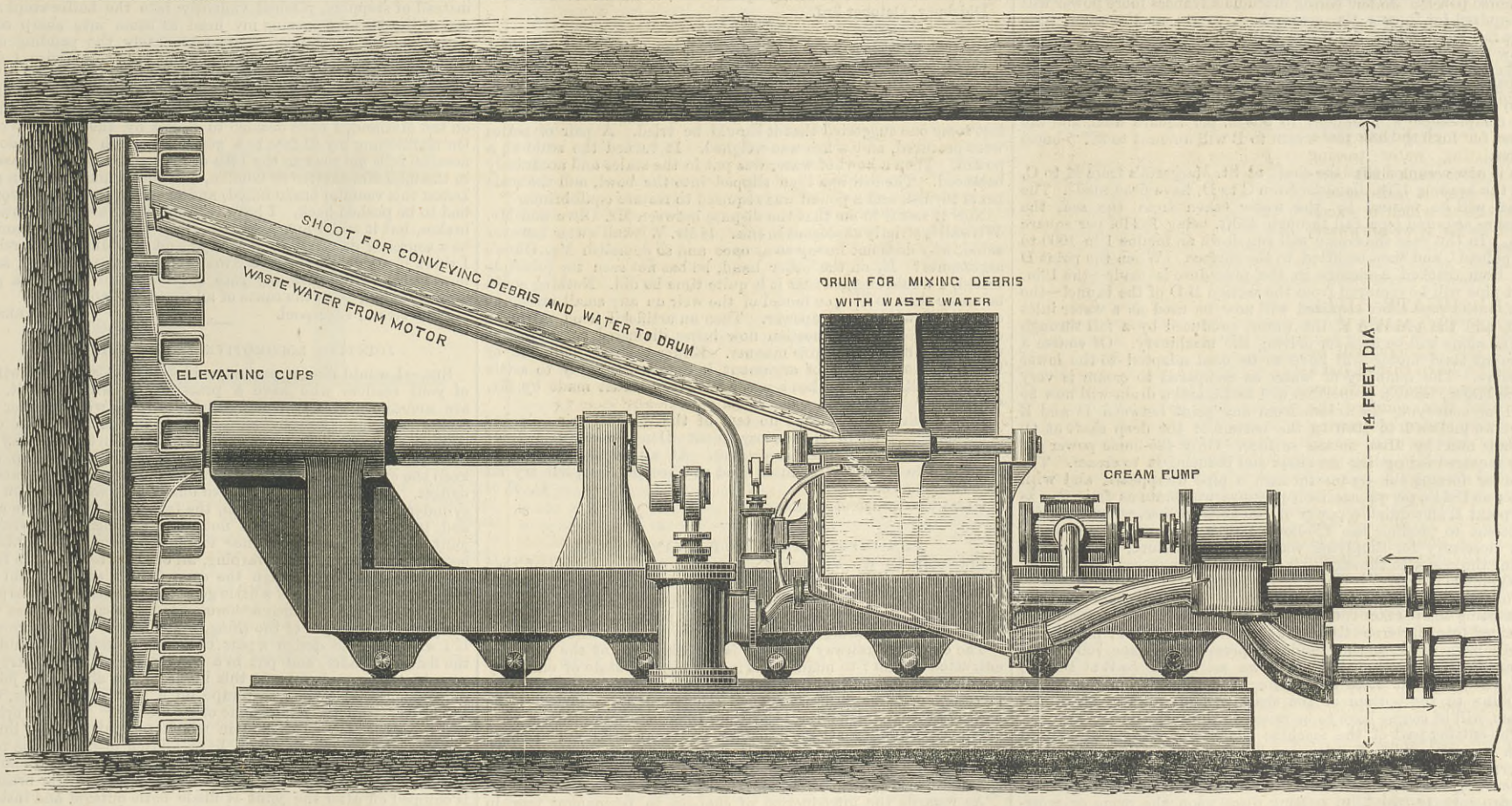
The piston is a long one, and has a recess turned out of the middle of its length just long enough to allow of both holes A and B being shut by its edges. It follows that as the live steam leaks past the periphery of the pistons of the valve into spaces *a* and *b* this steam will blow through the passages into the recess in the piston, and circling round, it finds its way out through hole C or D into the open exhaust. But if the piston is moved back or forward so that one shoulder of the recess covers one pair of holes, say A and D, as shown in Fig. 1, then the steam contained in space *b* will have no escape and will drive over the piston valve from that end, opening by that means the steam port to the rear end.

A further detail consists in the little slots K horizontally cut in the surface of the valve-box. When the piston valve is pushed over on one side the inner edge of the little piston passes this slot, and the live steam passes freely under the side of the piston to the space behind, and will tend to keep the valve in the central position. These slots thus answer the purpose of returning the valve to the mid position, and they come most into use when the drill is set out of the horizontal, as the weight of the valve itself then comes into play. The practical action of this valve is peculiar. The steam may be throttled until only enough to overcome the inertia of the piston is admitted; then the piston will move to and fro just the amount necessary to uncover one or other of the little holes A or B, and the stroke will be gradually increased as more steam is admitted till the full stroke is obtained.

Another feature is the great variety of pressure under which the same motion will work. We are informed that 5 lb. per square inch will vibrate the piston, and Messrs. Hathorn state that they have had the drill running under an air pressure of 175 lb. per square inch, when, although the motion was so exceedingly rapid that the drill clamp could not be seen in its reciprocations by the eye, yet the valve motion had perfect and unfailing action.

CRAMPTON'S HYDRAULIC TUNNELLING MACHINERY.





CRAMPTON'S SYSTEM OF EXCAVATING THE CHANNEL TUNNEL.*

By Mr. T. R. Crampton, M.I.C.E.

It is assumed, to avoid complications in this statement, that there underlies the bed of the Channel between Dover and Calais an uniform stratum of grey chalk—impervious to water and so soft that it can easily be cut by ordinary cutting tools or chisels.

Practical trials made with machines many years since and also more recently have established the fact that a rate of advance may be easily maintained of one yard per hour, or twenty-four yards per day, at which rate the excavation of half the length, or ten miles, would take two and a-half years to accomplish, taking the year at 300 working days. The tunnel is assumed twenty miles long independent of approaches; and the latter may be made at the same time as the main tunnel, and with work going on simultaneously from each side of the Channel, we have practically to deal with ten miles only. The tunnel is supposed to be 36ft. in diameter, and may be pierced in one operation. Each yard forward, therefore, represents a quantity of 113 cubic yards to be removed. To this quantity I add 50 per cent. for contingencies, making a total of 170 cubic yards, or 250 tons of chalk *débris* per hour to be dealt with.

If we now assume for the moment the use of the ordinary system of removal by trucks, we find that the transport of 170 cubic yards of *débris* would necessitate the passage of eighty-five trucks of two yards each per hour, or one truck every forty-two seconds; or, if trains be made up of ten wagons each, there will be one such train every seven minutes passing out and a train of empties passing in—in fact, a continuous traffic. These trucks will next have to be lifted up the shaft 450ft. high, and discharged of their contents. This means the lifting of some 6000 tons in twenty-four hours, independent of the weight of wagons, men, tools, stores, &c., a quantity more than double that lifted in some of our greatest collieries. In certain cases the trucks may be drawn up the incline approaches by locomotives.

The lining of the tunnel—3ft. thick all round—requires the

* British Association, Section G.

introduction of thirty-four cubic, or, with contingencies, say fifty cubic yards of materials per hour brought in, of course, by the empties coming back and discharged where required.

It will be easy, without entering further into details, to perceive the magnitude of the work to be performed—to line the tunnel at the rate at which the boring machine advances, and to have passing through the tunnel so great a traffic as will be going on for the removal of the *débris* from the face.

I proposed therefore to use a system which will be described more fully, which by the employment of hydraulic power for driving all the necessary machinery at the working face, will also remove the *débris* in an automatic manner, and convey it back in pipes to the surface, and then to the sea.

Near the mouth of the upright shafts at Fanhole—see section, page 255—and at St. Margaret's, I propose to erect machinery to pump water taken from the sea to any pressure that may be required, or in other cases simply to syphon the water from the sea and allow it to act by the pressure due to the head between tunnel and sea levels. The water will be led by a pipe to the machinery working at the tunnel face, and in order to facilitate the advance of the boring machine I interpose between it and the end of the inlet pipe a telescopic joint, with a free run of say twenty-four yards, or 72ft., whereby only one stoppage in twenty-four hours becomes necessary.

The cutting machinery—see page 255—of which diagrams are given, is driven by an ordinary hydraulic motor direct, without gearing. The *débris* of chalk cut down will be taken up by a series of cups and thrown into a shoot, at the top of which the waste water from the hydraulic motors is discharged. The water flowing down carries the *débris* with it, and both are discharged into a cylindrical drum, which revolves at a given rate. The quantity of water used by the motors is so calculated that it amounts to about three times the quantity of chalk *débris* in weight. When mixed with the water in the revolving drum the very small *débris* is almost instantly disintegrated and dissolves, and the result is a cream or sludge, which is either taken up by pumps and forced back to the bottom of the shaft, or where a sufficient incline exists it may be allowed to run down by its own gravity. In cases where the cream is forced back it is necessary to provide the outlet pipe with a telescopic joint similar to the one for the inlet pipe—both are attached to one another, and when they have run to the full extent of their length, the flow of water is arrested by the closing of valves. New lengths of pipes equal to the run of the telescopes are put in, then the pressure water is turned on again, and the work can be continued for another twenty-four hours without interruption.

The cream, whether forced back to the bottom of the shaft or allowed to run down by its own gravity, is collected there and raised to the surface by pumps worked from above, or the sludge may be pumped direct from the face to the sea without the intervention of pumps at the bottom of the shaft. It will now be seen that the space lying between the boring machinery and the top of the shaft is entirely free, excepting so small a portion of it as is occupied by the two pipes—the pressure water inlet pipe and the cream outlet pipe. The operation of boring the tunnel may therefore be carried on with the greatest facility—the only traffic on the rails being that necessary to transport the workmen, the stores, pipes, &c., and the building materials for lining the tunnel. These latter only amount to about one quarter of the weight which would have to be carried, if the work was constructed on the ordinary system—three-fourths of the weight therefore is carried in a pipe instead of by locomotives and trucks.

In commencing operations it is assumed that no water will be met with in boring downwards 1 in 80, from B to D—see section. If much water entered this would have to be dealt with separately, and might probably necessitate commencing at the lower end.

Referring now to the diagram representing the tunnel to be made, it is assumed that operations will begin by making the vertical shaft at Fanhole from F to B 105ft. deep, then with the boring machinery in the direction from B to D down an incline of 1 in 80. The water will be pressed to F to 955 lb. per square inch, and by falling another 105ft. will acquire an additional pressure of 45 lb., making a total available pressure of 1000 lb. per square inch. This acting on 490 cubic feet per minute will give an available theoretical power of 2140-horse power.

The pressure may therefore at first be considerably diminished, since the power necessary to force the cream back to the point B is very trifling, and will amount at the end of one mile to only 7·5-horse power. As the boring machine advances more power will be required for forcing the cream back to B; at the same time more fall is gained by the water falling through a greater height below the level of the sea, the difference in all cases having to be made up by increasing the pressure on the water on the surface.

When arriving near the point D, the natural fall of the water from the sea level gives a pressure of 192 lb. per square inch, and the compression will amount to 808 lb. per square inch, and the power for forcing back the cream to B will amount to 337·5-horse power.

It is now assumed that the shaft at St. Margaret's from M to C, and the heading 17ft. diameter from C to D, have been made. The latter will be worked by the water taken from the sea, the pressure acquired by a fall through 450ft. being 182 lb. per square inch. In this case the cream will run down an incline 1 in 1000 to the point C, and then be lifted to the surface. When the point D has been reached a change in the procedure is made—the 12in. inlet pipe will be removed from the section B D of the tunnel—the 22in. outlet pipe there required will now be used as a water inlet pipe, and the pressure of the water, produced by a fall through 425ft., alone will be used for driving the machinery. Of course a different sized motor will have to be used adapted to the lower pressure. The quantity of water as compared to cream is very much larger, being a proportion of 1 to 13, and a drain will now be used for conveying the cream from any point between D and E down an incline 1 in 1000 to the bottom of the deep shaft at C, when it must be lifted to the surface. Only 425-horse power are now required for cutting the chalk and reducing it to cream. The item for forcing the cream through a pipe disappears, and with water at 182 lb. per square inch pressure we obtain as far away as the point E an available power of 800-horse power, which is quite sufficient to produce the 425-horse power required. No power is now necessary for supplying water under pressure, but that for lifting the cream to the surface is considerably increased, amounting to 950-horse power.

For the section B to A, the machinery and 12in. pipes used for excavating the portion B to D will be employed, little power being obtained from the free fall of the water at this point; practically it will have to be worked under a pressure of some 700 lb. per square inch—the cream will run down an incline to B at 1 in 80, and therefore the item for forcing the cream from the boring machine to the bottom of the shaft will disappear. At B the cream will of course have to be raised to the surface.

The cutting part of the machine consists of a large disc fitted with a number of circular revolving cutting discs. I have ascertained that for a 36ft. tunnel 340-horse power will be required for cutting the chalk. To cut a clear face 36ft. in diameter will require seventy-two 12in. cutting discs upon the arms or cross-beam, each cutter taking off per revolution a concentric ring 3in. in width, and $\frac{1}{16}$in. thick—providing the head to turn at the rate of ten revolutions per minute. This would give the cutter on the extreme outside a periphery speed of 1130ft. per minute, which is well within practical limits.

For the reduction of chalk *débris* to cream, experiments have been made with a plain cylindrical drum 4ft. in diameter, and 2ft. 8in. long inside, revolving at the rate of thirty-two revolutions per minute. One face of the drum is made of a strong wire grating, but in the centre a hole is left of 15in. in diameter, through which the water and the chalk *débris* are introduced in whatever quantities required. As the drum revolves the particles of chalk are quickly reduced down, and a cream or sludge of more or less consistency is produced, which escapes through the wire grating, and collects in a reservoir, whence it is forced to the outside by pumps or allowed to run away by gravity.

In this apparatus a quantity of chalk *débris*, amounting to eleven cubic yards, or twenty-one tons, was reduced to cream within one hour with ½-horse power per cubic yard. The total on this head would therefore amount to 85-horse power.

Respecting the conveyance of cream to the bottom of the shaft, I found from trials made with cream passing through small pipes, that while an admixture of equal quantities of chalk and water, as compared with water alone, caused a loss of nearly 14 per cent. through extra friction—that of 1 of chalk to 2 of water 3¾ per cent., and that of 1 of chalk to 3 of water a loss of 2⅛ per cent.—it was therefore decided to use the proportion of 1 of chalk to 3 of water by weight, or of 1 of chalk to 6 of water by bulk. It was also ascertained that it would not be safe to pass cream of 1 to 1 through long lengths of pipe at a less velocity than 1½ft. per second, as otherwise there would be a tendency for the solid particles to settle. I have therefore decided upon a minimum velocity of 2ft. per second.

In a diagram I have given a statement relating to the powers and velocities required. As above stated, 170 cubic yards of chalk have to be excavated per hour, or seventy-six cubic feet per minute, and at a proportion 1 of chalk to 6·4 of water 490 cubic feet of water per minute will be required, and conveyed to the tunnel face by a 12in. inlet pipe. The pipe will deliver the water at a pressure of 1000 lb. per square inch., developing 2140-horse power.

The sludge or cream is composed of chalk, 76 cubic feet; water, 490 cubic feet; total of cream, 566 cubic feet per hour. This will be forced by pumps through 22in. pipes, at the rate of 3·56 per second, requiring 67·5-horse power per mile. But where sufficient gradient exists in the tunnel, the cream may be allowed to run by gravity in an open drain to the bottom of the shaft. From the bottom of the shafts to the surface the cream will be lifted by pumps driven by machinery on the top.

LETTERS TO THE EDITOR.

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

WISWALL'S TILTING WEIR.

Sir,—Reverting to the point upon which the foregoing discussion started, viz., the automatic action of this tilting weir, I would express an opinion that, in order to be of any practical value, automatic relief weirs should only be placed in such streams where the flood water will flow off below the weir at least as rapidly as it approaches it. This is not the case in this instance, for (1) the water at the back of the present weir rises twice as quickly as in front in times of flood, so that when these tilting gates are built the tail water will rise to such an extent as to render their automatic action practically useless, as the flood of the upper pool when suddenly freed has to drive before it a large body of water having a less velocity in the lower pool, which would cause at once a backing up along its whole course; while (2) the capacity of the lower pool is still further diminished by the deposited material scoured out from the upper pool through the manual opening of the gates mentioned; and (3) at the same time and in conjunction with this no improvements, with a view of increasing the discharging capacity of the lower pool below this point, have taken place. All river improvements, as a rule, should be commenced downstream and carried upwards.

As to the Medlock tilting weir, Mr. Wiswall's statement is again misleading. The governing outlet is not the vertical shaft, but the horizontal tunnel—see sketch in my letter of September 19th; and the velocity quoted, namely 23ft. per second, is due simply to the vertical drop of the shaft, which, of course, is immediately dissipated on the water reaching the bottom. The only outlet for it is by a tortuous tunnel nearly half a mile long, and of a diminished sectional area, and with practically no fall. The water, therefore, cannot attain even the velocity of the river above the weir—12ft. per second—so that the tunnel becomes gorged with water, which rises in the shaft until sufficient head is obtained to force the water through. The shaft would be completely filled and the tunnel submerged before the automatic action could come into play, and where, then, would be its use, for it is simply the head of water which would be the sole acting agent. William T. Olive.

Didsbury, October 3rd.

Sir,—A great many years ago, in the reign of Charles the First I think, a dispute raged among learned men as to whether fish weighed anything in water or not. The question was discussed with great acrimony and much ingenuity of reasoning. No one for a long time thought of testing the question practically. At last some one suggested that it should be tried. A pair of scales were procured, and a fish was weighed. It turned the scale at a pound. Then a bowl of water was put in the scales and accurately balanced. The fish was then slipped into the bowl, and the scale beam turned, and a pound was required to restore equilibrium.

Now it seems to me that the dispute between Mr. Olive and Mr. Wiswall is strictly analogous to this. If Mr. Wiswall's weir has ever acted, why does not he say so at once and so demolish Mr. Olive's arguments? If, on the other hand, he has not seen the principle tested, I would suggest that it is quite time he did. Nothing could be easier than to fit up a model of the weir on any small stream—one a foot wide would answer. Then an artificial flood might be established, and the question now being discussed set at rest at once in the most conclusive manner. Either the weir will work or it will not; no amount of argument, it appears, is likely to settle which, for Mr. Wiswall has a parry for every thrust made by Mr. Olive.

I am much surprised that no test of the Wiswall principle has been made. There is a story anent Don Quixote's helmet which Mr. Wiswall may remember. At all events I think he ought not to wait for a winter flood at Throstle Nest, but try an experiment at once. C. E.

Great George-street, October 3rd.

THE IMPROVEMENT OF PERMANENT WAY.

Sir,—Mr. C. W. Vincent is evidently entirely ignorant of that portion of the subject with which he has dealt in your impression for the 29th relating to the duties of railway engineers; while if he possesses any information concerning permanent way he has succeeded in concealing the circumstance with great care.

The duty of a railway engineer is to take care of the property entrusted to him; to maintain it in the highest state of efficiency for the smallest outlay, and from time to time to suggest to his directors, or to adopt himself, such improvements as appear to be worthy of trial. He has all the time to bear in mind that a very grave responsibility attaches to him, and that he is not specially employed or paid or expected to do anything which can incur risk to the public, his directors, or himself. Above all he must not speculate with the funds of the railway company.

As regards the introduction of changes in permanent way in this country, the question stands briefly thus:—We have now got on all our principal lines a road bed thoroughly consolidated by age and long use, and on this is laid a track which is admitted on all hands by experienced men to be of unparalleled excellence, much of which is no doubt due to the attention which it receives from gangs of men perfectly trained to their work. The only objection which Mr. Vincent has to urge against this track is that it costs more for renewals than an iron sleeper road would.

Now the railway engineer is expected to pull up the whole of this excellent track and relay it with iron permanent way of a totally different type. The plate-layers available have no experience of such sleepers, and would no doubt in the first instance make a mess of laying them. The road bed now firm and sound would have to be all rooted up to receive new sleepers, and the chances are a hundred to one that the whole road would be spoiled for at least three months, while the lives of passengers would be seriously endangered. Why, I ask, should a railway engineer incur the responsibility of recommending his directors to make the change? Mr. Vincent's answer is that the new permanent way would last longer than the old. Now it is very easy to make statements of this kind, but it is quite another thing to prove that they are accurate, and I challenge Mr. Vincent to prove his statement. A first-rate creosoted sleeper can be had for four shillings, and on a very moderate computation it will last six years. I have wooden sleepers down ten or a dozen years. But let me suppose that a sleeper lasts but four years. This represents a cost of one shilling a year per sleeper, and during this time there are no renewals or repairs of any kind required. Why, the interest on the purchase money of any good iron sleeper will represent a greater outlay than the cost of renewing wooden sleepers, to say nothing of the repairs which all systems of iron permanent way require under heavy traffic.

I now ask Mr. Vincent, since he is so enamoured of permanent way, to give me particulars of the first cost of twenty continuous miles of iron permanent way in any part of the world over which thirty trains run each way per day; of these five of the trains are not to have a less velocity than fifty miles an hour, nor a less load on each driving wheel than eight tons. The lowest speed of ten other trains shall be forty miles an hour, and that of the remaining—let us say goods trains—shall be not less than twenty miles an hour. Of course I do not tie him down to these precise figures. I use them to indicate that the road must bear a very heavy and high-speed traffic.

I maintain that there is no iron permanent way in the world, either laid by Mr. Wood or anyone else, which has to sustain anything like the traffic on the Great Northern, Midland, North-Eastern, or London and North-Western Railways, and that Mr. Vincent has nothing but pure assumption to go upon when he argues that such track ought to be adopted. Furthermore I can tell Mr. Vincent that he will find, if he makes due inquiry, that whenever iron permanent way has been tried under really fast and heavy traffic it has failed. Witness the result of the pot sleeper in India, where wood cannot be used because of white ants, &c. I contend that he has no facts to go on. The circumstance that Mr. Wood is sending out 40,000 tons of his system to the Continent has nothing to do with the point at issue, as it is all to be used for slow German and French traffic—twenty-five miles an hour maximum.

If Mr. Vincent can supply information he will be listened to with interest, but before he writes again he will do well to acquire some information for himself. Wooden Sleeper.

Doncaster, October 2nd.

RAILWAY ACCIDENTS.

Sir,—I have anxiously waited for the publication of your paper this week hoping to see full particulars of an accident caused by the failure of the vacuum brake at the Central Station, Liverpool. Duty requires me to travel very frequently between Liverpool and London. I cannot say if I am very unfortunate in the trains which I select to ride in, or whether this brake is always failing; but I should like to mention a little of my recent experience. On July 10th I had to leave London by the twelve o'clock from St. Pancras, and when stopping at Kentish Town I felt a jerk, looked out of the window, and saw the train was divided into two parts. A company's servant remarked, "The vacuum brake has done this." On another occasion, I think July 31st, I left Liverpool at nine a.m., and when stopping at a station, Wigston Junction I believe, the train broke in two again. On still another occasion, August 31st, I was a passenger in the twelve noon from Liverpool; the train ran past the platform at Leicester, and I saw a great examining of pipes, and was told the brake had failed again. Quite lately—I am not quite certain to a day—the nine a.m. train from Liverpool parted into two portions at Market Harborough, and again at Bedford. So far these cases, although a little alarming to a passenger, did not cause me any serious inconvenience; but on the 22nd of September—Friday—I left London by the 10.15 train; going into the station at Liverpool I felt the brake put on in the usual way, and it was grinding on the wheels of my carriage until about forty yards off the end of the line at Liverpool, when to my surprise the grinding ceased and the train seemed to jump forward as if all the brakes had suddenly gone off. I was just getting my umbrella down from the rack, when the train, instead of stopping, pitched violently into the buffer-stops at the end of the station, causing my head to come into sharp contact with the back of the carriage; fortunately the padding of the first-class carriage broke the force of the blow, otherwise I should have got a nasty hurt. As soon as I got out I inquired, "what ever was up?" I was told that it was not the fault of the driver, as the brake failed in his hands. After this experience of brakes on the Midland, I have decided to travel by the North-Western. On mentioning my ill-fate to a gentleman with whom I do business, he tells me that on the 14th of September he was a passenger in the 9.50 Manchester to London, and that when the train got to Luton this vacuum brake failed, and they ran past the station and had to be pushed back. I have read much in favour of continuous brakes, but it really appears to me that this one is beginning to be a source of danger, not of safety; and as a Midland shareholder I think it my duty to bring the matter before the company, as I am now about to do. At any rate I should like to have a proper understanding as to the cause of all these mishaps.

Lime-street, Liverpool. J. Clarkson.

JOINTING LOCOMOTIVE INSIDE CYLINDERS.

Sir,—I would like to exchange ideas on this subject with any of your readers who have a practical knowledge of it. We are sometimes greatly bothered here in India with cylinder joints giving way, and thereby necessitating the taking down of the cylinders to have the joint re-made. Very often the escaping steam has cut into the face, and the flanges have to be planed up, and to keep the cylinders to gauge we have to put in a liner between the flanges. It appears that, owing to unequal expansion, when inside cylinders get heated with steam, the face joint warps more or less, and in many cases, the bolts not being sufficient to prevent the joint opening, they commence to blow. Many expedients have been tried to prevent this warping, all of them resulting in failure. One idea was to cut through the deep flanges at either end of the cylinders. This plan did a little good in preventing the warping to some extent, but it is such a thoroughly un-mechanical idea to cut away all the strength of the thing, that I would not recommend it. If I was asked to design a pair of inside cylinders, I would make the flanges broader, and put in a double line of bolts. Are there any objections, and what, to this idea? Then about the joint: it takes such a long time to scrape up a pair of cylinders, that I would be inclined to adopt some other method. The old cylinders which we got planed up, and in which we put a copper liner, all the breadth of the flange, I have jointed just from the planing machine without any scraping, and with red lead thin enough to put on with a brush. The copper liner is left a little broad, and is chipped off after the joint is made both outside and inside the steam chest.

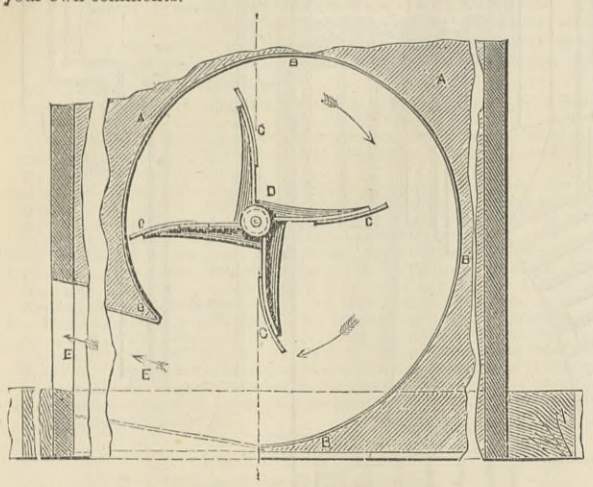
This I find to be the best method of jointing cylinders in my experience, and I wonder and would like to know what objection there is to making new cylinders this way. The copper liner being soft, yields a little to the warping of the flanges, and thereby prevents the joint blowing, and even should it blow a little the copper liner can be caulked. The caulking may be objected to as being too much of a boilermaker's idea, but if the objector's patience had been exercised as mine has been, he would be glad to try the caulking. I have seen cylinder flanges faced perfectly true to a face plate, and then scraped to a dead fit on each other, jointed with black varnish, and when tested with 120 lb. of steam, not only did the joint blow, but when the cylinders were separated it was found that the flanges had taken a permanent set or skew, and had

to be faced up again. Water is no test for cylinders. I have seen a pair of cylinders pressed to 200 lb. with water, and as tight as a bottle, but when 100 lb. of steam was put into them they blew badly. Neither is it a fair test to press cylinders with steam when they are not in the engine; when in their place they are in different circumstances, being greatly heated from the smoke-box, and this tends to keep the upper portion of the joint tight. Cylinders get badly corroded on the top surface from water thrown from the exhaust pipe and in washing out the boiler. Would it not be better if a plate was fixed on water-tight to protect the cylinders? I am certain this does not receive the attention it deserves. I have seen cylinders corrode from this cause only, until the piston came through the side. H. Adie.

Jumalpore, Bengal, August 26th.

FAN TRIALS AT READING.

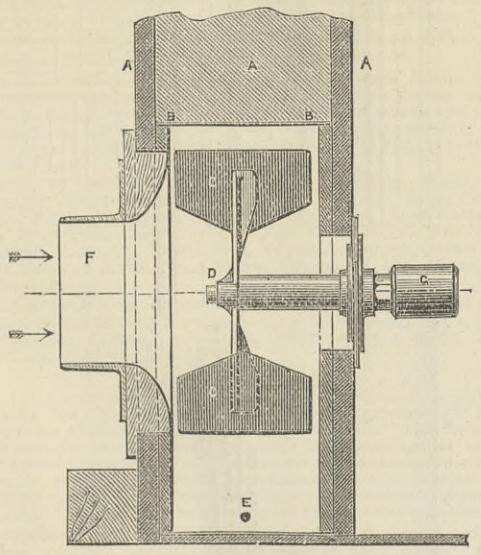
Sir,—In replying to criticisms which have appeared upon my letters in your columns, I hasten to acknowledge the fairness of your own comments.



