THE HORSE-POWER OF TURBINES.

By PROFESSOR R. H. SMITH.

No. I.

IN this short series of articles I propose to treat turbines in connection with the resistances to flow along the head-race. The head-race is an essential part of the whole machine, and the horse-power, or any other attribute of the machine, cannot really be correctly gauged by considering one part only of the machine detached from the rest of it. When there is a free air gap between the wheel and the tail-race, the tail-race has no influence on the working of the machine, and this case alone is directly dealt with here. The tail-race, or the first part of it, becomes an influential member of the machine when it is enclosed in such a way as to produce a partial vacuum under the wheel. Any one who rightly comprehends what is written here for the former case, will find no difficulty in applying the same method to the solution of this latter case. I also wish to bring into full prominence the fact that the flow of water through a turbine is a broken and unsteady stream. All, or nearly all, the hydrodynamics that one finds in text-books, or even in memoirs read before scientific and technical societies, refer only to the motion of steady streams—that is, streams whose walls or sides do not shift in position. So long as the turbine is working at a uniform rate and passing the same quantity of water per second, the flow along the head-race constitutes a steady stream, as does also that along the tail-race. But these two steady streams are connected by a short stream whose walls are continually shifting in position, not only with high velocity, but also with velocities that are different for different parts of the walls. The whole stream is broken by the interposition in its middle of an unsteady portion.

This unsteady part is, of course, the most important portion of the whole, so far as the working of the turbine is concerned. The fundamental law or equation for steady streams, from which nearly all we find in our text books is deduced, is not at all applicable to unsteady streams. Hence, I presume, has arisen all the confusion and frequent error that undoubtedly has appeared in dissertations upon turbines and water-wheels. It has never been attempted, of course, to solve the problem by the simple application of the fundamental law for steady streams. Such an attempt would be too obviously absurd; but the hydrodynamics of unsteady streams never having been plainly and directly taught, recourse has been had to somewhat shaky theories of impact of fluids on vanes. The fact has always been easily recognised that the water in flowing through the buckets partakes of two velocities; the one relatively to the bucket itself gliding over and parallel to the walls of the bucket, and the other in company with or along with the bucket over the earth's surface. The first of these components is ordinarily styled the "relative" velocity; the resultant of the two, or the whole velocity over the earth's surface, is called the "absolute" velocity. Both these velocities are really relative; as, indeed, all imaginable velocities are. The first component is that of the water relative to the bucket; the second component is that of the bucket relative to the earth; the resultant velocity is that of the water relative to the earth. I will therefore discard the usual inaccurate and misleading terms "relative" and "absolute," and use instead of them the simpler and more expressive phrases "over" or "through the turbine" and "over the earth." It is sometimes convenient also to speak of the former as being a velocity "in" or "through the field of the turbine," and of the latter as being "through the field of the earth."

The existence of these two components has, of course, never been overlooked. Various methods of dealing with them have been followed. But I suspect it has been too commonly lost sight of that the existence of both destroys at once the character of the stream as a "steady" one, so far at any rate as the motion over the earth is concerned, and makes the ordinary hydro-dynamics of steady streams to a large extent inapplicable. If we consider only the velocity through the field of the turbine, the flow considered relatively to this field alone may constitute a steady stream; and, in fact, does do so so long as the turbine runs and works at a uniform rate. But the flow through the field of the earth constitutes an unsteady stream with continuously shifting walls.

In this first paper I endeavour to produce clear ideas as to this double aspect under which the flow may—and indeed must—be viewed. In the second and third I work out the action of the machine constituted by a head-race and a turbine taken together. This leads to a final set of two or three equations from which may be calculated the horse-power obtainable from a given turbine under given conditions. The same equations give the data for the design of a turbine to give a desired power with the available hydraulic quantities.

The subject is a complicated one and requires careful thought to master it thoroughly. But I have made very considerable endeavours to put it as simply and clearly as is possible. This aim is not always reached by the use of the fewest possible words, but I have tried to avoid prolixity, and I have been able to dispense with any intricate and difficult mathematical symbolism.

The first thing to consider is the required or the available flow or supply of water. Frequently in the case of large turbines all the water that can be obtained from the source is sent through the wheel, except in flood time. The problem is then to find how much supply can be got, and how much power extracted from it. The use of small turbines drawing their water from town water mains, or some other practically inexhaustible store, is becoming much more common now-a-days, and in this case the problem is to calculate the amount of water that must be taken from the mains in order to develope the power desired.

In what follows the volumetric flow in cubic feet will be called V, and the flow in either pounds or gallons by the letter Q. The flow in pounds is ten times that in gallons, and from sixty-two to sixty-four times that in cubic feet according to the briny, muddy, or pure state of the water. The flow is most commonly reckoned in gallons per hour, but it may also be reckoned per minute or per second.

The flow obtained along any given passage or channel is the product of the cross section of the stream and the linear velocity; and this velocity depends on the fall and on the frictional, viscous, and eddy resistances to the flow, and also upon the resistance interposed by any machine set in the channel or passage and driven by the water. Let the linear velocity be called v, and the area of the cross section perpendicular to v be called S; then the volumetric flow is

$$V = v S.$$

V being in cubic feet, v and S must also be reckoned in feet. The velocity is not usually uniform over the whole section, and v must therefore be considered the *average* velocity over the section S. It must be noted carefully that S here means the *water* section, not necessarily the section of the passage which may be much larger than S.

So long as the channel is open at top the flow may be measured experimentally by measuring S and v separately. The average v can only be obtained by taking the mean of a considerable number of measurements of the velocity at different points of the cross section, which points must be evenly and symmetrically distributed over the section. The velocity often varies very irregularly over the section. The writer considers it desirable, therefore, to measure velocity at as large a number of points as practicable, and to use an instrument of very small size, of the least possible weight and frictional resistance, and such as to disturb the normal flow to the least possible extent. Velocity meters that pretend to give average results by exposing a large surface to the flow of water are untrustworthy, because the "average action"—of whatever kind—driving the instrument may not be at all in constant proportion to the average velocity.

In a closed passage, such as a pipe or turbine bucket, S can never be greater than the section of the passage; but it is often less. In calculating the flow it must be carefully examined whether the conditions are such as allow the pipe or bucket to "run full bore." The conditions will be explained presently.

Suppose the sides of the stream to be parallel. Take any oblique section, the area of which call S^1, and find the component of the velocity v which is perpendicular to the section S^1, and call this component of the velocity v^1. Evidently v^1 is less than v in the same ratio that S^1 is greater than S. Therefore we have

$$V = v S = v^1 S^1 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This possibility of calculating the flow of water from any section and the component of velocity perpendicular to that section, is particularly useful in considering turbines, because it is necessary always to consider the velocity of the water under at least two aspects, namely, its velocity over (or relatively to) the earth and its velocity through (or relatively to) the turbine blades. There is also one section which is particularly simple to measure, namely, the inlet area of the wheel, which is completely independent of the form and inclination of the blades, and which does not change with alteration of the speed of the wheel. In the case of an inward or outward flow turbine, if r_i be the radius of the inlet surface, and d_i its axial depth; the whole cylindric inlet surface being $2 \pi r_i d_i$, if m_i is the fraction of this surface through which the water flows, then the "inlet water section" is $m_i 2 \pi r_i d_i$. If v_r be the radial component of the water velocity, the flow is

$$V = m_i 2 \pi r_i d_i v_r \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Here v_r is the same, whether the component be calculated from the velocity over the earth or from the velocity through the turbine blades, these two differing only by a tangential component which does not affect the radial component. An exactly similar expression with the suffix e substituted for i will be used to represent the volumetric flow at *exit* from the turbine.

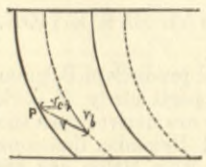
In a parallel or axial flow turbine the similar equation is

$$V = m \pi (r_2^2 - r_1^2) v_a \quad . \quad . \quad . \quad . \quad (3)$$

where r_2 and r_1 are the outer and inner radii of the wheel and v_a is the axial component of velocity, which component again is the same whether it be calculated from the velocity over the earth or from that through the turbine.

The flow through a section fixed in and moving along with the turbine passage is the product of this section by the velocity through the turbine passage, *i.e.*, relative to the turbine blades. This is not, however, the same as the flow through a section of the same area and occupying at any instant the same position, but fixed relatively to the earth. The equation may, of course, be used conversely to measure the relative velocity through the buckets, this being obtained by dividing the volumetric flow, supposed known, by the water section in the buckets. This latter section, however, is known directly only when the conditions are such that the passages run "full bore." In the above two equations, (2) and (3), there is the maximum simplicity, because the velocity of the turbine is parallel to the section taken and its component perpendicular to the section is, of course, reduced to zero; so that there is nothing to add to the perpendicular component of the velocity of the water along—*i.e.*, relative to—the turbine blades.

These elementary notions depending on the difference between the two aspects in which the flow of the water may be viewed—the one motion being over the earth and the other over the turbine blades—are of the greatest importance. No one who does not get a firm mental grip of them can hope to thoroughly understand the action of turbines, or, indeed, of any rapidly running hydraulic or pneumatic machinery. In connection with them, one other question arises, which, unless it be clearly comprehended and truly answered, is sure to lead to mental confusion and baffle any attempt at accurate thought on the subject. As above said, the volumetric flow is found by multiplying the section by the velocity. The flow through a section fixed to and moving along with the wheel is found by multiplying the section of the passage through the wheel—if it run "full bore"—by the relative velocity through the wheel. To find the flow through a section fixed relatively to the earth, it is comparatively easy to calculate the velocity relative to the earth, and it may be naturally asked whether we cannot multiply this by the section of the stream in its path over, or relative to, the earth; and if so, what is this latter section, and how can it be calculated? The true answer to this very plausible, and, therefore, dangerously misleading question, is that the flow cannot be so calculated, and that there is no such section. A stream can only have a definite section of flow when it is "steady," by which word is meant that the successive following particles continue constantly to build up a string or streamlet of water which has always the same position. If the position of the stream shift, the stream is not a steady one. Thus, in a steady stream the sides or walls of the stream, and also the sides of the streamlets into which the whole stream may be conceived to be divided, are parallel to the direction of the flow along them. These walls having a constant position, there is no difficulty in finding the flow through a section of the stream bounded by these walls. Except in so far as minute eddies complicate the flow, this is the case in the stream through the turbine considered relatively to the moving wheel. In this relative motion the velocity of flow is parallel to the walls of the passage, and we have a definite area of section to measure for the flow. But considering the motion over the earth of the water lying at any instant in one of the passages of the moving wheel, we see that the walls of this stream are moving, are continually shifting position in the field of the earth. If we draw stream lines through the water-filled space parallel to the direction of flow over the earth, we find these stream lines run right out of the stream on both its sides. This is indicated on the accompanying sketch.



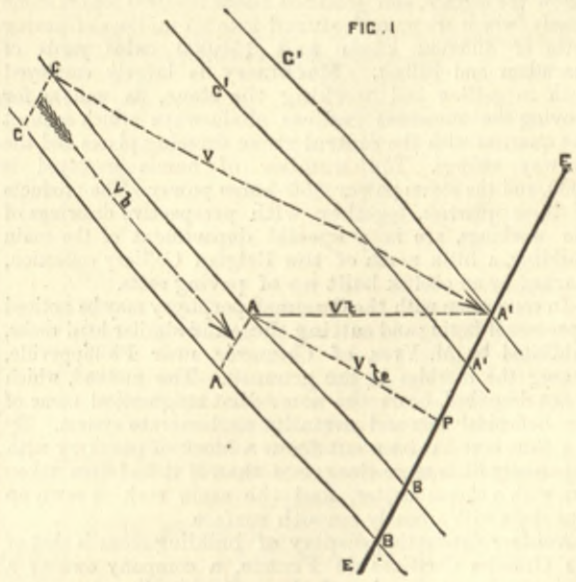
v_t = velocity of bucket over earth.
v_b = velocity of water over bucket.
v = velocity of water over earth.

The streamlines at point P in the flow through the field of the earth are parallel to the resultant velocity v.

Through this unsteady or shifting stream it is impossible to imagine any section through which we can calculate the rate of flow of water. A section, of course, can be drawn perpendicular to the velocity of the water over the earth and its area measured; but, although at one instant water may be flowing through the whole of this section, yet at the immediately succeeding instant part of the section round one side of its edge is outside the stream and has no water flowing through it; and at the immediately preceding instant another part round the opposite edge is outside the boundary of the stream. It is only an instantaneous section of the stream; it does not remain a stream section throughout any, even the minutest, period of time. We therefore cannot speak of the flow through this section, because flow is evidently a continuous quantity, continuous for at least a short period of time.

It is easy to calculate the volume of the stream water that passes per second through any plane fixed on the earth and of *indefinite* extent, *i.e.*, not bounded by the stream walls. This may be done by summing two flows, one calculated from the water velocity along the passage, and the other from the velocity of the walls of the passage over the earth. Let the first velocity be called v_b where the suffix b is intended to remind us that this velocity is that of the water over the blades. The other velocity we will call v_t, because it is the velocity of the turbine over the earth, or of the water along with the turbine over the earth.

FIG. 1



Referring to the accompanying sketch, let E E be the indefinite plane fixed relatively to the earth; and at any instant let B B be its instantaneous section of the stream. The position of the stream at this instant is taken in the sketch as C A B C A B. One second after this instant suppose the stream to have taken up the position C^1 A^1 C^1 A^1, the walls having a velocity in the direction of A A^1. The interval taken being one second, A A^1 will represent the velocity of the walls per second, or v_t. Thus the section A A of the passage has moved to A^1 A^1, and if there were no motion of the water along the passage, the volume of water that had passed through the plane E E would be measured by the area of the parallelogram A B A B. This area equals B B—the instantaneous section by plane E E—multiplied by A P let fall from A perpendicularly on E E; that is, A P equals the component of v_t perpendicular to E E. Call this resolved perpendicular component velocity of the turbine by the symbol v_{te}, and call the section B B by S_e; then this volume of water equals $v_{te} S_e$. Let now C A represent the velocity v_b of the water over the blades.

Evidently the particles of water that lay at the beginning of the second at C C move to $A^1 A^1$ at the end of it; so that besides the above volume, there passes through plane E E the volume C A C A due to the flow through the passage. If S_b be the section of the passage perpendicular to the blade, this latter volume is $v_b S_b$. Thus the whole volumetric flow through the earth-fixed indefinite plane E E is

$$V = v_{te} S_e + v_b S_b$$
$$= (v_{te} + v_{be}) S_e,$$

where v_{be} represents the component of v_b which is perpendicular to the plane E E.

If the plane E E be taken perpendicular to v_t the velocity of the turbine, the instantaneous section by E E may be called S_t, and then also $v_{te} = v_t$. We have in this case— $V = v_t S_t + v_b S_b$.

On reference to the sketch we see that C A^1 is the velocity of the water over the earth. Call this v, and call its component perpendicular to E E by the letter v_e. Evidently $v_e = v_{te} + v_{be}$ and the above equation may, therefore, be written— $V = v_e S_e$ . . . . . (4)

It should be observed that this volumetric flow is different for different directions of the section plane. This is the equation for an unsteady stream similar to equation (1) for a steady stream, but the V of (1) is the same in whatever direction the section be taken. Here in (4) V is the volumetric flow through a plane of indefinite extent, not through any definitely bounded portion of the plane; and S_e is the instantaneous section of the stream by that plane. This plane may be taken perpendicular to v, the velocity over the earth; then $v_e = v$ simply, and the flow through the indefinite plane equals the velocity over the earth multiplied by the instantaneous cross section of the stream perpendicular to that velocity.

THE ANTWERP INTERNATIONAL EXHIBITION.

No. III.

Among the more important mineral products of Belgium are its marbles, which are more particularly of dark coloured and variegated kinds. These are derived from the great mass of the carboniferous and Devonian limestone formations in the higher valley of the Meuse and its tributaries, flanking the older rocks of the Ardennes, and are well represented at Antwerp both in finished works and quarry blocks. The most important example of the latter is a block of black marble quarried by Velge and Cornet, of Ecaussines, about 40ft. by 5ft. by 2ft., placed in the grounds, near to which is a finished bench in one piece, 42ft. long, with the sides carved and the seat completely polished by P. J. Wincqz, of Soignies. The densest and most uniform black marble is that of the Merbes le Chateau Company, which probably, from its compact structure, bears the rather inappropriate name of "Granite de l'Ourthe." Another characteristic variety, the "Marbre St. Anne," is represented by a large block sent by M. Bayot, of Biesne. This has a black base variegated by small sharply defined white veins, a structure due to the crushing of the rocks at the period of the great flexure known as the Eifelian fault, which has inverted all the strata along the southern side of the Franco-Belgian coalfield. Probably similar marbles would have been produced in the mountain limestone districts of Derbyshire if the strata had been similarly disturbed.

The visitor to Antwerp and other large Belgian towns soon becomes aware of the uniform and not very agreeable character of their pavements, small square slippery setts being used for both roadways and footpaths. These are derived from a group of quartz porphyry dykes in the lower carboniferous strata at Quenast, which are worked upon a very large scale. The quarries, covering nearly 500 acres, are worked in open cast to a considerable depth below the surface, and produce about 380,000 tons of stone yearly, which are manufactured into 25 millions of paving setts of different kinds and 150,000 cubic yards of macadam and ballast. Machinery is largely employed both in getting and working the stone, as well as for moving the numerous endless chain-ways which connect the quarries with the central stone dressing places and the railway sidings. The number of hands employed is 2900, and the steam power 850-horse power. The products of these quarries, together with perspective drawings of the workings, are in a special department of the main building, a little north of the Belgian Colliery collection, marked by an obelisk built up of paving setts.

In connection with the Quenast porphyry may be noticed a process of boring and cutting these and similar hard rocks, exhibited by M. Yves, of Gomezée, near Phillippeville, among the marbles in the grounds. The method, which is not described, bears the somewhat enigmatical name of the helicoidal wire and metallic agglomerate system. By it a 19in. core has been cut from a block of porphyry with apparently little more clearance than if it had been taken out with a cheese cutter, and the same rock is sawn up into slabs with a nearly smooth surface.

Another interesting display of building stone is that of the Grandes Carrières de France, a company owning a large number of quarries of the soft white limestone commonly used in Paris and other large French cities. This occupies a building in the grounds, and includes dressed cubes of the different stones, which vary in weight from 1600 to 2675 kilogs. per cubic metre, according to the fineness of the grain, with indications of the different buildings in which they are employed, plans of the quarries, which are dotted about over the secondary rocks in different parts of France, and details of the production for several years. The increase from 2000 cubic metres in 1853 to 106,000 in 1881 bears witness to the extensive re-building that has gone on in most large towns in France during the past twenty-five years.

Iron ores as such are but feebly represented; the magnificent results in the form of plates, girders, &c., to which we have previously alluded, being only in a few instances accompanied by examples of the raw material employed. This in the case of Belgium is to be attributed to the insignificance of the native iron ore production, the total yield of the principal mines—those of the province of Namur—in 1884 having been only 55,260 tons, of which quantity about four-fifths was of the oolitic red ore, oligiste, or mine violette, found at the base of the carboniferous limestone, and the remainder brown ore or limonites obtained from superficial deposits by washing; so that the greater part of the ores smelted are of foreign origin, the principal sources of supply being Spain for hematite and other red ores, and Luxembourg for the cheaper and more abundant brown ores or minettes. The latter, as might be expected, are best represented in the Luxembourg Court, where specimens of the different beds are exhibited by Metz and Co. and other ironmasters. The ores are oolitic limonites more or less calcareous, in which respect they resemble those of Lincolnshire, and vary in colour from reddish-brown and yellow to dark green. The latter, known as the "grey bed," is similar in appearance to the unweathered condition of the Northamptonshire ore. The yield is from 30 to 35 per cent., giving a pig metal with 1·5 to 2 per cent. of phosphorus. At Esch, in Luxembourg, there are three beds averaging 10ft. to 12ft. each in thickness, which are extensively worked both for export and for smelting on the spot. The furnaces are of the ordinary Cleveland type of construction, and in the newer examples are provided with Cowper's or Whitwell's stoves, and run about 100 to 110 tons per day. Coke is imported from Belgium and Westphalia. One of the newest groups of furnaces, those of Rumeling and Ottange, are fully represented by drawings. They were designed by Herr Pohlig, of Siegen, and are noticeable for the great care taken in cleaning the gases from dust before admitting them to the stoves and boilers. Another novelty is the substitution of a wire-rope line for the ordinary lift, an arrangement which is becoming popular for similar purposes in Belgium, and for carrying slags or colliery waste to the tips. The Luxembourg furnaces produce good foundry irons, and in evidence of this quality Metz and Co. send a plate 1in. thick moulded to an elliptical curve forming the half of a slag mould which was cast at a distance of 183ft. from the blast furnace.

A method of small Bessemerising analogous to that of Clapp and Griffiths, as applied to the basic process by Walrand and Delattre, is exhibited by M. E. Servau, of Luxembourg. The plant includes a cupola, two converters, intermediate and final casting ladles, which are arranged in terrace fashion, the cupola being about 15ft. above the ground level. The charge is 30 cwt. of re-melted pig iron, for the cupola is blown in the upper ganister lined converter for about thirteen minutes until carbon and silicon are completely removed, when it is transferred by the intermediate ladle, which keeps back the silicious slag to the lower one. The second converter has a magnesian lining, and contains about 2 cwt. of caustic lime. The dephosphorising blow lasts about four minutes, great heat being produced by the reaction, but no flame. About 1 per cent. of ferro-manganese is added in the second ladle before running the metal into ingots. The total duration of the operation, including the final casting, is about twenty-two minutes; the blast pressure is about 14in. to 16in. of mercury; the loss on the weight of the pig metal treated is 18 to 19 per cent., or about the same as in the ordinary Thomas and Gilchrist process. These figures relate to an experimental trial made at the Hollerich Steel Works upon ordinary Luxembourg pig iron containing little or no manganese. Samples of the results are exhibited, with the following analyses, which show to what extent dephosphorisation has been realised:—

	I.	II.	III.	IV.
Carbon	3·504	3·467	0·218	0·158
Silicon	1·563	0·915	0·050	0·065
Sulphur	0·083	0·099	0·063	0·058
Phosphorus ...	1·514	1·994	0·014	0·007
Manganese ...	0·366	0·354	0·248	0·264

I. Grey pig iron. II. Mottled pig iron. III. Steel made from I. IV. Steel made from II.

Among the few representatives of blast furnace plant in the Exhibition, the drawings of the Liverdun furnaces, by I. de Schryver and Co., of Hautmont, are noticeable as illustrating an unusual construction. They are of Büttgenbach's pattern, the stack being entirely relieved of weight by an outer framing of ⊢ iron bars, which carries the platform at the furnace top. They are in the south-east corner of the French machinery department under the gallery.

A fine collection of the iron ores of the Bilbao district is contributed by the Sociedad Vizcaya, of Bilbao, who have recently erected two large blast furnaces, forming part of a steelworks at Sestao, on the beach between Bilbao and Portugalete. The furnaces, which are intended to produce about 90 tons each of Bessemer pig daily, are of 11,350 cubic feet capacity, and are supplied with blast heated to 1400 deg. by six fire-brick stoves. These works, in spite of the difficulties of the position, which necessitated foundations averaging 26ft. high, have been built and put in blast in thirteen months. The whole of the machinery and ironwork was supplied by the Cockerill Company, of Seraing.

Manganiferous iron ores for spiegel making from a comparatively new locality in Greece are contributed by the Société Française des Mines de Sunium. These contain 35 per cent. iron and 15 per cent. of manganese, and can be supplied at 9s. per ton. They are associated with lead and zinc ores, the locality being now famous for supplying calamines in a somewhat similar manner to the ores of Carthagena.

In the Brazilian collection, which at first sight appears to consist entirely of samples of coffee, there is a fairly good series of minerals, including gold ores from San John del Rey and other mines, and sundry samples of iron ores. The latter are interesting as representing, perhaps, the largest masses of hematite remaining undeveloped, and which, according to the accounts furnished by numerous observers, are developed on a scale of magnitude quite unparalleled in other localities. The ores, which are dense hematites and magnetites of great purity, occur in great stratified masses in crystalline schists like those of Lake Superior and other localities, and have in some instances been followed for great distances not for themselves, but as the matrix of gold ores. One deposit in the Mountain of Caraça, in Minas Geraes, is said by Gorceix to contain 8000 millions of tons of hematite. The degradation of these masses has given rise to large deposits of "canga" or limonite, which in many places serves as a building stone. But little use has as yet been made of these ores, there being only a single smelting works, that of Ypanema, belonging to the Brazilian Government, producing charcoal pig iron, and a few bloomaries making wrought iron directly from the ore. The latter are either Corsican forges or a debased modification of it, which is said to be of negro origin, and possibly reproduces some traditional African method. A large bloom is exhibited, which it is to be hoped may be preserved, as the process will probably become extinct before long.

Among the special kinds of pig iron, those for chill castings are well represented both in the raw state and in finished objects. Staffordshire cold blast pigs sent by Messrs. Grazebrook, of Netherton Works, Dudley, form the solitary illustration of British blast furnace products. Prominent in this class are the fine displays of plate rolls made by the Société Esperance and M. F. Gomrée-Walthery, both of Liège. The Gruson Foundry, of Magdeburg, so well known for the production of chilled armour plates for land fortifications, examples of which are to be seen in the forts on the Scheldt below Antwerp, has only contributed a pair of chilled flour mill rolls, which, however, are of a remarkably high finish.

Fine charcoal pig irons and castings, which are among the diminishing industries of Europe, are represented by the Hessen Nassauischer Hüttenverein, whose furnaces smelt the best Nassau red ironstone without any admixture of cinder or foreign ores, the metal being mostly run into castings without remelting. The castings are remarkably fine, and show a blue surface, said to be unattainable by any other process. There are some curious illustrations in the shape of cast strips resembling hoop iron. The tensile strength of this metal is 25·4 tons per square inch.