I admit that the large stack of Mr. Coultas was made of inferior grass; but that does not alter the fact of the presence of mould in great abundance. My point is, that so far as any of us failed or succeeded, the "very powerful" steam fans were not proved to be necessary. There were three of the stacks made of much the same hay, viz., my hand-fan stack, which sold for £24 3s.; Mr. Bamlett's hand-fan stack, £19; and Mr. Phillips's power-fan stack, £19. Here two were ventilated by hand-fans and one by a power-fan. There is no invidious disparagement necessary in drawing from this a conclusion not unfavourable to hand-power fans.

Turning to your leader of September 8th, we are all indebted to you for bringing to the front the all-important question of the true principle of construction. Everything else is now subordinate to this. The real success of the Neilson method as a system will establish itself in spite of the unfortunate Reading trials. Mr. Neilson has proved it himself by eighteen years' patient working, and nothing will long hide this from public appreciation. The only question for us is, How can this system be most suitably applied to the circumstances of the great mass of our farming community? In other words, given a 20ft. stack to exhaust through 8in. or 9in. pipes, what is the best kind of fan for the purpose, workable, if possible, by agricultural labourers?

As you have taken the pains to lay down the general rules of construction, perhaps I cannot do a better service at this stage of the controversy than submit to your own and public judgment the working drawings of the interior of our fan.



The hand-fan being 12in. diameter, has a 6in. inlet, and the blades are 3in. long, or deep. These figures agree with the orthodox proportions you quote from Mr. Buckle. The width of our blades we have made greater than usual, and the excentricity of the centre somewhat above the ordinary proportion. We draw air direct into one side. The shape of our blades is fully shown in the drawings. How we obtain a high speed by means of a large friction wheel driven by a sun-and-planet motion you have already explained to the public. By calculation such a fan, when running with forty revolutions of the handles, ought to raise the water gauge about 3½in. In my re-tests I get an average 3⅛in. By removing the lower side of the discharge pipe, and so enlarging the outlet, I got the higher results recorded in my first letter to you. That the fan was not adequately tried at Reading is very clear. I have some hope that you will conclude that this fan should perform the necessary work with hand driving.

I must now reply to Mr. Hodgson, who writes from Newport in defence of the fans of Mr. Phillips. His first statement is to the following effect:—"Mr. Greening's small hand fan . . . . . is run at a velocity at the tips of 6784ft. per minute; Mr. Phillips runs his hand-fan at 3768ft. per minute, or nearly 50 per cent. less speed. Mr. Greening's gives a column of 1·30in., and Mr. Phillips's 0·95in., or only 25 per cent. less. Then the dynamometer has 9 lb. on the lever for Mr. Greening and 4·25 lb. for Mr. Phillips. Thus Mr. Greening takes more than twice the power, and only gets 1·30in. to Mr. Phillips's 0·95in." This sounds straightforward, but there is a little fact omitted which Mr. Hodgson ought at least to have mentioned. At Reading the judges first settled that forty revolutions of the handle was the natural and accustomed speed for labourers to turn a machine. Mr. Phillips's fan and mine and all the others were therefore driven at that speed. Mr. Phillips's fan gave a singularly low result and required a high comparative power. Mr. Phillips's fan was then tried at 50 per cent. higher speed and gave double the result. Mine was not so tried. Mr. Hodgson sinks all mention of trials at the same speed of turning, and compares the result of my fan at forty revolutions against the result of Mr. Phillips's at sixty revolutions.

I admitted in my first letter that with an increase of velocity there is more than a proportionate increase of effect. In fact, I especially quoted the figures in this connection which Mr. Hodgson now uses otherwise. But if Mr. Phillips's fan doubles its effect by quicker running whilst it only requires a small increase of power, surely that proves that his fan is wrongly constructed to run at a low velocity when the men are turning it round at their natural speed. In the next place Mr. Hodgson speaks of a "discrepancy in the table I use," as if I had claimed that my fan would "discharge 1445 cubic feet 'of air,' instead of the 209 cubic feet which the air meter gives." (2) He speaks of the "next trial" of my fans as though my hand-fan had a second trial, and uses the figures relating to the trial of my power-fan in this connection. (3) He omits all mention of the fact that Mr. Phillips's hand fan was not tested at all for air discharge at the same speed as mine, but only at a higher speed. (4) He takes credit for the quantity of air discharged at this higher velocity by Mr. Phillips's fan, but makes no mention of the enormous power required to do the work, viz., 23,580 foot-pounds, or about three-quarters of a horse-power. He quotes the power required by my fan as if reliable, and the amount of air discharged as if beyond question. But he blames the dynamometer for showing too much against Mr. Phillips. (5) He substitutes for the actual power proved at Reading, a calculation of his own deduced from the figures of the water column; that is to say, he assumes that the power required to drive Mr. Phillips's fan when working open and drawing a large volume of air may be deduced from the forces required to work it when it was only operating on a thin tube filled with water.

The actual figures of the power required, as given in the table by The Engineer, were as follows:—

	When operating on a water column with fan closed.	When discharging air.
Phillips's fan	6,681 foot-pounds	23,580 foot-pounds.
Greening's fan ..	10,332 ,,	8,610 ,,

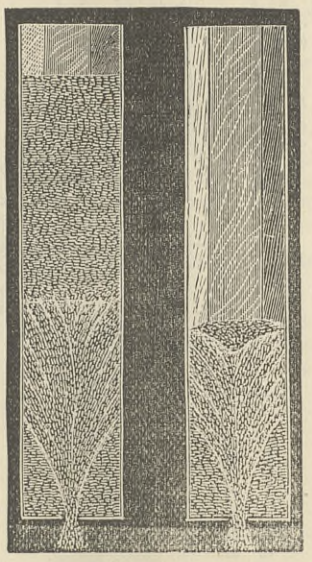
I draw a very different moral from these figures. I hesitate to throw doubt on the whole of the trials by condemning the Royal Agricultural Society's dynamometer, which is the one they use on all occasions; but I say as regards my own fan, it is evident that for some reason it was not operating to a fourth or fifth of its power, or it would certainly have required more power to drive it when it was discharging air than when it was closed.

Edwd. Owen Greening.

Agricultural and Horticultural Association, Limited,
3, Agar-street, Strand, W.C.

GRAIN HOPPERS OR BINS.

Sir,—If Mr. Roberts will carefully carry out a trial with his small elongated bins he will find that our statement, "that the grain moves like a fluid," is no error—but a fact. The best way to witness this is to divide one of the elongated model bins into halves, from bottom to top by a vertical glass division crossing the discharge orifice. It can then be seen that the moving grain, during delivery, assumes the shape as described in ours of September 20th.



The figures herewith show the shapes of the moving mass of grain during its discharge at two distinct stages. The depression of the top surface of the falling mass does not commence to show itself until the elongated hoppers are about two-thirds empty. The formulæ derived from experiments as carried by Mr. Roberts with small model elongated bins cannot be considered as safe and reliable for proportioning the strengths of the bottoms of large grain hoppers. A hopper 14ft. by 14ft. by 75ft. deep would hold about 300 tons of wheat.

The formulæ of Mr. Roberts makes out that the greatest pressure upon the bottom of such a hopper when full of wheat would be about 60 tons. We certainly should require more proof than Mr. Roberts adduces before spending money on the building of a large hopper in accordance with such formulæ. In our opinion this matter cannot be satisfactorily decided except by trials with a large experimental hopper which will take into account the movements of the grain during manipulation as pointed out in our former letter. Until this has been done we must continue our usual practice, which so far has proved safe and reliable, viz.:—"To treat the wheat as a fluid having a weight of 47 lb. per cubic foot, and to make an allowance or reduction for the friction of the grains amongst themselves and against the side walls. Such allowances being determined by the shape, area, and height of the proposed bin." Higginbottom and Stuart, Milling Engineers.

Liverpool, October 4th.

A PHASE OF FOREIGN COMPETITION.

Sir,—In my letter in your paper of January 3rd, 1879, under the heading "Iron Trade Wages," I alluded to foreign competition, and made some remarks upon one point having a bearing upon it. With your courtesy I may now make a few statements of facts bearing upon other points having also a bearing upon it in another department of trade. (1) Some years ago—I am bound to speak somewhat indefinitely owing to the nature of this communication—two gentlemen left an engineering establishment of considerable standing and repute, one a little time after the other; they were foreign gentlemen. The firm they had been engaged by within a few weeks after they had gone were surprised to find these gentlemen were advertising themselves as "Engineers and Machinists," and having a works in Germany—a works the buildings of which were just in course of completion at the time they left England, where they had been employed for some time. Their surprise was still more heightened when they found they were actually lithographing their designs, and that too without alteration of any dimension. At the Paris Exhibition they exhibited machines which, had it not been for the name upon them, might have been taken as having been made by the English firm, whose designs they had covertly got possession of whilst working in the capacity of draughtsmen. This firm has now no foreigners in its employment.

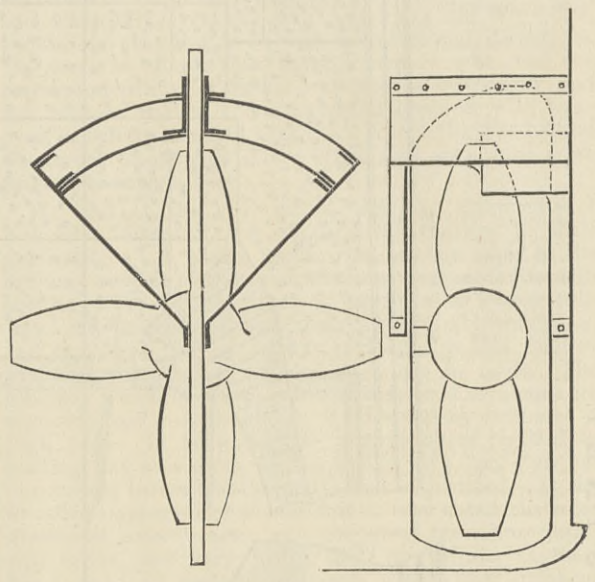
(2) Within the last few years all, of any design, that was in or being produced in the drawing office of another firm of standing was traced at a place in a northern town—the works were in its suburbs—and the tracings were sent direct to Germany. Other similar instances I might give, but they would add nothing to the point of the two given above, which to a thoughtful mind speak for themselves and need no comment. I myself have been connected with a firm as a shareholder—although I am not referring specifically to limited companies—in which I found persons higher in position than draughtsmen were guilty of the same kind of thing.

September 20th. Pro Recta.

GRIFFITHS' SCREW PROPELLER SHIELDS.

Sir,—The enclosed paper gives a short account of my propeller shield, which I discovered after a long course of model experiments to be the only arrangement that can be applied to screw ships to prevent the screw drawing away the dead water from the stern, which, as marine engineers are well aware, increases a ship's resistance nearly 40 per cent. In 1879 I explained to the Institution of Naval Architects that the most effective position for the screw propeller was two-thirds of its diameter from the end of the run, and since that time several ships have had their screws moved aft, and obtained very much better speed in consequence; but when the shield is applied the screw in the ordinary position becomes very nearly as efficient, the ship's speed being increased 6 to 8 per cent., or the present speed may be maintained with a saving of 16 to 20 per cent. of the coal, the vibration entirely prevented, steering improved, and racing reduced, while the cost of the shield and the patent right does not exceed one-twentieth of the value of the increased speed.

This shield consists of two plates, so arranged that they prevent the propeller acting on the dead water, and increase the speed of a ship from 6 to 8 per cent., and in addition prevent vibration, improve the steering, and reduce the racing when the ship is pitching.



The following result was obtained from a steam launch to which it was applied, the owner, Mr. C. Boursot, and Captain Curtis, Royal Navy, being present at the trial:—

	Without shield.	With shield.
Mean speed	6·417 ..	6·636
Mean revolutions per minute..	289 ..	265
Mean pressure of steam	45·1 ..	42·5

showing that 3½ per cent. more speed was got with a saving of 15 per cent. of power.

The shield is very inexpensive, the estimated cost for a 12ft. diameter propeller being only £12, and it can be put on without docking the ship. Taking the cost of marine engines at £40 per nominal H.P., and allowing a similar sum—a very moderate estimate—for the coal they require, space occupied in ship by the coal, repairs, &c., the increase of 6 per cent. in speed, to obtain which 19 per cent. more power would be required, is equivalent to an increase in the value of the ship of £1520 for every 100-I.H.P. of the engines. Robt. Griffiths.

54, Gresham-street, E.C., October 3rd.

A PROBLEM IN HYDRAULICS.

Sir,—Can any reader explain this simple hydraulic phenomenon:—A small pump, driven by steam cylinders, had a 6in. delivery pipe, but it was found that the power of the engine was not sufficient to deliver to the top of the reservoir. A "practical man" suggested the apparently stupid method of making the delivery pipes 3in., but strange to say the pump now works and delivers easily to the top. Why? Has the velocity anything to do with it? V. S. M.

Manchester.

THE NEW PUTNEY BRIDGE.

On page 258 we publish the second of a number of drawings of the new stone bridge to be constructed at Putney. In succeeding impressions we shall publish other drawings and descriptions.

Electricity and Torpedo Warfare.—In a short notice on gun-cotton at the end of the article on the above subject in The Engineer of September 1st, it appears that we were in error in attributing to Mr. Abel the discovery of the valuable property which gun-cotton, together with other explosives, possesses in being capable of violent explosion through the agency of detonation. The credit of this discovery is, we now understand, due to Mr. E. O. Brown, of the Chemical Department, Royal Arsenal.

Electric Lighting at the Royal Albert Dock.—As may be remembered four stations have been erected in the dock, each containing a 20-horse power condensing engine, supplied by Messrs. Marshall and Co., and a number of electrical machines. Some of these work the powerful arc lights suspended from tall latticed iron posts, and others, giving alternate currents, are connected with two main leading wires running along all the sheds on the north side of the dock. At each shed a commutator is provided, so that the current can be turned into the shed or the shed may be cut out. Specially constructed suspenders are suitably distributed over the interior, the front, and the back of the shed, to which the lanterns containing the electric lamps can be attached; provision is also made for connecting ships lying alongside the quay by means of movable leading wires to the circuit, so that electric lights can be placed in the hatchways and below for facilitating loading and unloading during night time. As this mode of working has given universal satisfaction on the north side of the docks, Messrs. Siemens have now received a further order from the dock company to fit up the sheds on the south side in a similar manner, and the work is being pushed on with all speed.

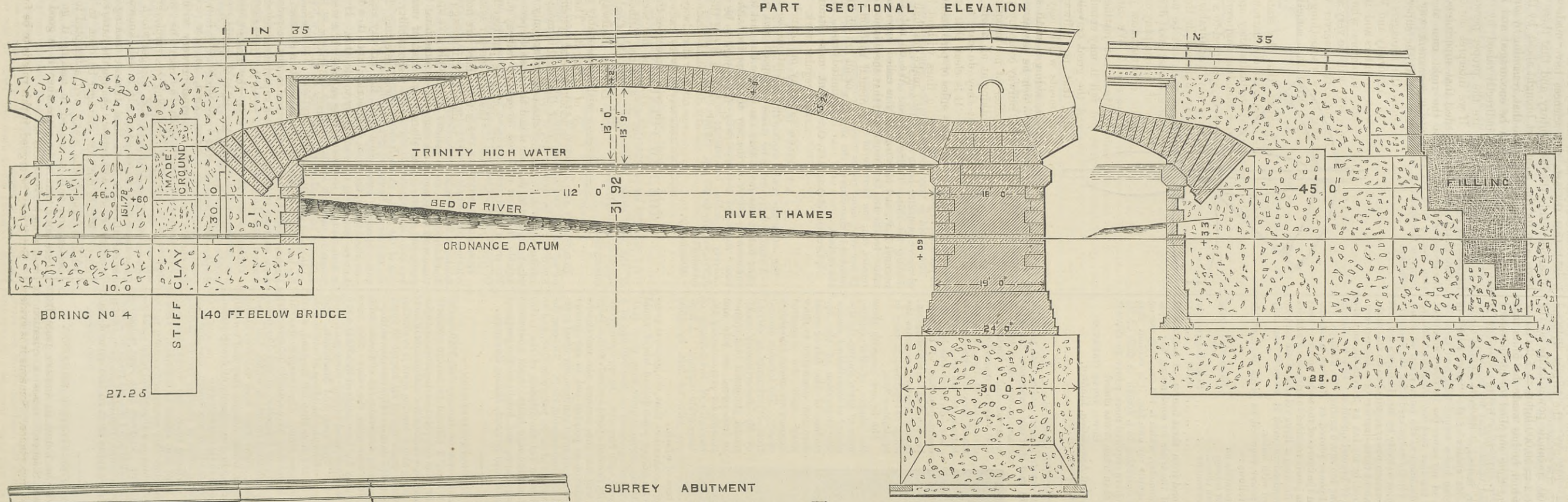
Chesterfield and Derbyshire Institute of Mining, Civil, and Mechanical Engineers.—The next general meeting of the members of the Institute will be held in the lecture room—the Stephenson Memorial Hall, Chesterfield—on Saturday, the 14th October, at 2.30 p.m., Lord Edward Cavendish, M.P., president, in the chair. The following papers will be open for discussion:—(1) On compressed air, viz.:—Mr. D. P. Morison's paper "On the application of Compressed Air to Coal Mines" (see Part I., vol. vii.). Mr. Joseph Timms' paper, entitled, "The connection between Heat Expended and Work thereby Done; also the use of Compressed Air as a transmitter of Power theoretically considered" (see Part II., vol. ix.). The late Mr. C. T. Owen's paper, on "A Compensating Air Compressor" (see Part II., vol. ix.). (2) Mr. J. A. Longden's paper on "Pit Ponies" (see Part IV., vol. ix.). (3) The report of the Coal-dust Experiments Committee. (See Part I., vol. x.). The following will be taken as read:—"On Mining Coal by Compressed Lime, under Sebastian Smith and Moore's Patent," by Mr. Sebastian Smith, Shipley, Derby. "The Manufacture of Coal Gas, and its application to Artificial Illumination—fifth paper of the series—distributing apparatus, meters, burners, &c," by Mr. Charles Edwin Jones. "The Electric Exhibition at the Crystal Palace, London; closed June 3rd, 1882," by Mr. G. E. Smith, Nottingham.

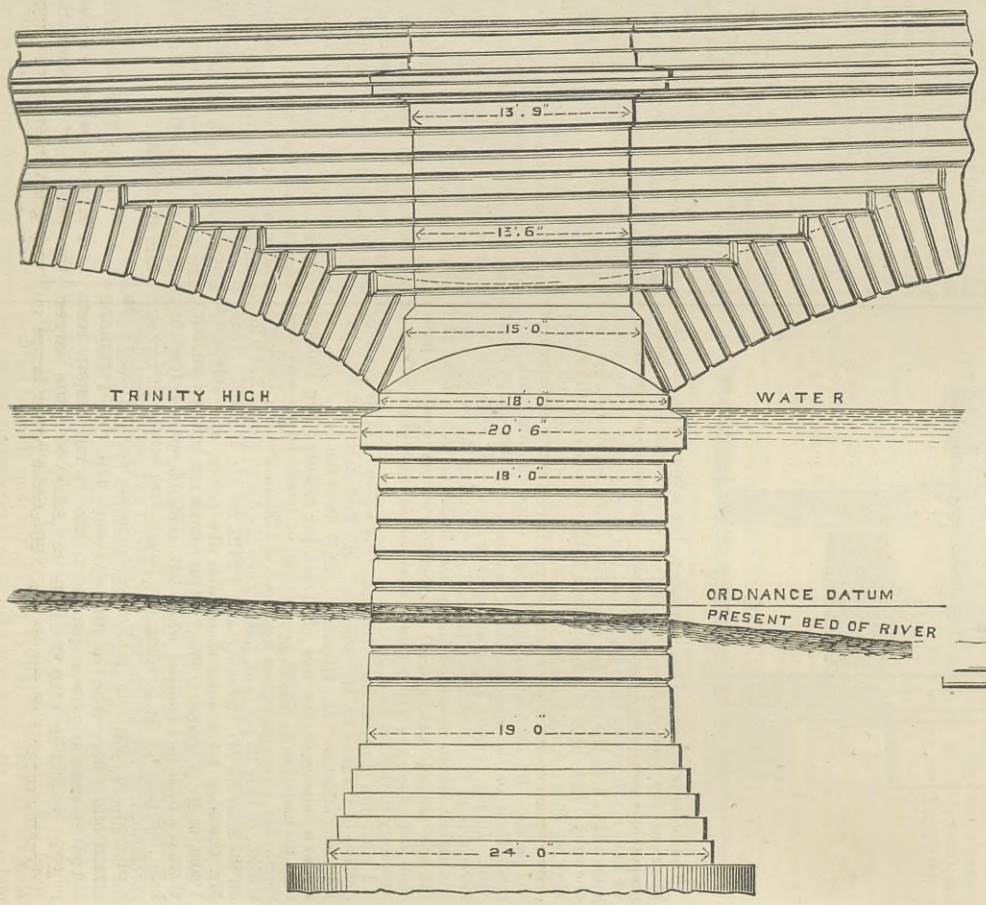
THE NEW BRIDGE OVER THE THAMES AT PUTNEY.

SIR JOSEPH BAZALGETTE AND MR. E. BAZALGETTE, MM. INST. C.E., ENGINEERS.

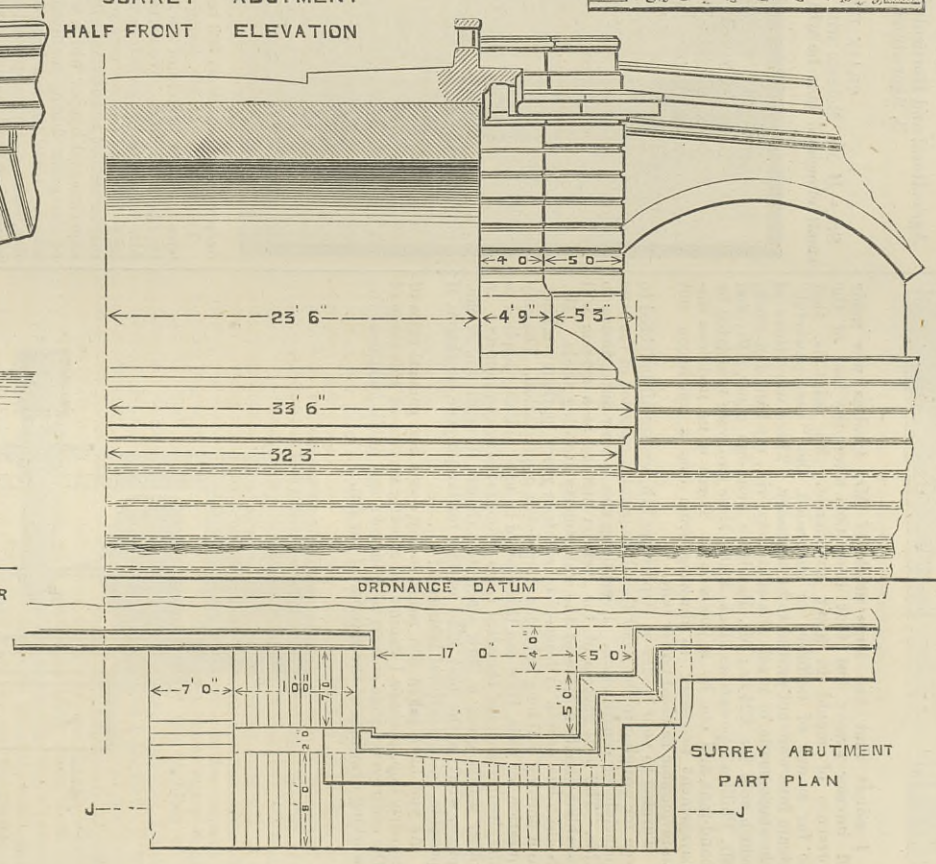
(*For description see page 257.*)

PART SECTIONAL ELEVATION

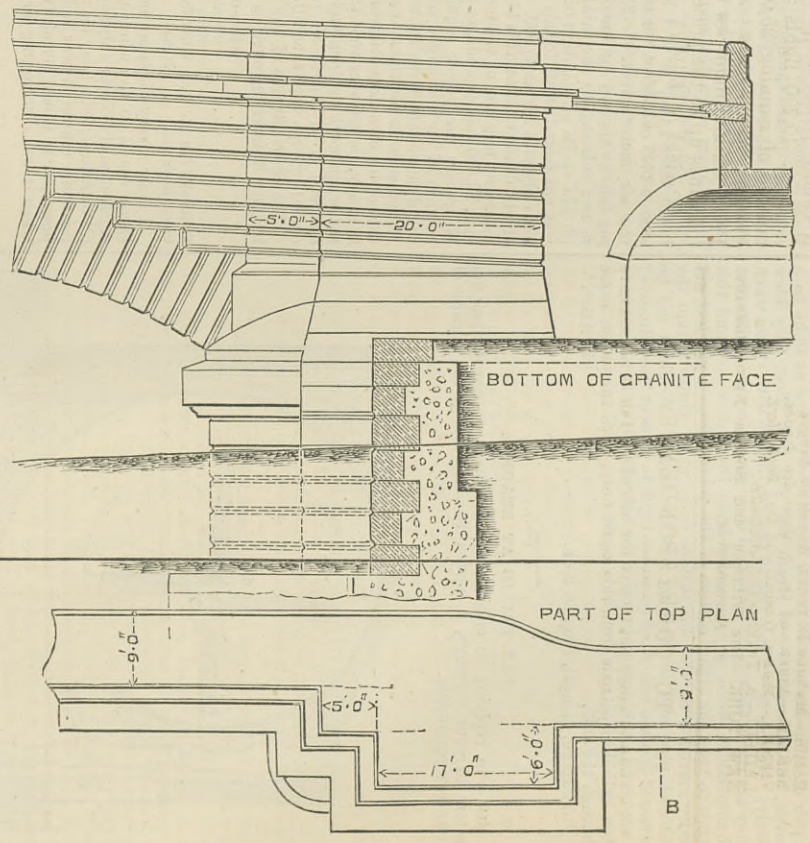




SURREY ABUTMENT HALF FRONT ELEVATION



SURREY ABUTMENT PART PLAN



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TO CORRESPONDENTS.

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

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C. H. (Plymouth).—*The Alaska's propeller is* 23*ft.* 3*in. diameter,* 34*ft.* 6*in. pitch, and has four blades, with a surface of* 190 *square feet.*

L. D. (Birkenhead).—*The governor which we illustrated in our issue of the* 22*nd of September, may be obtained of Messrs. Durham, Churchill, and Co.,* 23, *Leadenhall-street, E.C.*

F. and J. B. (Keighley)—*There is no book in existence on the production of malleable iron castings, but you may consult the books on founding referred to in this column in our last impression. If you will say what it is you wish to know, we shall be happy to supply you with information.*

Enquirer.—*Mr. A. Manning, Dock House, Billiter-street, the docks being promoted by the East and West India Dock Company, of which Mr. Manning is also the engineer. The contractors are Messrs. Kirk and Randall,* 83, *Horseferry-road, S W., and Warren-lane, Woolwich.*

C.—*The cross arms in your sketch do not in any way affect the pressure on the end* C *of the tube, and the force which applied at* C *will keep the apparatus at rest, will be precisely equal to that applied at* B *to drive the piston in. This ought to be evident to you at a glance, because it is easy to see that the cross arms being identical in dimensions, the strains on them must balance each other, leaving the force at* C *in your diagram to balance the strain on the piston* B.

FOUNDRY MIXTURES.

(To the Editor of The Engineer.)

Sir,—Will some of your correspondents kindly give their experience of the best mixtures of iron for light castings for agricultural machines, strong mixtures of pig and scrap that give good results under test, and work well in tooling? Foundry Manager.

Essex, October 4th.

THE ATTRACTIVE POWER OF MAGNETS.

(To the Editor of The Engineer.)

Sir,—Will any of your readers kindly tell me, First, what is the influence exerted by the size of an armature on the attractive force of an electro-magnet? In other words, I suppose the mass of the armature ought to bear some definite relation to that of the magnet to get the best result, but I can find no mention of this in any treatise on magnetism and electricity. Secondly, what is the proper relation to get maximum effect between the mass of a solenoid and its core? In other words, will a tubular core give as good results as a solid core? Thirdly, in making some experiments recently with a small electro-magnet, not horseshoe, with a resistance of about one Ohm, I put a thin plate of iron about four times the area of the pole on the magnet. On this I placed an ordinary §in. nut. On trying to lift off the nut, to my surprise the thin plate armature came with it, the nut under inductive influence attracting the armature more powerfully than the magnet itself did. Will any reader explain the cause of this phenomena to A Student.

London, October 4th.

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THE ENGINEER.

OCTOBER 6, 1882.

THE FERRANTI DYNAMO.

In our impression for September 22nd, we considered at some length the principles affecting the efficiency of dynamo-electric machines. Our remarks were evoked by a couple of letters which had appeared in the *Times* dealing with the efficiency of what is now spoken of as the Ferranti dynamo. Another correspondent has now taken up the subject, and the *Times* of Monday contained a letter from Mr. Frederick Pertwee, manager of the Birmingham and Warwickshire Electric Light Company, Limited, in which certain startling statements are made. Mr. Pertwee, after referring to the great outlay necessary to establish a system of electric lighting under existing arrangements, submits the following figures concerning the prices of the largest dynamo machines at present offered, of various makes, for incandescent lamps in multiple arc:—The largest dynamo capable of running 160 20-candle power lamps on the Brush system costs £720 × 310 = 49,600 lights = £223,000; the largest dynamo capable of running 200 20-candle power lamps on the Siemens system costs £300 × 250 = 50,000 lights = £75,000; the largest dynamo capable of running 1200 20-candle power lamps on the Edison system costs £2400 × 41 = 49,200 lights = £98,400; the largest dynamo capable of running 25,000 20-candle power lamps on the Ferranti system costs ? × 2 = 50,000 lights = £25,000 (?). From careful inquiries which he has made he finds that machines up to the present time supplied for incandescent work yield as follows:—Brush, four lights; Siemens, at the Savoy Theatre, eight lights; Edison, at the Holborn installation, ten lights; Ferranti, at the trial installation, eleven lights per horse-power.