Water pipes and similar large castings are very fully represented in the machinery department, mostly by Belgian, German, and French works. Prominent among these is the trophy of the Compagne Générale des Conduites d'Eau, of Vennes, Liége, which has carried out many important works for the supply and distribution of water in different European countries, including, among others, the suburban supply of Paris, Rome, Athens, Barcelona, Utrecht, Bremerhafen, and parts of St. Petersburg, with a length of more than 400 miles of pipes.

In the Italian Court some very large pipes are exhibited by the Terni Blast Furnace Forge and Steel Company. These are, however, not entirely of Italian origin, but are cast from imported iron, the works being as yet without blast furnaces. They are situated in the Umbrian Hills, about seventy miles from Rome, in a district without ores or fuel, the position being chosen with a view to utilising the power of the well-known cascade of Terni. It is intended to manufacture armour-plates and artillery for the Italian Government, the 100-ton Seraing hammer forming part of the plant.

In the Swedish department a series of piercing projectiles are sent from Finspong both of steel and of the chilled cast iron for which these works are famous. The trustees of Lars Lindberg's estates have contributed iron and steel from Kohlsva works of almost chemical purity. These are derived from the charcoal pig iron of Dahlkarlshytte, whose composition is the first of the following analyses:—

	I.	II.	III.
Carbon, combined	1·900	0·080	0·050
Carbon, graphitic	2·100		
Silicon...	0·444	·028	0·033
Phosphorus	0·023	·025	0·014
Sulphur	trace	trace	trace
Manganese	0·060	·020	0·020

II. is a Siemens ingot, and III. bar iron made in the Lancashire forge, which gave the following results when tested:—

	Kilogs. per sq. mm. Siemens ingot.	Bar iron.
Strain at elastic limit	12·68	14·26
Ultimate tensile strain	32·47	30·63
Elongation per cent.	36·3	37·4
Contraction of area per cent. ...	74·1	73·8

Here the ingot iron, as is usually the case, appears to be a little more rigid than the hammered bar, probably as being more homogeneous. Wire made from this iron has an electric resistance of only 0·099705 ohms per lineal metre per mm. square of section, or considerably less than that usually attributed to pure iron.

The product by which Belgian forges are best known in this country—namely, wrought iron girders for building purposes—is, as might be expected, very largely represented, especially by the Providence Company of Marchiennes au Pont, whose 12in. I bar, 130ft. long, we have previously noticed. The works where these are made are partly in Belgium and partly in French Lorraine, and contain seven blast, ninety-six puddling and forty-eight heating furnaces, and twenty-three rolling mills. The ores are oolitic, from Luxembourg and Lorraine, and the works do not, so far as position is concerned, appear to have any greater advantages for supplying London than many sites that might be chosen in the English oolitic iron districts. It seems strange that this part of iron making should be left so largely to foreign producers.

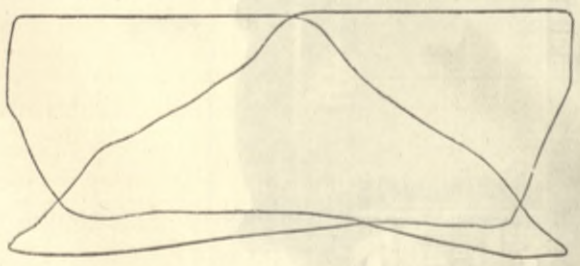
The collective exhibition of the ironworks in the neighbourhood of Saarbrücken contains two notable contributions, namely, armour-plates by the Dillinger Company and iron and steel girders by Stumm Brothers, of Neunkirchen. The first firm send a flat compound plate 18in. thick, and another of 8in. moulded to a cylindrical curve, and a mild steel one of 8in. with a spherical curvature. These plates have been used in the construction of ironclads built by the Vulkan Company, of Stettin, for the Chinese Government, which were detained by the German authorities during the late Franco-Chinese war. They are double turretted ships, 91 × 18·3 × 6 metres, with engines of 6000 indicated horse-power. A description of the method adopted for the manufacture of these plates was published

in our contemporary, *Stahl und Eisen*, about two years since.

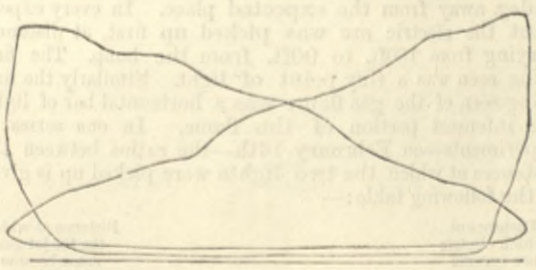
Messrs. Stumm Brothers' collection is mainly devoted to illustrating the manufacture of soft steel—ingot iron—girders, and a comparison of them with similar sections of welded iron. The most prominent object is an obelisk, about 40ft. high, built up of sections of the different sizes rolled, which are classified according to the normal scale, adopted by German engineers and architects, in which the bars are numbered according to their depth in centimetres. Thus, No. 10 is 100 mm. high; No. 19, 190 mm.; and so on, the sizes most used varying from No. 10, of 8·3 kg., to No. 24, of 36·2 kg., per running metre. The quality of the materials used is illustrated by a very large number of tests. Among these a series of etched sections, taken from a pile after passing each groove of the rolling mill, is of great interest as showing the displacement of the material due to the welding of the bars. It is extremely interesting, and has probably never been so completely done before. The steel girders are made of Thomas and Gilchrist ingots, with ·070 carbon, ·010 silicon, ·080 phosphorus, and 0·465 manganese per cent., and are extremely tough and malleable, as evidenced by numerous samples, bent, twisted, doubled, and otherwise illtreated, which form a notable part of the collection. The tests of these girders have been made by Prof. Tetmajer at the Swiss Polytechnicum, at Zurich, whose report upon them, containing a valuable mass of information with numerous illustrations, has been lately published. The large plate and girder mills at these works—which are said to be the most powerful mills of their class in Europe—are shown in a model. They include two pairs of cogging rolls, driven by a double cylinder geared reversible engine, and two pairs of finishing rolls and a plate mill, driven by a three-cylinder engine, also reversible, but without gearing, the cranks being coupled directly to the rolls. The cogging mill has steam setting gear, but the others are adjusted by hand. The axes of the rolling mills are all in one line, with the engines at either end. According to a statement of the exhibitors' representative, the engines are of 11,000 indicated horse-power.

STRAW-BURNING ENGINES.

Since the advent of compound portable and semi-portable engines, various statements have been made public concerning their small consumption of fuel; but, so far as we are aware, the only makers of such engines who have submitted them to independent tests are Messrs. Richard Garrett and Sons, of Leiston. We do not for a moment assert that the statements to which we have referred are untrue. But it is generally accepted that the makers and inventors of new machines are more likely to make mistakes concerning their merits than independent unprejudiced witnesses of their performance. In a former number of The Engineer will be found a report of a trial which we carried out, intended to determine the efficiency of a compound portable engine—made by Messrs. Garrett—in terms of pounds of steam used per horse-power per hour. We have been recently favoured with facilities for carrying out a yet more interesting experiment, intended to test two different things, namely (1) the comparative efficiency of the compound and non-compound portable engine, and (2) the value of straw as fuel. All the available information on this latter subject that has been published was contained in a paper by the late



High-pressure cylinder, 56 lb. to the inch.



Low-pressure cylinder, 30 lb. to the inch.

Mr. John Head, of Ipswich, read before the Institution of Civil Engineers, on the "Combustion of Refuse Vegetable Substances," January 30th, 1877. In that paper Mr. Head gave the value of straw burned on the Head and Schemioth system as about 21 lb. per horse per hour. It will be seen that Messrs. Garrett have succeeded in attaining a much higher efficiency—an efficiency best illustrated by saying that 5 per cent. of the weight of straw thrashed will suffice to thrash it when a compound engine is used.

Our experiments were carried out with great care. On another page will be found sectional drawings of the fire-boxes of the two engines tested. It will be seen that they are in many respects similar, the single cylinder engine having the larger box. The crown of the box is supported by two deep corrugations on a system well known as patented by Messrs. Garrett. The straw is put in through a wide, shallow aperture beneath the ordinary fire-door, by a man with a common pitchfork; and it is by no means to be supposed that the labour is hard and incessant. On the contrary, it is easy work; and the fireman has plenty of time to look after his feed-pump and the lubrication of the engine.

The cylinders of the compound engine are 7in. and 10½in. diameter and 10in. stroke. The crank-shaft was coupled direct to the shaft of the brake, which is similar to those which used to be employed by the Royal Agricultural Society. The brake wheel, therefore, made precisely the same number of revolutions as the engine, these being recorded by a counter in the usual way. Seven hundred pounds of wheaten straw were weighed out; the position of the water was marked on the gauge, and the experiment began as soon as the pressure was 95 lb. It was then raised to 100 lb., and this was maintained very closely throughout the run. Care was taken to have the water standing at the same height when all the straw was consumed, and as soon as the pressure fell to 95 lb., the counter was thrown out of gear, the time noted, and the run held to have concluded.

The suction pipe of the pump drew from a barrel. This was filled just to overflowing at the outset, and again at the end of the run. All the water was weighed pail by pail on a pair of scales, and the number of pails was checked by two observers. The temperature of the feed was noted every fifteen minutes. Every possible precaution was used to secure accuracy. The same system precisely was pursued with both engines. The results are set forth in the following table*:—

Compound Portable Engine.

Date	July 31,'85
Pressure—	
Beginning	95 lb.
Working	100 lb.
End	95 lb.
Time—	
Beginning	2.56
End	5.51
Total	175 min.
Weight of—	
Straw	700 lb.
Cinder	27·5 lb.
Net weight of straw	672·5 lb.
Weight on brake	251 lb.
Total number of revolutions	31,810
Revolutions per minute	181·7
Total number of foot-pounds	140,523,856
Foot-pounds per pound of straw	208,957
Foot-pounds per pound of water	{ 84,652 / 77,181
Total water evaporated	{ 1660 lb. / 1822 lb.
Horse-power on brake	24·32
Water per hour per B.H.P.	{ 23·38 lb. / 25·68 lb.
Straw per hour per B.H.P.	9·47 lb.
Water per pound of straw	{ 2·47 lb. / 2·70 lb.
Indicated horse-power	29·61
Water per hour per I.H.P.	{ 19·20 lb. / 21·09 lb.
Straw per hour per I.H.P.	7·78 lb.
Grate area	4·18 sq. ft.
Straw per hour per square foot of grate	55·1 lb.
Feed-water—	
Cold	76 deg.
Warm	174 deg.
Draught	0·5in.
Stoker	Woods

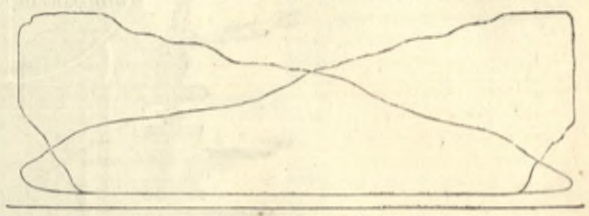
No. 10 Single-cylinder Engine.

Date	Aug. 1, '85
Pressure—	
Beginning	95 lb.
Working	100 lb.
End	95 lb.
Time—	
Beginning	9.45
End	11.40
Total	115 min.
Weight of—	
Straw	700 lb.
Cinder	22 lb.
Net weight of straw	678 lb.
Weight on brake	299 lb.
Total number of revolutions	17,577
Revolutions per minute	152·87
Total number of foot-pounds	92,497,204
Foot pounds per pound of straw	136,426
Foot-pounds per pound of water	{ 56,127 / 52,493
Total water evaporated	{ 1648 lb. / 1764 lb.
Horse-power on brake	24·38
Water per hour per B.H.P.	{ 35·26 lb. / 37·70 lb.
Straw per hour per B.H.P.	14·50 lb.
Water per pound of straw	{ 2·42 lb. / 2·59 lb.
Indicated horse-power	29·51
Water per hour per I.H.P.	{ 29·13 lb. / 31·14 lb.
Straw per hour per I.H.P.	11·9 lb.
Grate area	6·14 sq. ft.
Straw per hour per square foot of grate	57·6 lb.
Feed-water—	
Cold	74 deg.
Warm	145 deg.
Draught	0·6in.
Stoker	Woods

It will be seen that two sets of figures are given for the evaporation in each case. The smaller of the two shows the evaporation as deduced from the actual weight of feed-water poured into the barrel, but a portion of the exhaust steam was blown into the barrel and therein condensed to heat the feed-water, and this added so much to the total weight of water evaporated. Both sets of figures are given, although the larger of the two is that with which we have really to deal. Taking the indicated horse-power of the compound engine as 29·61, it will be seen that the total weight of steam used was just 21·09 lb. per horse per hour—a very admirable result. If, however, we neglect the condensed steam increment, the steam used was only 19·2 lb. We have some reason to think that some of the statements of remarkable economy which have been put before the public are true only if the condensed steam be neglected, and it is worth while to call attention to a manifest error. The straw comes out at 7·78 lb. per horse per hour, or each pound of straw evaporated 2·6 lb. of water; or for ordinary portable boilers 1 lb. of coal may be said to be equal to 3 lb. of straw. These figures may be compared with those given by Mr. Head. Of course, the result varies continually with the dryness of the straw; but that used during our trials was in average condition, and probably not nearly so dry as it would be in Hungary or other countries where straw-burning engines are used. The high calorific value of the straw is due to the efficiency with which it is burned. The heat is all got from flame. This flame fills the fire-box and has to pass over the top of the brick bridge before it can get into the tubes, and just at this point it is met by streams of heated air coming from the front of the smoke-box through the air flues provided for the purpose, and clearly shown in our drawings. It is quite easy to look down these tubes when the engine is at work; and it can be seen that the fire-box is filled with an intensely bright white flame. The air currents exert, too, a kind of baffling action, and compel the flame to linger a little in the deep corrugations in the crown of the fire-box. The result of this system of burning straw must be pronounced altogether satisfactory. We append copies of diagrams taken from the engine. It is worth notice that the difference between the indicated and brake horse-power was 5·29-horse power.

* In this table the net weight of combustible is used, the weight of the ashes being deducted.

The non-compound engine has a cylinder 10in. diameter, 12in. stroke. Although constructed to work at 80 lb. only, it was run at 100 lb., because in this way all objections to the effect that the economy of the compound engine was due to being worked at a high-pressure were eliminated, and the two experiments go on all-fours. The engine has only a single slide valve. We append a pair of diagrams. It was an ordinary "commercial" engine. The total weight of water evaporated was 1762 lb., or 2·517 lb. per pound of straw, or a little less than in the case of the compound engine. This is due to the circumstance that the single cylinder engine would not keep steam until a ferrule was put into the blast pipe and the draught in the smoke-box was raised to ⅞in. of water, while it was but ½in. in the compound engine. To countervail this, however, the tubes in the single engine are 10in. or



Single cylinder, 56 lb. to the inch.

so longer than they are in the compound engine boiler. In both engines the smoke boxes became very hot because the loads were heavy. The simple engine required 31·19 lb. of water per horse per hour, or very nearly one-half more than the compound engines. Messrs. Clayton and Shuttleworth's prize engine with special cut-off valve and jacketted cylinder, at Cardiff, required 31·668 lb. of water per brake horse-power, a difference in favour of the racer much less than might be anticipated.

The compound engine is fitted with a Pickering governor, which did its work very well. The simple engine is, however, fitted with one of the best governors we ever saw; it is of the ordinary two-ball pendulum type, running at about the same speed as the engine, but it is supplied with an exceedingly simple spring-loading arrangement, which exerts a very powerful effect in modifying the action of the governor. After the trial of the engine was over, we carried out a series of experiments to test the action of this governor. The pressure being maintained at 100 lb., the regulator full open, loads were successively taken off the brake until the power exerted fell from 33-horse brake load to no brake load at all. The results are set forth in the following table, small fractions of a revolution not being recorded:—

Weight on brake.	Revolutions per minute.	Brake horse-power.
411	151	32·91
355	152	28·78
297	152	24·23
236	152·0	19·13
180	153·5	14·73
124	154	10·12
0	162	0

When it is borne in mind that these results are obtained with an ordinary butterfly throttle valve, and a slow speed simple governor, we are tempted to ask what is gained by the use of the complex high-speed governors now in the market by the score. The mathematical principles of the new governor have not been investigated; the apparatus deserves the attention of mathematicians.

The facts we have set before our readers speak for themselves, they demand no further comment from us.

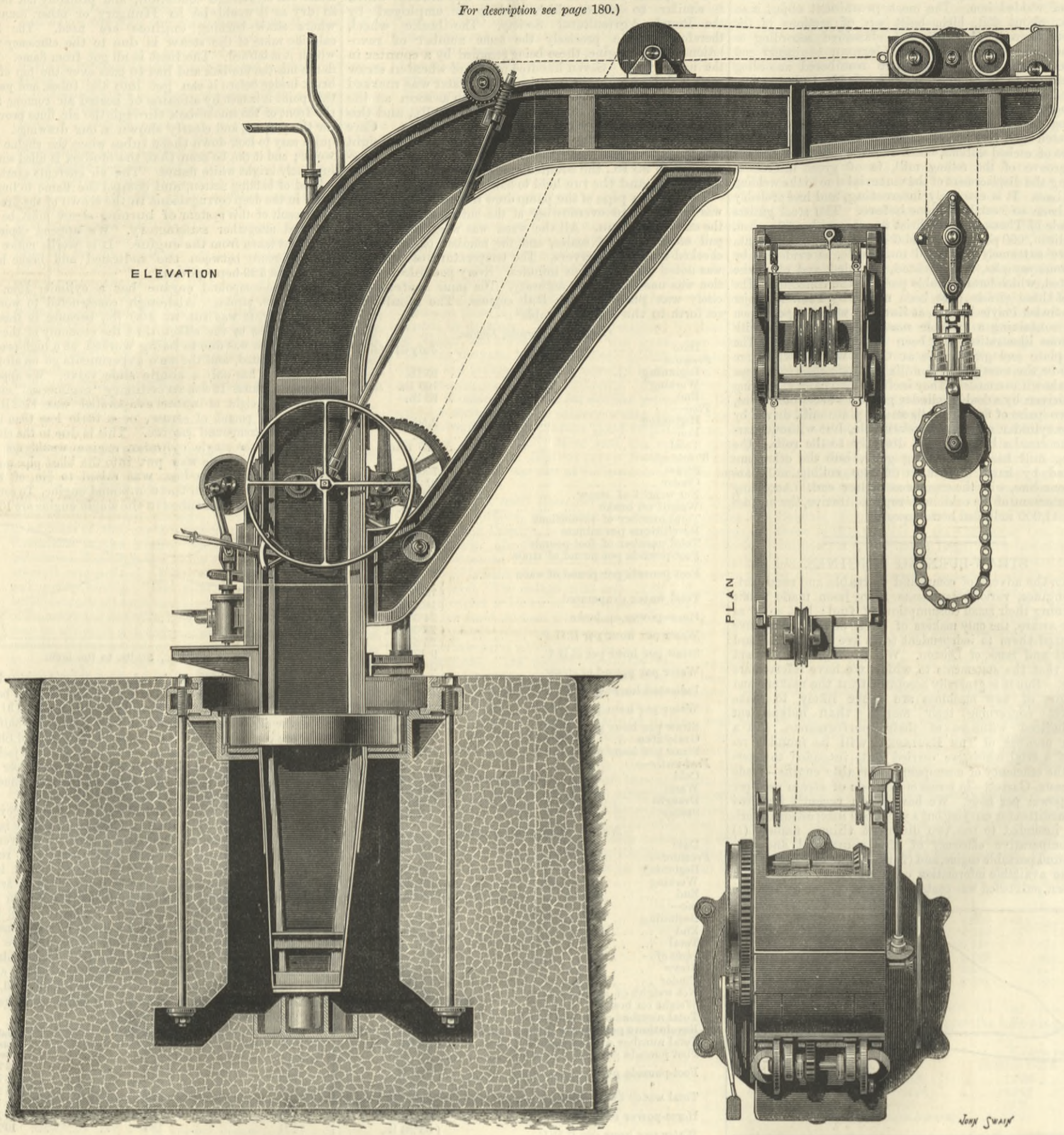
THE PENETRATIVE LIGHTING POWER OF ELECTRICITY AND GAS.

In continuation of our article of the 21st ult., on the report of the committee which has recently conducted the experiments on lighthouse illuminants, we now propose to deal very briefly, but in more detail than we were then able to do with that part of the report relating especially to the penetrative power of electricity and gas in thick weather. This question, we need hardly say, is not merely, though it may be primarily, one affecting coast illumination, but has an important bearing on the lighting of our large towns, enveloped in smoke and fog as they often are. That the electric light possesses an unrivalled intensity in ordinary states of the atmosphere, no one, of course, has ever seriously disputed; but that the most brilliant gas flames might eclipse it in fog has been contended with a considerable show of authority. The argument has been thus scientifically put:—"The electric light is much more powerful than other lights in clear weather; but, when a fog comes on, most of the violet rays are absorbed, leaving only the red. Therefore, the effect of the fog will be to cut off most of the violet rays, and leave a proportionately small number of red rays. In

FIFTEEN-TON FORGE CRANE.

MESSRS. ABBOT AND CO., GATESHEAD-ON-TYNE, ENGINEERS.

For description see page 180.)



the case of gas, there is, of course, a similar diminution, but there is not the same loss, because the red rays are not nearly so much absorbed." From this theory, possibly correct in the main, it has been argued that, to such an extent is the electric light thus impaired, that the most powerful gas flames, notwithstanding their inferior initial intensity, are more than able to cope with it successfully in fog. But into this question mere hypothesis seems to have largely entered. No prolonged and systematic experiments appear to have originated or confirmed the view thus enforced; and now that, for the first time, so far as we know, the matter has been put to a crucial test, the results which have been arrived at—and we see no reason to question their accuracy—are opposed to such a theory.

The chief requirement in a lighthouse is, as is well known, a highly penetrative illuminant in thick weather, the small power of 350 candles being in clear weather quite sufficient, when transmitted through the optical apparatus, to cover the average geographical coast light range of about 17 miles. The most important, therefore, of the questions demanding solution in the investigation at South Foreland was this particular one, which consequently received special attention in that inquiry; and we shall now describe, from the printed report of Mr. Harold Dixon—who, on the recommendation of Professor Williamson, F.R.S., was, as we have already said, entrusted with the photometry during the recent trials—the results of his careful readings of the powers of the electric and gas lights when transmitted through an impaired atmosphere. Comparisons, extending over several months, were made of the two illuminants in thick weather from various points of observation; and the means of the several photometric readings are represented by the following ratios:—

Single 108 jet gas burner 1,	single	power electric	... 12·6
do.	double	do.	... 21·6
do.	treble	do.	... 36·8

These figures are irrespective of superposing arrangements.

Calculating from Mr. Dixon's figures, how this superiority of the electric light in fog compares with its superiority in clear weather, we find the means of the numerous results to be as follows:—The single power electric light lost in fog 37 per cent.; the double power, 20 per cent.; and the treble power, 8 per cent. of their original higher intensities. Notwithstanding this relative falling off, which, however, it will be observed is in the inverse ratio of the initial powers, the positive greater penetration of the electric light in fog is sufficiently striking. The following further experiment was tried at South Foreland in connection with this point:—An artificial steam fog having been created in the photometric gallery, an electric arc, fed by one machine, and a Wigham 108 jet gas burner, were put in competition, their illuminating powers being about as 5 to 1 without lenses—which, in this trial, were not used—and two observers then started walking towards the lights, which were placed about 5ft. apart. "Long before the actual lights were seen," says Mr. Dixon, "the fog was brightly illuminated by the lights, the blue tint of the electric light greatly predominating. This illumination spread behind the observers, surrounding them with light. Even in the narrow gallery no exact idea could be formed of the direction from which the light came. Gazing through the fog to pick up the light as they walked, the observers were often astonished at the arc appearing 20 deg. or 30 deg. away from the expected place. In every experiment the electric arc was picked up first, at distances varying from 160ft. to 90ft. from the lamp. The first thing seen was a tiny point of light. Similarly the first thing seen of the gas flame was a horizontal bar of light, the intensest portion of the flame. In one series of experiments—on February 14th—the ratios between the distances at which the two lights were picked up is given in the following table:—

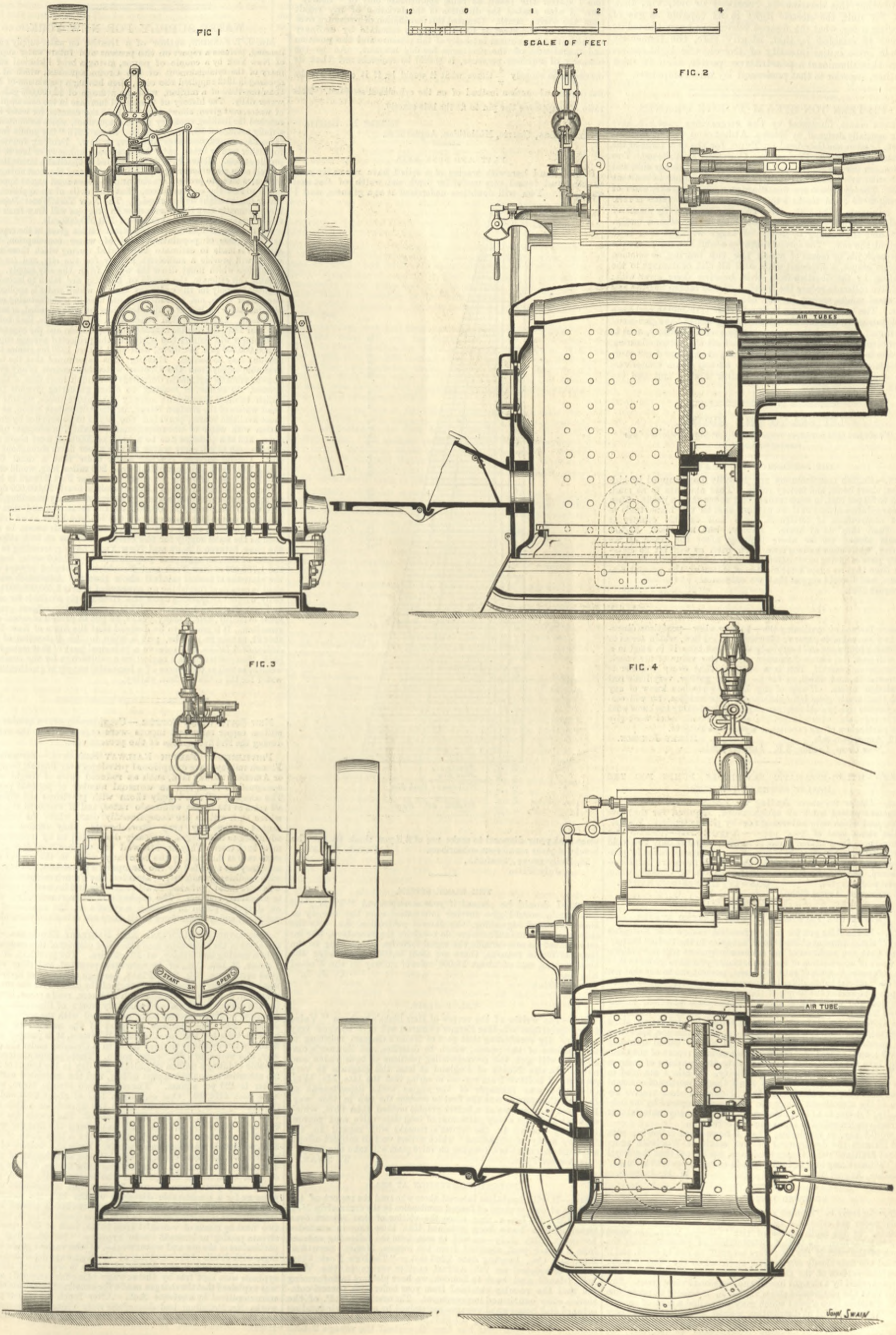
Distance at which electric arc became visible.	Distance at which the 108-jet gas flame became visible.
100	66·6
,,	61·9
,,	79·7
,,	85·1
,,	85·0
,,	79·1
,,	87·4
,,	70·6
,,	76·1
,,	84·6
100 mean	77·6 mean.

The foregoing results only confirm the views which Professor Tyndall has always expressed as to the penetrative power of the electric light in fog. Indeed, the professor goes much further in his championship of this question. Thus, in 1879, he said: "Such observations [referring to those that had been tabulated by M. Petit, chief of the Hydrographic Service at Antwerp] are rendered important by the fact that hazy weather has been thought especially inimical to the electric light; but they are in entire accordance with experiments which prove that the intro-

FIRE BOXES OF STRAW BURNING ENGINES.

MESSRS. RICHARD GARRETT AND SONS, LEISTON, SUFFOLK, ENGINEERS.

(*For description see page* 177.)



duction of the more refrangible rays, to which the electric light owes its whiteness, is invariably associated with a vast intensification of the less refrangible ones. The electric light, in short, is richly endowed with all the constituents of the radiation from oil—or gas—flames."

Whether this doctrine be received or not, viz., that, unit for unit, the electric light is as capable as gas of piercing a fog, what the figures which we have quoted do appear to establish is, that, at any rate, the immensely higher gross initial intensity of the electric light confers upon this illuminant a penetrative power, even in thick weather, superior to that possessed by any competitor.

FIFTEEN TON STEAM FORGE CRANES.

These cranes, illustrated by the engravings page 178, have been specially designed by Messrs. Abbot and Co., of Cannon-street, London, and Gateshead-on-Tyne, for the new forge of the North-Eastern Marine Engineering Company at Wallsend. Two cranes are used to supply each hammer, one on either side, and work with two furnaces, so as to keep the hammer in constant work. The cylinders are 6in. diameter, 10in. stroke, ratio of gearing 20 to 1 and blocks 4 to 1. The extreme raike is 18ft. and minimum raike 12ft. The turning is done by means of bevel wheels and reversing clutches fixed on the second motion shaft and the racking by means of large wrought iron hand wheel at the side. The special features about the cranes are the swan-neck jib, by means of which the top bearing, so common in forge cranes, is dispensed with, and all risk of damage to the building by the vibration from this bearing done away with; steel live rollers to reduce the friction of the centre bearing, and the steel volute springs in the blocks to reduce shock of the blow. The bottom gudgeon is lined with gun-metal, and has a hard gun-metal disc, and the whole of the shafts have gun-metal bearings. The foundations are arranged with a subway, so as to allow a man to go down to examine and oil the bottom bearing, and the holding-down bolts have cotters, so that one could easily be replaced in case of breakage. Two 12-ton steam cranes were also supplied with the above of similar design, and also two 4-ton hand-power cranes.

LETTERS TO THE EDITOR.

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

THE DEPRESSION OF TRADE.

Sir,—English manufacturers are heavily handicapped by high wages, short hours, and factory rules. This amounts to as much as 25 to 30 per cent. in some trades, and more than a profit. Then we have duties against us if we export, and in the home trade to meet competition of foreigners, who sell in this country at less than they do at home. Lastly, but not least, English consuls abroad are far above looking after the trade of the country, while other nations send such men as will let no opportunity pass of giving information likely to lead to business. It is high time that we adopt some means of altering the present conditions, and I would suggest that we commence at the last.

August 29th. Export Trader.

AIR VESSELS.

Sir,—Instead of continuing the—to my view—profitless discussion in your valuable paper *re* Newton's third law, which seems to be putting professors and everybody else that take it in hand in a fog, will you, Sir, start a discussion upon the value of air vessels to pumps in general? This is a subject that every engineer is interested in, and which, so far as I can gather, very little real knowledge exists. If any of my brother readers know of any work that really gives information on this subject, he will confer a favour upon an old foreman engineer by letting me know what book it is in, and where to get it; if not, I will next week give some particulars of my experience upon this subject.

112, Amersham-vale, Henry Johnson.
New Cross, London, S.E., August 27th.

SHONE'S HYDRO-PNEUMATIC SEWERAGE PUMPS FOR THE HENLEY SEWERAGE WORKS.

Sir,—Under the above heading we notice a specification for Sturgeon's patent trunk air compressors, required for the above works, and which were advertised for by public tender. We also, in the same issue of your paper—August 21st—perceive that twenty-three firms tendered, out of which number only two could have legally undertaken the contract, as the compressors in question are patented, and only two of the above firms are licensees—ourselves, and Messrs. Hughes and Lancaster, of Chester, whose tender was accepted. Galwey, Bainbridge, and Co.

Warrington, August 25th.

STEEL GUN FACTORIES IN THE UNITED STATES.

Sir,—In thanking you for your extended review last November of my "Establishment of Steel Gun Factories in the United States," I hope that the tardiness of my acknowledgment will not indicate any want of appreciation of the importance you have given to it.

In reference to some of your criticism, permit me to say that not only do "official habits differ in different countries," but so do the receptive powers of the people of those countries. While "English prejudice and conservative habits" have been startled, in the United States and some other countries the book has been accepted as an amplification of the report of the Gun Foundry Board, and a presentation of facts in a convenient form for reference, answering such questions as a reading of the official report would naturally suggest; and, instead of "throwing the official report of the Committee into the shade," has carried it into the sunshine of many a new locality and given it greater publicity. While I am glad to have the Board receive the benefit of all that is worthy of commendation in it—for as a member of that Board, I shall receive my share of the compliment—since the work was prepared by me individually, I desire to be held alone responsible for any material that deserves condemnation or unfavourable criticism.

I would say, in conclusion, that I have been following with great interest the development of the work at Woolwich under Colonel Maitland's able superintendence, and trust that the Royal Gun Factories may long be in the hands of so competent a chief.

London, August 25th. W. H. Jacques.

RIVETTED BOILER JOINTS.

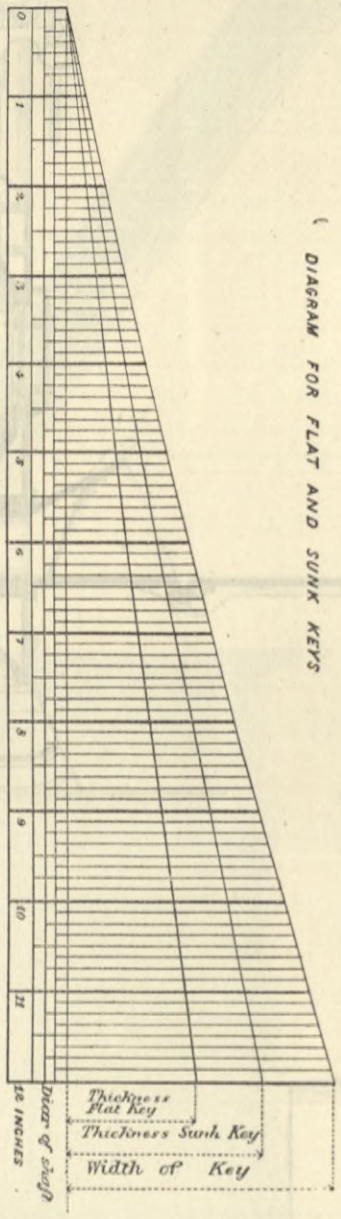
Sir,—In reply to "Inquirer's" questions, the values of q given in my paper are calculated from a formula developed in article "Joints," in the ninth edition of the "Encyc. Brit.," to which I beg to refer him. As to the distribution of pressure along the length of the rivet, if the rivet were so stiff as not to bend, and if it fitted the hole closely everywhere, then when the joint is under strain the surface of the compressed plate edge would evidently be represented by a straight line in the sectional view given. This means that the compressive stress varies in intensity in proportion to the distance from a point which may be called a sort of neutral axis. The same kind of distribution would arise if the plate edge were so hard and stiff as not to "give" in the smallest degree while the rivet became sensibly compressed transversely, but remained sensibly unbent. Since this would be the kind of distribution in the two extreme cases mentioned, evidently it remains so for the actual case which is intermediate between these extremes, and in which both plate edge and rivet become compressed. But the slight bending of the rivet modifies a little this distribution. This modification is left out of account in my reckoning, and therefore I stated the result as being approximate only or "nearly" true. I also stated the direction of the deviation of my result from the strict truth. Granted this distribution of pressure over the length of the rivet, it becomes easy to calculate by ordinary methods the maximum intensity of this pressure and the position and magnitude of the maximum bending moment. As to the intensity of surface pressure, it should be remembered that its maximum is closely $\frac{4}{\pi}$ times what it would be if it acted on the flat diametral section instead of on the cylindrical surface. This ratio $\frac{4}{\pi}$ supposes the pin to fit the hole exactly.

Robert H. Smith.

Lennox Lea, Currie, Midlothian, August 27th.

FLAT AND SUNK KEYS.

Sir,—I send herewith tracing of a scale I have recently constructed and found very useful for depth and width of flat and sunk keys. You will doubtless understand it at a glance, and I



place it at your disposal to make use of it if you think fit for the benefit of your numerous subscribers. Fredk. Evans.

26, Holly-grove, Seaforth,
July 14th.

THE BLOCK SYSTEM.

Sir,—I should be pleased if your correspondent "T. N.," of Dunchurch, would give further information upon the empty or block system of signalling, the dates of publication, &c. As the railway signal manufacturers do not claim the invention, the inventor must be one outside the signal factories. According to the Board of Trade returns, there are about 14,000 miles under the block system, out of about 18,000 miles of railway in the United Kingdom. C. J. L.

August 31st.

VALVE GEARS.

Sir,—The writer of the review of Herr Blaha's book on "Valve Gear," questions whether Zeuner's diagram will ever become very popular. By combining that part of Müller's diagram relating to the positions of the piston, which he describes, and Zeuner's diagram, he will get the corresponding positions of both valve and piston. In the North of England at least this diagram is very popular. I believe I am correct in saying that the late Mr. Wm. Gibb, who was manager of the engine works department of Palmer's Company, was the first to combine the two in this way. It is hard to conceive of a better graphic method than this, which shows at a glance every particular of both slide valve and piston. I heartily concur in the writer's remarks with regard to the "dreary array of equations" which writers on this subject adopt, and trust the next book-maker on valve gears will take the hint.

Jarrow-on-Tyne. T. Swan.

FORCED COMBUSTION AT SEA.

Sir,—It will doubtless interest those who read the report of the working of our system of forced combustion in the steamship New York City to learn that since the writing of that report even higher results have been attained than those therein stated—Engineer, 10th July—as will be seen from the following extract from a letter just received from the owners, Messrs. Scrutton, Sons, and Co., bearing date 22nd inst.:—"The New York City, having completed on 7th August another voyage to the West India Islands and back to London, we have pleasure in informing you that the results obtained from your boiler with forced combustion show continued improvement. The average I.H.P. of the outward and homeward voyages ascertained by our superintending engineer is 628, including 6 I.H.P. for the fan engine. The consumption of Welsh coal has been throughout the voyage 9 tons per twenty-four hours. The boiler continues in perfect order. The results altogether are most satisfactory." It will be noticed that the use of this system of forced combustion has now reduced the rate of consumption at sea with ordinary compound engines to 1·337 lb. per I.H.P. per hour. James Howden.

Glasgow, August 25th.

WATER SUPPLY FOR NEW YORK.

Mr. J. T. Fanning, author of a treatise on water-supply engineering, prefaces a report on the present and future water supply of New York by a couple of pages, giving a brief historical summary of the establishment of the Croton aqueduct, which at its opening in 1842 supplied the city, then having a population of less than one-third of a million, with an average of 12,000,000 gals. of water daily. The history of the rapid increase in the consumption of water, next given, shows that by 1875 the demand for water had reached the limiting capacity of the aqueduct, which amounted to a daily average of 95,000,000 gals. Since 1875 "the public fountains have ceased, one after another, to flow. Drinking fountains for either man or beast have been almost unknown of late in the public streets. Meters have been applied in charitable institutions, as well as in manufacturing establishments, and the most stringent measures taken to prevent waste, and at times most urgent appeals made to save the consumption, that the evils of an approaching water famine might be lessened." The New York Water Department estimates that the works now in progress will draw from the Croton watershed a daily average of 250,000,000 gals.

On the basis of numerous statistical tables given in the report, as to increase of population and of water consumption, the attempt is made to estimate the period during which these new works will provide a sufficient supply for the city, and for the population which must draw its water from the city supply. In making this estimate, the needs of the city are taken to include a sufficient supply for the ordinary uses to which water is applied in our larger cities, not excluding those uses in manufacturing establishments for the lack of which business must be curtailed, or settle elsewhere. The conclusion reached in this report is, that before the year 1898, the regular increase of population and the expansion of business will require the whole of the projected average supply of 250,000,000 gals. per diem, and that before 1930 fou rtimes that amount may be needed. Having thus determined that the total available supply from the Croton watershed cannot in any event answer probable legitimate demands for much more than a single decade, the author, in looking to other gathering grounds from which to draw a sufficient supply for future needs, regards the head waters of the Hudson River, in the Adirondack region, as the most available source, provided the city is to be supplied by gravitation with water of unexceptionable quality, in adequate quantities, and at a pressure due to a head of 200ft. or more above tide water—such as will carry water to the upper floors throughout the city. Careful surveys, *Science* says, show that a canal 60ft. wide, 13ft. deep, and somewhat over 200 miles long, would carry 500,000,000 gals. of water per diem from near Fort Edward to New York. The estimated cost of this conduit is nearly 30,000,000 dols., and the auxiliary structures, storage basins, necessary tunnelling, &c., 25,000,000 dols.; total, 55,000,000 dols. It is proposed that the canal run on the highlands east of the Hudson River at an initial elevation of 350ft. above tide water, and that this source be also used as the water supply for the cities and towns on both sides of the river, between Albany and New York, having, according to the census of 1880, an aggregate population of 250,000 souls, besides the 1,750,000 in New York and Brooklyn. Detailed surveys and the statistics of annual rainfall show that the Adirondack watershed is capable of furnishing an average of nearly 1,400,000,000 gals. daily without trespassing upon the river supply available for canal and manufacturing interests. This grand and beneficent project must evidently, before many years, be put in process of actual construction. It is greatly to be desired that the State of New York should, as soon as may be, put a stop to the destruction of the Adirondack forests, and reserve a principal part of that region for a park, thus preserving this region as a sanitarium for the commonwealth, as well as the source of a beautiful supply of good healthful water for the entire Hudson valley.

New South Wales Copper.—Considerably over a quarter of a million copper cakes and ingots were exported from the colony during the first five months of the present year.

Privileges of French Railway Servants.—Servants of French railways have exceptional privileges over English, German, or American railway men, such as reduced rates of freight when consigned to them, and an unusual number of personal passes. The company will also supply them with provisions and wines of all sorts at the lowest wholesale rates, and if stationed at points where such articles are exceptionally dear, where the company cannot conveniently keep store-houses, they receive certain additions to their wages, expressly designated as an indemnity to meet such cases. They are allowed to purchase their fuel at the same rate as that paid by the company, while in the case of sickness they are attended by the company's physicians, and supplied with medicine gratuitously. Besides, the French companies allow what are called "primies" to all engineers and firemen for economy in machinery and fuel. The orphans of all servants killed while on duty are placed in orphan asylums at the expense of the company, and are kept there until they are seventeen years old.

Association of Municipal and Sanitary Engineers.—The members of the Lancashire and Cheshire district of this association held a meeting last Friday, at Blackburn. The president, Mr. R. Vawser, M. Inst. C.E., of Manchester, presided, and there was a good attendance. Mr. S. S. Platt, borough engineer of Rochdale, was unanimously re-elected secretary of the district for the ensuing year. Mr. J. B. McCullum, borough engineer, read a paper, describing the various municipal and sanitary works of Blackburn. The principal points of interest were connected with the sewerage and sewage farm. The drainage of part of the area added to the borough being too low for the outfall sewers, it is pumped up to them by two hydraulic engines fixed in a chamber under the roadway, and worked by a 6in. water main. These pumps are together capable of lifting a million of gallons per day to the height of 20ft. No attention is required except oiling, and the estimated cost for water is £20 per annum. There are two sewage farms, which have cost £114,000. One entails a loss of about £600 and the Smalesbury farm yields about £900 per annum, or a little more than 1 per cent. on the £69,000 expended. The sewage has to be conveyed across two ravines, and in crossing the first the sewer, which is constructed of wrought iron, takes a leap down of from 80ft. to 90ft. in a perpendicular shaft. From the bottom of this shaft a tunnel passes through the hillside, at a height of about 40ft. above the river. A wrought iron tube bridge, of three spans of 40ft. each, crosses the ravine—the sewage being at this point under very great pressure—and the conduit is continued under pressure for a considerable distance up the hill, the summit of which is tunnelled through. The next ravine is crossed by an embankment containing some 14,000 cubic yards of earth, and the two next by means of wrought iron tubes, each of 40ft. span, the stream passing underneath these syphons. Mr. McCullum gave particulars of the gas and waterworks, of the various public buildings, with details of the working of the highways department. A discussion followed, in the course of which it was stated that the syphons were kept free by the sewage being first strained; and it was explained that the charges made for constructing private streets were negatived by a private Act. After lunch the various public works Mr. McCullum had described were visited and inspected, and the members dined together in the evening at the White Bull Hotel.

RAILWAY MATTERS.

THE South-Eastern Railway supremacy in unpunctuality provided its chairman a few days ago with the pleasure of about an hour's waiting for destination near Dover.

THE works of the Zaribrod-Sofia-Vakarel, Bulgaria, Railway have been begun and are proceeding fast, as the contractors have handed over portions of the line to several sub-contractors.

SIR ANDREW CLARKE recommends using the Suakim-Berber railway material for connecting the forts in rear of Chatham, Portsmouth, and Plymouth, and these with the great railway systems.

THE coroner's inquiry into the deaths of the driver, stoker, and another man, who were killed by the overturning of an engine on the Whitland and Cardigan Railway on Tuesday, the 25th ult., was held at Whitland. Colonel Rich, of the Board of Trade, and other expert witnesses attributed the accident to too high a rate of speed, for which the driver was alone responsible, and it was further stated that the engine was not fit for fast driving with such a train as was attached to it when the accident happened. The jury found a verdict of "Accidental death."

THE approximate weights of the fast trains on the New York division of the Pennsylvania Railroad are given as follows by the St. Louis *Railway Register*:—Engine, ready for service, 96,700 lb.; tender, ready for service, 56,300 lb.; two men on engine, 300 lb.; one combined car, 30,000 lb.; one parlour car, 50,000 lb.; two passenger coaches, 88,000 lb.; 140 passengers, estimated 21,000 lb.; total, 342,300 lb. Coal, estimated 5000 lb.; water, 3700 gallons; average schedule speed, 48·01 miles; maximum schedule speed per hour, 55·08 miles; distance from Jersey City to Philadelphia, 89·06 miles.

ON the occasion of the celebration of the fifty year jubilee of the Belgian railways, the Government of that country have issued some interesting particulars of the state and working of the railways. It appears from these that Belgian State possess 1740 engines, 3367 carriages, and 42,722 trucks, the number of railway officials being 40,459. In the course of fifty years the Belgian railways have carried 750 million passengers and 330 million tons of goods, the total freight being 500 million sterling. It is estimated that the railways have effected a saving to the public of nearly five times that amount.

ON December 31, 1879, the total railway mileage of the United States was 86,497 miles; on December 31st, 1884, the total mileage was about 125,000 miles; being an increase of mileage during that period of about 39,000 miles, or 45 per cent. The *Railway Review* says:—"On December 31, 1879, the total capital invested in the railway system of the States was £960,000,000; on December 31st, 1884, the capital invested was about £1,600,000,000; being an increase during the five years of over £600,000,000, or, say, 63 per cent." These figures seem rather big—£12,800 per mile for American lines looks very like high prices, charging double for single lines.

ACCORDING to *Poor's Manual* just published, the total number of miles of railroad in the United States at the close of 1884 was 125,379, of which 3977 miles were constructed during the year, the rate of increase being 3·17 per cent. The number of miles making returns of their share capital and funded and floating debts equalled 125,152, against 120,552 for 1883, the increase being 4598, the rate of increase being 3·8 per cent. The share capital of the mileage in operation in 1884 equalled 3,762,616,686 dols., against 3,708,060,583 dols. in 1883, the increase equalling 54,556,103 dols., the rate of increase being about 1·4 per cent. The funded debts of all the lines at the close of the year aggregated 3,669,115,772 dols., a sum 168,235,858 dols. in excess of the total of 1883—3,500,879,914 dols.—an increase of nearly 5 per cent.

A RETURN issued last week concerning the railway material shipped for Suakim for the construction of the Suakim-Berber Railway shows that twenty-seven transports, which loaded at Hull, Newport, and London, returned to London after a stay at Suakim with their cargoes practically intact. These amounted to 37,308 tons, and the total hire of the vessels to £93,773. Five vessels discharged part of their cargoes, amounting to 7076 tons, and their hire cost £20,507; six others entirely discharged their cargoes, amounting to 8764 tons, costing in hire £17,933; while two others, which loaded 2691 tons, at a cost of £2454, never left England at all. The total cost of the hire of these transports was £133,667, in addition to which coal, canal dues, and stevedores for loading and discharging them cost £70,000.

GENERAL ANNENKOFF has telegraphed to St. Petersburg that the workshops of the Transcaspian Railway near Kizil-Arvat, which were burnt down last May, have been rebuilt, and that the construction of the railway will now, therefore, be proceeded with much more rapidly. The Tiflis journal *Kavkas* draws attention to the great mistake committed by the Russian Government in regard to the choice of the harbour on the Caspian Sea with which the new line will be connected. It points out that Michailoff Bay is not accessible for vessels of large draught, and is constantly being obstructed by sand, while this is not the case with Krasnovodsk. The *Kavkas* predicts a poor future for the railway, and states that the Government chose Michailoff Bay because it is situated 110 versts nearer to Askabad than Krasnovodsk.

THE number of persons transported in 1884 by all the American lines was, according to *Poor's Manual*, 334,814,529, against 312,686,641 for 1883, the increase for the year being 22,127,888, the rate of increase equalling 7·8 per cent. The number of passengers carried one mile in 1884 equalled 8,778,581,061, against 8,541,309,674 in 1883, the increase equalling 237,271,387 persons carried one mile, the rate of increase equalling very nearly 3 per cent. The distance travelled by each passenger in 1884 equalled 26·24 miles; in 1883, 27·32 miles. The amount received per passenger per mile equalled 2·356c. in 1884, against 2·422c. in 1883. Had the passenger rates for 1883 been maintained for 1884, the earnings from this source would have equalled 212,617,233 dols.—a sum 5,826,532 dols. greater than that received.

THERE appears to be a basis of fact for the *National Zeitung* assertion that the Chinese Government has at last decided to adopt a "forward policy" in regard to railways, and that a contract has been signed with a Manchester firm for making a line from Taku to Tong-Chow. This firm has undertaken to supply the material and the rolling stock, while the Chinese Government is to furnish the capital and the labour. The construction of the line will be left in the hands of the Manchester firm, which will also work it when open. The loan of 100 million florins, for which the Chinese Government is now negotiating with several Dutch and German banking houses, is doubtless, thinks the *National Zeitung*, connected with this project. The *Times* and other journals have lately been eloquent on the grand future for enterprise in China.