Now, such a definite statement as this coming from the manager of an electric light company, may very well mislead the unwary. We have already explained that the electricity obtained from a dynamo cannot possess more energy than has been expended in producing it; and that, as waste, &c., has to be allowed for, the return will certainly not be so great. Of course, after the electricity has been produced its energy may be wasted. Thus, even if it be true that the Brush Company's dynamos give but four 20-candle lights per horse-power, as stated by Mr. Pertwee, it by no means follows that the fault resides in the dynamo. The wires, the lamps, the insulation, and many other things, may all be at fault. All, however, that it is necessary we should insist on is that, no matter what the construction of the dynamo may be, not more than about 90 per cent. of the power actually expended in driving it can be got out of it; and it so happens that the dynamo can, so to speak, be indicated. That is to say, the quantity of current and its potential or electromotive force can be measured by accurate instruments, and such instruments applied over and over again to half-a-dozen well-known dynamos have proved that a very high percentage of useful effect can be got from a sufficient number of these machines of different type to prove that there is very little room for improvement in this special direction.

We do not know what the construction of the Ferranti machine is; the secret has been very closely kept; but we have not the least hesitation in saying that it will not return in electrical energy available for lighting purposes more than 90 per cent. of the power put into it. On this point there is absolutely no room for doubt of any kind; there is no loophole or means of escape. It is as impossible to get more out of a dynamo than has been put into it as it is to make a mill wheel pump water to turn it and drive a pair of millstones besides. If we take Mr. Pertwee's own figures we shall come at some startling results. He asserts that a Ferranti dynamo can be made which will work 25,000 20-candle lamps—that is to say, a single machine will maintain 20 × 25,000 = 500,000 candles. Mr. Pertwee admits that the Ferranti machine can maintain but eleven lamps per horse-power. Now $\frac{25{,}000}{11} = 2270$ indicated horse-power. The great Corliss engine at Bradford, noticed in our pages, has a cylinder 40in. in diameter and 10ft. stroke, and it makes about 800ft. of piston speed per minute. Two such engines, making about 900ft. of piston, would be required to drive the single Ferranti dynamo of which M. Pertwee speaks. Whether it is advisable or not so to concentrate the power required in a large district is at least open to question; but if we assume that there is nothing objectionable about this part of the scheme, and that it is even better in some respects than the Edison system of sub-dividing the power required among a number of dynamos and engines, we have the fact remaining that so far as the efficiency of the dynamo is concerned nothing whatever has been gained. As far as can be gathered from Mr. Pertwee's letter, the Ferranti machine is simply a colossal dynamo; but there is no reason whatever, as regards the principles of action involved, why other dynamos should not be made just as large. Within moderate limits, the energy of the current generated when a coil of insulated wire cuts a magnetic field is quite independent of the velocity with which it cuts it. The power expended in cutting a series of magnetic fields at a double velocity will be doubled; but so will be the number of the currents produced, and the augmentation set up in actual resistance, will, of course, be returned in electrical energy. Consequently a dynamo may be made with an armature 20ft. in diameter as well as one with an armature of 20in. Practical difficulties of a troublesome character may be incurred, but there is no theoretical objection whatever to be urged against, let us say, a Ferranti machine with an armature 20ft. in diameter; only, as we have said before, it has yet to be proved that any practical advantage can accrue from the adoption of one big dynamo instead of several smaller machines. It may be that the Ferranti machine is after all of very moderate dimensions, but if that is the case it is impossible to see how over 2000-horse power can be imparted to it.

It is to be regretted that Mr. Pertwee has given no definite information concerning the reasons why the Ferranti machine will give 11 lights or 220 candles per horse-power. It may be worth while to add that this performance is by no means unprecedented. Indeed, with some lamps it has been beaten. If the angular velocity of the armature is very great—which it may be if the armature is very large in diameter, although its number of revolutions per minute is moderate—then the electro-motive force of the machine will probably be great, and this may conceivably enable a high candle power to be got per horse-power with special lamps; but Mr. Pertwee gives no information on this subject. In point of fact, up to the present moment we have heard nothing concerning the Ferranti dynamo but apparently extravagant assertions unsupported by an atom of proof. To say the least, the adoption of this course is unfavourable to the Ferranti dynamo, and will tend to prejudice it in the eyes of scientific electricians.

THE DUTIES OF SUPERINTENDING ENGINEERS.

A letter, which will be found in another page, from the pen of "Wooden Sleeper," raises a question of very great interest and importance. Someone it is evident must put inventions and improvements into practice, otherwise the inventions can be of no possible value, and the improvements can never do any good. It is also indisputable that the arts and sciences have made enormous advances within the last century, and that these advances have been for the most part brought about by the inventive energy of the nation; so that, reasoning by analogy, the inventor ought always to be encouraged and his inventions tried. The question indirectly raised by "Wooden Sleeper" is, simply, who are the proper persons to put inventions into practice? If we interpret our correspondent literally, he says in effect that superintending engineers of railways are not the right men to introduce improvements of any kind in permanent way; and by parity of reasoning, it follows that the superintending engineers of shipping companies, the managers of works, and ultimately, even our own Admiralty and War-office, should have nothing to do with inventors and inventions. We have no doubt that those inventors who read our correspondent's letter in this way will be very angry, and not without reason. The impartial observer will, however, be willing to admit that there is something to be said on our correspondent's side. What that something is we propose to explain here.

We find at the very outset that the statements of "Wooden Sleeper" are comparatively narrow in their application; but within certain limits they apply to the ordinary routine of the superintending engineer's life with startling force. An engineer is appointed to a large railway. He finds the permanent way in admirable condition; and the great body of railway engineers in this country say that the road is as good as it can be made. The company which he serves is prosperous; good dividends are regularly paid, and the shares of the company command a high price. Is he under the circumstances justified in making any alterations in the road? We can give but one answer to this question. He is not justified. If the so-called improvement should fail it may entail the most disastrous consequences; and the great travelling public will argue, and very justly, that no railway engineer has a right to make experiments which may endanger life for the sake of, perhaps, adding a small sum to the dividends of the company which he serves. Passengers will argue that whether the railway company pays 5½ per cent. or 5¾ per cent. is a matter of no importance whatever to them. They care nothing at all about the profits made by the carriers; but they do care a great deal about being carried safely. It is clear that no engineer could lay down two or three miles of permanent way of a new type on any of our main lines without incurring a responsibility great enough to make his hair turn grey before six months were over. We do not think that a salaried servant of a company is called upon to incur any such risk. But it may be said that there is no necessity for putting down a really experimental road on a main line. It may be first laid on sidings, or on branch lines, and so tested. This is only true in a limited sense. If a boiler or a bridge is being tested, we put more strain on them than they will have to carry in regular work. But this is not the case with permanent way on branch lines or in sidings. It will not in such situations be run over by heavy trains at excessive rates of speed, and consequently the experience acquired in any place but that to which the improvement is ultimately to be applied, although useful as far as it goes, does not go far enough to be very useful. The true experiment begins when a bit of the new track is laid, let us say, on a sharp curve on the main road, away from a station. A very large number of railway inventions have come to grief in this way. Every railway engineer who has reached middle life will remember the dozens of systems of permanent way which he has seen tried, and not one of which is now in existence, although it promised well in a station yard, or on a bit of out-of-the-way branch road. The North London Railway Company used to give every inventor with a reasonably good system of permanent way a chance of trying it. There is not a line in the kingdom on which several systems have not been tested; and in spite of this, at this moment the fact remains that in Great Britain there are only two systems in use—the longitudinal and the cross sleeper—and that in the United States, with a greater railway mileage than, perhaps, that of all other countries put together, there is virtually but one system—the cross sleeper system—in use. It does not follow from this that there are not better systems of permanent way available, but it does go to show that the superintending engineer who would give up the wooden cross sleeper for something else—a something that will be regarded as a radical change by a host of railway men—cannot help assuming a grave responsibility. It could, indeed, be argued that he was rejecting the acquired experience of nine-tenths of the railway engineers and railway companies of the world; and it would require more than ordinary audacity to do this. If we turn to the case of the superintending engineer of a steamship company we see that there are many points of similarity between him and his professional brother. The man, for instance, who puts boilers of a new type into a steamer intended to cross the Atlantic incurs a tremendous responsibility; and we are not at all clear that a superintending engineer is in any sense or way bound to incur it. If the ships under his charge have been doing well, why make a change, which may mean so much for the sake of gaining an uncertain advantage? We might go on to cite numerous other instances of the same kind, as, for example, the manager, let us say, of a great brewery with a splendid reputation. Would such a man be justified, for the sake of possibly increasing his employer's profits, in introducing modifications and changes which may imperil the reputation of his firm? It is well known that a very small alteration in a blast furnace making a particular quality of iron will entirely change the nature of the product. Would not that manager be open to rebuke who, when a furnace was going well, attempted to make it go better, and only succeeded in making it go worse? Is there not a time and a place when it is good policy to let well alone? We think so.

But it may be argued, if this rule is to be followed then

no improvements can ever be effected in permanent way or anything else. We have written nothing to justify such a remark. We have not said, for example, as regards permanent way, that risks should never be run, or that no inventions should be tried. We have pointed out that there is much to be said on the side of the superintending engineer who refuses to take the responsibility of trying new things; but this is quite a different affair. The proper course to be pursued is for the directors, who are supposed to know something about railway matters, to examine the invention proposed for adoption; to call on their consulting engineer for an expression of opinion, and after also consulting with the superintending engineer, to give the thing a trial. In this way they can always argue, and with truth, that they took every reasonable care to see that they were safe before they made the change. The superintending or executive engineer will then have his responsibility shared, and a load taken off his shoulders. In this way, perhaps, our correspondent, "Wooden Sleeper," would be quite content to try any reasonably good system of permanent way, and to give it fair play. He would practically have the orders of his directors to fall back on, to hold him scatheless should an accident occur. In the same way the superintending engineer of a steamship company, or the manager of a brewery, could be cleared of responsibility. In a word, we contend that executive engineers of all kinds are justified in refusing to make, *on their own responsibility*, changes in systems giving good results. Whether the directors of railway and steamship companies, and the proprietors of manufacturing establishments, are equally to be excused if they do not try new things or test the advantages of improved methods of working, is not, we think, a point worth discussing. We are dealing now with the duties of engineers, not with those of their employers.

If we further examine the question raised by "Wooden Sleeper," it will be seen that his contention appears to apply only to experiments the making of which may entail risk on some person or persons, or on the property of the railway company. At least, this is the light in which we read his words. If he holds different views from these, then we must beg to differ from him, and he will find moreover that his practice will be diverse from that of all the more efficient men of the day. For example, new and presumably improved types of locomotive are being designed every day and put to work, and there is no reason why this should not be done; nor does the engineer incur more than his legitimate responsibility by doing it. A new type of locomotive may burn more fuel than that which went before it, or prove unsatisfactory in various ways; but its use can in no conceivable way endanger the lives of the passengers whom it draws, so long, at least, as certain truths well known are kept in mind and acted upon. There can be no objection to testing a new carriage or a novel signal, because none of these things are likely to endanger human life by their failure. Yet even here we are close to very rigid limits. For example, the locomotive superintendent who puts a new type of leading axle under an express engine incurs a very grave responsibility. The rejection of iron axles for steel axles again was a very serious matter. So, reasoning in this way, we may lay it down as a rule that no executive engineer is called upon to incur the responsibility of testing inventions which, by their failure, may endanger life or property, or the reputation of the goods made by his employers. But, on the other hand, he is justified in giving careful consideration to, and in reducing to practice, any invention which appears likely to benefit his employers, and the trying of which entails no risk such as we have named. In practice this rule is acted upon very largely; and it will be found that all inventions whose adoption involves personal risk of any kind have moved slowly, and have in the end made their way into favour either because they were urgently needed, or because they were thoroughly excellent and new. There are hosts of inventions applicable to an immense number of departments of human life, every one of which entail greater or less risk in their adoption. It may be a risk of life or limb, or of property; but at all such inventions the world looks askance, and the engineer is certainly not to be blamed, if he follows the example of the world, and refuses to be made a martyr in the cause of progress. There are, we need hardly add, enthusiasts who will see no good thing in what we have written; but we do not write for enthusiasts of this type. Prudence is necessary to the success of every man, and the executive engineer who refuses to incur a grave responsibility is only manifesting prudence. Yet these gentlemen must not forget that there are occasions on which to display limitless audacity may be the most prudent course which it is possible to adopt.

THE MUNICH ELECTRICAL EXHIBITION.

The meeting of the Iron and Steel Institute at Vienna afforded an opportunity to many who would not have otherwise done so to visit the International Electrical Exhibition at Munich. The exhibition is held in a large building fashioned after the manner of our Crystal Palace, and called the "Glass Palace." The Exhibition following so closely after those of Paris and London, can hardly be expected to contain much that is new; yet it will be found to indicate progress. A special feature of this Exhibition was to have been the transmission of power by electrical apparatus; but at the time of our visit the arrangements were incomplete. There is it seems plenty of water within a mile or two of the town, and it was hoped to utilise this. According to the original programme the Exhibition will be closed about the middle of this month, whence it is doubtful if the experiments will be carried out. The attraction of these exhibitions of course centres around the electric light apparatus. Most of the better-known systems are shown here, even if it be on a small scale; thus we find Burgin, Brush, Fein, Schuckert, Siemens, Weston, and Edison dynamos, some differing somewhat from the types we are accustomed to see, while Edelmann, Schwerd, Schöneman, Einstein, &c., exhibit machines of a type, so far as we know, not yet familiar in England. An effort, and we think a successful effort, has been made to show the adaptability of the electric light, both of the arc and the incandescent systems, to interior lighting. In the restaurant a dining-room is lighted by Siemens lamps from the outside through coloured glass windows. A picture gallery is lighted from above. A model chapel constructed of paper and wood—designed to show the old style of church architecture and furnished with a kneeling figure of a cardinal in red hat and gown—is lighted from above by a Crompton lamp. The effect is very fine, the light being arranged to throw a flow of light like brilliant sunshine through a window over the kneeling figure. The small theatre, also built of gingerbread material, has the stage lighted by Edison lamps, whilst the body of the theatre was at first lighted by six Schuckert lamps from above through a glass screen. These were afterwards supplemented by Edison lamps round the walls—not, we should imagine, to increase the effect, which was undoubtedly good, but to show the different systems. Various other rooms were lighted by Edison and Maxim lamps. Prizes have been offered for the best designs for electric light fittings in the shape of chandeliers, with a very satisfactory result. Two new and interesting incandescent lamps are shown. These are the Müller and the Cruto. The former differs little if any, except in the form given to the carbon filament, from the Swan lamp. The carbon filament of the Swan lamp, as is well known, has a single complete loop; in the Müller lamp the carbon is spirally arranged throughout. This perhaps gives a greatly equality of radiating surface in every direction than any other form, otherwise it has no special advantage. The carbon of the Cruto lamp is electrolytically deposited upon another material which is afterwards removed, leaving a hollow filament. The resistance of the carbon varies directly as its length and inversely as the area of its section, and the heat developed is represented by the equation $H = C^2 R$, so that any alteration in R directly affects H—for example, doubling the resistance doubles the heat effect. Hence, with a hollow carbon the same current will give a greater heat effect, or a less current will give the same heat effect, both tending towards greater economy. The practical value of such hollow carbons is a question of the future; but the idea is by no means new, although these are the first lamps of the kind exhibited. The hollow carbons of the Cruto lamp are spirally arranged like those of the Müller lamp. Close to the stand upon which the Cruto lamp is shown are two very interesting archæological relics, these being Steinheil's original telegraph and Reiss' original telephone. Modern telephony, telegraphy, medical electricity, are well represented. The most important feature of this Exhibition is in the exhaustive tests which are being made of the dynamos and lamps. The commissioners have entered eagerly into the question, and no pains have been spared to make the tests complete and trustworthy. It is in this direction that the Munich Exhibition will probably play a more important part than either of its predecessors. In future articles we shall enter into a little more detail with regard to some of the prominent exhibits.

THE WORD "ELECTRIC."

Perhaps there is no scientific word in more frequent and general use at the present time than the term electric; and of the multitudes who are constantly employing it there are, we fancy, very few who know when and by whom the word was introduced into the language. To William Gilberd, who lived in the sixteenth century, is to be ascribed the honour. In 1600 was published in London his "De magnete, Magneticisque Corporibus et de Magno Magnete Tellure, Physiologia nova." This work, in which the foundation of the doctrines of terrestrial magnetism was set forth, contains the words, "Vim illam electricam nobis placet appellare quae ab humore provenit." William Gilberd was born at Colchester in 1540, and died in London 30th November, 1603. He studied at Oxford and at Cambridge, travelled on the Continent, and then settled as a physician in London in 1573. He soon gained a great name, was appointed body-physician to Queen Elizabeth, and afterwards to King James I. He was probably an intimate associate of Lord Bacon, who at the same time frequented the court, and considerable resemblance has been traced between the style in which these two men wrote. His work, "De Magnete," is written with great clearness, and full of suggestive experiments, and is decidedly the first of its kind. It is remarkable that he published less in England than abroad; and while at home, up to 1628, only two editions of his work appeared, five had been published in Holland and Germany. Gilberd will always be remembered in that it was he who propounded the idea that the earth is a great magnet having poles like a common steel magnet; he it was who made out that the cause of the direction of the compass needle was not to be sought in the heavens, nor in the situation of iron masses in the northern region, but in the globe itself taken as a whole. This great and correct idea gives Gilberd complete right to be regarded as the founder and establisher of terrestrial magnetism. To illustrate the analogy of the earth to a magnet, he constructed a spherical steel magnet, to which he gave the name, still retained, of "Terella." With such a Terella on which he acted with a magnetic needle, suspended from a thread, he showed how the direction of terrestrial magnetic force varies from place to place. He divined that the inclination was not the same over all the globe, but must increase from the equator to the poles, a divination established five years after his death by Hudson. He held that the magnetic poles accorded with the geographical poles, and the magnetic equator with the geographical equator; and, considering the few determinations made during his lifetime, this is not to be wondered at. He believed that the solid ground alone was negative, and not the water, and did not arrive at the truth in regard to declination. Moreover he knew that, and showed the why and wherefore of, a rod of iron becoming a magnet when placed in the magnetic meridian, and that iron became magnetic when hammered. He was buried in his native town, and the monument erected by two of his brothers is well preserved in the Church of Holy Trinity; on the lowest part of it is a black sphere let into a slab of alabaster representing the Terella to which we have referred.

THE PRODUCTION OF COAL.

The agitation amongst the miners of the United Kingdom has brought into prominence the question of the production of coals. It appears that there was a very large reduction in the average amount of coal sent to bank by each miner during the years of prosperity in the coal trade a decade ago. Since that time it is clear that there has been a large recovery, but the average amount sent out by each miner has been less last year than it was ten years ago, before the extraordinary increase in price. Eleven years ago it appears that every miner sent out on the average 315 tons of coal in the year—the quantity being obtained by dividing the annual production of coal by the total number of miners. For three years—years of high wages and less work—the average production decreased, but since that time there has been year by year an enlargement of the average output, but even last year the production was only 311 tons—or four tons in the year less than it was ten years before; and it is to be remembered that this is despite the fact that there has been a considerable growth of the trade in some of the centres where it is most easily worked, and also despite the fact that there has been an improvement in some of the facilities for production and for bringing the coal to the top of the pit. This lessened production is due in some degree to the large number of workmen who crowded into the trade during the years of high wage, and who, remaining in it, have had in many instances to work limited time, and thus have reduced the average production; and it is also noteworthy that the average yield varies much—the yield of the Monmouth and Glamorgan district being very low, and that of South Durham very high; whilst there is between the highest and the lowest nearly 100 tons a year, in the average, difference. Much must depend upon the class of seam that is worked, but beyond this, the most potent influence in affecting the average is the prevalence or otherwise of the practice of working short time. The more the miners work full time the greater is their average yield, and, of course, their average earnings. It is this that is the great obstacle to "restriction," the introduction of which would be fatal to the trade.

LITERATURE.

The British Navy. Vol. III. By Sir Thos. Brassey, K.C.B., M.P., &c. 1882.

This volume differs a good deal in character from its predecessors, being devoted to "Opinions on the Shipbuilding Policy of the Navy." These are taken in succession on the general question as to the classes of ships that should be built and in what relative proportions, and then to the actual construction and dimensions of each class, namely, sea-going ships of war and ships of special types, turret ships, monitors, torpedo ships, and circular vessels; also, in their place, armour, rams, torpedoes, and systems of propulsion, forms of bow, &c., are dealt with. Lastly, are given the parliamentary speeches and papers by the author on designs of ships of war. On the important question as to the best type of ship of war, the author, assisted by quotations and facts, brings us to rely primarily on sea-going armour-clad ships, all other classes, such as coast defenders and unarmoured ships, being quite subsidiary to those which would, if more powerful than those of our enemy, keep the sea, and cause us to be in the position of a besieging force, and our enemy that of a defending army, with most of the advantages of supply on our side. We read, "Having command of the seas, you may take the offensive on the shores of an enemy. If beaten, or reduced to the defensive, you will have to defend your own coasts;" to which may be added that coast defences, however good, will only have an opportunity of proving their power if an enemy chooses to attack, which will generally only be if he believes himself your superior.

Again we read, "Ironclad ocean-going vessels are not adapted to coast warfare. All the chief naval Powers, however, will possess a fleet of ocean-going ships; indeed, they have such fleets already, and all will desire to fight for the command of the sea in those European waters which will become the arena for great naval battles. Operations, therefore, will begin with encounters between ocean-going ships, and the conqueror in a general engagement, secure from attack on his own shores, will be able to employ his coast defence fleet to the best advantage." This consists, we are told, of two classes—river gunboats and floating harbour defences, and coast defence vessels capable of operating in European waters.

As to the best type of sea-going ironclad, we read:—"In concluding this general review of the most recent shipbuilding operations of foreign naval administrations, it will be observed that the list comprises four central battery ships, three barbette ships, seven ships in which the barbette and central battery are combined, thirteen sea-going first-class coast service ships, four belted cruisers, and three coast service ships, not of the sea-going type. The mastless turret ship predominates among the most recent constructions of foreign navies, the type in which the barbette tower is combined with the central battery ranking next in importance in point of numbers, but comprising the most powerful vessels now building in France."

As to armoured cruisers for secondary work, England will generally have a number of armour-clads which have become obsolete for commission in the Channel and Mediterranean which will maintain our position completely in Chinese waters and other distant seas, it is thought.

As to tonnage, the author appears to incline to a ship of about 8500 tons, carrying about 43-ton guns as the maximum size desirable, but thinks that the preference of France and Italy for monsters may compel us to keep a few. Unquestionably the increased power in new type guns tends to favour pieces of a moderate rather than an extreme bulk.

As to masts, there is no question that the mastless sea-going type has much greater fighting powers than can be secured by a full-rigged ship. "The turret ship, lightly rigged, is the most powerful type for the line of battle," we are told. We hope, however, that it will be so far modified as to carry a secondary armament of new type medium guns, and that the spectacle of one gun per 2850 tons, as in the case of the Inflexible, will not often be exhibited, the fault in our heavily-clad turret ships being that we have nothing to direct against the unprotected broadside batteries which the newer French and Italian vessels carry as auxiliaries to their very heavy guns. Sir T. Brassey suggests the substitution of such an armament for one turret in the Dreadnought as a possible expedient. The French barbette system appears to be preferred to the turret in many respects as giving better vision, greater command, decrease of weight of armour, and freedom from evils of gas, which may become very serious with breech-loading guns in turrets. The turret, of course, for close hard fighting must have a great advantage as to protection.

The reading of this book, as we proceed, becomes of great interest; for example, the contemplation of a gunless ram attacking at night or lying by till an enemy's ship is in difficulty and then charging her; Scott Russell's graphic description of an imaginary encounter and the general conclusions are most interesting; and among the letters and papers on dimensions, Sir T. Brassey gives us some amusingly strong abuse of his own views by *Engineering* and by General Mattei. With his predilection for small vessels, we are a little surprised not to find more on the

subject of the Elswick cruisers. We need not attempt to consider this work further. As we said, it mainly consists of a vast collection of opinions on the most interesting questions connected with the Navy.

THE PROPOSED MANCHESTER SHIP CANAL.

Now that the engineers instructed to make detailed surveys of the rivers Mersey and Irwell in connection with the projected construction of a canal to Manchester available for ocean-going vessels, have presented their reports, more trustworthy data are obtainable than has hitherto been afforded as to the feasibility of the scheme. At present the Mersey and Irwell navigation is but little used. The existing traffic is worked by the Bridgwater Navigation Company, Limited, through a canalised river, divided by locks and weirs into ten levels, with falls varying from 3ft. 6in. to 10ft., the total fall from Manchester to Warrington being nearly 60ft., but during the greater portion of the year the water maintained, only allows the passage of barges with small cargoes. The question of utilising this water-way in some such manner as that now projected has long been before the Manchester public, and more than forty years back one couplet of a topical song somewhat prophetically ran—

> And this be true, Sirs, I'll bet you a crown,
> Manchester shall be, Sirs, a seaport town.

But no previous scheme has been taken up with such a full determination to bring it to a practical issue as that shown by the present promoters. The steadily growing commercial requirements of Manchester have no doubt done much to give strength to the movement, and considering that the annual cost of overland carriage between Manchester and Liverpool is estimated at between £2,000,000 and £3,000,000, the importance of any improved means of transit for the vast shipping trade of the district is obvious. Practically the only present outlet to the sea is by transit over rail, carriage by canal being an item so small as scarcely to enter into calculation; but it can scarcely be alleged that so far as the railway companies are concerned, there has been any neglect to provide ample means of transport between Manchester and Liverpool. No stronger proof of this is needed than the fact that there are at present no fewer than five separate routes by which goods can be carried —the London and North-Western Railway, *viâ* Newton; the London and North-Western Railway, *viâ* Tyldesley; the London and North-Western Railway, *viâ* Lymm; the Lancashire and Yorkshire Railway, *viâ* Bolton; and the Cheshire Lines Railway, *viâ* Warrington. It is, however, strongly urged that the trade of the district is seriously handicapped by unfair and excessive rates, and as an illustration of the view which manufacturers and merchants take of the present railway arrangements, the following extract from the evidence given, quite recently, by Mr. Peter Spence, J.P., of Manchester, before the House of Commons Committee on Railway Rates, will be of suggestive interest in connection with the proposed ship canal. Mr. Spence, after replying to a series of questions with reference to the alleged proportionately excessive rates for carriage between Manchester and Liverpool, expresses his belief that manufacturers and merchants are helpless in the midst of the arbitrary and inequitable arrangements imposed by the railway companies, owing to the complete monopoly prevailing throughout the railway system of the country, and then adds:—"I now beg to cite an illustration afforded by the Manchester and Liverpool case. Although the men of Manchester and Liverpool were the first to construct a great railway, I speak advisedly when I say that so far as goods transit between these two cities is concerned, the invention of the locomotive has proved to be an unmixed evil. The charges per mile of the four railway companies who are fattening upon this traffic are nearly four times those between Manchester and Glasgow, and the South Lancashire trade is in this way annually fleeced of hundreds of thousands of pounds." A wagon and horses road service, Mr. Spence contends, could carry goods for 25 per cent. less than the present charges of the railway companies. "A plate railway," he adds, "has recently been proposed which would admit of the use of ordinary road wagon wheels, and thus save all terminal expenses at stations. By a ship canal between Manchester and Liverpool the economy of carriage would obviously be far greater than by any other system; steam navigation being, beyond controversy, the cheapest known mode of inland transit. I may add that the Manchester ship canal scheme has the approval of able engineers." All three modes of relief were, however, practically denied to the Lancashire manufacturer, because if a Bill were promoted in Parliament for a horse tramway or ship canal, either scheme would meet with the determined opposition of four railway companies, and should any one of the schemes be actually inaugurated it would have to face a long struggle with the companies, who would reduce their rates in the hope of starving it into the "conference," and the consequent acceptance of their former oppressive tariff. "I submit," Mr. Spence continues, "that the Lancashire manufacturer has a right to demand that Parliament shall require these railway companies to make reasonable rates, and also to abstain from using their enormous capital to crush any attempt he may make to provide a radically cheaper mode of carriage. On this branch of the subject, I would say that if the result of this Committee's labours is to fix the railway rates of the country, and to prevent them being lowered merely for the sake of destroying water carriage competition, there is no doubt that the scheme of a Manchester ship canal will be undertaken at once, and I for one will be happy to take shares in it."

A prevailing feeling such as this will in large measure explain the determination with which the project of a ship canal, hitherto regarded as a scheme hopeless of realisation, has at length been taken in hand with so much determination. The object of securing a cheaper carriage by means of direct water transit to the sea is, however, not the only stimulus the ship canal has received. There is the avoidance of the dock and harbour dues at Liverpool and the advantage which merchants would possess in being able to ship their goods under the direct supervision of their own staff, thereby saving also the commissions now paid to forwarding agents. In addition to this there are anticipations of new industries springing up in the district, of extensive shipbuilding yards, with their dependent trades, studding the banks of the ship canal; whilst it is urged that the exports of coal from the Lancashire collieries would greatly expand with the additional facilities afforded for competition with the seaborne coals from Wales. These and other considerations, amongst which may be added as not the least important the possibility of preventing the recurrence of the disastrous Irwell floods, have encouraged the promoters to persevere in a work which long ago was abandoned as impracticable. The work once again taken in hand, no time has been lost in placing the revived scheme on a definite footing. On the 27th of June last a meeting for the promotion of the improved navigation was held at the residence of Mr. Daniel Adamson, and a provisional committee for the carrying out of the project appointed. This was followed by the appointment of Mr. H. Hamilton Fulton, of London, whose name had for some time been prominently associated with a scheme for widening, deepening, and straightening the rivers Irwell and Mersey, so as to bring a broad tidal stream up to Manchester, and Mr. E. Leader Williams, of Manchester, formerly connected with the River Weaver Navigation, as engineers, who were instructed to make the necessary detailed surveys and report as to the feasibility of constructing a navigation to Manchester available for ocean-going vessels. In less than two months the engineers completed their surveys and presented their reports. Each engineer has acted independently, and Mr. Williams has presented a scheme essentially different from the original project of Mr. Fulton, which was practically the basis upon which the movement was again taken up. Mr. Fulton's proposal as first set forth, to make a tidal navigation the whole of the distance, no doubt possessed a certain amount of fascination for an inland town like Manchester. Mr. Williams has, however, been guided by considerations less on the sentimental and more on the practical side of the question, and the proposal he has submitted, to improve the present tidal portion of the river from Garston to Latchford, to make it from that point to Irlam semi-tidal, and thence to Manchester to construct a ship canal, has received the approval of Mr. James Abernethy, who has acted as the consulting engineer, and the subsequent adoption of the provisional committee and the promoters of the improved navigation.

The report presented by Mr. E. Leader Williams has evidently been prepared with great care, and deals with the whole question in a thoroughly comprehensive manner. In defence of his own scheme Mr. Williams has naturally been under the necessity of pointing out the disadvantages of the proposed tidal navigation. Amongst these the great depth of channel that would have to be cut, and the fact that the bottom of the Docks at Manchester would be, on an average, 92ft. below the level of the ground, are obviously serious obstacles in the way of Mr. Fulton's project, whilst even the supposed advantage to be gained in the navigation of vessels by the incoming and outgoing tides is shown to be fallacious. The distance from the bar at the mouth of the Mersey to Manchester by the improved navigation is fifty miles, and Mr. Williams holds this distance too great for even a steamer to reach Manchester in one tide; and that it would therefore, above Warrington, encounter the ebb tide, with the result of losing more time on the journey than would be consumed in passing up a still-water navigation with locks. On every ground, whether of speed and safety of navigation or cost of construction and maintenance, Mr. Williams reports that he cannot advise the committee to adopt the project of a tidal navigation to Manchester; and the alternative scheme he proposes is set forth as follows. The present condition of the water-way for navigation has already been briefly described, and to improve this in a manner to make it navigable for ocean-going vessels Mr. Williams, in his report, says:—

> I propose to continue the tidal river from Garston to Latchford, above Warrington; and above that point to Manchester, a distance of fifteen miles, construct a ship canal, with locks to raise the water level to nearly its present height at the proposed site of the docks at Manchester. At Latchford there will be a group of three locks of different sizes, placed side by side, close to and parallel with each other. Intermediate gates will be provided to each lock, so as to allow of the larger locks being used for shorter vessels or barges without waste of water. Through a similar group of locks on the Amsterdam ship canal, nearly 700 vessels of different sizes have been passed in one day, so that detention need not be feared, as the largest locks will hold several vessels at once, or a tug and large train of barges. The gates and sluices will be worked by means of hydraulic power, for which purpose the fall at the locks will be utilised, the vessels will be able to pass quickly through the locks. Except at low tides, the gates of this set of locks will be all open about high water, as the tide will rise to above the level of the upper pound. At such times vessels will pass through the locks or through special large tidal gates without any detention. The large flood sluices—which are provided at each set of locks—will also be opened, and thus through the tide gates, the three locks, and the sluices, a free flow of the tide will pass up the first pound —which will be thus partly tidal—to the next group of locks near Irlam, a distance of about eight miles. As soon as the tide turns on the ebb, the gates and sluices will be closed, and the level of high tide maintained in that long reach of river. The locks at Irlam will be above the railway bridges of the Cheshire lines, which will therefore have no higher water level under them than high tides. These locks will be the same in every respect as those described at Latchford, except that the tidal gates will not be required, as the second pound—four miles long—will be above the level of tidal influence. The Irlam locks and sluices will pen back the water to a short distance above Barton Aqueduct, where the third and last set of locks, similar in every respect to those at Irlam, will be constructed. The Barton locks will maintain the ordinary level of the river to a height 8ft. less than at present below Throstle Nest Bridge, a distance of three miles, and give a level for the water in the proposed docks which will enable trade to be carried on with facility and dispatch. Steam power will be provided at each lock to work the hydraulic apparatus in dry weather, when the whole of the flow of the river might be required for lockage. If necessary, this power could be utilised at such times to pump water back to the pound above, by means of large centrifugal pumps. In ordinary seasons the river will afford an ample supply for the Irlam and Barton locks; but I propose to excavate the channel through those pounds, 4ft. lower than will be required for purposes of navigation, so that the surplus depth may act as large reservoirs in exceptionally dry weather. The Irlam pound will also have the advantage of the supply from the Mersey, which will be taken, when required, by a conduit, through which the river will flow into the canal above the Irlam locks. The locks will be connected with each other by culverts and sluices, which will allow of a great part of the water in a lock being passed into the adjoining locks, and utilised again for lockage. The Welland ship canal in Canada, which has cost a much greater sum than is proposed to be expended on the Manchester ship canal, has no less than twenty-seven locks, with a total rise of 330ft. The rise by lockage above ordinary spring tides at Irlam will be 35ft. by two locks. There are few docks that are not entered by a lock, and as a vessel going up on high tides to Manchester will pass the Latchford locks when the gates are all open, it will only have to pass one lock more than usual at many seaports. The width of the canal between Manchester and Warrington will be 100ft. at the bottom. The Suez Canal is 72ft. wide, and the Amsterdam Canal 87ft. wide at the bottom. In the case of the Suez Canal, however, large steamers can only pass at certain places, where the canal has been widened for the purpose, and I consider it essential that the Manchester ship canal should be of sufficient width to enable large vessels to pass at any point. From Warrington the canal will gradually increase in width, until it is 300ft. wide at the bottom as it approaches Runcorn; through the tidal portion of the canal the depth will be dredged to 22ft. at low water; on the upper part of the canal, the canal will be 26ft. at ordinary water level. The question of floods will be dealt with by the proposed works in the most effectual way, as the water level between Throstle Nest, Manchester, and Latchford, near Warrington, will be permanently lowered, on an average about 10ft., while a much wider and deeper channel will be provided for the passage of the flood waters at the lowered level. Below Warrington the low water level will be reduced on an average 15ft., and the deeper and straighter course of the river will materially assist in decreasing the height of the floods. Thus without a River Conservancy Act, and without cost to landowners or tenants, a great public improvement will be carried out. The advantage will not be confined to the land near the Navigation, but will be felt far inland, up the valleys of the rivers Mersey, Irwell, Bollin, Glazebrook, and other tributary streams. The docks at Manchester will occupy the ground now used as a race-course, and some of the adjoining land, all of which is admirably adapted for the purpose. The ground is level, there are no buildings upon it, and there is ample room for future extension. The large dock is designed to be seventy acres in extent, the entrance will be near Mode Wheel lock, and will be provided with gates 80ft. wide; these can be shut in flood times, or when the river is lowered for scouring purposes. The dock gradually enlarges until it is 1350ft. wide, where four branch docks will extend out of the large dock, with wide quays between them, on which sheds will be provided. This system of dock has been lately adopted in London, Liverpool, and Hull, as it provides a large amount of quay space, and great facility of working. By this plan the maximum amount of accommodation will be given at the nearest point to Manchester, thus saving time and expense in the cartage of goods. The ordinary height of the water in the docks will be only 8ft. below the quay, which is designed to be, on an average, 8ft. lower than the present level of the ground. The existing river channel will be maintained for the passage of floods, and can, if required, be straightened by constructing a quay wall on the Salford side, and be widened to 300ft., so as to form a large float for coasting and other vessels; floods will pass off through this float without interfering with the large dock. The total quay space thus provided will be four miles in length, and the water area over 100 acres. At Barton, and Irlam, half a mile of quay will be constructed, suitable for coal tips or other trade. At Warrington the new canal will leave the existing river, which is wide and deep, almost entirely available for dock purposes; and locks and sluices will be constructed to enable the river to be thus used. The water can be maintained at any desired level, and great facility given for all the land adjoining the river being utilised for works, while side docks can be constructed, when required, at a moderate cost. The total length of river available at Warrington for docks and yards will be six miles. At Barton, the river is crossed by the aqueduct of the Bridgewater Canal, which is principally used at this point for coal traffic. I propose to construct here a new aqueduct, the centre portion of which will be a wrought iron caisson, kept full of water, which will swing on a central pier, in a similar way to a railway swing bridge, leaving a wide opening for the passage of vessels on either side. This is not a difficult work, as the present aqueduct is only wide enough to allow one boat to pass. There will be lifting gates at each end of the caisson, and also at each end of the aqueduct, so that when all the gates are closed the caisson can be moved round quickly by hydraulic power without loss of water. Even if a boat is on the aqueduct, and passing through the caisson, it need not delay the opening of the aqueduct, as the boat might remain while the caisson was swung, the weight and pressure on all points being the same. The water-tight joints will be of thick india-rubber, closed by pressure similar to the arrangement I designed for the Anderton boat lift on the River Weaver Navigation, where boats are lifted by hydraulic power from that river to the Trent and Mersey Canal, 52ft. high in three minutes, floating in a caisson. There are only four roads crossing the river that will be affected by the ship canal, one at Barton, another at Warburton, and two near Warrington. These will require to be raised, or made into swing bridges. The question of the railway crossings is one of importance. On passing up the Navigation from Liverpool, the first bridge reached is Runcorn, with three spans of 300ft. each, and a clear headway at high spring tides of 75ft. From the level of the proposed low water line the headway will be 100ft., and as the new channel will be dredged to 22ft. depth at low water, the bridge can be passed under at any state of the tide. As high spring tides occur only a limited number of days in the year the headway will average 90ft. at the state of tide when most vessels will pass the bridge. This height will allow of sailing vessels of large size passing under with their top-masts and top-gallant masts struck, and as they would always be towed up or down by steam tugs, the lowering of the top masts would not interfere with, but rather assist, the progress of the vessel.

With regard to the railway bridges crossing the water-way, of which there are five between Runcorn and Manchester, Mr. Williams points out that in every case Parliament has enforced the adoption of a clause providing that a swing bridge shall be substituted if the Mersey and Irwell navigation is made available for sea-going vessels. Three of the bridges are on the London and North-Western system at Warrington, and of these the two Walton bridges are so close together that they might be formed into one; the remaining bridges are on the Cheshire lines, near Irlam. Mr. Williams urges that if the railway companies were ready to meet the question fairly and raise the levels of these lines, swing bridges might possibly be avoided, as the level of the river would be lowered considerably, or tunnels might be used under the river; but these are questions which he leaves the railway companies themselves to consider. Another consideration, which does not directly affect the promotion of the ship canal, the facility it will afford for Manchester and the district to construct cheaply a main sewer along the side of the canal, and with regard to times of flood or freshes, Mr. Williams proposes to have near the locks, instead of weirs, flood sluices, each 20ft. wide, to lift

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clear out of the river, thus allowing an entire change of water.

Having dealt with the portion of the river to be canalised, Mr. Williams sets forth the work necessary for the requisite improvement of the lower section which would admit of tidal navigation :—

The river Mersey between Warrington and Runcorn takes a winding course through flat marsh land, part of which is covered with water at high tides. It gradually increases in width as it approaches Runcorn, where it widens out considerably, becoming again narrower when it passes Runcorn Gap, where it is crossed by the London and North-Western railway bridge. The new channel from Runcorn to Warrington has been designed so as gradually to widen out as it progresses downwards, in order to promote a full and free action of the tide, and enable the flood waters to pass off with ease. The existing course between Warrington and Runcorn is eleven and a-half miles long, and it will be shortened to three and a-half miles by cutting off the bends. Except where the new channel crosses the river it is all new cutting, and the line I propose will give very easy curves, and pass through the lowest and least cultivated property. Near Runcorn, the system of deepening the river by training walls and dredging will commence and be continued down to below Garston, where the channel is of sufficient depth for large vessels at low water. This portion of the work will confine the river to a fixed course, whereas it is now constantly shifting; I have known it vary a mile in a few days. The diminished depth of water at Runcorn is due to the fall in the bed of the river, and the great size of the tidal estuary below, which is from 1½ to 3 miles in width. It is proposed to improve this part of the river by training walls, constructed of rubble stone —brought from the canal cutting above Warrington—to such a height as will maintain a low-water channel in one defined course, without interfering with the free flow of the tide over the surrounding sand banks. As soon as the ebb and flow of the tide is fixed in one course, steam dredges will be used to dredge out the channel to the full depth of 22ft. at low water; the result of the dredging will be to lower the low-water line at Runcorn 12ft., and 17½ft. at Warrington, thus making room for a column of tidal water which will be of great service in scouring the lower channel and bar.

Before the best lines for the training walls can, however, be determined so as to meet the approval of the Conservators of the Mersey, further tidal observations and flood gauging will be necessary. The proposed docks and locks are to be constructed on rock or hard clay foundations away from the present river channel, and Mr. Williams believes the whole of the proposed works may be completed in four years. As to the cost, estimating it at contractor's prices, dealing liberally with questions of land and compensation, and allowing 10 per cent. for contingencies, the total is put down at £5,160,000.

With regard to Mr. Leader Williams's scheme, Mr. Abernethy reports that he approves of the salient features of the design without reference to matters of detail requiring more mature consideration. On one point, however, Mr. Abernethy offers a recommendation. Considering the importance of Warrington, where Mr. Williams proposes the construction of a lock, forming the present bed of the river, Mr. Abernethy would build a dock of twelve acres by widening out on the right bank of the present river, immediately below the crossing of the London and North-Western Railway; and with regard to the cost of the whole scheme proposed by Mr. Williams, this he increases to £5,400,000. Without detailed designs of the various works, Mr. Abernethy, however, admits the impossibility of arriving at the exact cost, but from long and varied experience in the design and construction of similar works he is of opinion that the sum above named may be considered a sufficient estimate for the tidal channel, canal, and dock works at Manchester, and that if energetically prosecuted the works may be executed within the period of four years set down by Mr. Williams, the borings taken indicating that the foundations for the various locks, sluices, and walls will be of a favourable character, whilst no peculiar engineering difficulties present themselves in the construction of the works.

Mr. Hamilton H. Fulton has not dealt with the question in the exhaustive manner which characterises Mr. Williams's treatment of the whole project, and Mr. Abernethy, who states that he has received Mr. Fulton's report without any relative plans, sections, or other explanatory data, has necessarily to confine his observations with reference to the alternative scheme to a limited and general area. Briefly stated, the works which Mr. Fulton proposes to carry out, in order to form a navigable channel for large vessels from Liverpool to Manchester, a distance of forty-two miles, are the improvement of the navigation by the construction of training walls, simply, between Otterspool and Runcorn, except where rock may exist between the latter port and Garston, so as to ensure a minimum depth of 22ft. at low water of spring tides; and from Runcorn to Manchester to excavate a channel with a bottom width of 80ft. of the same depth, with passing places, to Manchester, terminating in a tidal basin of 128½ acres, with a depth of 37ft. at high water spring tides, the estimated tidal rise being 15ft. and 12ft. at neaps. The cost of these works is put down at £5,072,921. With regard to this scheme, Mr. Abernethy is not of opinion that any such result as the above as to tidal range would follow by the formation of a channel of such length; nor, he adds, does he find in the report the data by which Mr. Fulton has arrived at his conclusion. With reference to the estimated cost he can form no opinion, as Mr. Fulton has not furnished detailed quantities and prices, and the general and limited information contained in the report does not induce him to alter his conclusion that the improvement of the navigation between Liverpool and Manchester can best be effected by the formation of a tidal channel of a length that can be safely navigated by vessels during a flood, and canalising the remaining upper section to Manchester.

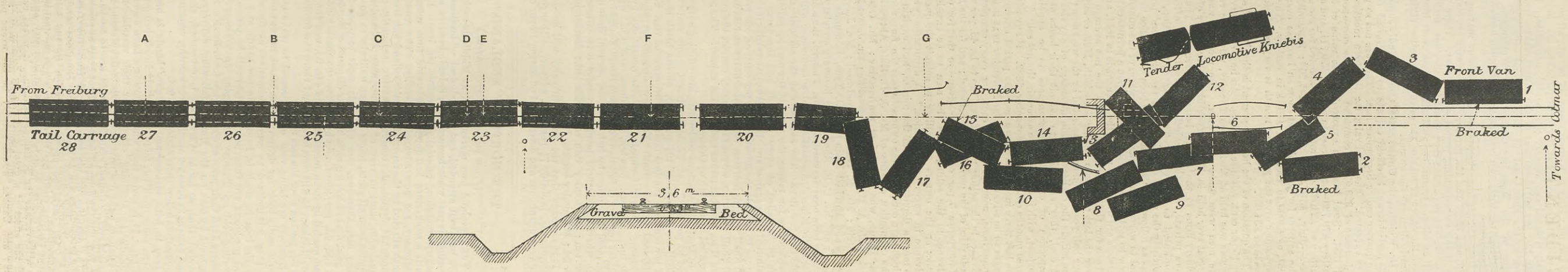
The scheme proposed by Mr. E. Leader Williams having now been definitely adopted, the promoters have before them the task of obtaining the necessary Parliamentary powers and raising the requisite funds. That a strong opposition both on the part of the railway companies and the Liverpool dock interests will have to be encountered there is no doubt. For the preliminary expenses the committee have come to the conclusion that it will be necessary to raise £100,000, and with the view of obtaining this amount, each subscriber is offered, as an inducement, the option of taking shares in the company when formed by Act of Parliament to the extent of ten times the amount of his subscription. It is, however, possible that a project of such magnitude and importance to the district may not be entrusted by Parliament to private enterprise, but may be vested in the hands of a public trust. With such an arrangement we understand the promoters would be quite content, providing the improved navigation were carried out; and in view of such a contingency the Manchester Corporation, whilst giving the heartiest support to the movement in its present form, have reserved to themselves the right to act as trustees should this course be desirable. No question can be raised that to secure an efficient and cheap means of water carriage to the sea for the shipping trade of the district would be of immense advantage to the commerce of Manchester. As to the project now before the public being quite possible from an engineering point of view, there is also no room to doubt, but whether its commercial success can be sufficiently guaranteed to secure that financial support to the undertaking by which alone it can be carried to completion is a point upon which it is undeniable many misgivings exist. A consideration which may also somewhat operate against the scheme is that, after leaving Manchester it does not, apart from Warrington—half-way on the route—and Widnes, near the outlet of the navigation, directly open out the many other large centres of industry which spread themselves over Lancashire. It would, however, carry a trade of enormous bulk, and the strong support the project has already received promises well for its ultimate realisation.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty :—Adam Shoolbread, Alexander G. Smith, Jeremiah P. Lloyd, Charles E. Stewart (a.), George Quick, Alexander Wilson, and Charles Platt, chief engineers, additional, to the Asia; Richard Irwin, and William A. Harvey, engineers, additional, to study at the Royal Naval College, Greenwich.

The British Association. — With respect to the proposed meeting of the British Association in Canada the *Toronto Mail* says :—"The announcement that the British Association will meet in Canada in 1884 will probably be received here with gratification, but without much consideration. It may be a good thing for the locality the Association may pick out to meet in, but we question whether meeting in Canada will be good for the Association, good for science, or good for Canada. In the first place, not even half of the busy men of science in England are likely to come to this country. The number of first-rate papers will therefore be limited. The Press will not be able to afford to report the proceedings at the length and with the accuracy of the English journals. Thus the usefulness of the proceedings will be greatly curtailed. The audiences likely to assemble will be small, and by no means interested in the scientific-proceedings as such. The mind of the average fashionable gathering is not scientific; it is not even literary in the most meagre sense. It very hazily comprehends Oscar Wilde; it fails to grasp Professor Tyndall or Professor Huxley. Therefore the readers of the papers will find little ready response to their theories and conclusions. Meantime the continuity of the proceedings in England will be broken up, and may not be so easily renewed. The English public, which contains a very large audience for pure science, will lose its accustomed prompt report of papers; and those of us in Canada who may take interest in the proceedings will have to wait till the papers go to England, and are published either in the leading magazines or in the society's 'Transactions.' There is hardly a particle of interest taken in the present proceedings at Montreal outside that city, and the same fate will overtake the British Association. It would be a pity to spoil the effect of a great gathering by holding it in the wrong place; and Canada would possibly be the wrong place for the meeting of the British Association."

THE HUGSTETTEN RAILWAY ACCIDENT.

DIAGRAM OF THE POSITION OF THE TRAIN AFTER THE ACCIDENT.



A, 130 yards from engine, left rail pushed sideway. B, 114½ yards from engine, a left rail overthrown. C, 101½ yards from engine, a wheel mark on top of sleeper. D, 90½ yards from engine, several wheel marks on top of sleepers. E, 88 yards from engine, from this point both rails were canted, and the track was almost totally destroyed. F, 68·7 yards from engine, sleepers were found broken and much upset. The greatest effort appeared to have been towards the left. G, point where engine seems to have left the track.

We are now able to give details, with an illustration from a photograph, for which we are indebted to our contemporary, the *Illustrirte Zeitung*, and diagram of this accident, the terrible nature of which will be apparent at a glance. It will be remembered that on Sunday, September 3rd, an excursion train, containing about 1200 passengers, when returning from Freiburg to Colmar, on the Baden State Railway, ran off the rails near a station called Hugstetten, about half-past eight p.m. From the official report of the Chief Government Inspector, Streckert, it would appear the train consisted of engine, tender, and twenty-eight carriages, of which seven had hand brakes, but only six were provided with brakesmen, and the result of the accident was that no less than sixty-three people were killed, while seventy-two were seriously injured, and a large number of others hurt. The weight of the engine—a goods engine—was 35½ tons, of the tender 18 tons, and the train weighed 325 tons, making a total weight of 378½ tons. The accident occurred on a falling gradient of 1 in 146, after running down four or five miles of 1 in 86, and 1 in 111 ; and that the speed was considerable may be inferred from the position of the engine, which ran over 40 yards across some very marshy land. The diagram above, which we reproduce from *Glaser's Annalen*, is one of the most curious and interesting of the kind we have ever seen. The vehicles are numbered in the order in which they stood when running. It will be seen that the effect of the accident was to alter their relative positions considerably, and we are not surprised to learn that whereas the total length of the train, before the accident, was 280 yards, it was afterwards only 182 yards, having thus been shortened about 100 yards. The engine, as we have said, after leaving the embankment ran over 40 yards across a marsh, and, as well as the tender, was almost uninjured. The first vehicle, a van, turned completely round, end for end, to the left of the line, and turning on its side, was telescoped by the third carriage. The second carriage was found overturned to the right ; the next five vehicles kept to some extent together, but were much crushed and telescoped ; the eight following overran the last of the previous group, and were totally destroyed. So complete was the destruction of these carriages, and so thoroughly mixed were they, that had it not been for the numbers, no idea could have been formed of what they had been, or in what order originally placed. The next three vehicles were also much damaged ; then came five which were off the rails, and the last four were found standing upon the line uninjured. The first marks on the rails were 246 yards from where the engine was lying ; at 185 yards from the engine, the rails were bent slightly, and at 156 yards were much more bent. At 115 yards from the engine the rails were turned over, and from about this point the track was almost destroyed.

How the engine came to leave the line is uncertain, but it is supposed that the oscillation had caused the rails to spread. It seems the driver felt some shocks before his engine left the rails, and this was probably at the point where the first marks were found, that is 246 yards from where the engine came to rest. At 115 yards, however, the rails were torn away, and at this time the front portion of the train was, no doubt, off the line

Now, here we have a train carrying 1200 passengers, and weighing 378½ tons, running down a heavy gradient, having every facility, in short, for gaining fearful momentum, but none for arresting it ; in other words, it was practically without brakes. From the distances given, and from our experience in this country, it is not too much to say that had this train been fitted with a good automatic brake not a life would have been lost. We have no doubt that, as is usual, the Baden States Railway will take immediate steps to provide for such calamities in the future, but we must confess we should like some of our own railway companies to profit by the experience of other countries rather than wait for similar occurrences on their own lines. How the engine, as we have said, came to leave the rails in the present case is not of so much importance, since the results were due not to this fact so much as to the want of proper appliances to prevent them. The annual reports from the Board of Trade show that derailments are very frequent, and we can scarcely hope that the causes which lead to them will cease altogether. It is possible, however, so to equip our trains that they and we may escape the consequences that otherwise may at any time ensue, and this can only be done by fitting them with a good instantaneous automatic brake. As we have pointed out over and over again, this is the only method of meeting that extreme suddenness which is the chief characteristic of such contingencies. A long series of accidents in this country of a similar character has taught us the want of these appliances, but not to much purpose. We have also learnt from some how it is possible to provide a remedy. Recently we had to comment upon a remarkable illustration of the value of automatic action in the case of the accident near Ely on the Great Eastern Railway, where a train fitted with the Westinghouse brake was brought to a stand without any telescoping whatever. The same results afterwards followed in the accident between St. Petersburg and Moscow to a train similarly fitted, and there have been many other illustrations of the value of this appliance. It is from experience of this kind that we draw our conclusions. Why the Westinghouse brake should be so well calculated to meet these emergencies may be readily understood. Air at high pressure is stored up on every vehicle of trains of any length ; every vehicle is, in fact, ready charged, and there remains but to pull the trigger, so to say, and all the brakes are simultaneously and instantaneously applied. Should the engine or part of the train break away, the brakes will go on automatically, and will remain on till purposely released.

Now, the loss of life in all such accidents as that at Hugstetten, is caused by the rear portion of the train with undiminished momentum, overrunning the front part which has been arrested. It follows then that to be of the greatest service at such times, a brake must be, first, exceedingly rapid in its action before the train parts, so as to get the brake on at the rear as well as at the front ; and secondly, automatic action is required to keep it on afterwards, or it may be, to apply it before the driver has time to do so. It should be understood that by the method of procuring automatic action, as mentioned above, the first step has been taken towards instantaneous action ; in other words, the quickest action in a brake cannot be attained unless it is made upon the automatic principle ; though at the same time brakes may be automatic and yet slow in action ; the latter kind could, of course, have been of no service. A non-automatic brake would not only have been useless, but would have served to intensify the disaster, by checking the front portion of the train so much sooner than the rear, that is, supposing there had been time to apply the brake at all. Moreover, after the couplings had once broken, it would have relaxed its hold. Vacuum brakes, whether automatic or non-automatic, may also be eliminated from consideration, since they are both quite impracticable upon trains of such a length as twenty-eight carriages.

That only one brake should have proved itself equal to dealing with such emergencies and under such conditions, may be a fortunate thing for the inventor ; but it should be equally so for the railway companies, since it greatly facilitates the adoption of an universal brake. According to the last returns, however, only one-fourth of the stock in the country was fitted with brakes on the principle laid down as essential, and only two-thirds of this number are of a kind which would be of service in such calamities as that at Hugstetten. It will be found from a note on another page that Holland has not been slow to take the lesson to heart, for a Royal Decree has been issued making it compulsory that all trains running at thirty-eight miles per hour must be fitted with automatic brakes by the month of May, 1883.

We make no apology for dealing at such length with this matter, for its importance cannot be over estimated. Crowded excursion trains of thirty to thirty-five carriages are by no means uncommon in this country, and heavy goods engines are employed in hauling them. Heavy gradients, too, are by no means rare. Some cause, impossible to foresee, may at any time throw such a train off the line, and Hugstetten may be repeated. We sincerely hope not, but it is not a pleasant subject for contemplation that so far as concerns the only appliance which could be of the slightest service in such a calamity, many of the trains on our large railways are as badly off as that which we have illustrated, and may some day be in as sorry a plight, if those who are responsible do not mend their ways.

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

(*From our own Correspondent.*)

The colliers' movement for a rise of wages has led to a strike at many of the collieries in and about Netherton on the Worcester or west side of Dudley, the men demanding a rise of 6d. per day or stint in the thick coal, and 3d. per day in the thin coal seams. They justify this action, in the face of the existence of a sliding scale, by explaining that their agent did not sign the last scale, and that, therefore, they are not bound by it. The terms they seek are the 15 per cent. rise which the Manchester Conference determined upon. In support of their claim they have this week been holding meetings and conducting processions in which some 3000 or 4000 miners have taken part. Some other parts of South Staffordshire have also been prejudiced by the movement. The Sandwell Park Colliery, for instance, has been only partially on. Generally, however, the men are ready to accept a rise of 4d. and 2d. a day respectively.

A conference of Staffordshire miners was held at Great Bridge on Tuesday, when reports from different localities showed that while the West of Dudley men were "out" for the 15 per cent., most of the men east of Dudley were "on," awaiting in confidence the meeting of the colliery owners, promised so soon as Mr. Fisher-Smith, the chairman of the Coalmasters' Association, had returned from Vienna. At such a meeting the hope of the men was that thick coal would be declared up 1s. per ton, which would entitle them to a 10 per cent. rise. A few colliery proprietors were giving that rise conditionally, while others would give it from the beginning of this month if the rise should be determined upon; and during the holding of the conference an application for men to return to work at 10 per cent. at a colliery employing eighty hands was received.