THE Hon. F. A. Wright, Minister for Public Works in New South Wales, recently stated that in 1855, when the population of that colony was 277,579, there were fourteen miles of railway, or 19,827 persons to every mile; the capital expended was £515,347, and the interest paid on capital was ·638 per cent., or about 12s. 9d. for every £100. In 1865 the population was 411,388; there were 143 miles of railway open, or 2877 persons to every mile; the capital expended was £2,746,373, and the interest returned was a little over 2 per cent. In 1875 the population was 606,652, and 473 miles of railway were open, or 1283 persons to every mile; the capital then expended was £7,245,379, and the interest returned upon it was 4·396 per cent. In 1883, the latest date to which the returns had been made up, the population was 869,310, and the number of miles of railway open had increased to 1320, or at the rate of one mile to every 658 persons of the whole population. The number of passengers carried in that year was over ten and a-quarter millions, and more than two millions and three-quarters of tons of goods were carried; the total capital expended then amounted to very nearly sixteen millions, on which interest was being returned at the rate of 4·484 per cent.

NOTES AND MEMORANDA.

IN Greater London last week 3111 births and 1177 deaths were registered, corresponding to annual rates of 31·2 and 17·8 per 1000 of the population.

FOR turning and drilling wrought iron and steel, one ounce of a mixture of soft soap, with half its weight of pearlash, in about one gallon of boiling water, is in every-day use in most engineering shops. The work, though constantly moist, does not rust.

THE deaths registered during the week ended August 29th in twenty-eight great towns of England and Wales corresponded to an annual rate of 18·4 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Bolton, Leicester, Norwich, Oldham, Nottingham, and Bristol.

THE medical officer of health of Brighton, Dr. Taaffe, has just issued his report for the second quarter of the present year, comprising the thirteen weeks ending July 4th. He gives the death rate at 15·5 per 1000, or, including 10,000 visitors being added to population, 14·4. The United Kingdom rate for the same period was 19·5. The zymotic rate is very low—only 0·56 per 1000, or 3·5 per cent. of the total deaths.

THE Dutch State Railway authorities have been conducting experiments on the behaviour of different paints for ironwork. They have shown that red lead best resists the action of the atmosphere. It was found, also, that the coat holds better on iron plates cleaned by pickling than when the plates have been scraped or brushed. The trial sheets were pickled with hydrochloric acid, washed with warm water, dried, and oiled while still warm.

SCHULTZE gunpowder consists of nitro-lingin carefully purified and mixed or impregnated with a nitrate or nitrates, other than nitrate of lead, and with or without starch or collodion—the collodion consisting of carefully purified nitro-lignin dissolved in commercially pure ether and alcohol—or pure solid paraffine, provided that the paraffine be free from mineral acid. Schultze blasting powder consists of Schultze gunpowder mixed with charcoal or sugar.

IN London last week 2413 births and 1371 deaths were registered. The births were 276, and the deaths 155, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 18·8 in each of the two preceding weeks, declined to 17·5 last week. During the first eight weeks of the current quarter the mean death-rate was 19·9 per 1000, as against 21·3 in the corresponding periods of the nine years 1876-84.

THE make of pig iron in the United Kingdom for the half year ended June 30th, 1885, compared with the corresponding half of 1884, is as follows:—In 1884, total, 3,991,220 tons; in 1885, 3,807,095 tons. The greatest reductions have been: Cleveland, 63,404 tons; Scotland, 43,444 tons; West Cumberland, 73,120 tons; South Wales and Monmouthshire, 67,086 tons; West and South Yorkshire, 15,565 tons; Northamptonshire, 30,009 tons. The net decrease of make in 1885 is 184,125 tons.

A STATEMENT has just appeared in the *Cologne Gazette* of the cost of restoring and completing the great cathedral from 1823, when the work was resumed after a neglect of nearly three-quarters of a century, down to the 1st of April of the present year. The amount, including a contribution of 250,000 marks from the cathedral tax, was 21 millions of marks, or £1,050,000. This is quite independent of gifts of valuable objects for the religious services or the decoration of the building, and of a large number of private donations and funds for pious foundations.

AMONGST the explosives licensed last year was "dynamite 1 S," consisting of not more than 75 parts by weight of thoroughly purified nitro-glycerine uniformly mixed with 25 parts by weight of a preparation consisting of an infusorial earth known as "Kieselguhr" and carbonate of soda, the said preparation being sufficiently absorbent in quality when employed in the above proportions to prevent exudation of nitro-glycerine; provided that the amount of carbonate of soda present shall not exceed three parts by weight in every 100 parts by weight of the finished dynamite.

IN his lecture to the Institution of Civil Engineers on "Heat Action of Explosives," Captain Noble remarked:—"Helmholz has given an estimate somewhere of the heat that would be developed if our earth were suddenly brought to rest, but if, looking at our earth in an artillery point of view, and following the principles I have to-night laid down, we considered our earth as an enormous projectile, and if we supposed, further, that we could utilise the whole energy stored up in gunpowder, we should yet require a charge 150 times greater than its own weight, or 900 times greater than its volume, to communicate to the earth her motion in her orbit."

THE production of open-hearth steel ingots in the United Kingdom, and in each district thereof, for the half-year ended June 30th, 1885, was, accorting to the British Iron Trade Association Report, as follows:—Scotland, 126,155 tons; South Wales, 77,986 tons; Lancashire, Cheshire, &c., 22,433 tons; Sheffield, Leeds, &c., 31,450 tons; North-East Coast, 26,825 tons; other districts, 6439 tons; total, 291,288 tons. The production of open-hearth steel ingots during 1884 was 461,965 tons; so that the above production for the first half of 1885 is at the rate of 120,611 tons per annum in excess of the production of 1884. The increase has chiefly taken place in the Cleveland district.

A TAPERING round tower of cast iron, weighing 200 tons, rises from the floor of the Colwell Ironworks foundry to the roof. It is the shell of the iron light tower to be erected on the Delaware Breakwater. For three months a large force of workmen have been casting the 150 plates that compose the shell. This novel and expeditious method of constructing lighthouses has but recently been put in operation by the United States Lighthouse Board. This shell sets the light 80ft. above water, and has a circumference of 66ft. at the base and 54ft. at the top. The lighthouse is all made, tested, and inspected at the works, and on arrival at its concrete foundations will receive an interior lining of brick. This new variety of lighthouses can be built very rapidly and at comparatively small cost.

IT is stated of the new metal gallium that, with the exception of mercury, which only becomes solid at 37·9 deg. Fah., there is no other element which liquefies at so low a temperature. It melts at 81·1 deg. Fah., so that it liquefies when held in the hand. The metal is hard and resistant, even to a few degrees below the melting point. It can be cut, and possesses a slight malleability. When fused, it adheres easily to glass, on which it forms a beautiful mirror, whiter than that produced by mercury. It oxidises but very superficially when heated to redness in the air, and does not become volatile. Unlike lead, it acquires only a very slight tarnish on exposure to moist air. Its specific gravity is a little under 6, that of aluminum being 2·6, that of zinc 7·1, and that of lead 11·4. Unlike lead, again, gallium is a highly crystalline metal, its form being that of a square octahedron. In its chemical characteristics, the rare element gallium shows the greatest analogy to the abundant element aluminum.

THE population of Germany was in 1872 41,228,000 persons; in 1883 it had risen to 45,862,000. In eleven years, therefore, the increase of the population was 4,634,000; and yet during those eleven years there had been a very large emigration from Germany. The authorities are unable to ascertain the amount of emigration over the land frontier; but the sea emigration has risen very largely. In 1871 only 75,912 persons left German ports and the port of Antwerp for countries beyond the sea; the next year it rose to 125,650; but then it rapidly declined until in 1877 only 21,964 persons emigrated. The number then began to increase until in 1881 there were as many as 210,547; and since that time there has been a slow decrease. The German Statistical Department computes the German residents abroad at a little over 2½ millions, of which nearly two millions are in the United States. In Switzerland there are as many as 95,262 Germans; in Austria, 93,442; and in France, 81,988.

MISCELLANEA.

THE Antwerp Exhibition is to remain open till the 15th of October next.

A VERY fully illustrated catalogue of fire-extinguishing machinery and apparatus, fire-escapes, hydrants, and all the articles forming the fire-extinguishing plant of a town, has been published by Messrs. Merryweather and Sons.

THE Chesterfield and Midland Counties Institution of Engineers—Lord Edward Cavendish, M.P., president—will make its Leicestershire excursion on Tuesday and Wednesday, the 8th and 9th inst. A number of papers will be read and various works visited.

A PIECE of very rapid well-boring is reported by Messrs. Le Grand and Sutcliff, at Brick Kiln Farm, Wolverton, near Stony Stratford, where they bored 50ft. of artesian boring, of 5in. diameter, in a single day of eleven hours. Previous to this, they say, 40ft. was the greatest depth reached in one day.

LIEUT. HILLIARD, navigating officer of the Orion, has made a long and careful survey of the entrance to Alexandria. He finds that the channel to the east of the present Boghaz Pass requires very little deepening, by dredging or dynamite, and the ground being soft the expense would be small. The channel would be available night and day, and is desirable especially for the English Navy. As at present the Orion is the only large ship of the Mediterranean fleet able to enter the harbour.

ON the 26th ult., Major Tulloch, R.E., held an inquiry at the Bexhill-on-Sea Board-offices, with reference to the application of the Local Board to borrow the sum of £6700 for works of sewerage. The scheme was explained by Mr. Bertram Nichols, C.E., of Birmingham, the engineer appointed by the Board, and evidence was given by Mr. Sydney Smith, the Board's surveyor, on behalf of the scheme. After the inquiry Major Tulloch, accompanied by the chairman—Colonel Lane—the engineer, and the surveyor, went over the ground, and examined the district. There was no opposition to the application.

A VERY serious strike is at present in progress amongst the engineers, mechanics, and smiths at Copenhagen, caused by the demand made to employers that a minimum rate of wages of 3½d. per hour should be paid to all workmen alike, irrespective of the work performed. With this the former refused to comply, considering the same equivalent to putting a premium on idleness. The strikers being encouraged by the socialistic association to which they belong, the entire body of manufacturers have dismissed all the workmen in their employ belonging to the same, a step which will no doubt have the effect of compelling them to submit. At present, however, many engineering firms are obliged to complete contracts into which they have entered from abroad.

DR. FRANKLAND reports to the Registrar-General the results of the chemical analyses of the waters supplied to the metropolis during the month of July, and states that the Thames water sent out by the West Middlesex, Southwark, Grand Junction, and Lambeth companies contained less organic matter than in the previous month's samples, while the organic matter in the Chelsea Company's water, although very moderate in amount, was slightly in excess of that present in the others. All the samples were clear and bright. Of the water taken from the Lea, that distributed by the New River, Company contained a remarkably small proportion of organic matter, the amount being but little more than that of the deep well waters. The East London Company's supply resembled the Thames waters. Both waters were clear and bright on delivery.

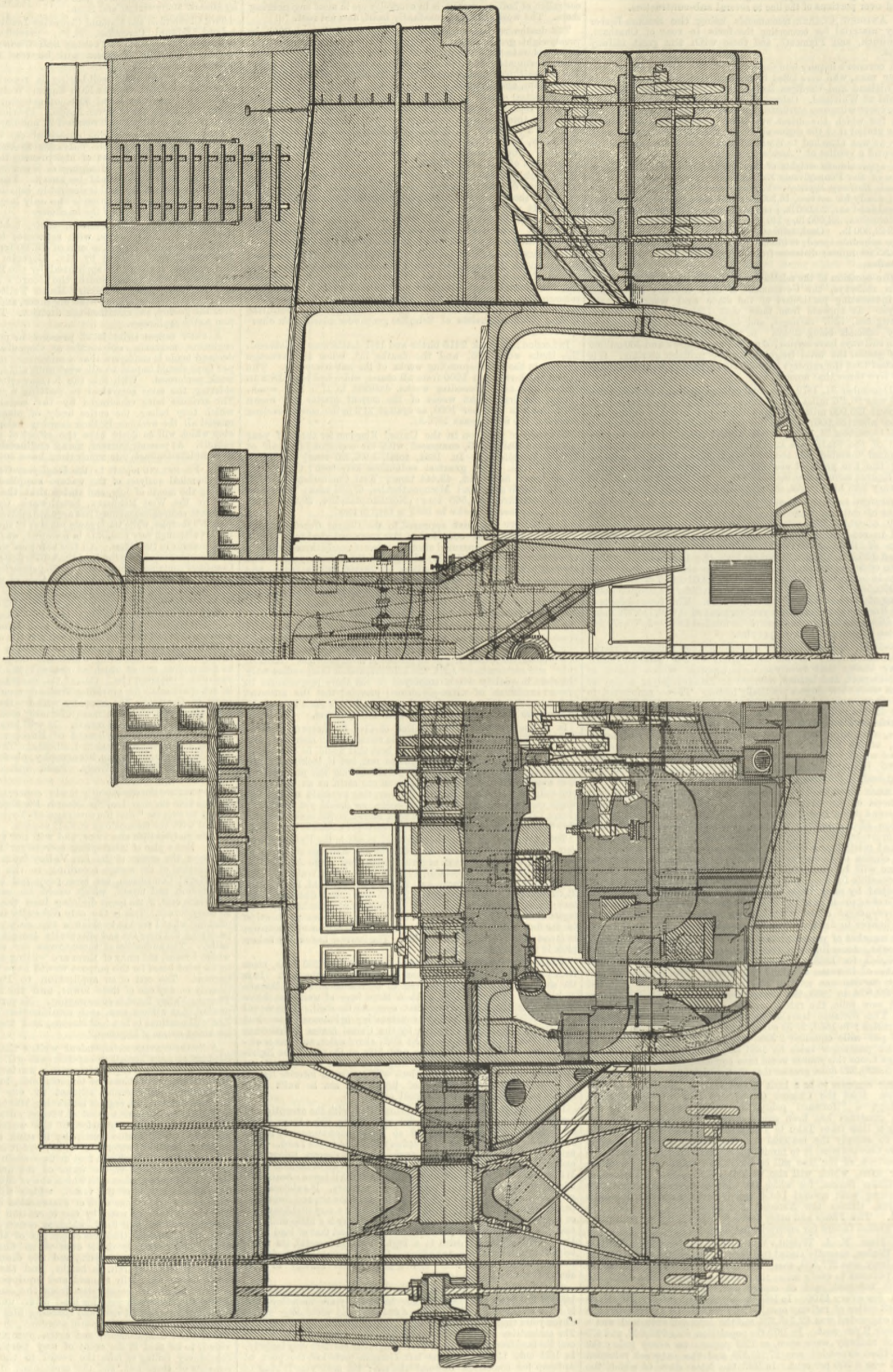
THE *United Service Gazette* says:—Colonel Thackeray, the commandant of the Bengal Sappers and Miners, is taking a step which will result in the formation within the corps of small bodies of men, each thoroughly qualified to perform well one or other of the operations in engineering which the corps may be called upon to accomplish, and of which at present the men can have but a vague and imperfect idea. One of the companies of the corps is to be set apart solely for providing trained men to supply technical work in the field. The company will be formed of picked men from the entire corps, the most efficient men in each branch of sapper work being drafted into it. It will be subdivided into seven squads, each with a complement of European non-commissioned officers and native commissioned officers. The squads will be for torpedo, telegraph, printing, lithography, photography, pontooning, and company duty respectively. Each unit of the company will thus be complete in itself.

RESPECTING the stir recently made concerning the discharge of sewage into the river Lea, Sir Joseph Bazalgette writes that it is wrong to suppose "that the sewerage of Tottenham might be connected with the metropolitan outfall sewers. They were designed for the metropolitan area alone, and will not suffice for an enlarged area. But a plan of intercepting sewers for the diversion of the whole of the sewage of the Lea Valley from that river, and the purification of the sewage according to the recommendations of the Royal Commission, has been prepared by Messrs. Law and Chatterton and myself, which could be carried out at a very moderate cost, if the towns draining into the Lea would combine to carry it out. This is the only difficulty in the way to accomplishing what I venture to think is the only means of thoroughly purifying the river Lea and effectually draining the towns in that valley. The authorities of those towns are aware of the plan to which I refer, and many of them are willing to carry it into effect, but a joint board for this purpose would have to be formed by Parliament. The cost of an application to Parliament would fall heavily on any one of these towns, and the failure of the Lower Thames Valley Board is discouraging. Nevertheless, I venture to predict that without some such combination and works, the river Lea will continue to be a foul stream, and the polluting sewage a constant source of litigation."

A SCANDINAVIAN correspondent writes that in the early part of September some important experiments will be carried out in the Sound with the last engine of torpedo warfare, constructed by M. Nordenfelt, viz., a submarine torpedo boat, built at Karlsvik, near Stockholm. This terrible adjunct of our modern destructive warfare is fitted with engines indicating 100-horse power, and will, it is said, easily attain a speed of fifteen miles an hour above, and thirteen miles below the surface of the water. When the boat is about to attack a hostile vessel, she is sunk to the required depth by the admission of water into tanks, but it is only intended to be submerged to the depth of a foot or two when about to attack. On catching the shadow on the water of the unsuspecting war ship, the Whitehead torpedoes with which she is equipped are discharged against the bottom of the vessel, which will have the effect of sinking her. When the work of destruction is complete, the boat re-emerges from the water by the operation of special automatic machinery. The hull itself, which is constructed of Swedish soft steel, of a minimum thickness of ⅛in., is of the cigar pattern, and is only with difficulty visible even when floating on the surface. The length of the boat is 64ft., and the diameter about 8ft., the engine room being 7½ft. in height, and the gross weight of the whole vessel when fully manned and equipped is 60 tons. A sort of bell-shaped glass cupola rises from the centre of the boat, into which the steersman puts his head when under water, thus commanding an all-round view, and enabling him to direct the general movements of the craft. In case of accident, the vessel is divided into water-tight compartments, and extra pumping machinery is provided, to be used in the event of any portion of the automatic machinery failing to raise the vessel to the surface. The crew consists of three men, and the armament of four torpedoes, two being of the "fish" pattern, and two of the ordinary spar kind. Against such an insidious foe as the boat constructed by Nordenfelt, it is obvious that the ordinary wire netting for the defence of ironclads from the hitherto employed torpedo boats will be useless; and if the boat fulfils expectations, warfare with our present huge vessels promises to be in serious jeopardy. The trials about to be carried out in Sweden will be witnessed by naval officers of various nations.

THE MAIL STEAMER, IRELAND—CROSS SECTIONS THROUGH BOILER AND ENGINE ROOMS.

(For description see page 158.)



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*** *In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a* 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.*

W. H. (Belfast).—*Yes.*

NEMESIS.—*If you are prudent you will not invest your money in the scheme.*

C F.—*We do not know where you can get soft steel wire made by the Clapp-Griffith process. Perhaps some of our readers can help you.*

B. A. T.—*Write to Mr. Henry Faija, M.I.C.E., 4, Great Queen-street, Westminster. There are books published on the subject by Messrs. E. and F. N. Spon.*

ENQUIRER.—*It would be quite impossible to give you a general answer. In no two engineering shops do things cost the same price to produce. The skill of the producer is shown by producing at low rates. A good manager will make a business pay a fair profit when a bad manager would work at a dead loss. The cost of rent, coal, labour, taxes, gas, railway carriage, all vary in different districts, and we shall not go too far if we say that one-half the engineers in business do not know what the individual parts of the machines they make really cost. A treatise on cost might be written with advantage. Nothing short of a treatise could answer your questions.*

THE ANTWERP AWARDS.

(To the Editor of The Engineer.)

SIR,—We beg to refer to your last edition, in which appears on page 169 the list of awards at the International Exhibition at Antwerp; but we are sorry to see that our firm was omitted, although we received the gold medal, and we shall be glad if you kindly will correct this in your next edition. C. W. JULIUS BLANCKE AND CO.

39, Bridge-street, Manchester, September 2nd.

CRANE BRAKES.

(To the Editor of The Engineer.)

SIR,—I should be obliged if any reader would kindly assist me to make the following calculation:—I have copied this table for a crane brake from a German book, but it only applies to one coefficient of friction for iron on iron = ·18. The question is to construct a table for any other coefficient of friction, as, for instance, wood on iron = ·5.

·2	1·25
·3	1·4
·4	1·57
·5	1·76
·6	1·96
·7	2·21
·8	2·47
·9	2·77
1·0	3·1

The right-hand column is the natural tangent for the coefficient of friction = ·18. The left-hand column is the proportion of surface of the periphery of the wheel gripped by the band. CRANE.

August 29th.

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MEETINGS NEXT WEEK.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.—The next meeting will take place at the Cannon-street Hotel on Saturday evening, the 5th inst., at 8 p.m., when Mr. R. J. Dawson—of Messrs. Merryweather and Sons—will read a paper "On Steam Tramway Locomotion of Modern Practice."

BRITISH ASSOCIATION.—Aberdeen meeting commencing on the 9th inst.

THE ENGINEER.

SEPTEMBER 4, 1885.

SANITARY WORK IN INDIA.

IT is with great gratification that we hear of steps being taken to promote among our Indian fellow-subjects of the Queen, the observance of those sanitary measures, the neglect of which in past ages may be held largely to account for the fact that cholera has always been more or less normally present in that country. The state of the drainage in what is known as Black Town, *i.e.*, the native quarter of the city of Madras, has long been a standing reproach to its municipality; but it is only within the last few weeks that that body has raised a loan in this country in order to enable the evil to be dealt with on an adequate scale It is not, however, to measures of that class, necessary as they are, that we desire to direct attention in this article. Steps are now being taken with a view to purifying individual habitations, and these are being initiated in a spirit of caution, but yet with a completeness of detail, that bid fair to win success. The Indian native is perhaps one of the most conservative beings in creation. It is hard to move him out of habits that have descended to him from generations immemorial, and the attempt to do so now has had, therefore, to be undertaken with a reserve to which we could hardly reconcile ourselves in such matters among our own population. One of such habits, the result of long-established custom and of that strong love of family privacy which distinguishes Eastern races, has been the association of the increasing members of the family upon the plot of ground upon which its progenitors first settled. Although that might well have sufficed for such first settlement, it does not take many years, as the sons of the family marry and each builds himself a hut within their boundaries, to seriously overcrowd such plots. It becomes impossible under such conditions to expect the observance of those cleanly customs to which, to their credit be it spoken, most of the natives of India adhere.

The action to which we have above referred, we are pleased to see, owes its initiation to the local municipalities of the larger towns. Such bodies in India have had as yet but a very short existence, and hitherto they can hardly have been said to have justified the expectations formed respecting them when they were first established. The advance now made seems, however, to point to the fact that their members are awakening to a sense of their proper functions. They could not have marked that awakening more favourably than by showing themselves alive to the necessity for by degrees bringing the mass of the people to a fuller observance of sanitary precaution. We have before us a document which affords strong proof that under proper guidance these municipal bodies may yet achieve considerable things. This document is issued by the Government of Madras, and under its title of "Private Scavengering" it reviews the steps taken by the municipal bodies, under the surveillance of the chief authorities, to arrange for the emptying of house latrines, and doing other scavengering work, instead of leaving such matters, as has been the case in the past, to the arrangements of individuals, the defective nature of which and its cause we have above pointed out. In some six municipalities this new departure appears to have already passed beyond the merely experimental stage, and the numbers of the natives who voluntarily avail themselves of the system is stated to be increasing. It was, of course, owing to the conservative tendencies of the natives previously quoted, necessary to proceed in the tentative steps taken with the utmost caution, in order to avoid shocking those notions of family privacy which so strongly prevail among them. No attempt was therefore made to force the adoption of the new system among them. It has been wisely left to the effect of time and example to ensure its development, and so the old habit has gradually given way before the advantages which it was soon recognised the new plan secured.

From that portion of the State paper which gives *in extenso* the details of procedure adopted by the Municipality of Calicut we learn the character of the measure by which this improvement has been introduced. A meeting of the municipality determined, in the first place, the locality and area over which to insert the thin end of the wedge, and that area was subdivided into blocks clearly marked upon the map of the township by variously coloured lines. A proclamation was then issued of the intention, at a given date, to close all private cesspools, and a house-to-house visitation was made to endeavour to secure the promised adherence of the families to a system of scavengering to be carried out by municipal agency; the heads of such families signing a printed form, binding them to pay a small fixed sum in advance for the performance of that service. The option was given to the householder visited either to use—he and all his household, men, women, and children—the public latrines already erected or to be further erected by the Municipal Commissioners, or to execute a printed agreement in the terms above named. When offering such option, however, the householder was distinctly warned of the intention to close at an early date all private cesspools, and that after that intention had been carried into effect rigorous prosecution would be resorted to if the cesspool was still surreptitiously used. The result of this visitation has been to enable the Commissioners to determine the number and locality of the public latrines required for the accommodation of those whose means or prejudices prevented their adoption of the alternative offered. The provision of the latrines must, of course, precede any arbitrary closing of the private cesspits. This stage having been reached, the system of private scavengering was then introduced experimentally into certain of the blocks marked on the town map, and after its fullest possible extension, then, and not till then, were the private cesspools arbitrarily closed within the limit of the selected area. Depôts for the disposal of night soil were arranged for as the working of the system extended, and it was contemplated to pass the vegetable refuse through incinerators, and mix the night soil with the ashes, so as to form what might constitute a really valuable manure.