The resolution adopted was that when any masters made such an offer the men ought to accept it; and as a communication from Mr. Smith's secretary, received by the conference, showed that Mr. Smith would be home on the morrow, it was determined that a deputation should wait upon him seeking the meeting of the trade "at once, as the men believed that the trade was sufficiently brisk to justify the rise of 1s. in prices." The interview came off yesterday—Wednesday—when Mr. Smith told the men that it was too short a notice to summon a meeting for to-morrow—Friday—but he would consult some of the heads of the trade so as to give the men an answer to their application by that day as they desired. What that answer may be is of course beyond definite statement to-day, but I may remark that the chairman of the Ironmasters' Association tells me that at the quarterly meetings next week marked bars will very probably be advanced either 10s. or 20s. per ton. Yet it is undeniable that marked bar firms of foremost position and long standing were unable to-day in Birmingham, or yesterday in Wolverhampton to report more than a decidedly quiet demand. Mr. Hingley, however, is certainly not in want of orders, since at the present time there is scarcely a firm rolling high-class bars which is busier.

Common bars were quoted up on both Exchanges. Two firms, indeed, had issued circulars for a rise of 5s. per ton, and there were exceptional instances in which makers of such iron, having booked somewhat freely at the prices current a few weeks since, offered to throw back 5s. a ton on half the quantity ordered if the customers would accept such a quantity in completion of the order. For immediate delivery the inquiry was not very pressing to-day ; but for forward delivery there were numerous offers to buy at prevailing rates, not, however, with striking success.

Hoops are in improved outturn on the week. Coopers' hoops were to-day quoted £7 at the works, and common hoops £6 10s. to £6 12s. 6d. Hoops cut to lengths for prompt shipment to the United States were £7 7s. 6d. in Liverpool as the lowest; yet most makers were asking £7 10s., and at that price, owing to the waste, makers do not much care for the orders.

There was again a brisk demand for sheets of a medium quality. One buyer from Liverpool sought to place an order for 700 tons, but the makers of such qualities are so full of work that they decline to quote in the face of the probable alterations of next week. The quotations for doubles for immediate delivery were unaltered at £9 5s. to £9 10s., and galvanised singles were again cited at £14 10s. in Liverpool.

Some of the best—thin—sheet firms were unprepared to quote. Certain of them have this week met with the intention of at once declaring a rise of 20s. per ton; but it was finally determined to postpone any declaration till it was known what action the coal-masters will take.

Nail strip was worth more money. For prompt delivery £6 12s. 6d. was the quoted price. Small firms required £7, delivered Liverpool, for 11½in. and 24in. sizes for Canada.

Wire rods made in the Shropshire mills are being sold in competition with Belgium, at, for best puddled sorts for screw making,

£8 10s., delivered in Liverpool. One order for export to the United States of 650 tons has recently been booked at that price. There is a second quality for which £7 5s. to £7 10s. is being asked.

Tank-plates were quoted £8 to-day for immediate use; and the recent improvement in boiler-plates continues at, for the moment only, £8 10s. and £9. Canada is just now the best export customer.

The improvement in trade is leading to preparations for the restarting of mills and forges that have long been doing nothing. Sparrow's Old Forge ironworks, near Wood Green, Wednesbury, have been acquired by Mr. Wilson Lloyd. These works have been lying idle for some time, but they will now be put into repair and restarted on the manufacture of sheets and bars.

The producers of all-mine pigs who were last week demanding £3 5s. and £3 7s. 6d., said that they should require £3 10s. if coal should be put up. Medium and common pigs were proportionately strong in anticipation of dearer fuel. Part-mines were £2 16s. 3d. on the average, and cinders, £1 19s. to £2. Foreign part-mines were dearer. For Awsworth and Wigan and Lincolnshire sorts, 52s. 6d. was quoted; and 48s. 6d. delivered at stations was refused for some Derbyshire sorts. Hematites were up to 72s. 6d., which was the price for Carnforth.

Ironstone was plentiful, but rather firmer, at about 6s. per ton delivered for Nothampton sorts. Purple ore for fettling purposes was 18s. 6d. per ton.

The South Staffordshire Mines Drainage Commissioners have just had brought under their notice, in private, an important proposition by Mr. Walter Bassano, one of the members, affecting the future method of carrying on the Commission. Next Wednesday this scheme is to come on for open discussion.

The high prices of copper, tin, and brass have made the prices of some descriptions of hardwares rigid, and the advancing tendency of iron causes wrought and stamped goods to be firmer now than a week ago. The galvanised iron hollow-ware producers have determined upon an advance of some 20 per cent. on general goods, and have fixed the new prices for buckets on the basis of 7s. 3d. per dozen for 12in. 36 lb. sorts.

The North Staffordshire colliers in the district south of Tunstall have now joined in the movement, which at first was confined to the collieries north of that town, for a 10 per cent. rise in wages. Hence the whole of North Staffordshire is now acting pretty much together in this matter.

Messrs. C. and W. Walker, of Birmingham, have sent a claim for £4000 to the Corporation in connection with the making of a new gasholder for Swan village, designed by the Corporation engineer. The contract was executed under pressure of time, and also, the firm allege, under difficulties arising from defective designing. As the work was not ready by the time contracted for, the Corporation deducted from the stipulated payment, penalties amounting to £1500. It is to recover this and the losses occasioned by the alleged defective designing, that the firm bring the claim. It will be resisted by the Corporation.

Notices similar to those which I reported last week as having been given to Wolverhampton by various electric lighting companies have since been received by the Birmingham Corporation to the number of seven. The gas committee were on Tuesday instructed to consider whether the Corporation had not better apply to the Board of Trade for powers to light the town by electricity themselves. On the same occasion the Town Council relegated to a committee an offer of Messrs. R. W. Winfield to provide the electric current for the interior of the Town Hall at the rate of £8 per night of six hours, and for the large lamp outside at the rate of £2 per night. The mayor said that from calculations he had made he found that such lighting would be about four times more expensive than the present gas lighting.

It was announced at a meeting of the Birmingham Town Council on Tuesday that the promoters of the London Smoke Abatement Exhibition had applied to the gas department of the Corporation for assistance in promoting in Birmingham a similar exhibition; but that owing to the difficulty of obtaining suitable premises the proposal had been declined. But the gas department have determined that a smaller exhibition for gas apparatus exclusively shall be organised next year, and preparations for it are already in hand.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Although I hear many complaints that the actual business of this district is not good, and that the requirements of consumers of iron in Lancashire do not bring forward any great weight of orders, the market itself is exceedingly firm. The explanation of this somewhat anomalous state of things seems to be that the strength of the market is due more to the absence of any pressure of makers in outside districts to secure orders here, than to any pressure on the part of local buyers for iron. Both at Glasgow and Middlesbrough iron is going away freely for shipment at better prices than are current in this market; district makers of pig iron also are in many cases so fully sold that they are quite indifferent about securing orders here, and the result has been that a considerable proportion of the business stirring has been left in the hands of Lancashire makers, whose comparatively low prices, as compared with other brands of pig iron, have enabled them to put on their books, during the past week or so, orders for a tolerably large amount of iron.

The general report on the Manchester Iron Exchange on Tuesday was that the amount of business offering, so far as pig iron was concerned, was only limited in extent, but there was a steady healthy tone throughout the market. Local makers of pig iron were still quoting late rates, viz., 46s., less 2½, for both forge and foundry qualities, but following upon the fairly large sales recently effected in local iron they were very stiff at these figures, as they are now pretty well covered to the end of the year. In some of the distant brands of pig iron offering in this market prices had an upward tendency, and one or two of the better makes of Lincolnchire were advanced 1s. per ton upon last week's rates, bringing quotations for delivery equal to Manchester up to 48s. 4d. for forge and 49s. 4d. for foundry, less 2½ per cent.; Derbyshire iron in some cases is quoted at prices which are altogether out of this market, but when makers have iron to sell their prices run about the same as for Lincolnshire. A few odd sales of Middlesbrough are made on the basis of 53s. 4d. net cash for g.m.b.'s delivered equal to Manchester.

In the finished iron trade business generally is reported to be fairly active and the local forges are all well supplied with work. The bulk of the business doing is still for shipment, and considerable American orders have recently been given out for bars and sheets, with hoops also being taken in moderate quantities. In the home trade, although the demand is still only moderate, inquiries are said to be improving. There is still some underselling on the part of merchants, who have iron yet to come in bought at under current rates; but so far as makers' prices are concerned the tendency is to stiffen; and for delivery equal to Manchester or Liverpool, good local bars now average £6 10s. per ton; hoops, £7; and sheets, £8 15s. per ton.

With regard to the engineering trades, it will be of interest to give the substance of a conversation I had this week with a gentleman who has exceptional opportunities of ascertaining the exact condition of the various branches of the iron industry. Trade in this district, he told me, was not so good as it had been recently. There were some branches, such as tool-makers, locomotive builders, and boiler-makers, which were still kept busily employed, although this to some extent was on the completion of orders for shipment. Machinists, however, have less work in hand, and millwrights and founders are not so busy as they were. As to the general condition of the trade, he pointed out that many people were doing so badly during the period of depression, that so soon as any activity made itself apparent, they rushed in to secure orders at low figures, and this, notwithstanding the considerable amount of work which had been given out, had tended to keep prices down.

With regard to the activity of locomotive builders mentioned above, I may add that from my own inquiries I find it is confined chiefly to the working out of old orders, comparatively little new business being at present put in the market. I may also here mention the many complaints I have heard with reference to the manner in which local firms who secured French contracts some time back have had to work under the specifications; and judging from the great dissatisfaction which is expressed, it will certainly be difficult to obtain again the acceptance of contracts to be carried out under similar conditions. It is not so much that in the first place considerable difficulty was experienced in working up to the specifications owing to the peculiarities of construction which were required, and which for a time entailed a special training of the men—to that, in fact, no complaint would have been raised—but little petty details, and small items of fittings, have been the source of such constant objections, which have not only been vexatious in themselves, but, having to be referred for decision to the principals in France, have necessitated frequent and considerable delay, that English makers will not care to work again under specifications interpreted in a manner which is altogether incomprehensible to English methods. Paltry matters which an English inspector would at once have decided upon his own responsibility have been the frequent cause of stopping work and most voluminous correspondence, and as an illustration of the manner in which the French inspectors have thought it necessary to fulfil their duties, I may mention that plates after they have been passed have been ultimately rejected because the inspector had not seen the piling of the metal.

Plant for ironworks seems to be in good demand, and the large orders which some of the local firms have on their books certainly do not indicate any apprehensions of declining prosperity in this branch of trade. Messrs. W. and J. Galloway and Sons, of the Knott Mill Ironworks, Manchester, who are just completing exceptionally heavy sets of machinery for a French ironworks, of which I have previously given a description, have now their books full of similar orders to be executed for English iron manufacturers. The firm have at present in hand no less than five large blowing engines, three of which will have cylinders of over 100in. diameter, two pairs of heavy reversing engines, besides a number of the ordinary compound and single-cylinder engines, and the pressure of work, chiefly for English iron manufacturing firms, is so great that an additional erecting shop, considerably larger than the one at present in use in connection with the works, is being built on the ground lately occupied by the old foundry.

In the coal trade of this district the demand is not quite so keen as it was towards the close of last month, the immediate apprehensions of a strike having been allayed by the temporary withdrawal of the notices sent out by the men for an advance of wages. There, is, however, still a good demand, and colliery proprietors have deliveries to complete on account of orders in hand that will in most cases keep them going well over the month. Pits, consequently, are kept on full time, and a good deal of coal is still being filled up out of stock. With the commencement of the month there has been an almost general advance of 6d. to 1s. per ton on round coals, which in some cases is in addition to an advance made during September, and engine classes of fuel have to a large extent been put up 5d. per ton. At the pit mouth prices now average about as under:—Best coals, 9s. 6d. to 10s.; seconds, 7s. 6d. to 8s. 6d.; common house coals, 6s. 6d. to 7s.; steam and forge coals, 5s. 6d. to 6s.; burgy, 4s. 9d. to 5d.; and ordinary slack, 3s. 6d. to 4s. per ton.

In the shipping trade there has been a tolerably good business stirring at Liverpool, and especially at Garston, where vessels have been considerably delayed by the scarcity of berths in the docks, whilst supplies of coal have in many cases been difficult to obtain, and, to meet temporary requirements, as much as 10s. per ton has been paid for steam coal delivered at Garston Docks. The average advance which is now being realised upon late prices is about 1s. per ton; steam coal delivered at the high level, Liverpool, or at Garston Docks, being quoted at 8s. to 8s. 6d., and seconds house coals at 9s. 6d. to 10s. per ton.

Although the notices for an advance of wages have been temporarily withdrawn by the miners in this district, the agitation has in no way subsided, and it is more than probable that the demand will be renewed with still greater determination at the end of the month, with the result that a strike will follow if an advance in wages is not conceded. In the meantime the policy of the men seems to be to restrict the output as much as possible.

The annual meeting of the Manchester Geological Society was held on Tuesday, and Mr. J. Aitken was elected president for the ensuing year. During the forthcoming session the society, which is now largely composed of mining engineers, will hold three meetings at Wigan.

Barrow.—During the week there has been a decided improvement in the hematite pig iron trade, and prices have consequently advanced 6d. per ton all round. I noticed last week that the present demand, if maintained, must of necessity carry up quotations, and the marked improvement which has taken place will, in all probability, raise prices very considerably, as consumers of pig iron appear to be disposed very favourably for business. Continental users are very active in their inquiries, and the demands made on American account are such as will provide plenty of employment for smelters. The business for the winter months will be good, as makers' books are pretty full with contracts which will carry them through the autumn, and the present active state of the market, if only maintained for a very short time, will find employment for the winter months. Stocks are decreasing, owing to the heavy exportation of metal. Steel makers have improved their position, and orders are being booked at prices higher than those quoted, viz., £5 12s. 6d. Some makers refuse to do business at present prices, having in hand very large contracts which will take some time to clear off. Iron ore in heavy consumption at 14s. to 15s. per ton at the mines. Spanish and Irish ore are being imported to the west coast in large cargoes. Iron shipbuilders will be busier shortly when present orders are more advanced. Engineers, ironfounders, boilermakers and others busy. Coal in better demand at high prices. Coke steady. Shipping active.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

The long-expected experiments with armour-plates at Spezzia have not yet taken place, owing to the absence of the Italian war-ship Duilio. On the outbreak of hostilities in Egypt, the Italian Government ordered that vessel to Alexandria, from which she will doubtless soon return. The Duilio is armed with 100-ton guns, which were to have been used against the plates. When the experiments do come off, they will excite general interest outside official and manufacturing circles, as they will practically settle the dispute as to the French and English systems of coating war-ships. The French favour all-steel plates—with which indeed the Duilio herself is clothed 22in. thick—while the English Admiralty have definitely made up their minds for the composite—steel faced—armour. It should be added, however, that a French firm has obtained the right of manufacturing "Wilson" compound plates by payment of a royalty.

A considerable order is certain to be given out on an early day for the Benbow, a new vessel with which the English Government intend to replace the old ship of that name. It is to be of a large size, and of the very newest type of British men-of-war. Her plating is expected to be of 18in.—composite. As soon as the contract for her construction is settled, the order for the plates will, as usual, probably be divided between Messrs. John Brown and Co., Limited, and Messrs. Charles Cammell and Co., Limited.

There is a considerable quantity of Great Northern stock being tendered for, and a number of Indian State Railway engines. A good share of the materials is certain to come to Sheffield as usual.

The Roumanian Minister of Public Works recently invited tenders for 16,500 tons of steel rails. Amongst the firms competing were the following:—Bolckow, Vaughan and Co., Middlesbrough, £6 8s. 3d.; Moss Bay Hematite Iron Company, Workington, £6 19s. 6d.; Herr F. Krupp, Essen, £7 0s. 3d., all per English ton. It will thus be seen that the price quoted by the most advantageously situated and keenest continental competitor, Herr Krupp, was 12s. per ton above that of the largest makers from Cleveland ores on the East Coast of England, and even higher than the price of the Moss Bay Company at Workington, who would doubtless use their own best quality of English hematite ore in the manufacture.

Bessemer pig iron—hematite—is at present making 67s. 6d. per ton, and forge iron 44s. per ton. These rates are about the same as at the corresponding period of last year. There is a rumour that certain important East Coast furnaces now making hematite will be altered to suit the production of common iron. This will have the effect of making the price of hematite stiffer, as it will greatly diminish the output.

Dr. Webster, the United States Consul, kindly supplies me with the particulars of Sheffield exports to the United States during the quarter ending September last. They are not so gratifying as was expected. The total value for the three months is £311,573, a decrease of £29,036 as compared with the corresponding period of 1881. Steel has been exported to the value of £98,231, and cutlery £79,720—an increase in steel of £20,711, and a decrease in cutlery of £2103. The total values exported for the three months were—July, £107,018; August, £85,265; September, £119,290. The exports for September last show an increase over September, 1881, of £3000 in steel and £6164 in cutlery. The increase of September over the preceding month is very satisfactory, being no less than £34,035.

The question of the hour at present is the demand of the miners for 15 per cent. advance in wages. An important meeting of coal-owners was held at Sheffield on Tuesday, when the resolutions of the men were under discussion. The meeting was one of the largest ever held in South Yorkshire, over thirty of the leading colliery firms in the district being represented. The proceedings were private, but the resolutions passed were afterwards communicated to the press. The principal resolution, which states concisely the whole question from the employers' point of view, was as follows:—"That there has been no advance in the price of coal to warrant any advance in the wages of the miners, but with a view to settle the question of wages upon a permanent footing, the masters are willing to renew the offer made in 1881, and to take as a basis for the regulation of wages the net average selling price over the last two years ending June 30th, 1882, or any one of the four half-years as may be selected by the workmen; and to give the miners the earliest possible advantage of any rise in the price of coal, they are willing to submit their books at once to the inspection of competent accountants to be appointed for the purpose, with instructions to ascertain the net selling price for the three months ended 30th September, 1882. If any advance during the last three months is shown over the period selected, the men's wages to be advanced from the 1st November next in the following proportions, namely:—2½ per cent. for every complete fourpence advance in the selling price of coal up to 1s. 4d. per ton over the basis price of the period to be selected; and for the fifth advance of fourpence 5 per cent. to be given—so that for every 1s. 8d. advance in the selling price the men to be entitled to 15 per cent.; or the owners are willing to submit the question of any advance in wages to arbitration." A deputation was appointed to meet a deputation from the miners, and explain the reasons which have compelled the owners to pass the foregoing resolution. The deputation consists of Mr. J. D. Ellis, Aldwarke Main and Car House, who presided at the meeting; Mr. George Wilson, Oaks; Mr. A. M. Chambers, Thorncliffe; Mr. James Moxon, Darfield Main; Mr. B. Sellars, Roundwood; Mr. Joseph Mitchell, Craiks and Mitchell Main; Mr. J. Tyas, Edmunds and Swaithe Main; and Mr. C. E. Rhodes, the honorary secretary. The resolutions have been forwarded to Mr. Pickard, the secretary of the Yorkshire Miners' Association, and a conference will no doubt be held in a few days. The executive of the association have issued instructions for taking the votes of the men by ballot. Meetings are to be called at every pithead, and the three points to be ballotted for or against are—(1) Shall we go on strike if the coalowners refuse to concede the advance of 15 per cent. on our present wages? (2) Shall we give fourteen days' notice to try and secure the same? (3) Shall we, when we get the advance, restrict the output of coal, and if so, by what means and to what extent? The result is to be reported by the 9th of October.

In Derbyshire various coalowners are offering advances of 5, 7½, and 10 per cent. At Tibshalf, Messrs. Seely and Co. have promised an advance of 12½ per cent. on the black shale coal, and 11 per cent. on the low main. The price of coal was generally increased in the South Yorkshire district on Monday. The Nunnery Colliery Company raised its quotations by 5d. to 10d. per ton. Messrs. Newton, Chambers, and Co., who send the largest tonnage of Silkstone coal from South Yorkshire to London, increased their prices by 10d. to 1s. 3d. per ton, their quotations on the wharf at Sheffield being Mortomley best Silkstone, 13s. 4d. per ton; Mortomley thin seam, 12s. 1d.; Mortomley best nuts, 9s. 2d.; Mortomley brights, 10s.

It is expected that the wages difficulty will be decided by a compromise, probably 7½ per cent. advance, although the miners are very unanimous and determined on having 15 per cent.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The Cleveland iron market held at Middlesbrough on Tuesday last was well attended, and a good deal of business was done. During the past week business has, indeed, been in a most satisfactory condition, especially as regards pig iron. Prices, which until a week since had for a considerable time remained almost stationary, are now advancing steadily. The market was not much affected by the report that in Scotland the iron trade was somewhat depressed, consumers having evidently come to the conclusion that, in view of the enormous demand and of good reports from all parts, prices are not unlikely to go still higher. They are, therefore, now extremely eager to place their orders. A good deal of No. 3 g.m.b. iron was disposed of for quick delivery at 44s. 6d. per ton f.o.b.; but before the market closed 44s. 7½d. was quoted by some merchants, and 44s. 9d. was the least others would take. It will thus be seen that there is a further rise of 3d. to 6d. per ton since the last report.

Smelters are being very much pressed to make contracts, and could easily book for delivery up to March next at present prices, if they felt inclined to commit themselves so far ahead. Most of the iron in stock is, however, in few hands, and firmly held, and producers are thus not bound to sell at present. At their meeting held on Tuesday before going on 'Change the combined makers fixed their price at 45s. per ton f.o.b. for No. 3, subject to payment by cash on the Monday following delivery. They also decided that, so far as Cleveland is concerned, the restriction shall remain in force for another three months, whether the Scotch ironmasters follow their example or not.

Iron in both makers' and merchants' hands is becoming very scarce, some qualities, more particularly No. 3, being very difficult to get. It is some time since shipowners have experienced such difficulty in obtaining cargoes for their vessels. It is not an uncommon sight just now to see four or five waiting their turn at the wharves. Connal's No. 3 warrants are to be had at 44s. 6d. per ton, but the demand for them is not great at present.

The quantity of pig iron shipped from the Tees during the month of September reached the enormous total of 100,838 tons. On only one previous occasion in the history of the northern iron trade has there been a greater quantity exported in a single month, namely, in September, 1879, when the total reached 101,154 tons. That, however, was the year of the American boom, and about 10,000 tons were sent to the

United States. Last month none was sent thither. The shipments for August were 95,861 tons, and for September last year 78,897 tons. Of last month's exports 26,105 tons were sent to Scotland, 10,075 tons to Wales, 3320 tons to Newcastle, 2845 tons to other English ports; 10,160 tons to France, 4860 tons to Belgium, 22,336 tons to Germany, 8747 tons to Holland. 860 tons to Spain, 3760 tons to Norway and Sweden, 5075 tons to Russia, and 2695 tons to other countries. The increase in the shipment of manufactured iron and steel is also very great, 28,829 tons having been exported, as against 18,787 tons during August. Of this amount 17,462 tons went to foreign ports, and 11,367 tons to British ports.

The stock of Cleveland pig iron in Connal's Middlesbrough store on Tuesday amounted to 108,858 tons, being 1190 tons less that on the previous Tuesday.

There is still very little doing in the manufactured iron trade, buyers being very reluctant to give out orders. Ship plates are £6 12s. 6d. to £7 per ton; angles are £5 17s. 6d. to £6 2s. 6d. per ton; and common bars, £6 to £6 5s. per ton, all less 2½ per cent. at makers' works. Inasmuch as coal, labour, and pig iron have all risen in price, it is not likely that manufactured iron will long remain at present rates.

The coal trade is very active just now. Household coal advanced on Tuesday last 1s. per ton all round, and coal for manufacturing purposes 6d. per ton. Coke also has risen to the extent of 9d. per ton above last week's price.

The North-Eastern Marine Engineering Company's new works at Gateshead have made a commencement in the foundry department. The fitting shops are almost completed, and it is hoped that soon all the departments will be fully at work.

The Cleveland ironmasters' returns have been issued for September, and are highly satisfactory. The number of furnaces in blast remains the same as at the end of August, namely, 120. Cleveland iron is being made by eighty-three of these furnaces, the remainder being at work on hematite, basic, &c. Messrs. Bolckow, Vaughan, and Co. have put a furnace out of blast, and the Claylane Iron Company has blown one in. One of Messrs. W. Whitwell and Co.'s furnaces have been changed from hematite to Cleveland iron. During August the make of Cleveland iron was 147,818 tons; in September it was 149,155 tons, or 1337 tons less. The make of other kinds of iron has decreased by 6294 tons, being only 70,655 tons. The total output for the month has been 219,810 tons, or 4957 tons less than the preceding month, a result due mainly to the less number of days in the month.

The amount of iron in stock in the stores on the 30th September was 269,273 tons, a reduction of 40,221 tons for the month. Makers' stocks show a decline of 15,217 tons, being now 105,102 tons, whilst in their stores the amount is 47,041 tons, a decrease of 14,796 tons. The quantity of iron in the public stores was 117,230 tons, being a falling off of 10,208 tons.

An address has been sent out to the ironworkers from the Executive Office at Darlington, in which the following appears :—"We wish to call the serious attention of all the iron and steel makers to their present weak and helpless condition, owing to the disorganisation now prevailing, and ask them how they expect that justice is to be obtained, or boards of arbitration continued, if they are determined to take so little interest in that which affects their own, as well as other workmen's, interests, and continue in their present disorganised condition, refusing to make any provision for their own protection, or render any assistance to those who are doing their utmost to advance and protect the general body of working men's interests, but, on the other hand, are doing all in their power to weaken the position of the representatives, and render them powerless to do good; and yet, after acting in this manner, demand and expect these men, upon whose services they have no legitimate claims—and who they repudiate every time it suits their convenience — will fight their battles, defend their interests, and protect them in all cases of difficulty which may arise."

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The Scotch iron trade is in a very satisfactory position, almost every branch being very fully employed, and in a number of cases considerable pressure is felt in meeting orders. In the iron market during the past week there has been great activity. Considerable speculation has taken place in warrants, the prices of which have fluctuated between 8d. and 1s. per ton. The scarcity of makers' special brands is still felt, and a further advance in prices has taken place. The inquiry for No. 4 pig iron for use at the forges has been unusually keen, and consumers are apparently anxious to make purchases in case of a further advance in the values of iron. The shipping trade has been better than during a few weeks previously, and it has been found impossible to place some of the orders in consequence of the difficulty of obtaining supplies from the ironworks. Several furnaces have been put out at Shotts with the object of making repairs, and a dispute is threatened at Coltness by the furnace men, who profess to be dissatisfied with having to work on Sundays, but who are understood to be quite ready to do so if their wages are advanced. The wages question is evidently one which the employers will immediately have to look in the face, the rise in the prices of iron having led the workmen to expect an increase of pay. The demand for pig iron on the Continent is well maintained. There are fewer inquiries from Canada, but rather more from the United States, where the stocks of Scotch pigs are reported to be all but exhausted. The stock in Messrs. Connal and Co.'s stores is decreasing at the rate of about 1000 tons per week.

Business was done in the warrant market on Friday up till 51s. 10d. cash. On Monday the market was rather quieter, when a reaction took place to 51s. 8d. On Tuesday forenoon transactions were effected at 51s. 4½d. to 51s. 3d. and 51s. 6½d. cash, and at 51s. 7½d. to 51s. 6d. and 51s. 9½d. one month. A stronger feeling prevailed in the afternoon, when business was done from 51s. 9½d. cash and 52s. ½d. one month. Business was done on Wednesday at 52s. to 51s. 7d. cash, and to-day—Thursday—between 51s. 6d. and 51s. 9d. cash. Makers' stocks are officially announced as 45,223 tons less than at the end of May last.

Since last report makers have all increased their prices, and the quotations are now as follows :—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 66s.; No. 3, 56s.; Coltness, 70s. and 56s. 6d.; Langloan, 68s. and 56s. 6d.; Summerlee, 65s. 6d. and 51s. 3d.; Calder, 65s. and 55s.; Carnbroe, 59s. and 53s.; Clyde, 55s. 6d. and 53s.; Monkland, Quarter, and Govan, each 53s. and 51s.; Shotts, at Leith, 66s. 6d. and 56s. 6d.; Carron, at Grangemouth, 53s.—specially selected, 57s. 6d.—and 52s.; Kinneil, at Bo'ness, 51s. 6d. and 50s.; Glengarnock, at Ardrossan, 59s. and 53s.; Eglinton, 54s. and 52s.; Dalmellington, 54s. and 52s. 6d.

There is considerable improvement in the arrivals of pig iron from Cleveland, but still the amount received in Scotland to date for the present year is fully 47,000 tons less than in the corresponding period of last year.

The hematite trade is moderately active, with hardly any change in prices.

At the malleable ironworks gratifying activity in almost every case prevails, and prices show an upward tendency.

The steel trade is likewise active, and there are several new works almost ready to be put in operation, while those going are working well up to their capacity. The engineering and iron-founding establishments are all busy, with numerous orders coming to hand.

In the coal trade a very large business is being done, the shipments being considerably larger than at this time last year, and the home inquiry for nearly every quality animated. Prices are still tending upwards, and an effort is being made by the coalmasters to obtain a uniform rise from the consumers of about 1s. per ton.

The wages question in the mining trade is engaging a great deal of attention. The masters are not unwilling to meet the terms of the men, at least to some extent. In Fifeshire they have intimated as much, stating at the same time that their efforts to increase the prices of coals have hitherto failed. These efforts, however, it is intimated, will be renewed at once, and if they are successful the advance will be granted. At a meeting of the men, when this communication was received, an opinion was expressed to the effect that the employers are able even at the present rates to increase wages, but in this part of the country, as well as in the west, the men have so far manifested extreme dislike to strike. It appears that a number of the coalmasters this week in Lanarkshire had not received a notice from the men of their demand for higher pay; but under the direction of the delegates every effort is to be made to bring the matter to a conclusion.

The trustees of the Duke of Hamilton have resolved to let the minerals under what is known as the North Haugh, stretching between Hamilton Palace and Bothwell Bridge. The new coalfield extends to about 800 acres, and it is said that it will include the minerals under the palace, which have hitherto been reserved. The coal is of excellent quality, and will greatly add to the productive capacity of the Hamilton coal-field.

The Clyde Coal Company, Limited, has sold its Spittalhill Colliery in the vicinity of Newton for £14,000 to Mr. John Wilson, coalmaster, Motherwell.

The West of Scotland Association of Gas Managers held their half-yearly meeting in Glasgow a few days ago, under the presidency of Mr. Dalziel, of Kilmarnock. Interesting papers were read on a variety of subjects, including one by Mr. Winton, of Grangemouth, on "An improved purifier lighting apparatus," which he has introduced into the Grangemouth works; and one by Mr. Andrew Napier, of Crieff, on the "Assessing of Gasworks," in which he contended that 7 per cent. would be a good basis of value. A discussion took place on the economy of using oxide of iron instead of lime, and the opinion generally expressed was that at large works it was cheaper to use the oxide, but where a high quality of gas was made it was better to employ both lime and oxide. Under the direction of Mr. Foulis, of Glasgow, the members of the association paid a visit to Dalmarnoch gasworks, and inspected the regenerative furnaces in use there for the distillation of coal.

The past month's output of new shipping on the Clyde is the largest on record, amounting to upwards of 40,000 tons.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

The first general meeting of Hill's Graving Dock Company was held in Cardiff this week. It is understood that Logan and Co. will have the contract. Mr. James Frazer, of London, is to be auditor. Quiet movements are still going on towards the proposed dock at Barry, and for connecting the Ocean and other collieries with the new docks. Levelling and other introductory operations are also going on from Quakers'-yard to Merthyr, for connecting the new steel works at Cyfarthfa with the Great Western and Rhymney systems.

The Powell Company is going in for fresh sinking in the Rhymney Valley.

The Ogmore Dock and Railway scheme is one of the most promising of latest ventures. The necessary money has been subscribed for preliminary expenses, and powers will be asked for next session. Plans have been prepared by Mr. James Abernethy and Mr. R. Price Williams.

The new works in the North Dock, Swansea, are rapidly approaching completion. The Swansea coal trade appears to be benefitting by the present state of things in the North, a good many new customers being diverted to this quarter.

The aspect of colliery labour throughout the whole of South Wales is satisfactory, though it is known that efforts have been made to try and bring about a kindred action for higher wages with the North of England and North Walian colliers. Two formidable and threatening movements in the South have collapsed—the Ocean Collieries scale agitation and the Coedcae and Havod difficulty. Both are now arranged, and colliers are all working tranquilly, satisfied with the prospect of a small advance.

The ironworks are all fairly busy. Prices are steady for most things, and for best steel rails are looking up. Bars—common—are firm at £5 15s. to £5 17s. 6d. There are plenty of inquiries for old rails at low prices. Cyfarthfa has sold an immense quantity of old iron, and is slowly going ahead in the direction of steel.

Neath Abbey Harbour Works—contractor Mr. Daniel—are progressing well. There are 500 men now fully employed.

A preliminary trial of the Merthyr Wireworks has been satisfactory in result.

The "big job" of the Pontypridd, Caerphilly, and Newport Railway, the bridge spanning the Taff, is progressing well, but I do not anticipate an opening much before Christmas, though unquestionably the contract is in excellent hands. The difficulties in the way of completion have been great, but have been successfully overcome so far.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

26th September, 1882.

4567. Obtaining Mechanical Effect by Electrical Energy, E. L. Voice, London.
4568. Heating Water, A. J. Billing, Holborn.
4569. Furnace Linings, &c., S. Pitt.—(*C. G. Francklyn, New York, U.S.*)
4570. Obtaining Fibre from Leaves and Stalks of Plants, &c., A. V. Newton.—(*The Sanford Universal Fibre Company, Incorporated, New York, U.S.*)
4571. Lamps, N. T. Hewens, Wellingborough.
4572. Gas Apparatus, S. Chandler, London.
4573. Portable Electrical Lighting Apparatus, J. Imray.—(*E. Arnould, Paris.*)
4574. Hydraulic Machines, R. H. Tweddell, London.
4575. Propellers for Steamships, &c., R. Gibbs, Liverpool.
4576. Camp Stools or Folding Seats, J. C. Mewburn.—(*W. Walcker, Paris.*)
4577. Stowing Bags of Wool, &c., H. M. Whitehead, London.
4578. Dredging Buckets, W. Clark.—(*W. H. Wood, New York, U.S.*)
4579. Ice-making Machinery, W. H. Beck.—(*G. Dubern, Calcutta, India.*)
4580. Decomposing Alloys for Electrotyping, &c., W. R. Lake.—(*H. R. Cassel, New York, U.S.*)
4581. Removing Ink Stains from the Human Skin, G. F. Redfern.—(*H. Buczkowski, Vienna.*)
4582. Preparing Crude Earth Wax for Candles, &c., F. E. Tucker, London.

27th September, 1882.

4583. Rotary Pumps and Blowers, M. Benson.—(*F. M. Roots, Connersville, U.S.*)
4584. Buckles or Fastenings for Braces, &c., J. B. Brooks and F. R. Baker, Birmingham.
4585. Aerial and Marine Navigation Apparatus, B. W. Maughan and S. D. Waddy, London.
4586. Locomotive Brakes, W. M. Lendrum.—(*S. C. Sloan, New York, U.S.*)
4587. Regulating the Transmission of Power for Operating the Bellows of Organs, J. Johnson and R. Talbot, Blackburn.
4588. Steam and Water-gauge Taps, T. Allison, Milnsbridge.
4589. Corset Busks and Clasps, C. A. Snow.—(*C. A. Adams, Asheville, U.S.*)
4590. Treating Soap Lyes to Recover Glycerine, &c., A. J. Lawson and H. L. Sulman, Bristol.
4591. Pasting and Applying Labels to Bottles, &c., F. Foster, London.
4592. Ventilating Appliances, H. Blair, Glasgow.
4593. Independent Car Wheels and Journal Bearings, H. J. Allison.—(*G. W. Fairman, W. H. Gray, and W. R. Austin, New York, U.S.*)
4594. Lamps, W. L. Wise.—(*F. Besnard, Paris.*)
4595. Fast and Loose Pulleys, T. Sharp, Smethwick.

28th September, 1882.

4602. Vessels for Holding Oils, &c., G. A. J. Schott, Bradford.
4603. Spinning Rings, B. J. B. Mills.—(*J. Schütt and J. Warnholtz, Neuminster, Prussia.*)
4604. Balls for Lawn Tennis, &c., J. Neville, London.
4605. Paper for Bank Notes, &c., J. H. Johnson.—(*E. Musil, Neusiedl, Austria.*)
4606. Compound Vacuum Pumps, J. H. Johnson.—(*W. Richter, Berlin.*)
4607. Obtaining the Extract or Soluble Portion from Tanning Materials, J. Hutchings, Warrington.
4608. Obtaining Artificial Light, J. Mayer, London.
4609. Raising, &c., Portable Rivetting Machines and the like, R. H. Tweddell, London, and J. Fielding, Gloucester.
4610. Mashing Malt, &c., D. W. Hamper and E. Harper, Sowerby Bridge.
4611. Boiling Wort, &c., D. W. Hamper and E. Harper, Sowerby Bridge.
4612. Preparing Finings for Wines, &c., D. W. Hamper and E. Harper, Sowerby Bridge.
4613. Feeding Wool, &c., to Carding or other Machines, R. Tatham, Rochdale.
4614. Clips for Securing Tires on the Wheels of Bicycles, &c., F. R. Baker, Birmingham.
4615. Sewing Machines, C. P. Evans, Birmingham.
4616. A New System of Advertising, S. Puente, London.
4596. Measuring, &c., Electric Currents, S. Z. de Ferranti, Shepherd's-bush, and A. Thompson, London.
4597. Bicycles, &c., T. Warwick, Aston.
4598. Utilising Heat as a Motor, H. Gruson and R. Handrick, Buckau, Prussia.

29th September, 1882.

4627. Cigarettes, O. W. T. Barnsdale, Nottingham.
4628. Boring and Tapping Holes in Boilers, &c., R. Davidson, Glasgow.
4629. Tricycles, &c., A. Gibbs, Birmingham.
4630. Hutches or Wagons, W. Cook, Glasgow.
4631. Bicycles, &c., F. G. Kinnaird, London.
4632. Furnaces, J. W. Couchman, Tottenham.
4633. Musical Instruments, H. J. Haddan.—(*W. F. Abbot, Montreal, Canada.*)
4634. Furnaces, A. G. Fenn, London.
4635. Stoppers for Bottles, &c., N. Thompson, London.
4636. Bismuth Bronze, J. Webster, Solihull.
4637. Steering Gear, E. J. Harland, G. W. Wolff, W. H. Wilson, and W. J. Pirrie, Ireland.
4638. Steam Generators and Furnaces, W. P. Thompson.—(*M. Monsanto, E. Odio, & F. Perozo, New York.*)
4639. Umbrellas, &c., W. Pickin, Birmingham.
4640. An Improved Game and Apparatus, J. H. Johnson.—(*H. Rovel, Paris.*)
4641. Ornamental Pile Fabrics, T. F. Firth and F. Farrand, Heckmondwike.
4642. Parallel Rulers, C. R. Baillie-Hamilton, Kent.
4643. Converting Reciprocating into Rotary or Rotary into Reciprocating Motion, W. R. Lake.—(*J. J. Larroque, Paris.*)
4644. Purifying Coal Gas, C. F. Claus, London.
4645. Electric Meters, S. D. Mott, London.
4646. Electric Meters, S. D. Mott, London.
4647. Fasteners for Ships' Side Lights, &c., R. C. Thompson, Sunderland.

30th September, 1882.

4648. Cylinder Glass Stylographs, H. L. Callendar, Saffron Walden.
4649. Producing Ornamental Frillings, C. Jackson, Nottingham.
4650. Musical Instruments, T. Machell, Glasgow.
4651. Artificial Light Apparatus, J. Y. McLellan, Glasgow.
4652. Securing Windows, &c., T. Young and G. C. Wood, Sheffield.
4653. Checking, &c., Apparatus, W. M. Llewellin, Bristol.
4654. Folding Knives, &c., L. Hager, London.
4655. Metallic Staircases, R. Hudson, Gildersome.
4656. Digging Apparatus, F. Proctor, Stevenage.
4657. Brakes or Drags, H. Downie, Corstorphine.
4658. Purifying Alcohol, A. J. Boult.—(*G. Fleury, France.*)
4659. Treating Sewage, J. Young, Kelly.
4660. Operating upon the Atmosphere of Apartments, W. W. Nightingale, Southport.
4661. Registering the Supply of Electricity, J. H. Greenhill, Belfast.
4662. Coupling, &c., Railway Carriages, J. Richardson and C. Greenwood, Harrogate.
4663. Obtaining Motive Power, J. Stephan, Worcester.
4664. Churns, J. Llewellin, Haverfordwest.
4665. Electro-motor, M. Immisch, London.
4666. Looms for Weaving, J. B. Alliott.—(*J. Wade, New York, U.S.*)
4667. Locks, J. Jackson, jun., and C. Sheekey, London.
4668. Velocipedes, S. Miller, London.
4669. Steam Generators, W. Clark.—(*M. Hervier, Paris.*)

2nd October, 1882.

4670. Composition for Boots, &c., E. and A. Wright, Surrey.
4671. Photography, C. P. Evans, Birmingham.
4672. Peat Fuel, G. Wilson, Elmers End.
4673. Coupling for Railway Vehicles, R. Stone, Bristol.
4674. Steam Engines, T. J. Handford.—(*T. A. Edison, New York, U.S.*)
4675. Keyless, &c., Watches, T. Waller, Coventry.
4676. Incandescent Electric Lamps, J. F. Phillips.—(*C. H. F. Müller, Hamburg.*)
4677. Railway Brakes, J. Pickle, London.
4678. Regenerating Sulphur from Alkali Waste, W. Weldon, Burstow.
4678. Protecting Bricks from Rain, J. D. Lampard and F. Coppen, London.
4680. Dynamo-electric, &c., Machines, J. S. Beeman, W. Taylor, and F. King, London.
4681. Doubling, &c., Yarns, E. Dyson, Milnsbridge.
4682. Looms for Weaving, J. H. Pickles, Burnley.
4683. Axles, W. Clark.—(*J. H. Huyler, Tenafly, U.S.*)
4684. Centrifugal Machines, A. Steenberg.—(*L. B. Nielsen, Denmark.*)
4685. Lathes, W. Allan, Sunderland.
4686. Pressing Oil from Seed, W. Bushell and W. T. Haydon, Dover.
4687. Transmitting, &c., Power Force or Motion, W. P. Thompson.—(*J. D. Wright, Worcester, U.S.*)
4688. Nut Locks, A. J. Boult.—(*W. Mack and J. B. Deeds, Terre Haute, U.S.*)
4689. Metal Punches, A. J. Boult.—(*E. A. Bailey, G. W. Constantine, T. W. Fowler, and F. W. Smith, Washington, U.S.*)
4690. Safety Hooks for Harness Traces, H. H. Lake.—(*W. K. Rairigh, St. Petersburg, U.S.*)
4691. Generating, &c., Electric Energy, F. C. Phillips, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

4569. Furnace Linings, &c., S. Pitt, Sutton.—A communication from C. G. Franklyn, New York, U.S.—26*th September*, 1882.
4589. Corset Busks and Clasps, C. A. Snow, Washington, U.S.—A communication from C. A. Adams, Asheville, U.S.—27*th September*, 1882.
4633. Musical Instruments, H. J. Haddan, London.—A communication from W. F. Abbot, Montreal.—29*th September*, 1882.

Patents on which the Stamp Duty of £50 has been paid.

3875. Electric Lighting, C. W. Harrison, London.—25*th September*, 1879.
3887. Suspending and Detaching Boats, &c., E. J. Hill and J. L. Clark, London.—26*th September*, 1879.
3902. Cooling Water, &c., H. S. Boase and C. Miller, Dundee.—29*th September*, 1879.
4357. Grain Elevators, E. Power, London.—25*th October*, 1879.
3881. Filtering and Drying Sewage, &c., W. and G. C. Gibbs, London.—26*th September*, 1879.
3926. Tablets for Erasing Writing, A. W. L. Reddie, London.—30*th September*, 1879.
3953. Rotary Engines and Pumps, B. Tower, Blackheath.—2*nd October*, 1879.
3901. Moulding Machines, J. Anderson, Jarrow.—27*th September*, 1879.
3966. Earthenware, &c., Drinking Vessels, A. Dunn, Birmingham.—3*rd October*, 1879.
4313. Knife-cleaning, &c., Apparatus, J. O. Spong, London.—23*rd October*, 1879.
3996. Treating Solid Residues after the Extraction of Starch from Indian Corn, A. Manbré, jun., Liverpool.—4*th October*, 1879.
4038 Producing Vinegar, C. Kesseler, Berlin.—6*th October*, 1879.
3935. Bottles and Stoppers, &c., H. Barrett, Hampton.—30*th September*, 1879.
3938. White Lead, W. R. Lake, London.—30*th September*, 1879.
3971. Concentrating Liquids by Evaporation, P. Calliburcès, Pera, Turkey.—3*rd October*, 1879.
3952. Moulding Traps for Water-closets, &c., W. M. Smeaton, London.—2*nd October*, 1879.

Patents on which the Stamp Duty of £100 has been paid.

3374. Electric Telegraphs, J. Muirhead, jun., Wimbledon.—27*th September*, 1875.
3380. Sewing Machines, T. McGrah, Sheffield.—28*th September*, 1875.
3426. Fog Signals, F. H. Holmes, London.—2*nd October*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 20*th October*, 1882.

2241. Boilers, S. Jones, Wrexham.—12*th May*, 1882.
2463. Apparatus for Lifting Cloth, &c., T. Stead, Leeds.—24*th May*, 1882.
2465. Slide Valves, J. W. Joyce, Durham.—24*th May*, 1882.
2480. Compounds Suitable for Electrical Insulation, F. Field, Beckenham.—25*th May*, 1882.
2481. Looms for Weaving, W. Thompson, Blackburn.—25*th May*, 1882.
2482. Organs, &c., J. B. Hamilton, Hammersmith.—25*th May*, 1882.
2484. Metallic Alloys, G. A. Dick, London.—25*th May*, 1882.
2486. Supporting the Net employed in the Game of Lawn Tennis, &c., J. M. Croisdale, Manchester.—25*th May*, 1882.
2500. Heels for Boots and Shoes, E. A. Brydges, Upton.—A communication from M. Rachler, G. Henneberg, and I. Rothziegel.—26*th May*, 1862.
2501. Insulator for Electrical Purposes, B. Rhodes and G. Binswanger, London.—26*th May*, 1882.
2504. Unicycle or One-wheeled Velocipede, J. Simonton, Comber.—26*th May*, 1882.

2506. External Lamps for Railway Trains and Signals, A. M. Silber, London.—26*th May*, 1882.
2510. Frames for the Manufacture of Stay Laces, &c., A. W. L. Reddie, London.—A communication from La Société Industrielle des Tresses et Lacets de St. Chamond.—26*th May*, 1882.
2517. Fousel Oil, J. K. Field, Battersea Park.—A communication from H. Ujhely.—26*th May*, 1882.
2527. Producing Inflammable Gas for the Production of Motive Power, H. Davey, Leeds.—27*th May*, 1882.
2543. Looms, W. R. Stitt and J. Lees, Belfast.—30*th May*, 1882.
2554. Vulcanising India-rubber, J. H. Johnson, London.—A communication from H. M. F. Jules and A. M. Auguste.—30*th May*, 1882.
2591. Water Gauges, W. R. Lake, London.—A communication from L. M. Fleet.—1*st June*, 1882.
2621. Horseshoe Nails, H. P. Fenby, Leeds.—3*rd June*, 1882.
2622. Appliances for Arresting a Person Attempting to open a Door, &c., E. L. Missonnier, London.—3*rd June*, 1882.
2648. Bathing Machines, H. Westman, Birmingham.—6*th June*, 1882.
2761. Paper-bag Machines, M. and L. Campe, Berlin.—12*th June*, 1882.
2777. Matches, W. T. Evans, Manchester.—13*th June*, 1882.
2788. Wheeled Vehicles for Facilitating the Unloading of Timber, &c., E. Rayner, Liverpool.—14*th June*, 1882.
2876. Bicarbonate of Soda, H. Gaskell, jun., and F. Hurter, Widnes.—17*th June*, 1882.
2896. Shunts or Switches for Protecting Telegraphic, &c., Instruments, C. T. Howard, Providence, U.S.—19*th June*, 1882.
2928. Mule Spinning Machines, S. Mock, Providence, U.S.—20*th June*, 1882.
3016. Ascertaining Approximately the Trim and Initial Stability of Ships, &c., A. Taylor, Newcastle-upon-Tyne.—26*th June*, 1882.
3276. Piston Valve Musical Instruments, B. J. B. Mills, London.—A communication from C. G. Conn.—11*th July*, 1882.
3513. Telephones, S. Bidwell, London.—25*th July*, 1882.
3538. Permanent Way of Railways, A. M. Clark, London.—A communication from J. Elmer.—25*th July*, 1882.
3728. Railway, &c., Carriages, U. Scott, London.—5*th August*, 1882.
3782. Bicycles, J. Beale, Blackheath.—9*th August*, 1882.
3808. Steam Boilers, &c., G. Sinclair, Leith.—10*th August*, 1882.
3818. Type and Space Holders, J. C. Mewburn, London.—A communication from A. A. Low and L. K. Johnson.—10*th August*, 1882.
3832. Self-acting Steam Traps, L. Dove, Stratford.—11*th August*, 1882.
3880. Manufacture of Leather, J. H. Johnson, London.—Com. from A. G. Fell.—15*th August*, 1882
3888. Lubricating Apparatus for Steam Engine Cylinders, &c., W. R. Lake, London.—A communication from T. Holland.—15*th August*, 1882.
3914. Steam Engines, P. Armington, Lawrence, U.S.—16*th August*, 1882.
3926 Spring Mattresses, &c., W. R. Lake, London.—Com. from G. Gale.—16*th August*, 1882.
3942. Improved Pump, W. B. Tibbits, Clifton.—17*th August*, 1882.
4109. Gas Lamps, F. H. Wenham, London.—28*th August*, 1882.
4113. Sewing and Trimming Knit Goods, &c., J. H. Johnson, London.—A communication from C. H. Willcox.—29*th August*, 1882.
4135. Valve Motions and Cylinders of Steam Engines, A. C. Kirk, Glasgow.—30*th August*, 1882.
4137. Flanging Holes in Metal Plates, A. C. Kirk, Glasgow.—30*th August*, 1882.
4501. Embroidering Machines, A. M. Clark, London.—A communication from J. A. Groebli.—21*st September*, 1882.

Last day for filing opposition, 24th October, 1882.

1908. Strains for Straining Pulp, G. Tidcombe, jun., Watford.—21*st April*, 1882.
2372. Syrup from Date Fruit, &c., T. Webb, London.—19*th May*, 1882.
2524. Central Buffer and Coupling Gear, W. R. S. Jones, Ajmere, India.—27*th May*, 1882.
2529. Digging, &c., Machines, W. Doubleday, Chelmsford.—27*th May*, 1882.
2550. Sifting Machine, M. Shearer, sen., and M. Shearer, jun., London.—30*th May*, 1882.
2552. Steering Quadrants, &c., J. Cook, jun., Washington, and W. Prosser, Newcastle-upon-Tyne.—30*th May*, 1882.
2553. Hinges, A. J. Boult, London.—A communication from E. Salomon and E. Armant.—30*th May*, 1882.
2564. Barges, &c., E. Moxon, Tunbridge Wells.—31*st May*, 1882.
2569. Electric Lamps, T. E. Gatehouse and H. R. Kempe, London.—31*st May*, 1882.
2586. Sugar Cane Mills, E. Hunt, Glasgow.—Com. from J. Thomson and J. Black.—1*st June*, 1882.
2587. Catches for Ratchet Wheels, J. F. Davies, Blackburn.—1*st June*, 1882.
2589. Screw Buttons, F. Wirth, Frankfort-on-the-Main.—A communication from L. E. E. Hunrath.—1*st June*, 1882.
2590. Glazing, &c., T. H. P. Dennis, Chelmsford.—1*st June*, 1882.
2597. Stoppering Bottles, &c., G. Falconnier, Switzerland.—1*st June*, 1882.
2598. Loading and Unloading Grain, &c., W. Cooper and J. Holdsworth, Hull.—2*nd June*, 1882.
2599. Moulds for Casting Steel, A. Patrick, Glasgow.—2*nd June*, 1882.
2601. Attaching to Purses Certain Appendages to Prevent Loss of same, S. Cooke, London.—2*nd June*, 1882.
2602. Secondary Batteries for Storing Electricity, C. T. Bright, London.—2*nd June*, 1882.
2624. Water Gauges for Steam Boilers, H. Slater, Derby.—5*th June*, 1882.
2634. Pleating Machines, C. G. Hill, Nottingham.—5*th June*, 1882.
2691. Stopping or Plugging the Ends of Boiler Tubes, D. McMillan, Govan.—A communication from N. McMillan.—8*th June*, 1882.
2712. Electric Lamps, W. R. Lake, London.—Com. from F. Krizik and L. Piette.—9*th June*, 1882.
2746. Breech-loading Fowling Pieces, L. Gye, London.—10*th June*, 1882.
2747. Rigging of Sailing Vessels, W. H. Hall, Kew.—10*th June*, 1882.
2863. Checking Apparatus, H. R. Landon and G. L. Dezille, London.—17*th June*, 1882.
2997. Oil Can, G. Cornut and A. Castelin, Paris.—24*th June*, 1882.
3151. Sewing Machines, F. Wirth, Frankfort-on-the-Main.—A communication from Junker and Ruh.—4*th July*, 1882.
3342. Producing Alkali Salts from Sulpho Acids, F. Wirth, Frankfort-on-the-Main. — Com. from Farbfabrik, vormals Brönner.—14*th July*, 1882.
3415. Separating Grain, P. V. Gelder, Sowerby Bridge.—18*th July*, 1882.
3603. Buttons and Fasteners, C. Daggett, London.—29*th July*, 1882.
3776. Coke, &c., J. Wood, Flockton, near Wakefield.—8*th August*, 1882.
3786. Furnaces, J. Imray, London.—A communication from C. H. F. Russmann.—9*th August*, 1882.
3802. Secondary Batteries, C. T. Kingzett, London.—9*th August*, 1882.
3840. Neck-ties, D. T. Keymer and F. Theak, Walbrook.—11*th August*, 1882.
3870. Steam Boilers or Generators, J. Imray, London.—Com. from C. Russmann.—14*th August*, 1882.
4014. Hydrocarbon Furnaces, J. Mundell and W. J. Gordon, Philadelphia, U.S.—22*nd August*, 1882.
4025. Working Gear for Electric Lighting, K. W. Hedges, London.—22*nd August*, 1882.
4093. Harvesting Machines, J. Howard and E. T. Bousfield, Bedford.—26*th August*, 1882.
4197. Sewing Machines, J. Warwick, Manchester.—2*nd September*, 1882.
4241. Purifying Steam Boilers, &c., M. Coulson, Spennymoor.—6*th September*, 1882.
4569. Furnace Linings, &c., S. Pitt, Sutton.—Com. from C. G. Francklyn.—26*th September*, 1882.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 29th September*, 1882.)

1322. Drying by Cold Process Printing on Tin, &c., H. Mathieson, London.—18*th March*, 1882.
1323. Transferring Printed Designs from Paper to Sheets of Tin, &c., H. Mathieson, London.—18*th March*, 1882.
1600. Electrical Apparatus for Indicating, &c., Fires, G. W. von Nawrocki, Berlin.—1*st April*, 1882.
1601. Air Economiser, W. Teague, jun., Tincroft.—1*st April*, 1882.
1610. Feeding Wool to Carding Machinery, W. Cliffe, Ley Moor.—3*rd April*, 1882.
1614. Magneto or Dynamo-electric Machines, W. R. Lake, London.—3*rd April*, 1882.
1619. Carbon Conductors for Electric Lamps, W. R. Lake, London.—3*rd April*, 1882.
1623. Bicycles, A. E. Gorse, Birmingham.—4*th April*, 1882.
1634. India-rubber Coated Fabrics, W. R. Lake, London.—4*th April*, 1882.
1643. Buttons, G. W. von Nawrocki, Berlin.—5*th April*, 1882.
1644. Portable Apparatus for Extinguishing Fires, &c., M. Vinning, Walbrook.—5*th April*, 1882
1647. Incandescent Electric Lamps, St. G. L. Fox, Westminster.—5*th April*, 1882.
1670. Incandescent Electric Lamps, J. Jameson, Newcastle-upon-Tyne.—6*th April*, 1882.
1671. Extinguishing Fires, P. Ambjorn, Paris.—6*th April*, 1882.
1680. Bicycles, &c., W. Scantlebury, London.—6*th April*, 1882.
1684. Telephonic Instruments, A. E. Dolbear, Somerville, U.S.—6*th April*, 1882.
1694. Cornice Poles and Curtain Suspenders, C. F. Grimmett & J. Cook, Birmingham.—8*th April*, 1882.
1721. Lead Peroxide, F. M. Lyte, London.—12*th April*, 1882.
1725. Manufacturing Soap and Fat Acids from Oleaginous Fruits, &c., F. C. Glaser, Berlin.—12*th April*, 1882.
1793. Velocipedes, J. White, Coventry.—14*th April*, 1882.
1817. Obtaining Crystallisable Sugar from Raw Sugar, &c., J. Johnson, London.—17*th April*, 1882.
1859. Velocipedes, H. E. Newton, London.—18*th April*, 1882.
1866. Purifying Raw Spirits, &c., F. M. Lyte, London.—19*th April*, 1882.
1913. Treating Ores, A. M. Clarke, London.—21*st April*, 1882.
1941. Crystallised Hydrochlorate of Alumina, W. R. Lake, London.—24*th April*, 1882.
1956. Electric Batteries, T. J. Handford, London.—25*th April*, 1882.
2021. Cleaning and Removing Oily Matters from Wool, &c., E. Mansfield, London.—28*th April*, 1882.
2220. Ornamenting Ribbons, A. H. Horsfall, Coventry.—11*th May*, 1882.
2239. Separating Sugar from Molasses, &c., C. Scheibler, Berlin.—11*th May*, 1882.
2544. Colouring Matters for Dyeing, &c., J. Erskine, Glasgow.—30*th May*, 1882.
2864. Bleaching Cotton Cloth, &c., E. de Pass, London.—17*th June*, 1882.
2888. Capstans, &c., S. Baxter, London.—19*th June*, 1882.
3041. Internal Stoppers for Bottles, W. Froggatt, Nottingham.—28*th June*, 1882.
3044. Producing Derivatives of Alpho Oxyhydro-Chinoline, &c., J. Erskine, Glasgow.—28*th June*, 1882.
3112. Removing Surplus Bronze from Paper, &c., J. Bromley, Leeds.—1*st July*, 1882.
3216. Producing Ortho-nitro-meta-methyl-benzaldehyde from Meta-methyl-benzaldehyde, &c., J. Erskine, Glasgow.—7*th July*, 1882.
3218. Producing Cinnamic Acid, &c, from Benzylidenacetone, &c., J. Erskine, Glasgow.—7*th July*, 1882.
3232. Stand for Photographic Cameras, J. F. Plücker, Antwerp.—7*th July*, 1882.
3293. Cigarette Machine, W. R. Lake, London.—11*th July*, 1882.
3362. Combs for Twist Lace Machines, W. Spowage, Nottingham.—15*th July*, 1882.
3485. Telegraphing to and from a Railway Train in Motion, W. B. Healey, London.—22*nd July*, 1882.
3495. Connecting Links for Attaching Chains, &c., J. H. Shoebotham and J. F. C. James, Birmingham.—22*nd July*, 1882.
3547. Electric Cables, J. G. Lorrain, Westminster.—26*th July*, 1882.
3575. Electric Lamps, J. G. Lorrain, Westminster.—27*th July*, 1882.