Such is a brief outline of the plan upon which this most important reform in the social custom of the natives of India has been inaugurated. We can hardly doubt but that, with perseverance, and care exercised in not unduly enforcing what is intended to proceed upon a voluntary basis, the extension of the reform will be but a matter of time. Dwellers in India have often remarked with gratification the exceeding care with which native compounds are swept two and three times daily; but this is but a cleansing of the outside of the platter. Below that clean-swept surface the whole soil has become impregnated with the deposits of years of the several families living within exceedingly narrowed limits; and, sweep and clean the surface as they may, the natives cannot escape the consequences of such impregnation. Not only do we cordially congratulate the newly-formed municipalities of India upon their attention to family sanitation, but we accept it as affording evidence that, step by step, we may expect to see such bodies emerging from the condition of *laissez faire* with which they have hitherto been reproached. We have been told, and we know from personal observation, that the natives of India have hitherto been unfit to exercise the rights of representation. We have never concluded, however, that the day of such fitness would never arrive; and we welcome gladly, therefore, this instalment of proof that that day may be approaching more rapidly than the Anglo-Indian of the last generation could possibly have anticipated.

SCHOOL AND COLLEGE TRAINING FOR ENGINEERS.

THE number and scope of subjects more or less expedient to be studied by youths proposing to enter any of the liberal professions increase and extend year by year. The means of and facilities for study have almost kept pace with them. Another factor in the question of education, however, remains, and must remain, ever the same. It matters nothing whether a youth undertakes five subjects or fifty for study, he has but twenty-four hours in a day for study, food, rest, and recreation, and if an undue number of the twenty-four be allotted to the first of these, nature asserts herself, and the student's body suffers. Of all the professions, none more than engineering demands vigorous health for its successful pursuit; consequently the means of training need attention on the part of parents or guardians. The present system consists in sending the child to an elementary school, then to one more advanced, next to college, finally to the workshop or the field, and to the drawing-office. Civil engineering is as ancient a profession as either law or physic, but, unlike them, it seemed to have died out as a profession for some centuries until the railway era revived it. The means for learning physic are as complete and practical as they can be. The student has not only to read, but he has to attend at the bed-sides of patients, and oftentimes when some of these patients die he is able to dissect their bodies and see the effects of at least certain diseases. In law all a student can do is read, listen to lectures, and attend the courts, and rarely does he get a chance of exercising his calling by receiving a brief till well advanced in middle life. Ever since the development of steam power, and especially in its use for locomotion, and the revival of engineering consequent thereon, the means for training students in the profession have been developing, following for the most part the lines laid down for the study of medicine. It would seem that, during the middle ages, both the science and the art of civil engineering became totally lost, and had to be learned all over again; but at present it deservedly ranks with any other of the learned professions. At the same time, however, it is one comprising so many branches that it is no longer sufficient for a parent or guardian to simply say, "I will make my son an engineer;" he must also decide which branch of the profession his son or ward shall take up. Evidently mining engineering requires a different training from that necessary to qualify a man to construct docks or railways. The formation of such institutions as Owen's, King's, University, and other colleges, besides some smaller schools established in connection with their works by certain large firms for the benefit of their apprentices, all supply ample facilities for study to industrious youths, while periodical examinations gauge pretty clearly the various capacities of the students, and bring the influence of rivalry to bear as a stimulus.

There is, however, another aspect of our present school and college systems deserving of criticism. We have adverted above to the influence exercised by time upon study, and it is to be feared that the prevailing fashion of teaching one and the same boy or class a great variety of subjects, if not checked, will so increase as to have the effect of merely imparting a superficial acquaintance with each, but conferring no real thorough knowledge of any, as well as creating a confusion of ill-digested ideas in the student's mind. It almost seems time in some way to codify engineering studies, and to lay out a programme of particular subjects pertaining to each special branch of engineering, and that teachers and students alike should confine themselves strictly to it, excluding rigidly everything superfluous. There is danger in engineering schools that their curriculum will be as diverse by-and-bye as are the subjects considered appropriate for a health or other nominally special exhibition; and the absence of concentration will beget confusion in the student's mind, and result, as we have said, in superficiality. "Grooviness"—too narrow a field of study or practice—as we observed in a former article, is to be avoided; but a tendency to the other extreme is still more to be shunned. As regards intermediate school training, the cram system prevails to too great an extent, except for boys of exceptionally fine abilities, well endowed with very robust health, and for boys intended to become engineers the system has certain evils. Thus, as the careers of engineers in the future will be for the most part abroad, it is of the greatest importance that the student should have a thorough knowledge of at least one European language, say either French or German; better, far better, that he should know both. Not know them in the fashionable and conventional sense, but in such fashion that he can take charge of foreign workmen or a staff of foreign assistants, to understand and be understood by them. If his time only admits of his giving two hours a day to study languages, then instead of splitting that up amongst Latin, Greek, and two or more modern languages, let him rather throw the classics aside, and give all the time to a living tongue in general use. Apart from the administrative or executive use of a familiarity with French or German, there is that the power either confers on its possessor of studying the engineering literature of its country, and comparing it with that of his own. Again, in some branches of engineering a familiarity with shorthand is of far greater use than one with the differential or integral calculus. Unfortunately, as education at intermediate schools is now imparted, a uniform method seems to prevail at all. A system is established resembling an educa-

tional bed of Procrustes, to which the mental powers of the students are fitted; and a boy who will especially need in after life to be a proficient in certain subjects has to waste much useful time studying others, which, however important, perhaps, to his next class-mate, will be perfectly useless to him.

It may and no doubt will be argued that in a large school it would be impossible to give special training to several sets of classes—to subdivide the school into a number of smaller seminaries. Exactly so, and this brings us to the fact that in consequence of the advancement of knowledge we are rapidly approaching the time when, at all events for engineering students, special schools must and will be started which, while imparting the general education of a gentleman, will at the same time exclude all studies save those directly or nearly cognate with engineering, and where students can be most efficiently prepared for the engineering colleges, the fields, or the workshops, whither they will subsequently go. If it be desired to grow a particular flower in the best manner, then the soil must be specially manured beforehand, as the same earth will not suit all equally well; the same reasoning applies to the preliminary preparation of the engineering student for his particular studies. In this matter it is just at present difficult to anticipate how or when a reform of the existing school system will come. There are, however, indications that changes will be introduced. The City of London Guilds, for example, appear to very clearly understand what is wanted. Individual parents or guardians have no power; neither, it would seem, have the heads of individual schools. The former have to send their boys to the best schools they can afford, and the boys have to take up the school course, that or nothing being the alternative. The heads of schools, individually and single-handed, can do little, however well disposed, for reform; besides, the present system works well as a whole, and pays well too, so there is little inducement to masters to initiate or agitate for change. It is true that it might prove profitable to qualified men to start special schools for engineers, but such men are either too poor to embark in speculation or else are already satisfactorily employed. It is certainly open to parents or guardians to resort to home tuition, but this is expensive, and is also bad for the boys so taught. Home teaching lacks that spirit of emulation begotten of rivalry, and which is itself one of the best features of the school system. Home training does not accustom boys to the world and its ways, it cannot teach them their own level, or give them that courage, coolness, and self-confidence so absolutely essential in men who in after life will be called on to decide, and that quickly, on points of great moment to public or private interest, and to know how to get good results from very defective appliances.

Passing from the school to the college, defects here again are to be found in greater or less degree in the tendency of their systems to dilettantism; they are too often leavened with that unfortunate contempt for practical work that prevents the thorough welding of theory with practice, a lack of which brings engineers afterwards in too many cases into contempt with contractors or their own executive staff. There is, too, one point in education apparently overlooked at all centres of instruction. The expediency, if not the absolute necessity, of cultivating habits of observation in the minds of students does not seem much attended to. All the daily surroundings of the engineering student are replete with instruction to the observant mind. Every railway station is a valuable subject of study; every engine and carriage in it teaches something. Numbers of engineering students visit watering places during their holidays. At many of these watering places there are iron promenade piers, easily inspected underneath from a boat. Do any of the students, when out for a row, ever think of taking a note book, and, tying up their boat under a pier, make sketches of the joints or arrangements of the several parts? Here, we repeat, is a volume of essentially practical matter for the student; but we again ask, Are college students taught to observe these things? We have known young fellows, pupils in an engineer's office, come down from time to time to see a large iron lattice road bridge in course of erection; but they never left the casual spectator part of the works, nor asked a question, or took a note. Here they had no one to blame but themselves, save and except in so far as that they had never been educated in habits of personal observation.

To sum up our criticism on the prevailing system of preparing and finishing students for the practice of engineering of whatever branch: The preparatory school system ought to be more condensed in its field, excluding anything not likely to be useful, such as a study of dead languages to the exclusion of a mastery of living tongues. The college course ought to give prominence to practical pounds, shillings, and pence costs of manufacture, as well as to practicability of construction or execution, and not confine the student too closely to mere theory alone, and, above all, habits of observation should be cultivated.

Before we conclude this article we will say a word about examinations. The education of a son for any profession, engineering included, is costly, and oftentimes it is the only legacy that a parent can bequeath. However hard the son may work, nevertheless much of his after success in life will in very many cases depend upon how far successful he may be in passing his examinations, therefore examining bodies have great responsibilities imposed upon them. They should refrain from putting "cut questions" or cruxes as puzzles or stumbling blocks in the way of the students, simply confining themselves to the exercise of their proper functions of testing the acquirements of the examinees, without prejudice or partiality. Engineers do not as yet require by law licence to practice; but the great unwritten law of public opinion gives preference to the man with his degrees over the man without them. Hence no one should lose both his degree and his expenses, simply because he is unable to answer curious special questions. It may be pointed out that in nearly all great public schools there is a "modern side;" but, unfortunately, the modern side does not find much favour. We are perfectly alive to all the advantages that a liberal education comprises; but the additions made daily to knowledge are enormous, and it is obvious that no one boy can learn everything. The questions we have raised have, we are happy to add, for some time attracted the attention of those best qualified to deal with it, and a candid expression of opinion on the part of parents and guardians would help to hasten a change for the better in the earlier education of engineers.

GAS PRODUCTION.

On several occasions we have in The Engineer drawn attention to the question of the extent and cost of production of gas in specific localities. It may now be interesting to notice it in one of the towns on the edge of the Durham coalfield. In the past year—ending with June last—the Hartlepool Gas Company carbonised a little over 15,100 tons of coals, so that its production of gas may be taken as over 151,000,000 cubic feet. The coals, the cost of loading, &c., amounted to £5502, so that it is evident that there is the advantage of cheap fuel. When labour, supervision, renewals, &c., are added, the cost of the manufacture of the gas was £9374, apart, of course, from interest. The receipts from gas, which is chiefly sold at 2s. 6d. per thousand cubic feet, were £16,491, and when residual product receipts, &c., were added, the total was for the year £22,458. The distribution of this gas, the management, and other items, brought the total expenditure up to £13,300, so that there was on the year's working the very satisfactory balance of £9070. We need not pursue the matter into the question of the dividend, for the company is both a gas and water supplying company; but it may be added that the capital expended on the gasworks, plant, &c., was about £147,000, and on the gasworks alone it would seem that there is a fair dividend attainable. As we have said, the company has the advantage of coal comparatively cheap, and though its area of distribution is a large one, and there must be of necessity a heavy cost in mains, pipes, &c., in that area of distribution, yet with a sale of over 106,000,000 cubic feet at a price which is not the lowest in the county it is in, it must be concluded that the result is a fair one for the owners of the works, and with possibly a further increase in the future consumption there would be a yet better return.

RAILWAY COMMUNICATION.

One hears a good deal about the importance of effective communication between passengers and the guards of railway trains, and there is no minimising the consequence of such arrangements. Yet there is another form of railway communication never even mentioned, which seems to be worthy of some consideration. The other evening a brief delay took place on a well known Northern line. The train, known as the dining saloon express, travels so swiftly and promptly to its hour, that a few minutes behind time sets the public by the ears. Passengers were waiting at a great Yorkshire station, and as the delay reached fifteen minutes, the curiosity deepened to anxiety. All that could be gathered of the whereabouts of the express was that it had left a station fifteen miles away up to time, and had not been heard of since. After six minutes further delay the express steamed slowly into the station. It then transpired that within three miles of the station "a heavy goods," lumbering up the hill, could not make headway, and the express had to wait patiently till the "slow" had safely climbed to the summit and reached a roadside station to be shunted. The point is this:—Is it impossible to have some ready means of communicating to a great station, so near at hand, the real cause of the delay, so as to obviate all unnecessary alarm? This incident occurs on a part of the line belonging to a company which is singularly careful of the comfort and feeling of all concerned when a calamity happens, and it is not likely to neglect any suggestion which is in harmony with a humane and sensible policy.

HAMMERSMITH BRIDGE.

A visit lately paid to the works of reconstruction proceeding at Hammersmith Bridge has informed us more fully as to their character and the nature of the design to be carried out. We learn that all idea of utilising the present suspension chains has been abandoned. They will be entirely removed, and instead of four-bar chains as now existing, two only, of steel wire cable, will be used. The contractors are now actively engaged upon the excavations at either end of the bridge for the massive anchorages of concrete which the increased scope of the new structure will necessitate. Those which have served this purpose in the past have now been laid bare. They are about 24ft. in length by 18ft. in depth and width. Those to be constructed, and which will embody the existing anchorage blocks, will be 40ft. in depth and about 60ft. in length, with a width extended to 36ft. The large increase of dimension to be thus given to the new anchorages evidences the extended character contemplated for the new bridge. This will enable it to be free from the disabilities of that it supersedes which the increasing traffic caused to be severely felt. When last noticing this work we referred to the inconvenience of only a single footway on the temporary bridge. We regret to hear that that has been proved to be more than a mere inconvenience, and that several serious accidents—one, if not more, terminating, if we are correctly informed, fatally—have resulted from the want of full provision for the crowds of foot passengers who use this thoroughfare between the two shores of the river.

A BIRMINGHAM SHIP CANAL.

Fired by the success of the Manchester Ship Canal Bill, the Birmingham people are going to have a ship canal to join the Severn at Gloucester, or rather, the preliminary prospectus of such an undertaking has been issued. After setting out the importance of direct water communication with foreign ports and the advantage which Birmingham enjoys from its central position, the prospectus says:—"It is confidently expected therefore that the application to Parliament for the usual powers will be unopposed, or, if opposed, that the opposition will be overcome at trifling expense. Years ago the trade of Staffordshire and Worcestershire flowed down the Severn Valley. By the genius of Brindley, who made canals running northwards, was this trade diverted; it will be but simple justice if, by the exercise of higher genius, and the construction of a grander canal, the trade should be restored to its former course. It may be that engineering evidence will be sought in order to throw discredit upon the project, but experience has shown that the opponents of canals, especially engineers, have always been wrong." Amongst the social and economic advantages which will accrue to the community, the advocates of this scheme mention sea bathing and a cheap supply of fresh fish. "Salt water bathing will no longer be a luxury for the rich alone, and the dwellers in inland cities will not be compelled to submit as each summer returns to the exactions of the seaside lodging-house keeper. It has been estimated that the annual saving to the British householder in the matter of pilferages from the tea-caddy and surreptitious cuts from the joint will alone be sufficient to defray the entire working expenses of the canal." Shrimps, turbot, soles, cod, and other favourite sea fish are to be trained to swim up the canal to Birmingham, Wolverhampton, and other large towns, and "a very large amount is expected to be realised by the granting of concessions to individuals or corporations, granting them the right of sea-fishing in the Midlands." It is confidently expected that considerable thirst for naval glory will be created "by the sight of so many of the finest models of marine architecture," and that a large number of recruits for the naval and merchant services will spontaneously offer themselves. A high dividend may be hoped for; but, as the prospectus concludes, "should no dividend ever be earned, the promoters will have had the satisfaction of constructing a masterpiece of engineering skill; they will have given lucrative employment to many restless intellects; they will have brought healthful breezes and civilising methods to many a home, and they will have redressed ancient wrong and have written a new, inspiring, and glorious chapter in their country's history." Further information may be obtained from Messrs. Tryett, Onne, and Co., 41, Elizabeth Martin-street, Birmingham.

THE MAIL STEAMER IRELAND.

In our last impression we briefly described and illustrated the City of Dublin Steam Packet Company's new mail steamer Ireland. Messrs. Laird Bros., of Birkenhead, by whom she was built and fitted with her machinery, have succeeded in producing the fastest ship afloat, as the Ireland has attained the unprecedented speed of 20·25 knots, or 23·344 miles an hour; not on a measured mile, but in making a run from Holyhead to Kingstown.

On Wednesday morning, the 26th ult., the Ireland left the pier at Holyhead on her first trip to Kingstown at 12.8 p.m. Using round numbers, she passed the end of the breakwater at 12.15, and she passed the lighthouse on the end of the pier at Kingstown at 3.13 p.m.; thus making the trip in two hours fiffty-eight minutes, the shortest time on record. The total number of revolutions was 4395. She returned to Holyhead on Thursday, the 27th ult., passing the east pier head, Kingstown, at 9.57, and the end of the breakwater at Holyhead at 12.58; thus making the return or eastward trip in three hours seven minutes, the best time on record. The total number of revolutions was 4699. From some cause, probably connected with the tides, the run from west to east always takes more time than the run from east to west. On the same afternoon she returned to Kingstown, making the run in two hours forty-seven minutes, or in about twenty-five minutes less time than any other ship. The distance in a straight line from Holyhead to Kingstown is 65 miles. Now, however well a ship may be steered, it is impossible for her to keep an absolutely straight course, and we should perhaps not be far wrong if we put down the whole distance actually traversed as 70 miles; but, neglecting this and adhering to 65 miles, we find that the ship must have maintained an average speed of 23·344 miles, or 20·25 knots per hour over the whole course—a performance which we believe to be entirely without a parallel in rough water steaming.

The run on Wednesday morning was in a sense private. Among those invited may be named Mr. Watson, managing director of the company; Messrs. Laird, Mr. Messam, representing the Postmaster-General; Mr. Sennett, from the Admiralty; Mr. Trevor, of the Board of Trade; Captain Bell, R.N., superintendent of the company's steamers; Captain Cay, R.N., superintendent for the company at Holyhead; Mr. J. Nicholson, marine superintendent; and Admiral M'Kenzie, harbour master. The engines were in charge of Mr. Beavis, representing Messrs. Laird. The ship is commanded by Captain Kendal, commodore of the mail fleet. She is provided, as our readers are aware, with four large fans for creating a plenum in the two boiler rooms, which can be closed for the purpose; but the first run was made with natural draught. The weather was very fine, with a light breeze from the east, or very nearly aft. The smoke ascended straight up from the ship's funnels, and as the vessel ran nearly before the wind, it was impossible to get much aid from the wind sails. For this reason, after the vessel had been steaming for about an hour, the fans were started at a very slow speed, in order to ventilate the stokeholes, which were, however, left open, so that there was no plenum established in them. There was a following sea, which getting under the ship's starboard counter and "hanging there," as a sailor would say, caused her to roll, and thus brought one of her perfections to light. The vessel is comparatively tender; that is, she is not very stable when nearly upright. It is well known that stiff ships are very uncomfortable rollers, while tender ships are the reverse; and the motion of the Ireland is so easy and slow that it is not until the passenger recognises the fact that the vast deck has become inclined to a considerable angle that he is aware of the circumstance that she really is rolling. The engines worked without hitch or difficulty, making about 25 revolutions per minute, and, as we have said, Kingstown was reached in two minutes less than three hours. In estimating the value of this performance, it must be borne in mind that there was a dense haze on the Irish coast, which prevented it from being seen until the vessel was within a couple of miles of it; and in spite of the utmost care it was found that the Ireland had gone out of her course about five miles too far to the north—that is to say, she had described, roughly speaking, a curve with a versed sine of five miles instead of a straight line.

Thursday morning broke cold and gloomy. There was a strong wind from the east and east by north, and evidence of the heavy sea running outside was supplied by the performance of the mail boat which left Kingstown at 7 a.m., and could be seen from the deck of the Ireland. The weather was so unpromising for a speed trial that it was at first proposed to postpone the trip. As, however, a very large number of guests had been invited, it was ultimately decided to cross to Holyhead, and this was

the more to be desired because a test would be supplied of the sea-going qualities of the boat. A train from Dublin brought down some 250 guests, and as soon as these were on board a start was made, the engines turning ahead at 9·47 English time.

Concerning the machinery of this ship it is now time to speak. It is very easy to say that the cylinders are 8ft. 6in. in diameter by 8ft. 6in. stroke, but these figures give no idea whatever of the tremendous dimensions of the engines. Possibly we may be more successful if we say that each cylinder weighs 3·15 cwt., without cover or valves, or as much as a heavy locomotive. There are two piston rods in each cylinder, connected by a crosshead, in which is lodged the crank pin brasses. The crank pin is 24½in. in diameter. The two piston rods alone weigh 4 tons. Each piston weighs 8 tons, and is fitted with packing rings 13in. deep. At 27 revolutions per minute this huge mass of metal travels with a velocity of 459ft. per minute. The total strain on the piston, allowing 30 lb. as the initial steam pressure, and 13 lb. for vacuum, or 43 lb. total, is 351,353 lb., or over 156 tons. There are two slide valves to each cylinder; each valve weighs 1¼ tons. The paddle and intermediate shafts, with crank and crank pins, weigh 47 tons. The air pump excentric, with its strap and rods, weighs 10 tons 15 cwt. Each paddle-wheel weighs 55 tons. The engines are remarkable for the fact that they have no bed-plate. In order to get a long stroke in a shallow ship with a sharp rise of floor, every inch had to be saved, and instead of a bed plate proper, a heavy strip of wrought iron runs round, and is secured to special engine frames and keelsons, so that the engines are virtually built into the ship as part of her structure. In Liverpool it is very difficult to run engines in a ship moored alongside the quay or dock wall, because of the swell created; and it is no matter for surprise that Messrs. Laird were never able to run the engines of the Ireland within the stated conditions at more than ten revolutions per minute. Under these circumstances it was next to impossible to get brasses and bearings in order, and the utmost care was necessary to prevent a hot bearing during the preliminary trips of the ship. There were no hot bearings on Wednesday, but then the sea was smooth; and it is well-known that large paddle engines which will run quite cool when in smooth water may give incessant trouble in a rough sea. This heating seems to be due to the rolling of the ship forcing the shaft endways against the brasses, now at one side, now at another; and as there was every prospect of a rough passage on Thursday, a hand was allotted to each of the four main bearings, and the hose was laid ready for work. During the run there were a few anxious moments when incipient heating manifested itself, but the hose and the oil-can judiciously used cured this, and the much-wished-for lather soon made its appearance on most of the six bearings—that is to say, the four main journals and the crank pins. The former run in brass; the latter on white metal let into brass. For the benefit of a few of our readers, perhaps it is well to say that when a heavy shaft runs with water on it, the oil and water become converted into a species of soap, which makes a lather about a bearing so long as it is running perfectly cool. If heating takes place, the lather is not formed at all, or, if formed, disappears.

Standing on the upper platform, which is level with the main deck, the great cranks, with the tremendous excentric for working the two air pumps between them, present an imposing spectacle. Leaning on the fence round the crank shaft, we look down on the tops of the great cylinders oscillating below. The water from the main bearings has fallen on the cylinder covers, and is unable to escape because of the undercut rib cast round them to prevent oil from running down. This water—a veritable hot pond—swishes backwards and forwards as the engines revolve, a light steam rising ever from it.

Descending to the middle platform, we get a closer view of the cylinders with their gigantic gleaming piston-rods. Here is one of Messrs. Laird's staff taking diagrams under stupendous difficulties. He can only reach the indicator once in every revolution, as it is brought to him by the inclination of the cylinder. During the short interval that elapses when the cylinder, having nearly reached its maximum inclination forwards, has not yet begun to move backwards, the barrel must be slipped off or on. All the leading gear had been arranged before, one end of the line being fixed close to the crank pin bearing. A spring roller secured to the edge of the flange of the cylinder, and fitted with reducing gear, suffices to take up the 8ft. 6in. of line drawn out and wound up at each revolution, and bring it down to a stroke of 12in. or so, sufficient for the indicator drum. The water pouring down from the bearings above, or slapping over the edge of the cylinder, suffices to drench the operator to the skin, and were it not that indicator paper is practically indestructible, no diagrams would have been got; but the operator is clever at his work, patient and indefatigable, and so diagrams are got and in plenty, and very satisfactory diagrams they are, showing that the slide valves have been admirably set.

Walking round the engines, we come to a small doorway in the bulkhead; this doorway is on the level of the main deck, and opens into the boiler-room aft. Here is an air lock, two doors being provided, one of which can be opened at a time, and only one, because the fans on deck are running at over 100 revolutions per minute. The stokehole is closed, and there is a considerable pressure of air. Passing through the air lock, we stand on a platform at the top of an iron ladder. We are at the end of a street of boilers. In this stokehole are sixteen furnaces, eight on each side. There are eight firemen here, besides coal trimmers and water tenters, and the devouring furnaces, urged by a fierce draught, swallow coal almost as fast as it can be heaved into them. The gauges show nearly 30 lb., the pressure to which the safety valves are loaded. Forward of the engines is a precisely similar boiler-room. Economy of fuel is an entirely secondary consideration, though no doubt the engines are as economical as the type can be, because the conditions of working are such that there is little or no blowing off, the *bête noir* of the jet condenser system of working with sea-water.