(*List o Letters Patent which passed the Great Seal on the 3rd October*, 1882.)

1646. Bobbins and Spools, J. Spence, Shipley.—5*th April*, 1882.
1652. Curbs for Roads, J. J. Wheeler, London.—5*th April*, 1882.
1653. Travelling Bags, &c., T. A. Mitchell, Chislehurst.—5*th April*, 1882.
1661. Mills for Grinding Grain, W. R. Lake, London.—5*th April*, 1882.
1665. Producing Tannin, E. A. Brydges, Berlin.—6*th April*, 1882.
1666. Steam Boilers, G. Stevenson, Airdrie.—6*th April*, 1882.
1674. Safety Apparatus for Cages in Mines, C. D. Abel, London.—6*th April*, 1882.
1683. Peroxides of the Alkalies, &c., L. Mond, Northwich.—6*th April*, 1882.
1692. Dynamo-electric, &c., Machines, D. P. Piot, London.—6*th April*, 1882.
1695. Breakwaters, G. H. T. Beamish, Queen's Town.—8*th April*, 1882.
1697. Incandescent Electric Lamps, R. Brougham and F. A. Ormiston, London.—8*th April*, 1882.
1698. Boxes, &c., M. I. Verkouteren, London.—8*th April*, 1882.
1700. Galvanising Sheet Iron, T. H. Jones, London.—8*th April*, 1882.
1703. Projectiles for Ordnance, E. Palliser, London.—8*th April*, 1882.
1766. Finishing, &c., Corrugated Metallic Tubes, S. Fox, Leeds.—13*th April*, 1882.
1771. Steel, &c., S. Fox and J. Whitley, Leeds.—13*th April*, 1882.
1777. Increasing the Diameters of the ends of Metallic Tubes, S. Fox, Leeds.—14*th April*, 1882.
1801. Motive Power Apparatus, T. C. Boutet, Paris.—15*th April*, 1882.
1819. Collecting, &c., Water from Gas Mains, T. Pullin and H. Bonser, Newcastle-under-Lyme.—17*th April*, 1882.
1831. Reducing Metals from their Ores by Gaseous Fuel, R. S. Ripley, London.—17*th April*, 1882.
1853. Transmitting Apparatus for Printing Telegraphs, W. J. Burnside, Lower Norwood.—18*th April*, 1882.
1868. Gas Engines, H. A. Dufrené, Paris.—19*th April*, 1882.
1957. Turning, &c., Steam Ships, A. W. L. Reddie, London.—25*th April*, 1882.
2092. Electric Light Apparatus, C. Lever, Bowdon.—3*rd May*, 1882.
2652. Date Indicators, W. R. Lake, London.—6*th June*, 1882.
2963. Mules for Spinning Fibres, J. S. Cooke and A. Hardwick, Liversedge.—22*nd June*, 1882.
3329. Reproduction of Designs, W. P. Bruce, Midlothian.—13*th July*, 1882.
3591. Electric Producer and Power Machine, J. Imray, London.—28*th July*, 1882.
3617. Flour Dressing Machines, W. B. Dell, London.—31*st July*, 1882.

List of Specifications published during the week ending September 30th, 1882.

238, 6d.; 493, 2d.; 700, 10d.; 729, 6d.; 765, 6d.; 766, 4d.; 779, 6d.; 807, 8d.; 818, 8d.; 839, 6d.; 842, 6d.; 855, 1s. 2d.; 856, 2s. 4d.; 867, 6d.; 880, 8d.; 881, 4d.; 891, 6d.; 892, 6d.; 897, 2d.; 900, 6d.; 906, 6d; 911, 6d.; 914, 6d.; 918, 6d.; 926, 8d.; 933, 6d.; 937, 6d.; 940, 6d.; 941, 6d.; 942, 4d.; 943, 6d.; 944, 4d.; 948, 6d.; 949, 6d.; 950, 6d.; 951, 6d.; 954, 6d.; 956, 6d.; 959, 2d.; 961, 6d.; 962, 2d.; 964, 6d.; 966, 4d.; 967, 2d.; 969, 2d.; 971, 6d.; 972, 2d.; 973, 8d.; 974, 6d.; 976, 8d.; 977, 6d.; 978, 8d.; 980, 6d.; 981, 4d.; 982, 2d.; 985, 6d.; 986, 6d.; 988, 2d.; 989, 6d.; 990, 8d; 991, 2d.; 993, 4d.; 997, 8d.; 998, 6d.; 999, 2d.; 1000, 4d.; 1001, 2d.; 1002, 2d.; 1003, 6d.; 1009, 6d.; 1010, 2d.; 1011, 6d.; 1012, 2d.; 1026, 6d.; 1028, 6d.; 1029, 6d.; 1031, 6d.; 1032, 6d.; 1100, 4d.; 1230, 10d.; 1879, 6d.; 1970, 4d.; 2259, 6d.; 2770, 6d.; 2794, 6d.; 3132, 4d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

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

238. Lubricating the Spindles of Spinning and Doubling Machines, *J. Dodd and G. Little, Oldham.*—17*th January*, 1882. 6*d.*

A chamber or cavity is formed round the collar or tube within which the spindle revolves and serves as a reservoir for the lubricant. Through the tube or collar, openings are made communicating with the interior of the reservoir and spindle. The reservoir is secured to the spindle rail, and in the upper part is an opening to supply the lubricant, and in the lower part is an opening to remove the same, such opening being usually closed by a screw plug.

329. Telephone Transmitters, *S. P. Thompson, Bristol.*—23*rd January*, 1882.—(*Not proceeded with.*) 2*d.*

Substances other than carbon are to be used in telephone transmitters, preferably sulphides of certain metals, as molybdenum, lead, silver, &c.

333. Electric Cables, *T. J. Handford, London.*—23*rd January*, 1882.—(*A communication from P. B. Delauy, New York.*) 6*d.*

The cable is composed of a number of braided or plaited insulated wires in a metallic tube.

493. Preparation of Asbestos as an Insulating Material, *C. J. Allport, London.*—1*st February*, 1882.—(*Provisional protection not allowed.*) 2*d.*

The asbestos is soaked in a hot bath of black wax obtained from suitable hydrocarbons and then pressed in heated moulds. Sulphur or other hardening material may be introduced.

540. Dynamo-electric and Electro-dynamic Machines, *J. D. F. Andrews, Sauchiehall-street, Lanark.*—3*rd February*, 1882. 6*d.*

The claims are in the construction of the armature by winding on a non-magnetic core iron wire rope with insulated conducting wire, driving the armature through a spring from the shaft carrying the commutator, and driving the armature and commutator through a differential coupling having the brushes attached to a spring frame carrying the intermediate gear of the coupling.

687. Telephone Central Office System, *A. M. Clark, London.*—11*th February*, 1882.—(*A communication from G. M. Hopkins, Brooklyn, New York.*) 6*d.*

Relates to the arrangement of switch board for a central office.

689. Improvements in Telephone Receivers, *A. M. Clark, London.*—11*th February*, 1882.—(*A communication from G. M. Hopkins, Brooklyn, New York.*) 6*d.*

The object of this invention is to obtain increased efficiency, compactness, and lightness in receiving telephones. According to one modification a series of right-angled permanent magnets are arranged radially with their poles of like sign converging to and touching the soft iron core of a central magnet, and their other poles in contact with the underside of the iron diaphragm near its circumference. The soft iron magnet core is in the centre of the case close to the diaphragm, and at its other end it has a broad thin flange, against which the poles of the magnets are pressed by an elastic rubber ring confined between them and the back of the case, to which the case is attached by a screw. The core is surrounded by a fine wire helix, whose terminals are connected to binding posts.

729. Folding Packing Cases, *E. J. Billing, Cheltenham.*—15*th February*, 1882. 6*d.*

This relates to improvements on patent No. 1969, A.D. 1880, and consists, First, in making the hinges of sheet metal and fixing them outside the case, the middle part being cranked and the edges of the case notched to receive the crank; Secondly, in inside fasteners to secure the sides of the case, and formed by attaching a notched plate to one part, and a second plate to interlock therewith on the other part; Thirdly, in forming the ledge of the lid at each end only, and screwing a metal angle plate at each corner; and Fourthly, to machines for driving and clenching the hinges described.

740. Improvements in Electric Lamps, &c., *A. M. Clark, London.*—15*th February*, 1882.—(*A communication from Solignac and Co., Paris.*) 6*d.*

This invention relates to a means of regulating the arc by making the feed of the carbons dependent on the fusion or softening of a stick of glass attached to each of the carbons, and which when the heat of the arc has attained a certain altitude softens, bends out of the way, and allows the carbons to approach, they being urged forward by cords and pulleys. The inventor also claims the combination with his lamps of a dynamo machine having long narrow induced magnets, and in which the inducing or field magnets are placed in a shunt circuit.

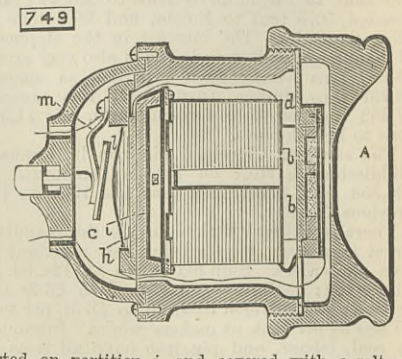
758. An Improved Telegraph Instrument, *F. J. Cheesbrough, Liverpool.*—16*th February*, 1882.—(*A communication from W. A. Shaw, Brooklyn, New York.*) 6*d.*

This invention consists of a telegraph instrument composed of stationary magnets, combined with a conductor having a vibrating section that is detached and swings freely in the main circuit and in the field of the magnet without breaking the circuit, and which is combined with a sounding device and operated by the action and re-action of a make-and-break current through the vibrating section in the field of the magnets.

749. Improvements in Telephonic Exchange Systems and Appliances, *G. L. Anders, London.*—16*th February*, 1882. 8*d.*

The inventor combines a telephonic transmitter of the Hunning's type, a receiver, and a battery in a portable case, capable of being held in the hand; the several apparatus being so arranged that the sound waves shall act both on the receiver and transmitter during transmission, whereby a louder articulation is obtained. The figure shows a longitudinal vertical section of a combined transmitter, receiver, and battery, lettered respectively A, B, and C. First comes the Hunning's transmitter, with the poles *b b* filled with powdered carbon, and a thin diaphragm between them and the mouth or ear piece. Behind the metal plate *d* is the receiver B, which may be an ordinary electro-magnetic one; and behind this comes the battery C, consisting of a carbon plate *h*, sup-

749



ported on partition *i*, and covered with a salt of mercury, and of a zinc plate *l* kept out of contact with the salt of mercury by a spring *m*. When required for use the push button shown makes the required contact. The inventor also claims improvements in telephonic exchanges.

756. Machines for Producing Electric Currents, *J. Brockie, Brixton.*—16*th February*, 1882. 6*d.*

The armature has two iron rings mounted on a non-

756 FIG. 1

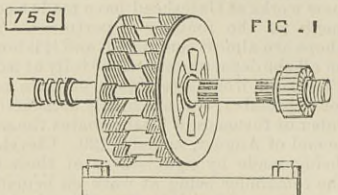
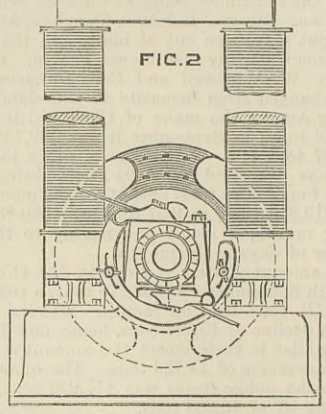


FIG. 2

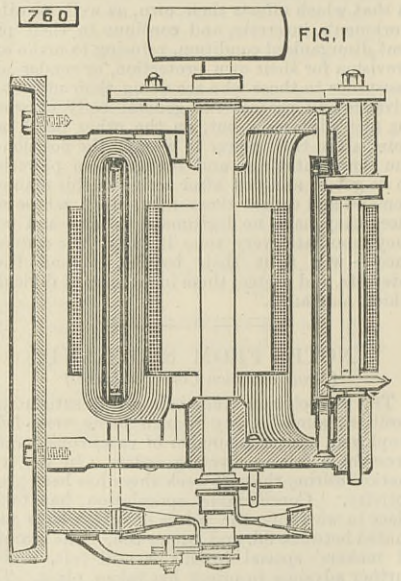


magnetic boss, and transverse compound iron bars fixed between the rings, upon which coils of insulated wire are wound. The figures show the construction.

760. Dynamo-electric or Electro-dynamo Machine. *C. W. Siemens, Westminsier.*—16*th February*, 1882.—(*A communication from E. W. Siemens, Berlin.*) 6*d.*

A magnet formed as a segment of a hollow iron cylinder revolves within a number of stationary coils

760 FIG. 1



which have their wires connected successively to one another and to an external circuit. Claim is also made for the arrangement of parts. Fig. 1 shows an end

760 FIG 2

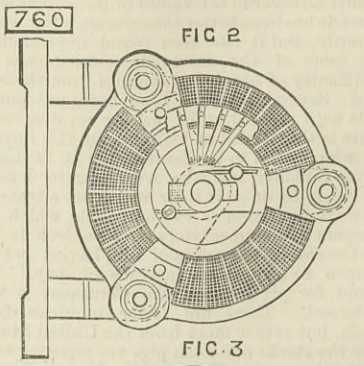
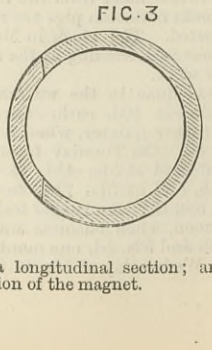


FIG. 3



view; Fig. 2 a longitudinal section; and Fig. 3 a transverse section of the magnet.

761. IMPROVEMENTS IN DYNAMO-ELECTRIC AND MAGNETO-ELECTRIC MACHINES, *C. J. Chubb, Clifton, Gloucestershire.*—16*th February*, 1882.—(*Not proceeded with.*) 2*d.*

This invention consists in causing the electro or permanent magnets to revolve in an opposite direction to the armature, and other improvements.

765. VESSELS, LANDING STAGES, FERRIES, &c., *W. May, London.*—16*th February*, 1882. 6*d.*

This relates, First, to steam vessels for conveying passengers and merchandise, and consists in shipping or unshipping the cargo from the sides of the vessel, a portion of the top of which is hinged or made to slide; Secondly, to fixing in the deck of the vessel turntables for facilitating charging and discharging; Thirdly, to a tidal landing stage running on rollers, and drawn up and let down by suitable machinery as the tide rises or falls, so as to bring it level with the deck of the vessel; and Fourthly, in connecting the tidal platform with the land by one or more travelling platforms actuated by suitable machinery.

779. PIANOFORTES, *E. Outram, Greetland, Yorkshire.*—17*th February*, 1882. 6*d.*

This consists, First, in stringing pianofortes, and more especially bichord and trichord instruments, by endless strings passing over antifriction pulleys adjustable in the rails; and Secondly, in raising or lowering the pitch or tone of the instrument by increasing or diminishing the distance between the rails.

807. DRYING WOOL AND OTHER FIBRE, *J. B., C. H., and W. Whiteley, Lockwood, near Huddersfield.*—20*th February*, 1882. 8*d.*

This relates to improvements on patent No. 2150, A.D. 1874, the object being to blow blasts of hot air into and through the fibres while passing through the machine, so as to dry the same in a shorter time, and it consists in the use of heaters from which the hot air is conveyed to the machine by means of a fan.

818. REAPING AND MOWING MACHINES, *W. P. Thompson, Liverpool.*—20*th February*, 1882.—(*A communication from W. F. Cochrane and J. L. Mothershead, Indianapolis, U.S.*) 8*d.*

This relates especially to reaping and mowing machines in which the shoe is coupled to the frame by a spherical joint, through a portion of which passes a rotating shaft geared to the axle, and within which the rotation of the shaft is converted into a reciprocating movement, and it consists, First, in a system of bevelled planetary gear obtained by placing on the rotating axle of the machine an extended sleeve, with arms radiating diagonally therefrom, so as to form a conical bifurcated spider, the arms of which support the spindles of the bevelled pinions, rotating each on its own axis, and about the axle in planes at an angle thereto. The spider can be coupled to the axle by a clutch. The pinions engage a stationary annular wheel fixed inside a stationary outer casing enclosing the shaft, and whose periphery is adapted to engage a pinion on the upper end of a crank shaft extending diagonally to the shoe for the purpose of driving the cutter bar; Secondly, in the combination with the shoe, connected by a spherical joint to the frame of an arm extending to a guide and linked to a tilting lever; Thirdly, in lifting the cutter bar by one of the driving wheels or by a treadle; and Fourthly, in making the finger bar, so that it can be withdrawn from the cutter bar endwise.

831. ELECTRIC LAMPS, *J. Rapieff, London.*—21*st February*, 1882. 6*d.*

This describes various ways of using weights to operate the carbons in arc lamps.

839. RATCHET BRACES, *S. Gardner, Adderbury.*—21*st February*, 1882. 6*d.*

This relates to a self-acting feed arrangement for ratchet braces, an essential feature being that a spring which is compressed by a nut or screw to any required pressure, according to the feed desired, causes frictional resistance between two surfaces, one of which is stationary while the other is in connection with the internally threaded sleeve or body which receives the screw of the drill shaft. This frictional resistance is at one time sufficient to prevent the rotation of the sleeve with the drill shaft, so that the screw will produce a feed, and then, when owing to this feed, the resistance between the screw and sleeve overcomes that tending to retain the latter, the sleeve will rotate with the screw until more feed is required. These actions take place alternately through the whole range which the ratchet is capable of working.

842. MEASURING THE VOLUME OF GAS UNDER DIFFERENT CONDITIONS, *A. G. V. Harcourt, Oxford.*—21*st February*, 1882. 6*d.*

The instrument consists of two glass tubes standing side by side, one of which is open at top but bent over to exclude dust, and the other terminates in a bulb at top, the capacity of which is about four and a-half times that of the tube. Both tubes extend into a hollow box at the bottom, and are connected by flexible tubes to a reservoir containing mercury and situated in the box. The reservoir has a loose top, and is intended to be contracted by the application of pressure so as to drive the column of mercury into the vertical tubes, such pressure being applied by a screw passing to the outside. The pressure is regulated until the mercury is at the same level in both tubes, when a reading is taken and represents the volume occupied at the actual atmospheric pressure and temperature by a mass of gas which, under standard conditions, occupies a volume 1000.

855. MOULDING MACHINES, *F. Wirth, Frankfort-on-the-Main.*—21*st February*, 1882.—(*A communication from J. G. Sebold and F. Neff, Karlsruhe, Germany.*) 1*s.* 2*d.*

A revolving frame arranged on a wagon carries a moulding-box with a moulding or pattern plate and a covering frame. After sprinkling the box with moulding sand, it is filled with casting sand from a sand-box having on the fore part two vertical hinged wings, which can be set according to the aperture of the moulding-box to be filled. The box when filled is scraped on the top, covered with a press-block, and driven under a press where pressure is exerted from above, suitable indicating mechanism being provided to show the amount of pressure exerted. The box is then removed from the press, the upper cover removed, and the superfluous sand raked off, after which the frame carrying it is revolved on the wagon, whilst the other half of the box on its wagon is being operated upon in the same manner.

867. CARRIAGES OF BOBBIN-NET OR TWIST-LACE MACHINERY, *H. B. Payne, Nottingham.*—22*nd February*, 1882. 6*d.*

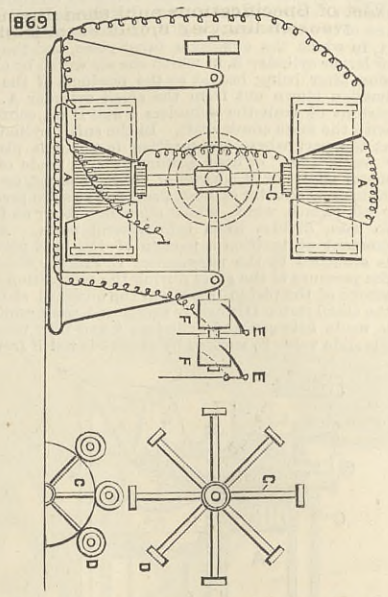
This relates to means for covering or guiding the threads over the bobbin at each particular point where the warp or other threads are likely to catch, and thus preventing the bobbins from cutting out the threads in their usual course of working; and it consists in having the part of the spring for keeping the bobbins in position, which is opposite the point where the threads are likely to catch, flattened out, so that it projects on each side of the surface of the carriage at such point. The same means are used to cover or protect the bobbin at the back part or other half of the carriage, the spring being then placed at the back or in any other suitable position. A double verge is used at the back part of the carriage for a certain distance, in combination with the projecting surfaces of the spring.

872. IMPROVEMENTS IN AND APPERTAINING TO ELECTRODES OR CONTACTS FOR TELEGRAPHIC INSTRUMENTS, &c., *F. des Vœux, London.*—23*rd February*, 1882.—(*A communication from G. Cumming and Clara M. Brinkerhoff, New York.*) 6*d.*

This relates to improvements in the contacts of telegraph keys, &c., and consists in making both contact points adjustable and in the shape of discs, the axes of which are either parallel or arranged at right angles to each other, the discs being provided with platinum metal rims or tires of round triangular cone-shaped or other cross section whereby a perfect electrical connection is ensured, and at the same time the smallest possible surface of contact is obtained.

869. DYNAMO-ELECTRIC MACHINES, *C. E. Spagnoletti, Maida Hill.*—22*nd February*, 1882. 6*d.*

The electro-magnet A is capped to collect the lines of force to a central point, between which revolves the



wheel C carrying coils D. The brushes E E collect from F F, and convey the current to the lamp or lamps.

881. WOOL COMBING MACHINES, *W. R. Lake, London.*—23*rd February*, 1882.—(*A communication from W. H. Grundy, Pennsylvania, U.S.*) 4*d.*

This relates to providing such machines with a guide so disposed in relation to the aprons that the two slivers are connected into one, and so directed to the delivery rollers.

891. PROJECTILES, *T. Nordenfelt, London.*—23*rd February*, 1882. 6*d.*

The object is to construct projectiles of iron for steel, coated with a softer metal for the following purposes, First, to prevent the hard projectile damaging the grooves of the rifling; Secondly, to enable a projectile nearer to the gauge of the calibre of the gun to be employed; Thirdly, to ensure better centreing of the projectile in the bore, and a consequently steadier flight through the air; and Fourthly, to give rotation to the projectile, if required, by means of the softer metal covering, by letting it enter the grooves of the rifling. The softer metal covering can be either applied or secured in position by electrical deposition.

892. DESICCATING OR DRYING SEWAGE, &c., *J. H. Johnson, London.*—24*rd February*, 1882.—(*A communication from E. Coignet, Paris.*) 6*d.*

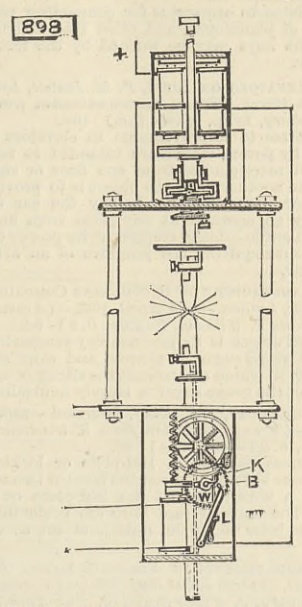
The object is to provide apparatus suitable for drying or desiccating by the employment of the heat of steam under pressure, whereby it is rendered possible to concentrate a great amount of heat in a given space; and it relates to the class of drying apparatus known as "Firman's," the improvements rendering the same suitable for treating very watery matter. The driving cylinder has double ends and sides, and a series of plates are carried by the shaft, so as to increase the heating surface. The cylinder is caused to revolve, and at each revolution, the hottest steam being at the upper side, heats the inner wall to its maximum degree, and the water of condensation upon this side is discharged at the same time by a special arrangement. The central shaft is caused to revolve in the opposite direction, and steam is admitted to both the cylinder and to the shaft.

897. STEAM COOKING APPARATUS, *J. Mitchell, Newcastle-upon-Tyne.*—24*th February*, 1882.—(*Not proceeded with.*) 2*d.*

Steam is generated in an outer case by coal or gas, and within it are fitted cooking pans arranged so that a water space is left between them and the case.

898. ELECTRIC ARC LAMPS, *J. Brockie, Brixton.*—24*th February*, 1882. 8*d.*

This is an improvement upon older forms of the Brockie lamp, and combines with a periodic feed a particular method of reversing the polarity of the readjusting magnet by means of the arrangement shown in the figure, the parts used being a wheel W,



an insulated boss B, a lifting pin, a contact lever L, and spring K. Other modifications are described, as with a definite feed to one carbon, while the other is regulated by a solenoid, &c.

900. GAS BURNER APPARATUS, *G. S. Grimston, Brockley.*—24*th February*, 1882. 6*d.*

This relates to a gas burner in which the flame is entirely enclosed, and all air passing to it to support combustion has to pass through a generator kept heated by the products of combustion as they pass away. The flame also may be directed downwards, and then allowed to curl upwards under the edge of a deflector, so that the flame may be at the bottom of the lamp, and consequently avoid any downward shadow.

906. MOTOR APPARATUS, *W. R. Lake, London.*—24*th February*, 1882.—(*A communication from M. Rosenstock, New York.*) 6*d.*

A series of balls act by gravity on a wheel fitted with pockets, which receive the balls at about the level of its centre shaft, and discharge them at the lowest point of their revolution, when the weights are raised again to the desired position by an elevator actuated by a spring motor, the spring of which can be automatically rewound by the machine itself.

911. BRICKS AND TILES, *J. Parker, Kilmarnock.*—25*th February*, 1882. 6*d.*

The object is to approximate the bricks more closely to uniformity of size, and consists in subjecting them before being fired, but when dry enough for such operation, to operations whereby excess of material is removed from the upper and under sides, and inequalities which show themselves in the drying process are corrected. The bricks are placed on a travelling endless band which conveys them between suitable dressing surfaces consisting of wire card or other suitable roughened surfaces.

914. WATER-CLOSETS, URINALS, &c., *S. S. Hellyer, Strand.*—25*th February*, 1882. 6*d.*

This relates to valve closets, urinals, and slop sinks, and has partly for its object to prevent matter rising up in the valve box of a valve closet and entering trap of the overflow. For this purpose the overflow trap is connected with the bent pipe of the valve box at a point above the level of the basin, such vent pipe being open to the atmosphere, or where a vent pipe is not used, the overflow trap is connected at a point above the valve with a horn in connection with the valve box. So as to screen the upper edge of the valve and prevent anything lodging thereon, the surface of the arm carrying the disc is raised at the part next the hinge, so as to bring it flush with the surface of the valve, while its forward edge fits closely up to the upper edge of the periphery of the valve. To ensure a thorough flushing of the overflow trap, and secure its water seal without depending solely on the water rising in the basin, the inlet or flushing arm of the basin is connected directly with the overflow arm by a passage in the basin itself.

918. VENTILATORS, *H. J. Haddan Kensington.*—25*th Februa y*, 1882.—(*A communication from P. Mihan, Massachusetts, U.S.*) 6*d.*

This consists in part of a hood with a mouth on one side of retangular or other suitable form, and having arranged within, and across it and the hood a partition. Two deflectors are employed, one hinged at top to the lower part of the partition, and the other hinged to the partition on a level with the top of the mouth. The ventilator is principally for use on shipboard.

926. OMNIBUSES, &c., *A. G. Margetson and W. S. Hek, Bristol.*—25*th February*, 1882. 8*d.*

The chief objects are to set the body lower than usual for convenience of getting in and out, combined with lighter draught for the horses by the front wheels at same time being higher than usual; fitting the springs so as to work more freely; an arrangement of gearing beneath to render the steering more easy and to make the vehicle answer more quickly in turning; and a considerable saving in weight and improved accommodation for passengers riding on top. The ends of the springs carry rollers on which the body of the vehicle rests. The axles are secured to the vehicle by a central pin and have rods or chains working across each other and connecting the front and hind axles. The top seats face the direction in which the vehicle travels and the passages to reach them are on either side thereof.