Let us go on deck and see how matters fare. The ship has a spar deck, and in this respect differs from her older comrades. To move about this deck is a matter of difficulty. The wind is dead ahead. Our own velocity would create a very stiff breeze if it were a dead calm. Put against us running at over twenty miles an hour, a wind at the same velocity, and we are face to face with a whole gale, which seems as if it would blow us bodily overboard. Get under the lee of this screen and look ahead. The bows of the ship rise high and slowly, descend as though they never were going to stop, and then away to starboard and port fly tons of spray in great clouds. Very little touches her deck. Right out near the heel of the bowsprit sits a merry little maiden in working yachting costume, who laughs at the spray that flies round her, as she jams her cap down tight when a stronger gust than usual blows. She is unconsciously supplying admirable testimony to the qualities of the ship. If the Ireland took in seas forward, no one would be there. But the knife-like prow, the lovely, curved lines, take old Neptune in. Before a wave is made, the flare of the hull is over it, and instead of getting a fair chance of coming aboard, it is driven off to port or starboard. Come to the side and look at her wheels. See how quietly they do their work. In spite of the immense size of her floats—13ft. long by 5ft. 6in. deep—little or no surf is raised, and there is none of that thrashing so commonly met with when wheels are badly designed. Here we have another reason why the deck is dry. A splendid sea-boat indeed we have here. Let us turn our backs to the wind, and look up at the two great elliptical funnels towering above us. See how the mighty wreaths of smoke pouring from them are torn off by the fury of the gale, and hurried away in a long, rolling cloud column to leeward — all wrong, no doubt, in a scientific point of view, but presenting a spectacle so grand in its own way to those who can see it aright that we rejoice that on this day, at all events, smokeless coal is not being burned. From the escape pipes of the safety valves light clouds of steam arise, and cling, as it were, to the funnel till they too are torn off and cast to leeward by the wind. The boilers are making more than the engines are permitted to use. They are doing so well that it would be a pity to risk anything in the way of a hot bearing by over-driving them. As the day advances the rain ceases, and the wind moderates a little, but there is a smart tide against the ship. The log is heaved. A good idea of the tremendous pace at which the ship is moving is supplied by the number of sailors needed to haul the long line in. She is going 21 knots an hour through the water. Here is indeed a triumph of naval architecture and engineering. The South Stack rock looms up through the mist, and a few minutes afterwards a crowd, watches in hand, stand by the rail to take the time in passing the end of the breakwater. There is wonderful unanimity considering the number of observers. Three hours six and a-half minutes is the time. We learn from those on shore the mail boat which we saw starting in the morning had required nearly four and a-half hours to make the passage.

When the ship was fairly alongside the jetty, luncheon was served in the dining saloon; the toasts were few and the speeches were short, for the vessel was timed to return at 3 p.m. to Kingstown. Her trip was delayed, however, a little by a curious circumstance which is worth detailing here, as it supplies an admirable example of the influence of trifles. The crank pins are lubricated by means of long brass boxes fixed to the heavy slabs of iron which form the keeps of the top brasses. In these boxes is an ingenious arrangement of wick wipers secured to small brass chains about 4in. long each. These chains draw the wipers through the oil and over a roller, from which the oil runs down to the bearing. Some little time before the ship arrived at Holyhead one of these chains was missing in the port engine. It was impossible to say what had become of it, but it seemed probable that it had dropped down the oil tube on to the bearing, and it was feared that it would get into the oil groove cut in the bearing, and thence probably become embedded in the white metal, where it would perhaps do harm. While the guests were at lunch, therefore, Mr. Beavis had the top brass lifted, and search made for the chain, which was not found, however. The operation, in spite of the great weight of the parts to be moved, was rapidly effected, and no matter what became of the chain, it gave no further trouble. The official particulars of the trial are given in the following table:—

	No. 1. Holyhead to Kingstown under natural draught.	No. 2. Kingstown to Holyhead under moderately forced draught.	No. 3. Holyhead to Kingstown under slightly increased draught.
Time	h. m. s. 2 57 45	h. m. s. 3 6 30	h. m. s. 2 46 15
Mean pressure of steam	25½ lbs.	27½ lbs.	27 lbs.
Mean revolutions of engines	24·72	24·94	27·17
Mean I.H.P. ...	5111	6101	6337
Speed	18·9 knots	18·0 knots	20·2 knots

The general dimensions and arrangements of the vessel having been agreed upon with the company, the design for hull and machinery was left entirely in the hands of the builders, with the stipulation that the mean draught of water should not exceed 13ft. 9in. when complete with coal and passengers on board, and that the engines when working with the boilers under natural draught should be capable of developing 5000 indicated horse-power and 6000-horse power with the boilers under air pressure in the stokeholes, the smaller power to give a speed which should make the passage across channel from Holyhead Breakwater Light to Kingstown Pier Lighthouse—a distance of 56 knots—in three hours, equal to a rate of over 18 knots without the help of tide; and the larger power to give a speed of 20 knots an hour, for which the time allowed was 2 hours 48 minutes.

How completely these conditions have been fulfilled will be seen by the foregoing particulars. The draught of water when starting on the trial runs with the contract weights in was 13ft. 8½in. mean. The preceding table shows that the Ireland has more than fulfilled the conditions of the design, but there is no doubt that after she has been on the station a short time, and the officers and crew become used to working her, a passage may be made under favourable conditions of weather which will exceed for rapidity the fastest passage made on Thursday last, for to maintain these extreme speeds from start to finish requires a combination of skill and experience which it takes a little time to bring into play.

The direct distance is 56 knots on which the speed is taken, without any allowance for the unfavourable weather or deviation of course, and during the second run the wind force 6 to 7 was right ahead.

On page 182 will be found a cross section of the ship, and in a future impression we shall give an external view, and more detailed particulars of the fleet to which the Ireland forms so remarkable an addition. We think it cannot be said that we give undue prominence to this vessel, when it is borne in mind that she has done what was never done before—placed England and the sister isle within two and a-half hours of each other. Messrs. Laird have achieved a splendid success, and we heartily congratulate the City of Dublin Steam Packet Company on the possession of a vessel which is at present entirely without a rival in British waters for speed and comfort.

THE IRON AND STEEL INSTITUTE.

IT is thirteen years since the members of the Iron and Steel Institute visited Glasgow, and during those thirteen years great improvements have been made in the iron manufacture, while the iron trade is being revolutionised through the growing importance of mild steel. Thirteen years ago most of the furnaces had open tops, and there was no such thing as a stove for heating the blast. Firing with raw coal is the rule in Scotland, and its consumption has gradually been reduced until at the present time a ton of iron can be made with less than two tons of coal. The gases of coal-fired furnaces contain a large quantity of that valuable substance ammonia, and in many of the Scotch furnaces it is recovered and turned to account.

During these thirteen years, while the manufacture of finished iron has greatly fallen off, a new industry—that of mild steel making—bids fair to replace it. Thirteen years ago crucible steel was made on a very small scale in Glasgow, and preparations only were being made for starting the Newton Works of the Steel Company of Scotland. During these thirteen years the production of pig iron, though fluctuating considerably, has roughly averaged a million tons per annum, while the annual production of Siemens steel has increased from zero to 300,000 tons.

This year science and industry are associated with the fine arts, for the meetings of the Iron and Steel Institute are being held in the Corporation Galleries in Sauchiehall-street, which contain a rare collection of paintings. On Tuesday morning, in the absence of the Lord Provost of Glasgow, who had been summoned by the Queen to Balmoral to present the addresses voted by the Corporation on the occasion of Princess Beatrice's marriage, Bailie Bertram welcomed the members. He regretted that the local industries, especially those of shipbuilding and engine making, were not so flourishing as could be wished, but he hoped that the discussions on the papers read would contribute, if not directly at least indirectly, to the revival of trade throughout the country, so that England might maintain her proud position of being the great commercial emporium of the world.

The Earl of Glasgow, in supporting the welcome on behalf of the West of Scotland, said that the members who had travelled from the south by the Caledonian on the Glasgow and South-Western Railway could not fail to be struck with the intimate connection there was between the West Coast and the iron and steel trade, and he hoped that by the time the Institute next visited Glasgow those trades would again be prosperous, and that fresh fields would be opened up in India and China.

Dr. Percy, F.R.S., on taking the chair, as President of the Iron and Steel Institute, expressed the thanks of the members for the welcome extended to them by the great, venerable, and glorious City of Glasgow, which he had first visited forty-four years ago. Scotland held an important place in the iron and steel manufacture, for there the Blackband was discovered, and the hot blast and blowing cylinder first introduced. Indeed, the invention of the hot blast by James Beaumont Neilson was one of the most important of any connected with the iron manufacture. The present depression of trade was due to overproduction, and its remedy was to be sought either in limiting production or in increasing consumption—which of the two he must leave it to the united wisdom of iron and steel masters to determine.

Mr. F. J. Rowan, of Glasgow, then read his paper, which he divided under three heads, historical, statistical, and general,

ON THE IRON TRADE OF SCOTLAND.

It appears that the first record of iron-making in Scotland occurs in an Act of the Scottish Parliament in 1686; two charcoal furnaces were erected in 1750; and the Carron Ironworks were founded in 1759, with one blast furnace fired by charcoal, and for which a blowing engine was soon afterwards erected by Smeaton. These works became celebrated for the manufacture of cannon, to which the name of "Carronades" was consequently given. At the present time Scotland has 143 blast furnaces, of which 92 are in blast, with an average weekly production of 200 tons, while at the beginning of the present year there were 367 puddling furnaces, of which 269 were active, producing puddled bars at an average of 732 tons a furnace. Although there are a few blas

furnaces in the neighbourhood of Glasgow, the centre of the iron-making district is Coatbridge. From an annual make of 37,500 tons in 1830, when the introduction of hot blast took place in Clyde Ironworks, the output was doubled in six years; in nine years it had reached five times the extent of output in 1830, and in 1843 it reached eight times that quantity. In 1845 the extent of the manufacture was thirteen times that of 1830, and it increased very steadily from that point until 1870, when the largest annual production ever recorded in Scotland was reached. There have been fluctuations in quantity since that year, but the make of 1881, which was the highest since 1870, did not reach the former quantity by 30,000 tons. The large and increasing trade in steel is lessening the importance of the malleable iron trade, and it would seem that, to put the ordinary pig iron manufacture in the future abreast of the times, either means must be found by which the ordinary qualities of pig are made available for steel-making, or ironmasters must so perfect their processes of manufacture as to eliminate in the blast furnace all the ingredients which make the difference between their iron and the very best used for open-hearth steel. The basic process of steel-making seemed to offer the means for realising the first of these conditions, and as to the other alternative, there has been so much advance in the science of iron-making that it is not impossible means may be found to purify either the raw materials or the iron produced from them. Tabulated results show that iron was produced in 1868 and 1869 with 1 ton of coke, 2 tons 1¾ cwt. ore and coked ironstone, and 9¾ cwt. limestone per ton of pigs. About two-thirds of the coal raised in Scotland are got from the coal measures and one-third from the carboniferous limestone series, while Lanarkshire now produces about 60 per cent. of the whole quantity put out in Scotland. Ironstone is raised principally from the carboniferous limestone series. The celebrated Blackband is nearly exhausted in the western districts, but large quantities still exist in Lothian. The total number of mines or workings for iron ore in Scotland in 1880 was 125, the average output being 21,316 tons per mine. It seems probable that the first cylinder blowing engine was introduced into Scotland, and the first use of raw coal in the blast furnace has been claimed for both Carron and Wilsontown. The story of the discovery of Blackband ironstone by David Mushet, and of the invention of hot blast by James Beaumont Neilson, and its introduction into Clyde ironworks, has been often told. At Dundyvan, about 1845, the largest furnace of its day—65ft. high—was built, and very nearly, if not the first, attempts in Britain were made to collect and utilise the gases from the tunnel-head. Iron ore was successfully calcined by means of these gases at Coltness in 1852, and there is no reason why such a method should not again be used with advantage. And a great improvement in dealing with furnace gases has of recent times been introduced at Gartsherrie, Langloan, and Summerlee Works. There is no doubt that the enlightened practice of some of the Middlesbrough ironmasters has led to a general enlargement of furnaces and the closing of their tops. At Carron, where the first two regenerative blast stoves in Scotland were put up, furnaces are now working with blast at 1440 deg. Fah. temperature, economy resulting from that temperature as compared even with 1240 deg., which was tried. Of other hot blast stoves there are nine Massicks and Crookes stoves at Glengarnock and three Whitwell at Carnbroe; and some ironmasters are working regularly with 1000 deg. temperature of blast from iron pipe stoves. There are indications of future prosperity in the remodelling of the Carron Ironworks, and the rapid development in some branches of the finished iron trade, such as that of malleable iron; while during the last twenty-five years the manufacture of butt-welded tubes has increased sixfold, and that of lap-welded tubes ten-fold.

As no discussion followed Mr. Rowan's paper, for which a vote of thanks was duly accorded, Mr. J. Riley, manager to the Steel Company of Scotland, proceeded to read his paper on

The Rise and Progress of the Scotch Steel Trade,

which dealt with the changes which had taken place during the last thirteen years in what he still termed the iron industry of the district. There are now, or were very lately, six firms in Scotland producing about 1500 tons of crucible steel yearly. The reason why the acid Bessemer process had not taken root in Scotland was not to be sought in any want of enterprise, because Scotch ironmasters were among the first to arrange for licences. After mentioning the various attempts to establish this process, which has had until quite recently no place in Scotland as a manufacturing industry, Mr. Riley observed that it was difficult to find a satisfactory reason for this in view of its almost universal adoption elsewhere. Doubtless the unsuitability of the pig had a great deal to do with it, though it had not prevented the extensive adoption of the open-hearth process. Since the application of the basic lining, there was every prospect of its being worked on a large scale.

Finely equipped works were set in operation a short time ago by Messrs. Merry and Cunningham for the production of basic steel at Glengarnock, and they are to be followed in the same direction in a few weeks by the Glasgow Iron Company at Wishaw. The former have erected four 10-ton and the latter three 7-ton converters, so that in a few months there should be a production of, say, 100,000 tons of ingots per annum of basic steel. To deal with these, both companies have put down the most modern arrangements of furnaces, soaking-pits, mills, shears, &c., for the production of plates, bars, &c., for general use. In 1870 some experiments were made which had an important bearing on the subsequent development of the steel manufacture of the district. At no great distance from the works of Messrs. Rowan the Tharsis Sulphur and Copper Company had accumulated an immense stock of the residue of their operations—the familiar "Blue Billy" or "purple ore." The late Sir William Siemens and some others thought it possible that this product might be converted into steel in a modified form of the Siemens furnace. Messrs. Rowan having erected a regenerative heating furnace, arrangements were made for a trial therein; and the furnace having been altered so that the "ore" could be charged through hoppers on to sloping banks formed along its sides, some charges were worked and cast into the ingot moulds in the ordinary Bessemer casting pit. It appears, however, that no steel was produced, the ingots being composed almost entirely of slag—the ore having in reality fused and run off; and other experiments resulted in the production of sponge iron, which was let down into a bath of molten pig iron and there dissolved, but at the expense of a large portion of the sponge, which went off into the slag. Notwithstanding these apparently adverse results, it seems that the opinion was strongly entertained that success would be achieved both practically and economically, for shortly afterwards, in the year 1871, the Steel Company of Scotland was formed for the manufacture of steel by the Siemens process; and a contract was entered into with the Tharsis Company for over 20,000 tons of "purple ore" at 25s. per ton delivered. It was not, however, until August, 1874, that operations were commenced with Dr. Siemens' ore-reducing revolving furnace, at which time one furnace was complete and two others in a very forward state. This furnace was continued working until January, 1875, and produced about 170 tons of puddled ball iron, which was chiefly remelted in the open-hearth furnaces. The cost of production was, however, so great that the furnace was stopped and the plant removed. Meanwhile there were erected of Siemens' melting furnaces four in 1873 and four in 1874, all nominally of 6-ton capacity; these were followed in 1875 by three and in 1876 by one furnace, all of 10 tons capacity. In 1877 two 6-ton furnaces were erected for the production of steel castings. Up to the year 1879 the Steel Company was the sole manufacturer of steel in Scotland, when there were fourteen melting furnaces, which had produced in 1873 about 1200 tons of ingots; in 1874, about 18,000 tons; in 1875, about 23,000 tons; in 1876, about 32,000 tons; in 1877, about 36,000 tons; and in 1878, about 42,000 tons. When the company was formed they looked to the increasing demand for steel rails for a market for nearly the whole of their products; and yet at the end of 1874 the directors were looking out for other outlets, viz., plates, bars, castings, and forgings. In 1875 a small beginning in these branches was made, and slightly extended in the following year, when the Admiralty declared for steel, giving Siemens steel a preference, and gave an order for plates for Government gunboats. Towards the end of 1877 a plate-mill was got to work, and a fair production obtained; while Messrs. John Elder and Co. were building two steamers with the company's plates, and the Columba was to be built by Messrs. J. and G. Thomson, also of their manufacture. The production of bars, &c., for general purposes had steadily increased until it had reached over 1500 tons for the year. The year 1878 proved a very depressing one in many respects; there was a slackness of orders in all branches, and prices were very low. Yet in that year was added the manufacture of heavy angles, large tee-bulbs, and tin-plate bars, while arrangements were made for working the Terre-Noire process for making steel castings. In 1879, through the lead taken by the Admiralty, the concessions made to steel by Lloyd's and the Board of Trade, and incessant efforts on our part, the company's products came into great demand for shipbuilding and other purposes, so that the rail manufacture was steadily superseded by that of boiler and ship plates, with angles, bars, &c. Mr. Beardmore decided to take up the manufacture of steel, and built three 10-ton furnaces in May, 1879, making his first cast on 22nd August of that year. In the same year Messrs. Williams and Co., of Wishaw, commenced the erection of three furnaces. In 1880 the Steel Company of Scotland added four more melting furnaces at its Hallside Works, and erected eight large furnaces at the Blochairn Works, which had been purchased. Mr. Beardmore added two furnaces to his plant, and the Mossend Iron Company and Messrs. D. Colville and Sons built, the former five, and the latter four furnaces. Since that period, in addition to furnaces erected at all the before-mentioned works, there have been completed one furnace by William Wylie and Co., one by Gray and Watt, two by the Govan Steel and Forge Company, two by the Clydesdale Iron Company, and one by the Mount Vernon Steel Company, making a total of seventy-three furnaces, with two others in course of reconstruction. In 1883 there were produced 230,000 tons of ingots, yielding over 90,000 tons of plates, 35,000 tons of angles and bars, and 20,000 tons of sundry products; and during the first half of the present year the production has been at the rate per annum of 300,000 tons of ingots, yielding 120,000 tons of plates, 56,000 tons of angles and bars, and 12,000 tons of sundry products. Rails, which now form a comparatively small portion of production during the last two years or so, are omitted; but orders for about 15,000 tons of plates for sleepers have been executed. The large and constant development in production has been largely due to the judgment and enterprising spirit of the shipbuilders and marine engineers on the Clyde, who, recognising great opportunities for the development of their business by the use of mild steel, were not slow to avail themselves of the "new material," and to the fact that the somewhat severely critical treatment which mild steel underwent at the hands of Lloyd's surveyors and those of the Board of Trade has demonstrated its thoroughly trustworthy character, more especially where severe manipulation had to be endured; and to civil engineers having recognised that in using this product they were able to overcome difficulties in constructive engineering which would otherwise have been most formidable. Skilful workmen also soon discovered that they had at hand a material which they could use with much less risk of failure than the best iron usually supplied to them, and preferred it in all cases of difficulty. Thus mild steel has now practically displaced iron for boiler making, has been very largely adopted for ships and bridge building, is now being used in the construction of an immense block of bonding warehouses in London, requiring a total of over 8000 tons of steel, in the form of castings is now largely used in the framing of marine and other engines, and in small but rapidly increasing quantities is being used in a thousand forms which we would not have thought of five years ago.

In conclusion, Mr. Riley commented on the great increase in the weight and dimensions of the plates required, which has necessitated an increase in the strength of engines, mills, &c., to such an extent that they will probably bear comparison with those of any other country. He also took exception to the estimate of the application of steel made by the president of the Institution of Mechanical Engineers in his recent address at Lincoln.

Sir Henry Bessemer, in explaining why his process had not made so much progress in Scotland as in England, said it was only fair to him to bear in mind that at Messrs. Dixon's works he did not attempt to make steel, but only malleable iron. But this failure with phosphorus Scotch pig led to the production of Bessemer pig. In the early days of his process at Sheffield he induced Mr. Jones, of Liverpool, to build a small vessel of steel, which was followed by sixteen more; and if Bessemer steel was found suitable for shipbuilding twenty-five years ago, he did not see why it should not be so now. At any rate, about 12,000 boilers had been made of Bessemer steel at Crewe, and another thousand had just been completed elsewhere.

Mr. John Head, representative of Mr. Frederick Siemens, pointed out that recent discoveries had proved that the first Siemens' furnaces put up in Scotland had been constructed on wrong principles.

After a short reply from Mr. Riley, it was announced by the secretary that the luncheon room would not hold all the members together, so that meal must be taken at two sittings. While the first batch was feeding, the remainder listened to part of Mr. William Jones' paper on "The Recovery of Tar and Ammonia from Blast Furnaces," the discussion of which was adjourned to the following day.

In the afternoon there were three alternative excursions by special train on the Caledonian Railway. One party visited the Steel Company of Scotland's Hallside Works, at which great interest was manifested in a hydraulic appliance, devised by Mr. Harrison, the mill and forge manager, for receiving the ingots from the crane which lifts them out of the soaking pits, and for delivering them horizontally to the steam hammers. It consists of an arm which moves radially through a horizontal arc of 90 deg. The end carries a cradle which receives the ingot vertically from the crane. The arm is made to swing round to the hammer and back by means of chains worked by two hydraulic presses. A supplementary hydraulic press underneath the cradle deflects the latter from a vertical to a horizontal position during its progress from the crane to the hammer.

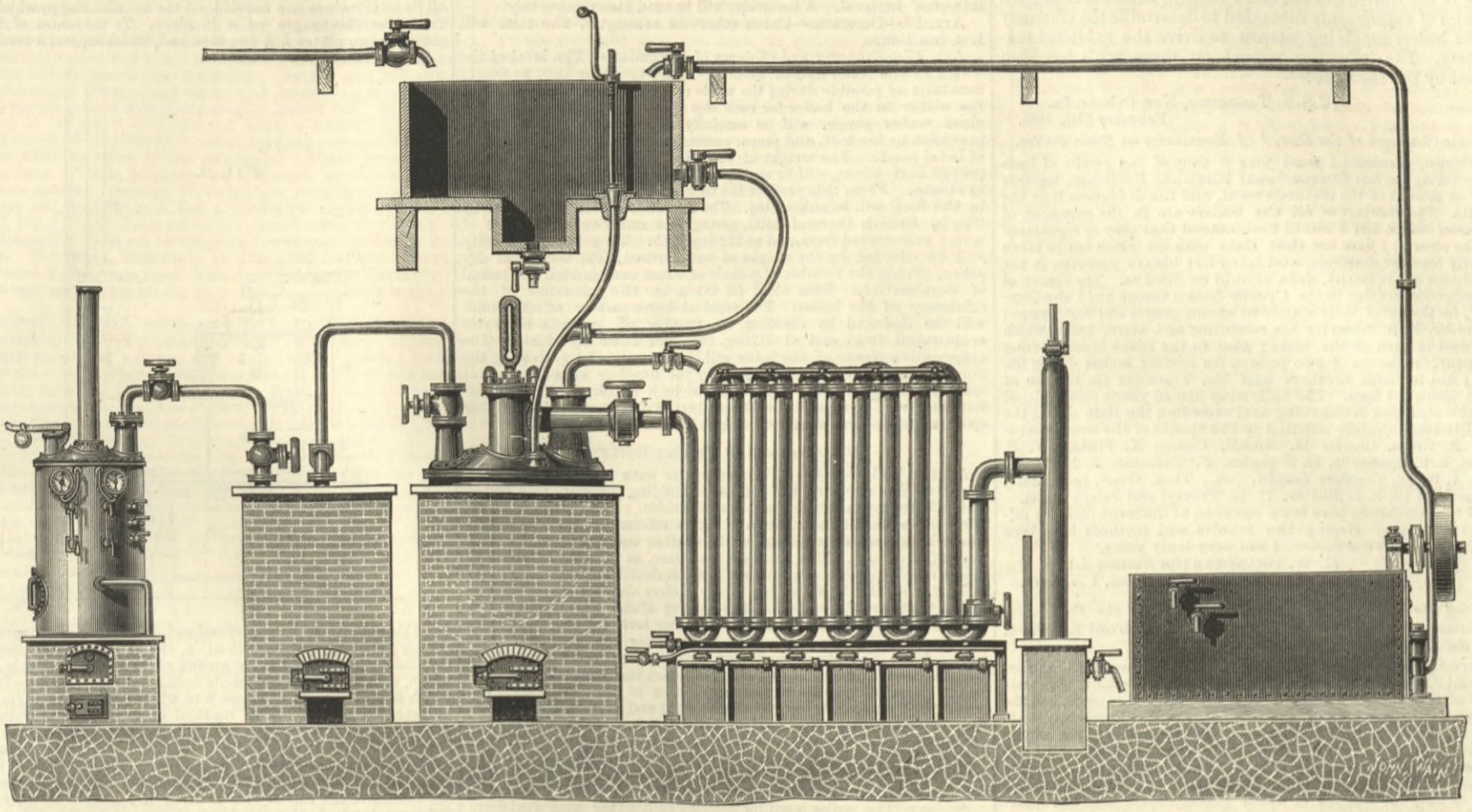
After visiting the Hallside Works, the members continued their journey to Motherwell, where they went over the Dalsell Steel Works of Messrs. D. Colville and Sons. They watched with interest the tapping of one of a long line of open hearth furnaces, the reception of the metal in a large ladle, provided with plug for running the metal and also with trunnions for tipping the slag, and running on a truck in front of the furnaces. The ingot moulds are arranged in a pit between the rails, and are picked up with the ingots by a travelling crane running on an outer line of way. The second party visited the Gartsherrie, Summerlee, Calder, Mossend, and Langloan Works, while the third, after devoting a short time to the Hallside Steel Works, went on to Earnock Colliery at Hamilton, the best appointed and most representative colliery in Scotland, where the first attempt was made, under the direction of Professor Jamieson, to light the underground workings with incandescent electric lamps.

Merchant Steamers as Admiralty Cruisers.—A parliamentary return has been issued showing the number, names, tonnage, and terms under which the Admiralty chartered merchant steamers for employment as naval cruisers at the time when the difficulties with Russia in relation to the Afghan frontier were at an acute stage. The return is as follows:—

Name of each cruiser.	Gross tonnage	Freight per ton, per month. Owner finding crew.	Freight per ton, per month. Government paying crew.	When engaged.	Where taken up.	Minimum term of engagement.
		£ s. d.	£ s. d.			Months.
America	5527	1 2 6	0 15 0	March 27, 1885	Liverpool	6
Oregon	7375	1 2 6	0 15 0	March 28, 1885	Ditto	6
Umbria	7718	1 2 6	0 15 0	March 30, 1885	Ditto	6
Arizona	5148	1 2 6	0 12 6	March 27, 1885	Ditto	6
Alaska	6932	1 2 6	0 15 0	March 27, 1885	Ditto	6
Rosetta	3502	1 2 6	£3000 a month £5000	April 16, 1885	En route to Hongkong	6
Massilia	4908	£7000 a month	0 15 0 a month	April 13, 1885	Sydney	6
India	4065	1 2 6	£3000 a month	April 14, 1885	Colombo	6
Glenogle	3749	1 2 6		April 24, 1885	Hongkong	6
Pembroke Castle*	3936	0 17 6	—	April 1, 1885	Suakin	7 from Feb. 10
Lusitania	3832	1 2 6	£3000 a month	April 17, 1885	Sydney	6
Moor	3688	1 0 0	0 12 6	April 14, 1885	Simon's Town	6
Mexican	4668	1 0 0	0 12 6	April 14, 1885	Southampton	6
Coptic	4448	1 2 6	0 15 0	April 18, 1885	Sydney	6
Britannia	4129	1 2 6	0 15 0	April 22, 1885	Valparaiso	6
Stirling Castle	4916	1 5 0	0 15 0	April 21, 1885	Malta	6

* Originally engaged as an infantry ship for the Soudan Expedition, but diverted after arrival at Suakin, and her period of hire —two months —extended as shown.

APPARATUS FOR PURIFYING OZOKERIT.



OZOKERIT.

OZOKERIT, the best electrical insulator known, is a fossil paraffine, sometimes called earth-wax. It is not abundantly distributed, for its production is confined to a few localities, chiefly in Moldavia and Galicia, where in surface mines it is dug up in nodules of about the size of potatoes. According to Gmelin, the ozokerit from Slanik in Moldavia is leek-green or yellowish-brown, translucent, flexible, and of the consistence of tallow or wax. Its specific gravity is 0·955 to 0·97; its melting point, 82deg. Cent.; its boiling point, 210 deg. Cent.; and on distillation it yields gaseous, oily, and solid hydrocarbons, leaving 5·7 per cent. of carbon in the retort. It is slightly soluble in boiling absolute alcohol; it dissolves completely in bisulphide of carbon, rock oil, and oil of turpentine; it forms a jelly under benzol, and does not dissolve completely until it is warmed. Ozokerit from Zietriska, in Moldavia, melts at 84 deg. Cent., boils at 300 deg. Cent., specific gravity 0·946 at 20·5 deg. Cent. It is not attacked by alkalis, it softens in chlorine, and becomes soluble in boiling ether; it is not affected by cold sulphuric acid, but is carbonised by it when hot. The ozokerit from Trascowiec in Galicia melts at 59 deg. Cent. to 65 deg. Cent. Ozokerit from Boryslaw, in Galicia, is dark brown, and can be kneaded by the fingers; its melting point is 60 deg. Cent.; its specific gravity, 0·944. Its solution in boiling alcohol deposits, on cooling, crystals of the three forms in which paraffine crystallises. By fractional crystallisation it yields products melting at 60 deg. Cent. to 65 deg. Cent. of the same composition as paraffine. That melting at 61 deg. Cent. contains 84·94 per cent. of carbon, and 14·87 per cent. of hydrogen; that melting at 65·5 deg. Cent., 85·78 per cent. carbon, and 14·29 hydrogen. This ozokerit, when melted at a high temperature, is altered, and becomes softer than the natural substance. The solid product obtained by the dry distillation of melted ozokerit crystallises from boiling alcohol in laminæ, which differ from wood tar paraffine in their high melting point, which is 62 deg. Cent. Ozokerit from Obora dissolves in nitric acid of specific gravity 1·34, after boiling for several days. Herman states that Neftgil, or Nefte dagil, is identical with ozokerit; it is a body which is brittle at 10 deg. Cent., and of the hardness of wax at 15 deg. Cent., obtained by the Tartars of the island of Tschelekän by burning a thick earth oil. Its specific gravity is 0·956; its melting point, 81 deg. Cent.; at a high temperature it distils almost without evaporation; boiling ether softens it, but dissolves very little. By dry distillation it yields oils and a buttery distillate, from which Hermann's "keron" may be obtained. This resembles, but is distinct from, paraffine, has a specific gravity of 0·893, melts at 67 deg. Cent., and on cooling solidifies to a crystalline brittle mass. According to Wöhler, the meteoric stone of Kaba and that of the Cape contain an easily fusible carbonaceous substance resembling ozokerit.

According to Gmelin, the ozokerit from Urpeth coal mine, near Newcastle, is soft, unctuous, and sticky; it melts at 60 deg. Cent., and is limpid at 70 deg. Cent.; it contains 85·18 per cent. carbon and 14·06 hydrogen; it is a mixture of three substances of the same composition, all equally indifferent to boiling acids. The residue not taken up by boiling ether or alcohol, and amounting to one-sixth of the whole, is dark brown, soft, of specific gravity 0·965, melts at 73 deg. Cent., and boils at 260 deg. Cent. This residue is not absolutely insoluble in boiling alcohol and ether.

The ozokerit supply and distribution are in few hands. The Austrian mines are in the possession of a few capitalists, and the purification, distillation, and distribution of ozokerit in Great Britain rests with the firm of Messrs. J. C. and J. Field, whose stearic acid works at Lambeth were described in these pages last Christmas. Mr. Leopold Field states that Galicia is the only district from which good crude ozokerit can be obtained, and that, too, from only one mine in the district, Boryslaw. His firm has received samples of asserted ozokerit from every quarter of the globe, but they nearly all proved to be either bitumens or sand infiltrated with petroleum. True crude ozokerit gives from 80 to 90 per cent. of solid paraffine; the rest of it consists of oil and dirt.

Messrs. Field's ozokerit works are at Battersea, on the southern bank of the Thames, up which river the ozokerit is brought from the Hamburg steamers in barges. The ozokerit arrives in blocks of chocolate colour and somewhat sugar-loaf shape; each block measures about 2ft. by 1ft., and weighs from ¾ cwt. to 1 cwt. These blocks are made at Boryslaw by casting the crude lumps into tanks, and melting or steaming them down; the stones and foreign matters, which would increase cost of freight, sink to the bottom, and are thus separated in greater part. Crystals of rock salt, which are never far from an ozokerit mine, frequently project from the crude nodules, which also sometimes contain striæ of gypsum infiltrated with a small proportion of tarry matter. The ozokerit is usually nearly pure, and the inorganic materials traverse the substance in regular layers. When the cast blocks arrive at Messrs. Field's wharf alongside the works, they are taken out of the barges and stocked until required for refining or distillation; and it may here be mentioned that there are two ways of obtaining commercial products from crude ozokerit. The one method is to treat the material with Nordhausen sulphuric acid, and heating it until the acid is decomposed or evaporated, and has charred or decomposed the more destructible foreign matters present; the wax is then partly decolorised until it has a golden hue, and becomes what is known as ceresin, a substance largely used on the Continent for the adulteration of beeswax. Ceresin can, if necessary, be made almost a pure white; it resists the action of powerful chemical agents better than the true beeswax; it is not of much use for candle-making because of its unconquerable tendency to smoke.

At Battersea the ozokerit is distilled, which hitherto has always been necessary in preparing it for the making of candles, although Ujhely has devised a process by which the crude substance is dissolved in benzine or some other spirit, then filtered through charcoal to decolorise it, after which the solvent is distilled off for future use. At Messrs. Field's works the blocks, to the extent of about 5 tons at a time, are put into an iron tank about 9ft. square, and subjected to the action of superheated steam, so that any remaining dirt of a coarse nature sinks to the bottom. The melted ozokerit is then pumped into a tank above the still, but when it is extra dirty is first treated with a little water and sulphuric acid. In this clarifying process the temperature employed is 190 deg. Fah. There are three iron retorts, each of about 4 tons capacity, with a furnace below, and a steam pipe down the interior of the retort; the steam keeps the mass in agitation, and helps to drive over the volatile products into the condenser; it also largely prevents what is technically termed "cracking," that is to say, the breaking up of the oil into lighter hydrocarbons. The residue in the retort at the close of the operations is the "black wax," or insulating ozokerit; it melts at a temperature of 180 deg. Fah., and would make capital candles, but the public would no more buy black candles than they would buy white coals, or drink bottled stout out of a teacup. Why should black candles excite such subjective psychical impressions?

The series of U-tube condensers are of the usual description. They contain about 100ft. of iron tubing of 1ft. internal diameter. In the act of distillation a little oil comes over first, which is useful for burning purposes, then comes the mineral paraffine, known at this stage of the process as "press cake." The distillates are drawn out from the lower bends of the condensing tubes into little tanks, and the press cake is drawn off from the tanks into flat tin trays, in which it solidifies into flat oily cakes, measuring 24in. by 14in. by 1in., and is then ready for pressing. The hydraulic pressing is effected in canvas bags between iron plates; it amounts to half a ton to the inch at a temperature of 150 deg. Fah.; the iron plates are hollow for the entrance of steam to keep up the temperature. Oil is thus squeezed out, and it is of use for the lubrication of machinery. The four hydraulic presses at the works act each upon twenty-six cakes at a time; the twenty-six cakes weigh 2½ cwt. The time of pressing is variable, but averages about two hours. To facilitate the pressing operations a little naphtha or paraffine oil is first added to the press cake, it is found to help to bring the natural oil out.

After the pressing the ozokerit is re-melted in vats at a temperature of 170 deg. Fah.; there are five of these vats. In the final process it is decolorised by boiling for several hours with fuller's earth. The material in the boiling tanks is kept in agitation and dried by hot air being driven through it. When decolorised, the material is left in the tanks all night to settle and cool, then is removed as the pure white ozokerit of commerce, the melting point of which is 140 deg. Fah.; the melting point of some of the solid coal tar paraffines is as low as 115 deg. Fah., hence the ozokerit candle has much less tendency to bend in hot climates or in hot rooms. The light of an ozokerit candle being reckoned at 10, that of sperm for the same weight of material is 7·5, of wax 7, of stearic acid 7·25, and of tallow 3·5.

Three boilers, working up to a pressure of 30 lb. to 35 lb. to the inch, furnish the steam used for heating purposes in the manufacture of distilled ozokerit at Battersea. Two 14-horse vertical engines furnish the motive power consumed. The air-pump is of the double-cylinder construction; each cylinder is 30in. by 15in. There are extensive appliances at the works for the extinction of fire, for the cracking of a retort full of boiling ozokerit would be no trifling matter.

The engraving accompanying this article is not to scale, but represents diagrammatically the apparatus for the distillation of ozokerit as just described. It will be noticed that two pipes from the upper tank communicate with the still; the second is used as a safeguard, supposing the other should be accidentally choked with dirt. At the end of the condensers is what is known as the essence tank; some of the lighter hydrocarbons will not condense, so a little jet of water plays up the inside of this tank, catches the lighter vapours, and brings them down with it.

In the course of the ozokerit manufacture a bye-product is obtained resembling vaseline though differing from it in chemical composition. This substance is in general though limited use for the dressing of leather, and as axle grease; it is also used to some extent in pharmacy. The black wax so well known in telegraphy for its insulating powers is further used by coopers to help in making barrels watertight, also by makers of tarpaulins and waterproof fabrics.

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—James G. Bain, chief engineer, additional, to the Repulse; F. W. Parkes, engineer, to the Thunderer; John Miller, chief engineer, to the Asia, additional, for the Lord Warden; and Henry Jolliffe, chief engineer, to the Himalaya.

SHIPBUILDING IN THE ROYAL DOCKYARDS.—A parliamentary return—Navy, ships built—has been issued, showing the amount of shipping—tons weight of hull—estimated for and calculated to have been actually built from the year 1865-66 to the last financial year. There is an appendix showing the amount of money proposed by programme to be expended for labour and that actually spent on the several ships building in her Majesty's dockyards during the year 1884-5, with the tonnage corresponding thereto; and also a similar return for ships building by contract, based on payments to contractors. As regards ironclads, built or building in the dockyards, in the last financial year, 10,500 tons weight of hull were provided for in the estimates, but the weight estimated to have been built, calculated on the actual expenditure for labour, was 10,704 tons, representing an expenditure on wages of £369,785. In a foot-note it is explained that this amount includes the pay of leading men of shipwright up to July 1. These officers were at that date made inspectors, and have since been paid out of the salary vote. As regards wooden, iron, and composite ships, 5555 tons were provided for and 5475 tons are estimated to have been built, representing a value of £220,175. Of ships building by contract 2114 tons weight of ironclad hull were provided for in the estimates, and 2218 tons are estimated to have been built, the value of labour and materials being £178,595, while as respects wooden, iron, and composite ships likewise building by contract 2510 tons weight of hull were provided for, and 2040 tons were built, the value being £130,956. Thus the grand total amount proposed to be spent for the three classes of unarmoured, protected, and armoured ships built or building in the royal dockyards in the last financial year was £541,202, while that actually spent was £589,960, giving a net gain in weight of hull built of 124 tons. The total amount spent upon armoured and unarmoured ships built by contract was £39,551, as compared with £309,750 proposed to be spent, while the weight of hull calculated to have been built was 4258 tons as against 4624 tons proposed to be built, or a net loss of 366 tons. This difference is more than explained by the fact that £25,000 were proposed to be spent upon a "new torpedo ship," representing a weight of hull of 577 tons, but the ship in question does not appear to have been yet laid down, and so there is an apparent loss in tonnage built to that extent.

THE EFFICIENCY OF AMERICAN STEAM BOILERS.

During the International Electrical Exhibition held last year in the United States, the Franklin Institute conducted a series of experiments intended to determine the efficiency of the boilers supplying steam to drive the exhibited machinery. The following report on these trials has been issued by the Institute :—

U.S.S. Tennessee, New Orleans, La.
February 13th, 1885.

To the Chairman of the Board of Examiners on Steam Boilers.

Gentlemen,—Enclosed I send you a copy of the results of tests made during the late International Electrical Exhibition, together with an account of the methods used, and the deductions from the results. The drawings of all the boilers are in the possession of Professor Marks, and I would recommend that they be reproduced for the report. I have not that data with me which can be taken directly from the drawings, and have left blanks wherever, in the description of the boilers, data should be filled in. The thanks of the committee are due to the Crosby Steam Gauge and Valve Company, for the use of their standard steam gauges and test pumps ; also to Mr. M. B. Edson for his recording and alarm gauge, which was used in each of the tests ; also to the Blake Manufacturing Company, for the use of two pumps for feeding boilers during the tests ; and to Riehlé Brothers and Mr. Troemner for the use of scales during the tests. The following named young men rendered valuable assistance in observing and recording the data during the tests, and are especially entitled to the thanks of the committee :—Geo. R. Green, Charles H. Small, George K. Fischer, W. F. Lubbe, L. F. Roudinella, H. Szlapka, F. Thibault, E. E. Alcott, Wm. A. Bigler, Theodore Gould, jun., Thos. Grier, Leon Kraft, Richard McCall, R. L. Rutter, D. E. Tracey, and Joseph Israel.

All the calculations have been checked at different times by different computers. Hoping the results and methods have been satisfactory to the committee, I am very truly yours,

H. W. Spangler (for Section X.),
Assistant Engineer, U.S. Navy.

Code of the Proposed Quantitative Tests for the Evaporative Efficiency of Boilers at the International Electrical Exhibition, by the Franklin Institute, of 1884.

Special Notice.—Boilers may be exhibited and used at the International Electrical Exhibition, but will not have quantitative tests made of their efficiency unless formal application is made, and the subjoined code accepted before July 15th, 1884. Competitive tests will not be made unless at the joint request of the parties desiring a competitive test, and after they have agreed to and subscribed to this code, and fixed upon a rating for the points enumerated in Article 4. The committee of judges reserve the right to limit the number of tests made, should time and opportunity not permit all the tests desired to be completed.

Section I.—Preliminaries to the Tests.

Article 1—Capacity.—The boilers entered may be of any capacity, having an evaporative power not less than 750 lb. of water per hour. Each boiler must be so drilled as to enable its whole internal capacity to be determined by being completely filled and emptied of water. Proper cocks, piping, &c., must be so placed as to enable this to be done readily.

Art. 2—Pipes and valves.—Each exhibitor will furnish all the pipes and valves necessary to make connection with the main water and steam pipes in a proper manner, and subject to the orders of the superintendent. He will also make any alterations in water and steam pipes required for the tests, furnishing all tools, piping, cocks, and mechanical labour at his own cost.

Art. 3—Space.—Each exhibitor will be furnished with space at the regular rates established for the exhibition, in which space he must build his foundations and boiler setting, and make connection with the chimney flue, if required, at his own cost, and subject to the approval of the superintendent.

Art. 4—Specifications.—Each exhibitor must furnish to the chairman of the committee of judges on steam boilers, such description and drawing, both of the boiler in position and of the details of the boiler, as will facilitate the labour of that committee, together with his claims as to meritorious points for his exhibit. The following points will have special consideration :—(1) Economy of fuel; (2) economy of material and labour of construction ; (3) evaporative power—space occupied; (4) simplicity and accessibility of parts; (5) durability of whole structure. Exhibitors desiring a competitive test made, must agree upon a rating for these points before it will be made. Exhibitors must also file the following data :—Area of heating surface to the nearest hundredth of a foot; area of grate surface to the nearest hundredth of a foot; area of calorimeter to the nearest hundredth of a foot; area of chimney flue to the nearest hundredth of a foot; height of chimney required; number of pounds of coal per square foot of grate to be burned per hour. Should the calculations of the committee of judges differ in result from those of the exhibitor, he will be required to give all the details of his calculations, and an agreement must be reached before proceeding with the test.

Section II.—Preparations for the Tests.

Art. 5—Coal.—Anthracite coal will be used and will be furnished free of charge, provided the steam made is used for the general purposes of the exhibition. The same quality and size of coal will be used in all the tests, unless special arrangements be made for another kind of fuel. An analysis will be made of the coal used. The coal will be weighed to the boiler.

Art. 6—Water.—The water used will be taken from the city mains. The feed water for the boilers will be weighed by means of scales and a large tank, and will be run into a smaller supplemental tank, from which it will be pumped into the boiler by means of a feed pump actuated by steam from the boilers. The temperature of the feed-water will be taken by means of a standard thermometer in the supplemental tank.

Art. 7—Pressure.—The steam pressure used shall not exceed 90 lb. per square inch by the gauge, unless by special arrangement with the committee of judges. A standard gauge will be used and also a standard thermometer immersed in a mercury pocket in the steam space.

Art. 8—Safety valve.—The safety valve will be set to blow off at 10 lb. above the pressure fixed upon.

Art. 9—Leaks.—Within twenty-four hours preceding the test of a boiler, it must be subjected to hydraulic pressure, 10 lb. greater than its steam pressure during the test, and proved to be perfectly tight.

Art. 10—Attendants.—The attendants in charge of the boiler tested must be approved by the party whose boiler is tested and by the judges. All attendants are to be subject to the orders of the judges during the progress of the test.

Art. 11—Ashes.—All ashes will be weighed on being withdrawn from the ashpit, and must not be damped until weighed.

Art. 12—Calorimeters.—The calorimeters used will consist of a barrel, scale, and hand thermometer. Two calorimeters will be used and simultaneous observations made at fifteen minute intervals.

Art. 13—Fires.—The exhibitor shall be allowed one day previous to the test to clean boilers and grates. The steam having reached the required pressure, the ashpit shall be thoroughly cleaned and swept, and thereafter the fire maintained as nearly uniform as possible, the test closing with the same depth and intensity of fire as it opened. This point is to be decided by the judges, who may make allowance if it be clearly shown to have been impossible to maintain uniform fires. If in the judgment of the committee of judges the firing is inefficiently or improperly done, the test may be terminated at any time, and a repetition of the test refused.

Art. 14—Pyrometer.—The temperature of the gases of combustion immediately upon entering the chimney flue shall be taken by means of a suitable pyrometer, read at fifteen minutes' intervals, and close to the boiler.

Art. 15—Manometer and barometer.—The vacuum in the chimney flue shall be taken by means of a water manometer, read at fifteen minutes' interval. A barometer will be read simultaneously.

Art. 16—Duration.—Unless otherwise arranged, the tests will last ten hours.

Art. 17—Economy and efficiency of the boiler.—The level of the water in the boiler and the state of the fire must be kept as nearly constant as possible during the whole of the trial. The weight of the water in the boiler for each one quarter of an inch, on the glass water gauge, will be carefully determined and recorded previous to the test, and proper correction for unavoidable changes of level made. The weight of water fed to the boiler, subject to proper corrections, will be multiplied by its observed thermal value as steam. From this product the thermal units of heat brought in by the feed will be subtracted. The remainder will be divided by $966\frac{7}{10}$ British thermal units, giving the number of pounds of water evaporated from and at 212 deg. Fah. This latter quantity will be divided by the weight of coal burned, less weight of dry ashes, giving the number of pounds of water evaporated per pound of combustible. This shall be taken as the measure of the efficiency of the boiler. The nominal horse-power of the boiler will be deduced by dividing the number of pounds of water evaporated from and at 212 deg. Fah. per hour by thirty. The evaporative power of the boiler will be determined by dividing the normal horse-power of the boiler by the number of cubic feet of space it occupies. The space occupied by a boiler and its appurtenances will be regarded as the product of the square feet of floor space occupied by its extreme height in feet.

Methods used in Testing Boilers.

All the boilers tested by this committee were located in a boiler-house to the north of the exhibition building proper, this boiler-house being open to the weather on the sides. It is probable that the boilers would have shown a higher efficiency had the boiler-house been entirely enclosed, as the weather was quite cold during part of the tests. The methods used were, as nearly as possible, the same for each boiler, and are given in detail below.

Water.—All the water fed to the boilers during the tests was taken from two large tanks, each holding about 2400 lb. of water when full. In starting each test the water level in the boiler was noted, and all water put into the boiler after the test began was taken from the above-mentioned tanks, which were alternately weighed and emptied. At the end of a test the water level in the boiler was brought to the same point as at starting, and the amount of water left in the tanks weighed and properly accounted for. The steam pumps used on all the boiler tests worked very satisfactorily, there being no leaks about either pumps or pipes. Before testing a boiler, a joint on each water pipe leading to the boiler was broken, and all the pipes disconnected, excepting the one feeding from the pump used in testing.

Scales.—The scales used for weighing feed-water and coal were of Riehlé's make, and those used for the calorimeters were partly of Fairbank's and partly of Riehlé's make. All the scales were very accurate, and were checked by comparison with Fairbank's standard weights of 50 lb. each.

Temperature of feed-water.—The temperature of all water fed to the boilers was taken at intervals during the tests, and the mean of these temperatures was taken as the temperature of the feed. The thermometers used were made by J. and H. J. Green, of New York, and were very accurate.

Coal.—The coal used in these tests was purchased at different times and the size was as desired by the exhibitors of the various boilers. All coal was weighed in barrows and allowance made for all that was not used. The coal in all the tests was as it came from the dealer and was slightly wet. In each test a number of barrows full of coal were dried at the temperature of the air, and again weighed, but no appreciable loss of weight was perceptible. In the test of the Root boiler, the floor under the coal was constantly wet from water from the calorimeters used, but the greater part of the coal used was in the same condition as that used in the other tests. A careful analysis of the coal was made under the direction of Professor Samuel P. Sadtler, from samples taken, from time to time, during the test by Mr. Spangler.

Wood.—The wood used was such as happened to be most convenient, and was not all of the same kind, but the amount used was so small in comparison with the total amount of fuel, that the same allowance was made in each case for the relative values of coal and wood.

Ashes.—All ashes were weighed dry, and at the end of the test the fire was drawn, and where any unburnt coal came from the furnace, it was credited to the coal account, the remainder was charged to the ash account. In the case of the Dickson boiler, the ashes were very wet as they were drawn from the ash-pan, as the steam blower discharged directly into the ash-pan. A number of barrows of ashes were weighed and the percentage of moisture was calculated from the weight after drying, and due allowance made for the same in the ash account.

Barometer.—The readings of the barometer were taken from the observations made by the United States Signal Service in Philadelphia, during the time of the tests.

Thermometer.—The temperature of the air was taken from the same source, and agreed very closely with that taken during the tests.