933. COMPASS CORRECTORS, *J. J. Wilson, Sunderland.*—25*th February*, 1882. 6*d.*

The dial or inner central movable dumb card is formed with an outer movable graduated ring, and both the card and ring work in an outer gimballed weighted ring with the words "ship's head" marked with an index line. By a central screw the card and the ring can be fixed in position relatively to the gimballed ring and to each other. The dumb card is marked to quarter points only; the points of the compass are placed on opposite sides in reverse position to ordinary cards, that is, E is where W is, and so on. The movable ring is graduated along the inner edge from north to 180 deg. both ways, and the outer edge from the line of the 180 deg. 30 deg. or 40 deg. right and left to indicate easterly and westerly variation. At 90 deg. on the easterly variation side P. M. is marked and on the opposite side A. M. In the centre is mounted a movable sight vane with a slit in the upright part and a fine wire stretched between it and the point of the vane. The sight has a black centre line on white ground in continuation of the slit and reaching to the point of the sight.

937. CORRUGATING MACHINES, *V. B. Daelen, Berlin.*—27*th February*, 1882. 6*d.*

This relates to a machine by which corrugations are formed in plates and tubes by rolling, or in plates by pressing or stamping, and it consists in making the rings of the rollers or the ledges of the stamping or pressing dies movable, and combining with them suitable devices to cause them to approach each other, while the rollers or dies are gradually brought closer together.

940. TAPS FOR BEER, &c., *J. E. Chambers, Smethwick.*—27*th February*, 1882. 6*d.*

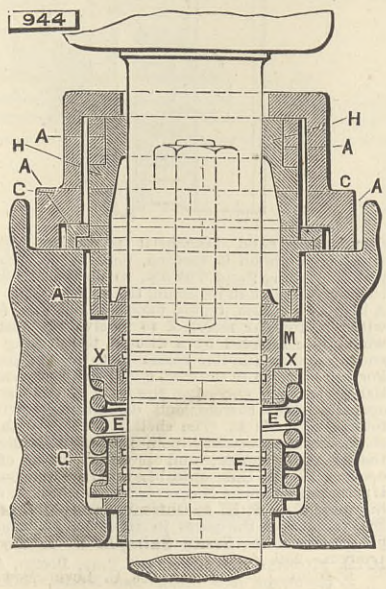
A socket with a female screw is secured inside the barrel and receives a screwed plug or valve perforated to allow the fluid to pass. The outer end of the plug has recesses to receive projections on the end of the stem of the tap, which is also screwed to fit the socket, so that as the tap is screwed in the plug is screwed out of the opposite end and so opens the fluid way.

942. HAIR CLASPS, *F. L. R. Kopp, Hamburg.*—27*th February*, 1882.—(*Complete.*) 4*d.*

This relates to forming hair clasps with a double bend so as to render them elastic and with straight or curved teeth.

944. PACKING RECEPTACLES AND GLANDS FOR PISTON ROD PACKINGS, *H. J. Haddan, Kensington.*—27*th February*, 1882.—(*A communication from O. Lonze, Paris.*) 4*d.*

The object is to render an automatic packing applicable to piston rods having both ends larger than the body of the rod which passes through the packing, and it consists in forming the packing receptacle H in two



halves, and holding it in place by the rings A, the cap C securing it in position. M is the follower, also in two pieces held together by ring X at one end, and by passing into the packing receptacle at the other. F is a bushing ring in two pieces held together by ring G, and E is a spring which automatically feeds the packing rings forward into the conical part of the packing receptacle, causing them to press on the rod and form a steam-tight joint.

948. LAMPS AND BURNERS, &c., *P. Molloy, Limerick.*—27*th February*, 1882. 6*d.*

The lamp can be used at any distance from the reservoir, from which the oil flows to the burner through a suitable tube as it is consumed. Air is admitted to the burner through inlets in the lamp, arranged to cause a current of air to pass round the burner between it and the oil. The burner has one segmental and one flat wick, each worked up and down by cog wheels.

949. FOLDING AND DELIVERING SHEETS OF PAPER, &c., *F. Wolff, Copenhagen.*—27*th February*, 1882.—(*A communication from J. G. A. Eickhoff, Copenhagen.*) 6*d.*

An upper and lower spindle are caused by suitable gearing to rotate together, the former carrying a knife blade-shaped folder, and the latter plates forming bearings for two rollers, which are geared with each other, and with a stationary wheel on the lower spindle, so that as the latter revolves the rollers revolve with it and also round their axes. The folder is placed so that it can pass between the rollers without touching them, and the sheet is delivered to the rollers, forced between them by the folder, and then passes through the rollers.

950. WINDOW AND OTHER FASTENINGS, *W. P. Bonwick, Shepherds'-bush.*—27*th February*, 1882. 6*d.*

A plate is fastened on the upper sash and carries a pin, on which is a tubular bar with a hole in its outer end, through which a pin is capable of a limited up-and-down movement, and which engages with a cam-shaped plate secured to the other sash. Within the tubular bar is a round piece of metal, so that if it is attempted to file through the bar, the file will come in contact with the round metal and cause it to revolve to and fro.

951. CLEARING WOOLLEN MATERIALS FROM VEGETABLE IMPURITIES, *C. D. Abel, London.*—27*th February*, 1882.—(*A communication from La Société Anonyme La Laine, Paris.*) 6*d.*

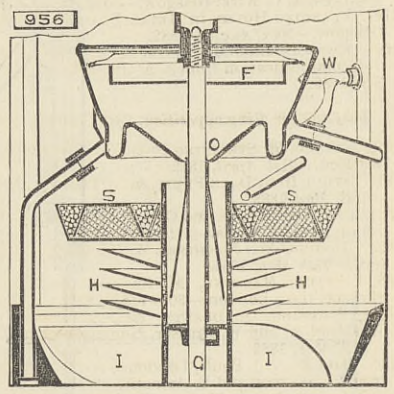
This relates to preventing excess of heat while treating materials with acids, so as to destroy any vegetable substances they may contain, and it consists in causing the heat generated to be absorbed in evaporation of the moisture present with the materials operated upon, which for this purpose are kept constantly agitated while acid gas is transmitted uniformly through them. The evaporation is also promoted by creating a partial vacuum.

954. PRODUCTION OF ICE, *C. D. Abel, London.*—27*th February*, 1882.—(*A communication from Osenbrück and Co., Germany.*) 6*d.*

This relates to means for agitating the water in the freezing cells so as to remove air bubbles, and according to one arrangement this is effected by injecting cold air into such cells, while a second arrangement consists in the use of vertically reciprocating agitators.

956. VENTILATING APPARATUS, *C. D. Abel, London.*—27*th February*, 1882.—(*A communication from E. Oehlmann, Berlin.*) 6*d.*

This relates to apparatus in which a turbine driven by a water jet carries on its shaft helical blades, by the rotation of which air is propelled in the axial direction of the apparatus, and it consists in enabling the same to be used as exhaust or forcing fans at will, and by providing the turbine F with two nozzles W



for the water jet, placed in opposite directions, and through either of which the water can be directed. A water-spray apparatus H is combined with the ventilating fan I on shaft G, for the purpose of moistening and purifying the air, the water passing from the turbine casing into the spray apparatus by funnel O. A disinfecting apparatus S may also be secured to shaft G, and consists of a perforated trough containing sponge, to which a disinfecting fluid is supplied and thrown out in a spray.

959. PAPER WRAPPERS FOR POST PURPOSES, *T. Singleton, Darwen.*—28*th February*, 1882.—(*Not proceeded with.*) 2*d.*

The wrappers are made of taper form, so as to effect an economy of material, and in them holes are formed, so that the stamp may be attached partly to the wrapper and partly to the enclosure, which is thus securely held.

961. MACHINERY FOR CAPSULING BOTTLES, *F. W. Boldt and P. C. Vogel, Hamburg.*—28*th February*, 1882. 6*d.*

This relates to machines in which the capsules are compressed by rubber jaws, and the objects are, First, to communicate a sliding motion in the direction from the mouth to the bottom of the bottle to the compressing jaws; and Secondly, to facilitate the driving of the different parts of the machine.

962. SUPPORTS FOR ROWLOCKS OF OUTRIGGER BOATS, *J. H. Clasper, Oxford.*—28*th February*, 1882.—(*Not proceeded with.*) 2*d.*

This relates to supporting the rowlock and the pin on which it swivels, and it consists in placing at the back of one or the other, and nearly midway between the upper and lower portion on which the rowlock swivels, a supporting web leading to the junction of the stays.

964. STEERING SHIPS, &c., *T. F. Walker, Birmingham.*—28*th February*, 1882.—(*A communication from J. C. Robinson, Acton.*) 6*d.*

This relates to improvements to steering apparatus in which the power employed for operating the rudder is that of steam or hydraulic apparatus instead of manual force, and it consists in providing means for causing the steersman to experience the "sensation" which in hand-steering gear is conveyed to him according to the position the rudder is brought to, and this is effected according to one arrangement by causing a cord, to which a weight is suspended, to overwind itself on a drum on the axle of the small steering wheel, and thus offer increased resistance to the operation of the latter.

967. STOVES FOR WARMING ROOMS, &c., *F. Wirth, Frankfort-on-the-Main.*—28*th February*, 1882.—(*A communication from E. Schöneberg, Frankfort-on-the-Main.*)—(*Not proceeded with.*) 2*d.*

The stove consists of a pedestal with a closely fitting door and a cinder box, a fire receptacle with a removable grating at its lower part, an outside casing with two doors at front and an outlet pipe, and a spiral plate arranged between the fire receptacle and the outer casing,

966. Spring Hinges and Stops, *J. T. B. Bennett, Aston-juxta-Birmingham.*—24*th February*, 1882. 4*d*.
This consists, First, in applying a spiral wire spring to the pivot of hinges, so as cause the flaps to close together; and Secondly, in the application to such springs of stops, screws, levers, or other suitable means to release the spring acting upon the hinge.

969. Extracting and Separating Metals from Silicious, Aluminous, and other Substances, &c., *J. P. Kagenbusch, Lambeth.*—28*th February*, 1882.—(*Not proceeded with.*) 2*d*.
The above substances are pulverised, and then roasted with charcoal and thrown whilst red hot into water. They are then dried, and when mixed with suitable fluxes containing soda ash or potash, placed in crucibles and heated to white heat. When the smelting is finished zinc and copper are added, and the mass stirred, the object being to cause a development of electricity, which facilitates a further and complete separation of the metals from the silica, alumina, and other earthy matters.

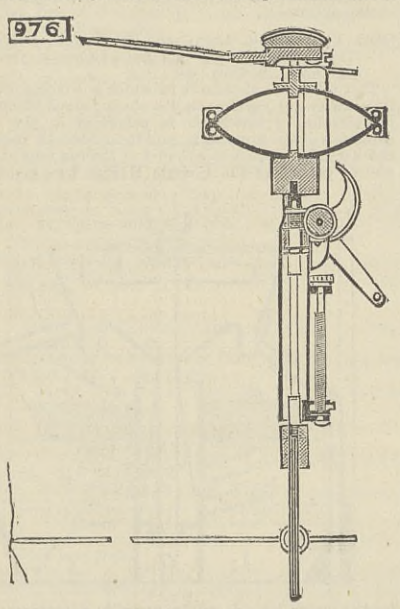
971. Ratchet Braces, *C. T. Colebrook, Islington.*—28*th February*, 1882. 6*d*.
This relates to ratchet braces in which the drill is automatically fed by a differential arrangement of gearing, and it consists in an improved arrangement of the parts of such braces.

972. Cutting Screw Threads on Tubes, &c., *J. Whitham, near Leeds.*—28*th February*, 1882.—(*Not proceeded with.*) 2*d*.
A boss or sleeve is fixed in the desired position on the tube, and at one end has a guide screw of the same pitch as the screw required. On the guide screw is a nut from which an arm extends, and is fitted with a hinged tool box free to slide thereon. The nut is turned by a lever fitted to the arm, and also regulates the depth of cut.

973. Compensating Apparatus for Railway Signal Wires, *F. W. and W. W. Brierley, Harrow-road.*—28*th February*, 1882. 8*d*.
A "floating" wheel has attached to it a chain connected on one side with the signal wire, and on the other with a weight, a locking device being employed, the action of which is governed by a curved and inclined slot, so as to lock the wheel and cause it when revolved to pull off the signal.

974. Fans, *C. Cockson, Wigan.*—28*th February*, 1882. 6*d*.
The inventor claims the manufacture and use of fans of similar character to that known as the Guibal, provided with close fitting casings and vanes diminishing in breadth as they approach the periphery.

976. Machines for Drilling Rocks, &c., *W. R. Lake, London.*—28*th February*, 1882.—(*A communication from A. Skedlock, New York.*) 8*d*.
This invention relates to that class of rock-drilling machines designed to be operated by hand power, and comprises certain improvements in the supporting legs, whereby the machine may be readily adjusted in working position; also improvements in the construction and arrangement of the striking hammer and its



actuating spring, whereby the hammer has a direct linear movement to and from the drill-holder, and the spring is easily removed to be substituted by a stronger or weaker one, as the quality of the rock operated upon may demand; also an improved device for actuating the drill to and from the bottom of the hole, and partly rotating it between each successive blow, so constructed as to obviate the necessity of using spring pawls or springs, and to make the said movements of the drill perfectly positive; also an improved feeding device for carrying the drill forward as fast as it performs its work. The drawing shows a vertical longitudinal central section of a drilling machine constructed according to the invention.

977. Staple for Use with a Hasp, *W. R. Lake. London.*—28*th February*, 1882.—(*A communication from G. Smith, Chicago.*) 6*d*.
The invention consists essentially in a staple having one long and one short leg, the long leg being screw-threaded and the short one provided with a foot to rest on the surface of the part to which the staple is applied, the said foot being provided with an aperture to receive a screw.

978. Manufacture of Gas, *W. R. Lake, London.*—28*th February*, 1882.—(*A communication from T. B. Fogarty, New York.*) 8*d*.
The invention relates to the manufacture of heating and illuminating gas through the decomposition of steam by incandescent carbon, and to apparatus used in such manufacture.

980. Moulding Bricks, &c., *T. Le Poidevin, Guernsey.*—28*th February*, 1882. 6*d*.
The invention consists essentially in the combination with a pug mill of a series of moulds supported on travelling platforms or trucks running on a railway beneath the pug mill and receiving the clay direct therefrom, the train and carriages and moulds being made to travel along as fast as the moulds are filled by gear from the pug mill itself or otherwise.

981. Treating Dynamite to Remove its Liability to Explosion, &c., *W. Howitt, Ilford.*—28*th February*, 1882. 4*d*.
Ten parts india-rubber are dissolved in a suitable solvent, and ninety parts dynamite are then mixed with it in an earthenware vessel, the mass being constantly agitated. The plastic mass is then filled into a case of india-rubber, and a fuse inserted.

982. Protecting Seats from Damp, Dust, &c., *C. P. Sharpley, Brixton-road.*—(*Complete.*) 2*d*.
This consists in covering seats with sheets of metal or other rigid material, which are capable of being turned out of the way when not required.

988. Application of Grinding Mills, &c., to Engines, *B. Asplen, London.*—1*st March*, 1882.—(*Not proceeded with.*) 2*d*.
The object is the application of grinding, crushing, or mortar mills to portable, semi-portable, or stationary engines of the ordinary locomotive type by placing the pan on the under side of the boiler and mounting the rollers on an axis arranged preferably transversely to the boiler.

989. Locking Device for Vessels Containing Milk, &c., *C. Bolle, Berlin.*—1*st March*, 1882. 6*d*.
A handle or bridge piece is, by means of a bolt or equivalent, jointed to a hinge piece on the upper part of the can or other vessel. The bridge piece is rigidly attached to the cone-shaped lid of the can by soldering or otherwise, so that when the bridge piece is rotated around the aforesaid bolt the lid will turn together therewith, and thus the can may be opened or closed.

991. Suspending the Windows or Sashes of Railway Carriages, &c., *G. Haycraft, Lyme Regis.*—1*st March*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to racks fixed in the grooves of the door frame in which the window slides, one at either side, having inclined teeth, preferably rounded at the points, in combination with steel springs affixed to the edges of the window sash, said springs having curved or rounded ends, which project from the sash and bear against the racks.

993. Pocket Hanger for Hats and Coats, *A. M. Clark, London.*—1*st March*, 1882.—(*A communication from T. McDonald, Austin, U.S.*) 4*d*.
The hat or coat-holder consists of two parellel plates, connected at each end by a rivet, and two hooks pivotted on said rivets and turned in opposite directions.

997. Manufacture of Horseshoe Nails, *I. Briggs, Middlesbrough, Mass., U.S., and J. W. Booth, Birmingham.*—1*st March*, 1882. 8*d*.
This relates to improvements in the cutting and shaping tools of machines for the manufacture of horseshoe nails, and in the appliances connected with the cutting and shaping tools.

998. Ring Spinning and Doubling Frames, *S. Brooks, Manchester, and A. Holden, Gorton.*—2*nd March*, 1882. 6*d*.
This consists partly in arrangements by which mechanism connected with the copping motion will, when the set is full, release a catch and allow a weight or spring to traverse the driving belt from the fast to the loose pulley, and will act upon and put in gear mechanism for lifting the ratchet pawl of the copping motion, and winding it back ready for a fresh set.

999. Fastening Scaffold Poles, &c., *G. Wilson, New Cross.*—2*nd March*, 1882.—(*Not proceeded with.*) 2*d*.
The instrument consists of three main parts, viz., two parts hinged or connected together by a slotted or yielding point, the one part being of a shape to fit firmly against the pole or other article, and the other being preferably rounded at its outer side. The third part is a wedge, which is to be driven between the two other parts.

1000. Process for Rapidly Etching and Matting Patterns, Letters, &c., on Glass, *E. C. Hancock, Worcester.*—2*nd March*, 1882.—(*A communication from Dr. W. Grüne, Berlin.*) 4*d*.
The inventor claims in vitreous etching the direct result of a "matted" pattern by the corrosion of fluoric acid.

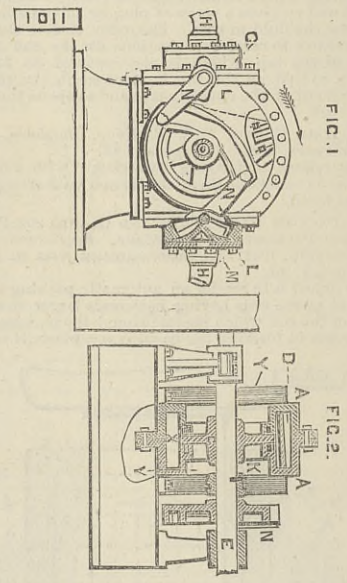
1001. Saddle for Velocipedes, *S. Fry, Hampstead.*—2*nd March*, 1882.—(*Not proceeded with.*) 2*d*.
The saddle is a double one, composed of two complete saddles attached together, and the front seat is the smaller.

1003. Fish Joints for Rails, *A. Davy, Sheffield.*—2*nd March*, 1882. 6*d*.
This consists in constructing fish joints for rails with the fish plates extended some distance below the rail, where they are made to bear against each other as a fulcrum, while they are caused by a bolt or bolts passing through them immediately below the bottom head or flange of the rails, to grip the latter above and below such bottom head or flange and beneath the upper head or on the upper part of the web.

1009. Construction of Ships, *H. H. Lake, London.*—2*nd March*, 1882.—(*A communication from A. P. Bliven, New York.*) 6*d*.
This consists of a vessel constructed with the sides and the main deck forming the three sides of a triangle.

1010. Railways, *G. M. Minchin and L. H. Despeissis, Staines.*—2*nd March*, 1882.—(*Not proceeded with.*) 2*d*.
This relates to a means of securing a direct communication by electricity between two or more trains on a line of railway where there is danger of collision between them, owing to their distance apart being within limits arbitrarily fixed.

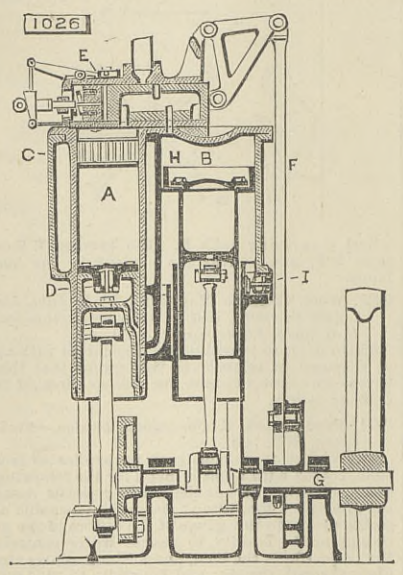
1011. Rotary Engines, *A. M. Clark, London.*—2*nd March*, 1882.—(*A communication from the Elastic Wheel and Manufacturing Company, Virginia, U.S.*) 6*d*.
This relates, First, to the construction of segmental exhaust valves and their combination with a cam, whereby their proper action is ensured when the engine is running rapidly under low pressure; Secondly, to the combination of the piston with a



disc having solid tangential projections between which the piston is secured, and to an improved piston packing; and Thirdly, to means for shifting the reverse valve in reversing the engine. The casing A is in two pieces, bolted together, and each formed with an annular recess X to receive the piston D, which is connected by a disc to the driving shaft, and a smaller annular recess Y to receive packing. Ports are formed in the disc, and issue through tangential projections enclosing the ends of the piston on opposite sides thereof, and communicate with the interior of shaft E. The shell is formed with valve chambers G at opposite points communicating with the steam chamber, and provided with exhaust opening H. In each chamber is an oscillating valve L actuated by levers N operated by a cam. A reversing valve K is fitted on shaft E, and connected with the valve over the ports in ths disc, and also with plug valves M in the valve chambers.

1012. Machine for Labelling Tins, Boxes, &c., *G. J. Hutchings, New Cross.*—2*nd March*, 1882.—(*Not proceeded with.*) 2*d*.
The machine consists in the combination with an inclined bed of apparatus for performing in succession during the rolling of the tin down this incline the several operations of gumming the circumference of the tin or box, applying the label to the gummed surface, gumming down the overlapping edge of the label, and smoothing the label so applied around the tin or box.

1026. Gas Engines, *J. Niel, Millwall.*—3*rd March*, 1882. 6*d*.
The invention consists, according to one arrangement, as shown in the drawing, in the application and use of two cylinders A and B, one the smaller cylinder A, in which the explosion takes place, and the other or larger cylinder B, in which the air works by expansion after being heated by the products of the combustion blown out from the small cylinder A. The pistons of both the cylinders A and B are connected with the same crank shaft. In the small cylinder A, at the part where the ignition is made, is placed a "regenerator," or heat accumulator, C, made of thin metal sheets or of a series of tubes or wires, or other suitable conductor of heat, arranged so as to present a great surface, which, whilst allowing the air and gases to pass, divides them into several parts. At the moment of ignition a portion of the heat produced is absorbed by the regenerator C, thereby steadying the pressure of the gases during the completion of the stroke of the piston D. When the outward stroke of the small piston D is nearly completed, communication is made between the cylinders A and B by means of the slide valve E, worked by excentric rod F from the



crank shaft G of the engine, the piston H of the large cylinder B at that same moment commencing its outward stroke. Previous to this, however, the large piston H during its inward stroke has drawn in air on its outward side through the air or shifting valve I placed at the outer end of the large cylinder B, and which may be as shown or a slide or other suitable form of valve. The air thus drawn into the cylinder B is forced by the large piston H during its outer stroke through the piston D of the small cylinder A into the latter at its inner or ignition end.

1028. Indicating and Registering Apparatus for Pumping Engines, *H. Davey, near Leeds.*—3*rd March*, 1882. 6*d*.
This relates to apparatus whereby the lengths of strokes of a pumping engine are indicated, the quantity of water pumped by it in a given time is registered, and the level of water in the well is shown.

1031. Vacuum Pumps for Exhausting Bulbs of Electric Lamps, &c., *F. Wright and M. W. W. Mackie, London.*—3*rd March*, 1882. 6*d*.
This relates to vacuum pumps for exhausting the bulbs of electric lamps or other vessels in which great rarefaction of air is required, the object being to provide in simple and compact form for utilising the barometric column of mercury as a seal for the outlet of the discharged air.

1032. Apparatus for Aiding Persons in Swimming, *C. D. Abel, London.*—3*rd March*, 1882.—(*A communication from J. A. Andrée, Esens, Germany.*) 6*d*.
This relates to apparatus whereby the body of the swimmer is sustained above water, while at the same time means are provided for effecting his propulsion in addition to that afforded by the usual swimming motion of his limbs.

1100. Pianofortes, &c., *J. Ainsworth, Brinscall.*—7*th March*, 1882. 4*d*.
This relates to apparatus for connecting pedals to the keys of pianofortes and other like instruments, so that the keys may be worked by the feet of the performer.

1300. Elevators or Lifts, *P. M. Justice, London.*—14*th March*, 1882.—(*A communication from G. C. Tewksbury, Lynn, Mass., U.S.*) 10*d*.
This relates to improvements in elevators or lifts operated by power, which are intended to transport goods and merchandise from one floor or story of a building to another; and the object is to provide such an elevator with devices whereby the car may be started by an operator at any point from any other point, and automatically stopped at its proper destination without requiring the presence of an attendant on such car.

1879. Manufacture of Saccharine Compounds, *W. R. Lake, London.*—19*th April*, 1882.—(*A communication from E. Wilhelm, Buffalo, U.S.*) 6*d*.
The chief object is to produce dry saccharine compounds of grape sugar or glucose and cane sugar or beet sugar, in which compounds the sticky or adhesive property of the grape sugar is largely neutralised.

1970. Nut Locks, *J. T. King, Liverpool.*—26*th April*, 1882.—(*A communication from S. Gissinger, Pittsburgh, U.S.*)—(*Complete.*) 4*d*.
The devices used are a leaf-plate or locking dog, which passes or falls between the faces of two adjacent nuts, and a wire to which the leaf-plate or dog is hinged. The ends of said wire are preferably bent around the bolts under the nuts, and act as washers thereto.

2563. Improvements in Electric Lamps, &c., *W. R. Lake, London.*—31*st May*, 1882.—(*A communication from J. J. Wood, Brooklyn, New York.*) 6*d*.
This relates to an arc lamp with an improved means of cutting it out of circuit when faulty, the cut-off being actuated by a shunt magnet in the magnet regulating the carbon feed, and combined with it, instead of separate as heretofore. The safety switch or cut-off consists of a spring acting constantly to close the switch, a trigger latch acting to hold the switch open, and an electro-magnet circuited in such relation with the arc that an abnormal length of arc will cause the armature of the magnet to trip the trigger-latch, release the switch, and allow it to be closed by the spring, and thereby permanently throw the lamp out of circuit. With this switch is also provided a hand switch for throwing the lamp out of circuit at will. The feed of the carbons is regulated by an electro-magnet in a shunt circuit, and the arc is formed by an electro-magnet in the main circuit, the upper carbon being attached to a rack gearing into a train of wheels connected with an armature common to both magnets.

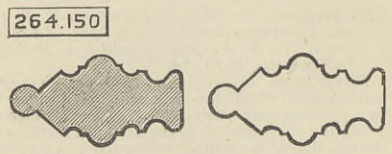
2570. Improvements in Electric Lamps, &c., *W. R. Lake, London.*—31*st May*, 1882.—(*A communication from J. J. Wood, Brooklyn, New York.*) 6*d*.
This relates to duplex or double carbon arc lamps, and the object is to provide apparatus so that only one carbon shall be in action at one time, and the strain of one only borne by the regulating mechanism, &c. In the inventor's lamp both carbon holders are constantly engaged with the regulating mechanism, but one is in "idle" engagement and the other in active engagement, the weight of the one which holds the second carbon being supported by a latch, while the weight of the active carbon is borne by the regulating mechanism. When the latter is consumed, its terminal movement will trip the latch and allow the second carbon holder to fall into active engagement. The carbon holders are connected with the regulating mechanism by means of a spindle, to which each is engaged by clutches which bite in one direction and slip in another. The inventor claims the above and other improvements.

2594. Ammunition Boxes or Cases for Machine Guns, &c,, *W. R. Lake, London.*—1*st June*, 1882.—(*A communication from E. G. Parkhust, Hartford, U.S.*)—(*Complete.*) 4*d*.
The box is formed of pasteboard, the inner part to receive the cartridges being of ordinary construction, and fitted with an outer case formed of a strip of cardboard bent to the required form and placed over the inner part and secured in position by a strip of paper pasted over its edges.

SELECTED AMERICAN PATENTS.

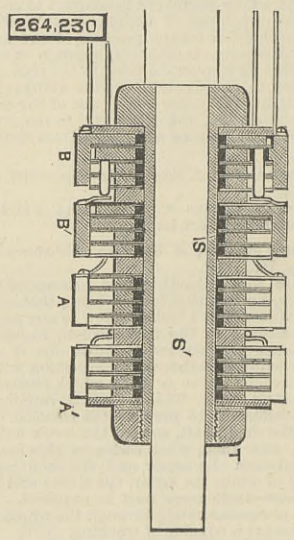
From the United States' Patent Office Official Gazette.

264,150. Process of Spinning Sheet Metal, *Henry Grom, Newark, N.J.*—*Filed August 3rd*, 1882.
Brief.—Gets a pattern by turning it out of wood or metal, or by taking any article that has been spun in two or more pieces. From this pattern a soft metal



form is cast. Spins the metal over this forms in the usual way. Then heats in an oven or a metal bath to melt out the soft metal form.

264,230. Commutator for Dynamo-electric Machines, *George W. Beardslee, Brooklyn, N.Y.*—*Filed May 29th*, 1882.
Claim.—(1) The combination of a commutator wheel A^1, having insulated metallic segments, with a commutator wheel, A, having segments secured to or



forming parts of discs, provided with pins E, adapted to form electrical contacts with the segments of the wheel A^1. (2) The combination of a commutator wheel A^1, having insulated segments and spring fingers E^1, with a commutator wheel, A, having segments secured to or forming parts of discs, provided with pins E, to come into contact with the fingers E^1.

CONTENTS.

The Engineer, October 6th, 1882.