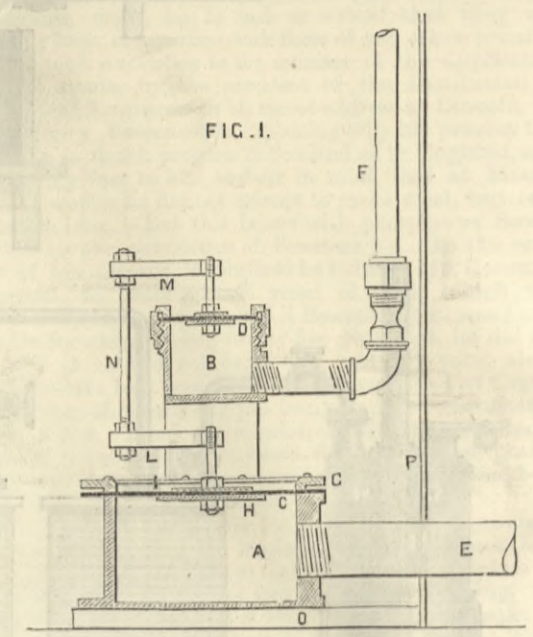
Steam pressure.—The steam gauge used on the tests was furnished by the Crosby Steam Gauge and Valve Company. One of these gauges was tested by Thomas Shaw, of Philadelphia, with a mercury column for every 5 lb. from 0 lb. to 120 lb., both ascending and descending. Before and after each test the gauge used on the boilers was carefully compared with this standard, both ascending and descending throughout the range of pressure used on the tests. The gauges were very accurate, and agreed as well at the end as at the beginning of the set of tests. Readings were taken at frequent intervals, and the mean of these readings taken as the mean pressure of the steam. In addition to the Crosby gauge used, an Edson recording gauge was attached to each boiler as it was tested, and records made during the entire test. The indications of this gauge were accurate and reliable, but the clock-work required frequent adjusting to keep the recording slip moving at a uniform speed. The alarm attached to the gauge was not used.

Temperature of the steam.—A large monitor thermometer was used for indicating the temperature of the steam. It was screwed into the steam space of the boiler, and its indications noted from time to time. These thermometers were a little slow in acting, as there was a considerable body of iron and mercury to change in temperature, but the indications are considered very reliable.

Temperature of smoke stack.—In determining this temperature a monitor thermometer was inserted in the smoke stack, just back of the damper in the Root, Baldwin, and Harrison boiler, and at the bottom of the smoke pipe in the Dickson boiler. It was not practicable in all cases to put the thermometer in vertically. In the Harrison test it was vertical; in the Dickson test it was inclined at an angle of about 30 deg. to the vertical; and in the Root and Baldwin tests the thermometer was inclined about 10 deg. from the horizontal. The bulb of the thermometer was put as near as possible into the centre of the flue, while the stem projected into the air. The openings into the flue around the thermometer were carefully closed so that no air could enter. Readings were taken as often as practicable from these thermometers, and the mean of the readings taken.

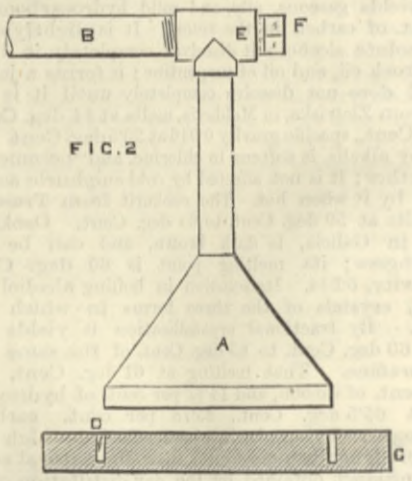
Draught in chimney.—A number of devices were used for measuring the draught in the chimney. That used on the Root boiler was suggested by Professor Lanza, and was the design of Mr. Fisher, of the Massachusetts Institute of Technology. It consisted of two chambers *a* and *b*, Fig. 1, each covered by a rubber diaphragm *c* and *d*. The interior of the chamber *a* is connected with the interior of the chimney by means of a pipe *c* supplied with a three-way cock, so that the interior of *a* can be connected with the chimney or with the air. The interior of *b* is connected by means of a pipe to a vertical glass tube *f*, open at the top. The chamber *b*, the glass tube *f*, and the connecting pipe are filled with water, the air being entirely excluded. The chamber *b* and all its attachments are carried on the annular ring *g*, which holds the rubber diaphragm of *a* in place. To the centre of the diaphragm *c* two plates *h h* are attached, which support a vertical rod

FIG. 1.



k. This rod screws into a crosshead *l*. To the diaphragm of *b* a similar crosshead *m* is attached in the same way, and these two crossheads are connected by means of two side rods, only one of which, *n*, is shown. The whole apparatus rests on a base board *o*, which carries a vertical piece *p* to which a paper scale graduated in inches is attached. The method of using the apparatus is as follows :—The three-way cock in *c* being turned so that *a* is in communication with the air, the reading of the scale opposite the head of the water-column is noted. The three-way cock is turned so that the inside of *a* is connected with the chimney, and the reading of the top of the column in *f* is again noted, and the difference between the readings is caused by the difference in pressure inside and outside the chimney. This difference divided by the ratio of the areas of the chambers *a* and *b* is the vacuum in the chimney in inches of water. Comparison was made between this apparatus and the one referred to as the invention of Professor Webb, and the two methods were found substantially to agree. As the Webb apparatus was more convenient, the one just described was used only on the Root boiler. In testing the other boilers the following described apparatus, the invention of Professor J. Burkitt Webb, a member of the committee, was used :—It consisted of an inverted funnel-shaped vessel *a*, Fig. 2, whose interior is connected through the pipe *b* to

FIG. 2.



the chimney. A piece of gas piping was put into the chimney and connected directly to the pipe *b*. The T *e* had one end closed by a plug *f*, so that, if desired, the interior of the funnel *a* could be connected to the air. The funnel *a* and pipe *b* were suspended over a board *c*, having a circular groove *d* cut into its upper face. This board rested on a pair of Fairbanks' scales weighing two ounces. The groove *d* was filled with mercury and the edge of *a* dipped into this mercury. The method of using the apparatus was as follows :—The plug *f* being removed, the scales were balanced; the plug was then replaced, and *b* being connected to the chimney, the scales were balanced again and the difference or loss of weight noted. The loss of weight divided by the area of the mouth of *a* is the loss per square inch, and represents the difference in pressure inside and outside the chimney; and this multiplied by 1·728 gives the corresponding draught in inches of water. The apparatus worked very satisfactorily, and the results are very reliable.

Quality of steam.—One of the most difficult subjects presented to the committee was the quality of the steam generated, and we do not think the results obtained are to be implicitly trusted. The data was taken as carefully as could be, but the imperfections of the apparatus were such that it is a matter of much doubt as to how much reliance can be placed on the results. There were a number of devices presented to the committee for use and discussed in their meetings, and the three following described were adopted and used in the tests. It will be noticed that two different methods of testing the quality of the steam from each boiler were employed, except in the case of the Baldwin boiler, and the results vary so much that no conclusions can be drawn as to the degree of accuracy of either. While it may be considered that the apparatus giving the most regular results is most to be depended upon, I am satisfied that the conditions in the best boiler are such that the quality of the steam must be very valuable, and it is doubtful whether a mean result is a satisfactory one or not. The entire subject requires much more investigation than your committee had the time to undertake.

(To be continued.)

The pressure in a closed vessel with ordinary powder reaches about 6500 atmospheres, or about 43 tons to the square inch. We have, says Captain Noble, "found it possible to measure the pressures due to the explosion of charges of considerably higher density, and have observed pressures of nearly 60 tons with a density of about 1·2, although the great difficulty of retaining the products of explosion of heavy charges of gunpowder—it is far easier to retain the products of explosion of gun-cotton than of gunpowder—makes the determination a little doubtful.'

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, August 22nd.

THE railway projectors are halting between two opinions. Some twelve thousand miles of road are to be constructed as soon as all conditions justify. At present money is abundant, but traffic requirements do not call for more mileage. The crops are large. Cotton will exceed last year; corn also. Wheat will fall behind. Despite the dulness in manufacturing, factory and mill owners are pursuing a policy of expanding and improving, in order to be ready for the general revival universally looked for. The Wabash system of Jay Gould is threatened with a strike, which Wall-street people assert, possibly for stock-jobbing purposes, was caused by the arbitrary action of the managers. Peace prevails on all other lines. Traffic is improving between north-western and Atlantic markets. Earnings for July show irregular improvement. Traders and manufacturers feel a moderate improvement in demand, but the railroad companies are contributing very little to it. The locomotive works are turning out fewer engines than for some years. The largest, Baldwin's, at Philadelphia, are employing one-fourth their average force three days per week. The car-building works are running slack; ship and boat building is at a low ebb.

Material of all kinds continues very low. The rail makers are endeavouring to advance prices from 27 to 30 dols. The bridge builders are full of autumn and early winter orders. Brokers report the wrought pipe mills of Pennsylvania better off with orders than they have been for three months. New gas and oil pipe lines are under construction, and new gas and oil producing territory in Western Pennsylvania and contiguous territory is being developed.

The iron trade has not developed any new features. The iron mills are in very few cases making double turns, full capacity. Considerable interest is felt in the extension of steel plants. Merchant bars are 1·40 to 1·75 cents per pound; iron nails, 2 dols. per keg.; puddled bars, 26 dols.; steel slabs, 30 to 33 dols.; plate iron, 1·75 cents; structural iron, 1·80 cents for angles, 3 cents for beams and channels. Wrought pipes are firm, and an advance is probable. Steel rails have been sold at 27 dols.; for early delivery higher prices are obtainable.

No important engineering enterprises are under way, but the dawn of better times would precipitate half a score. Investors profess to regard the present as fraught with danger. One company has taken a contract for 6000 tons of tubing, sufficient to lay fifty-five miles. Thirty-six miles of it will be of regular 8in. wrought iron mains, and the remaining nineteen miles will be of 4in., 6in., and 10in. diameter. Each length will be from 18ft. to 22ft. long, and will fit so perfectly that none of the gas will escape. The line is to be extended to Buffalo, on Lake Erie.

The rival natural gas companies at Pittsburgh were consolidated three days ago, with a capital of five million dollars. Prices will advance. Several manufacturers have arranged to use coal slack at thirty cents a ton. The glass manufacturers will resume in ten days with large winter orders. The bituminous coal trade throughout the West is dull. Should the railroad companies settle their difference, and traffic increase even slightly, a more liberal policy will be adopted on their part in purchasing material and making improvements.

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

(*From our own Correspondent.*)

ON 'Change in Birmingham to-day—Thursday—and in Wolverhampton yesterday, the better condition which was manifested in some circles last week was increased. The advance in prices in the northern iron markets, accompanied by a rise in iron companies' shares, and the belief in some of the important buying centres that a revival is at hand, had a good effect upon our exchanges. Vendors of finished and raw iron were less disposed to accept earlier rates, and forward orders of any magnitude they declined to book except at an advance.

A sustained revival at the present time would be very welcome. A more satisfactory state of things than now exists in the matter of profits would soon be apparent, and there would be less of the hand-to-mouth business which now rules.

In manufactured iron sheets again occupied the best position on the market. Some makers reported that the inquiries in the past ten days had been larger than during any similar period for eight or nine months. A few makers of miscellaneous iron state that they have now orders sufficient to keep them going for a couple of months.

Common sheets for India and Russia are being rolled in large quantities, and better sorts are going briskly to Canada, Australia, Germany, South America, and other export markets. Sheets for galvanising were stronger than in Wolverhampton last week by 2s. 6d. to 5s. per ton. Makers quoted 24 gauge for galvanisers' purposes £7 to £7 5s.; and 27 gauge, £8 to £8 5s. Merchant sorts of 14 to 20 gauge were quoted £6 10s. to £6 15s. at works.

Galvanised sheets fully maintained the advance of 5s. per ton decided on last week by the Galvanisers' Association, as the result of the increased price of spelter. Makers announced that the advance had in no way checked the inflow of orders, which continue good alike from Australia and South Africa. A considerable business is also doing with South America and India.

Ordinary galvanised sheets are now quoted £11 per ton, delivered Liverpool, as against £10 15s. previously; and best sheets £12 5s., as against £12 before. Spelter was quoted firm, at £15 5s. to £15 10s. delivered Birmingham—which is a considerable rise.

Certain of our ironmasters will submit tenders for the supply, under a standing contract, of iron plates and sheet less than ¼in. thick, for which the Chief Director of the Navy Contracts is just now enquiring.

Marked bars remain at £7 10s. to £8 2s. 6d.; second qualities, £6 10s.; and common, £6 down to £5 10s. Good Indian and colonial orders for bars are coming to hand. Gas tube strip was in rather better sale, at £5 5s. to £5 7s. 6d., delivered in the district. Some sales are being made at 1s. 3d. per ton advance on previous rates.

On account of the home market, rounds, flats, and squares are generally realising steady sales. Angles and tees are not in large outturn, for current inquiries, although numerous, have not resulted in much business at present. Common sorts are £5 15s. per ton upwards.

The wire and nail-rod mills are working limited time, makers, as a rule, having nothing special in hand. Rolled wire rods, Nos. 0 to 6, are £6 delivered Liverpool, and drawn rods, Nos. 8 and 9, £7 5s. per ton Liverpool.

The pig market was decidedly stronger than a week ago, more particularly for Midland sorts. Buyers manifested more desire to place orders, but vendors held off in other instances than those in which they could get their own price. Derbyshire pigs were quoted up 1s. to 1s. 6d. on the week. Lincolnshires were quoted 41s. 6d. at stations; Derbyshires, 39s. to 40s.; and the Thorncliffe —South Yorkshire—brand was 50s. delivered. Northampton pigs were 38s. to 39s. per ton.

Best pigs are not yet much influenced by the altered front of the market. Tredegar hematites, No. 4 forge, were 52s. 6d., and No. 1 55s. Ulverston hematites, No. 4, were 53s.; Staffordshire all-mine pigs were 55s. up to 60s. for hot blast sorts, and 77s. 6d. to 80s. nominal for cold blast sorts. Part-mines were 40s. up to 45s. according to mixture, and cinder pigs 32s. 6d. to 35s.

The men who came out on strike at the Tipton-green furnaces of Messrs. Roberts, in consequence of a reduction of 2½d. in their beer allowances, have expressed their willingness to accept the masters' terms, and already one of the three furnaces has been restarted.

The coal trade wears a more hopeful appearance, and owners look for better prices with the advance of the season. The rise of 1s. per ton in South Yorkshire coal is regarded with favour.

It is satisfactory that the Indian States Railways are again in the market for steel rails, and that the Madras and the Great India Peninsula Railway Companies are inquiring for rails, tires, nuts and bolts, chains, platelayers' tools, and other stores.

In the wrought iron tube trade the coming on of the gas tube season is anticipated with interest, and it is to the probabilities in this direction that the tube makers are just now paying most attention.

Agricultural implement manufacturers and agents report a good season's trade done in reapers and horse-rakers, and they are now preparing to fill early orders for ploughs, harrows, cultivators, drills, and other implements for autumn cultivation.

Cultivating tools continue in heavy demand for India, South America, Australia, and other distant markets. The goods chiefly ordered are hoes, spades, shovels, picks, and railway and mining tools. Axes are also in increased demand from certain of the foreign markets, notwithstanding American competition.

The East Worcestershire Waterworks Company, Birmingham, are anticipating an important addition to their business from an offer which they have made to the city of Worcester to furnish it with water. The company hope that the offer will be accepted.

At a general meeting of the South Staffordshire Waterworks Company, held in Birmingham on Saturday, the chairman said that there had been an expenditure on capital account during the past half-year of between £15,000 and £16,000, the bulk of which was upon mains. They had extended their mains upwards of 11½ miles. The revenue, however, did not compare so favourably on account of the falling-off in the consumption for trade purposes.

The extension of Shrewsbury Waterworks is to be undertaken. An additional engine is needed, since in the case of a breakdown of the present engines, which have been in use for twenty-five years, the town might be left without a supply for a fortnight or three weeks. The corporation has determined to apply to the Local Government Board for powers to acquire the necessary land.

The Worcester Town Council has resolved to commence negotiations with the gas company to ascertain if they will sell their business and plant. This step arises out of the company having given notice of an increase of 4d. per 1000ft.

The Dudley, Sedgeley, and Wolverhampton Tramways Company has been fined £5 and costs, at the instance of the Inland Revenue, for having kept seven cars, whereas they only hold licences for four. The stipendiary said that he hoped that the decision would be a warning to tramway companies.

Important alterations will be made in the Midland Company's train service on 1st October, by which it is believed that Bristol will be brought twenty minutes nearer to Birmingham, and that in the journey between Bristol and Derby and other northern stations nearly half-an-hour will be saved. At the present time Midland trains from the North to Birmingham and the West of England are broken up outside Birmingham; but after 1st October this disconnecting and connecting process will be avoided by the employment of the new direct West Suburban line of the company.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Last week I pointed out that there were some indications of a growing conviction that prices had got to the bottom, which might possibly lead to more active buying. This has been followed by an increased inquiry in the market, with more actual business stirring and a stronger tone in prices, but it can scarcely be said that there is any really substantial improvement in the actual condition of trade. The requirements for consumption do not show any tendency towards expansion, and any greater weight of business that is doing is coming forward chiefly from buyers who have been holding back, and who, now that prices appear to be touching their lowest, are showing more disposition to cover. As yet no material advance in prices has been established, but buyers are finding it difficult to place orders at the low rates that makers have recently been open to take, and offers are coming forward at better prices than buyers have hitherto been willing to give. So far any improvement in the market has been confined to ordinary qualities of pig iron, hematites being practically unchanged, and manufactured iron, with the exception of some of the better qualities of sheets, still meets with only a very slow demand at the minimum rates that have been ruling for some weeks past.

The Manchester iron market on Tuesday was only moderately attended, but there was a better feeling generally, and a fair amount of business offering in pig iron at prices nearer to makers' terms than they have been for some time past. For Lancashire pig iron 38s. to 38s. 6d., less 2½, remain about the average prices for delivery equal to Manchester, and at these figures local makers are very firm. In district brands there was some attempt at an advance, and for one of the Lincolnshire brands list quotations have nominally been put up 2s. 6d. per ton above the minimum prices that have recently been ruling; this, however, has practically placed the makers out of the market, and the average prices remain at 38s. to 39s., with iron still to be bought at 6d. per ton under these figures. For Middlesbrough iron delivered equal to Manchester 3d. to 6d. per ton above the lowest prices that have recently been taken was asked, but Scotch iron could still be got at late rates.

Hematites continue in very poor demand, and extremely low prices are still quoted to effect sales.

If anything, a slightly better tone is apparent in the manufactured iron trade. Here and there forge proprietors report rather more work stirring, and for sheets a tolerably good demand is kept up, which has resulted in a further upward movement in quotations for some of the best Staffordshire qualities. Local made sheets are, however, still to be got at about £6 15s., and for other descriptions of finished iron there is only a slow demand, with bars averaging £5 5s., and hoops £5 15s. per ton, delivered into the Manchester district.

In a few odd instances engineers report that they are rather better employed, but in the general condition of trade there is no improvement, and the tendency in nearly all branches is in the direction of lessening activity. The returns as to the condition of trade contained in this month's report issued by the Steam Engine Makers' Society are much the same as those given last month, and when all the different causes affecting employment are taken into account the number of unemployed varies very little. There are fluctuations in different localities which in some instances have relieved the funds, and in others have brought upon them increased calls by suspensions or disputes, but the number on the books is practically the same as last month, and is a little under 4 per cent. of the total membership in receipt of out-of-work donation. A number of men are at present on the books in connection with a dispute in the London district on the question of piece work. Generally throughout the country trade is reported as only slack, but in some parts it is returned as moderate, and in the North of England seems to be improving, unless the strike at Messrs. Armstrong's works should interfere with its development.

Gas engines are now in a large number of cases being adopted by Local Boards where they have to put down plant for pumping purposes, and Messrs. Crossley Brothers have now in hand a number of engines specially designed for this purpose. For the Wednesbury Local Board they are making a pair of 16-horse engines with air compressors combined, which is a decided novelty in gas engines. They have also in hand two 12-horse engines with vertical pumps combined, for the Bristol Waterworks; and two 9-horse engines for the Wellington Local Board, which are to be employed for pumping at their new waterworks. The smaller type of Otto engine is also coming largely into demand for private houses, stables, laundries, and dairies, where small driving power is required.

An automatic wheel cutter specially designed for cutting spur and worm wheels, and which presents one or two features of novelty, is being constructed by Messrs. Hetherington and Co., of Manchester. This machine is arranged with a self-acting feed and quick return motion, with automatic dividing motion. There is a straight length of bed about 6ft., with a vertical bracket carrying the cutter slide; the cutter spindle is driven by a worm wheel and continuous screw driven through mitres, and a cross shaft having a cone pulley upon the end of it. On the same shaft, next to the cone pulley, is a drum with a belt, driving pulleys actuating the slow feed and quick return motion of the cutter slide. From one side of the cutter slide is a projecting arm, actuating two stops upon a vertical rod, giving a semi-rotary motion to the shaft alongside of the bed connected with the automatic dividing motion on the table. By the introduction of an excentric ratchet wheel and change wheel a perfectly accurate dividing motion is obtained without the use of clutches.

A special tool that Messrs. Hetherington have in hand may also be briefly noticed. This is a frame plate slotting machine for the Crewe Railway Works. In general construction it is very similar to the ordinary machine of this class, except that it is stronger and more powerful. The bed is 36ft. long, 5ft. wide between the standards, and weighs 20 tons. Upon the bed slide three massive headstocks and carriages carrying the slotting rams, which are balanced, and have quick return motion. The machine is driven by a 5in. steel shaft running down the side of the bed and coupled to each headstock by means of bevel gear and Mather and Platt's patent friction couplings, which can be easily engaged or disengaged from the front side of the machine. The main shaft is driven through a large cone pulley, having three speeds, in the outer end of the bed. The front of each ram is provided with circular tool-holders for radiusing purposes. The headstocks are traversed by means of screws running down each side of the bed, these longitudinal feed screws being coupled to the cross feed screws by means of change wheels, thus enabling any angle of slotting to be obtained. The total weight of the machine is about 50 tons, and it is capable of slotting simultaneously twelve steel frame plates each 17in. thick.

The condition of the coal trade remains without much change beyond what is naturally to be expected from the increasing house fire requirements incident to the season of the year. But even in this direction there is no very materially enlarged demand coming upon the market as yet, and no better prices are being got. Common round coals for steam and iron making purposes and engine classes of fuel continue in very poor demand, and there are very few collieries that are working more than an average of four days a week. Prices are altered from last month. There is, perhaps, not quite so much underselling, but with the output still in excess of requirements, very low selling is still prevalent where accumulations of stock have to be moved away. At the pit mouth best coal averages 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common coal, 5s. to 5s. 6d.; burgy, 4s. 3d. to 4s. 9d.; best slack, 3s. 6d. to 4s.; and ordinary qualities, 2s. 6d. to 3s. per ton.

Reports as to shipping are variable. In some instances there appears to be rather more doing, but generally trade is but quiet, and prices for steam coal both at Garston and Liverpool are quoted very low to secure orders.

The proposal to ask for an advance of 15 per cent. of wages has been unanimously adopted at a special conference of miners' representatives from the Lancashire, Cheshire, and North Staffordshire districts, and to secure this advance it was also decided that the entire mining community should be brought out on strike. It is difficult to decide which of the two propositions is the most impracticable.

Barrow.—There are further indications that the trade in hematite pig iron will, during the ensuing winter, be still further depressed. This is shown by the blowing out of one or two furnaces this week. At Barrow there are only seven out of fourteen furnaces in blast, and the output of the district may now be put down at one-half its capacity. There is probably at the present moment less demand for hematite pig iron than at any previous date during the last decade, and the markets all round present a dull and unsatisfactory aspect, which is a sure indication for some time to time, at least, of the continuance of a poor demand and of low prices. I am told some large sales of pig iron have been made at prices rather below official quotations for mixed Bessemer samples, prompt delivery, but this business is not representative, and is only indicative of a desire to reduce stocks. The steel trade is all round quiet, the only redeeming feature being an extension of the make in tin bars. The fire which occurred at the Barrow Shipbuilding Works on Tuesday night resulted in the destruction of what is probably the largest engineering shop in the United Kingdom, and in untold injury to the valuable machinery and tools, consisting of gigantic planing, turning, and other machines, both for iron and brass work. The damage, which is covered to a large extent by insurance, will be exceedingly great, and the fire will, unfortunately, result in the stoppage of a very important industry in Barrow at a time when all the commercial interests of the place are more or less stagnant. Iron ore is in quieter request, owing to the cessation of work on the part of some of the furnaces. Coal and coke show no new features, but the demand is restricted. Shipping is again quieter.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THERE was a large attendance at the Cleveland iron market held at Middlesbrough on Tuesday last. The improved tone already reported was again noticeable, and for the first time for many months the price of pig iron was advanced by both merchants and makers. For prompt delivery of No. 3 g.m.b. merchants will not now accept less than 32s. 3d. per ton. This is 6d. per ton advance on the lowest price they have accepted, and 3d. more than the quotations of last week. For forward delivery higher prices are demanded, and considerable unwillingness is manifested to enter into engagements extending beyond the immediate future. Makers ask rather more than merchants, but do not press sales, as most of them have orders which will keep them employed for some time to come. Merchants have sold largely during the past week for prompt delivery, and it is expected that consumers will come forward and purchase freely, now that the tendency of prices is upward. Forge iron has been advanced to 31s. 3d. per ton.

The stock in Messrs. Connal and Co.'s Middlesbrough store is increasing faster than ever; 7362 tons were sent in last week, making the quantity held on Monday 77,362 tons. The increase during August was 17,080 tons. Holders of warrants now ask 33s. 3d. per ton.

The returns for August show a decided improvement in the quantity of pig and manufactured iron and steel exported. The total shipments of pig iron were 78,515 tons, being an increase of 11,102 tons, as compared with July. The principal items were as follows, viz.:—Scotland, 32,005 tons; Wales, 3500 tons; Germany, 17,258 tons; France, 3885 tons; Holland, 6910 tons; and Russia, 5985 tons. The shipments of manufactured iron and steel during August amounted to 37,997 tons, as against 23,473 tons for July.

No change is as yet apparent as regards the finished iron trade. The demand is no better, but prices are well maintained.

The directors of Messrs. Bolckow, Vaughan, and Co. have informed their shareholders that in consequence of the condition of the iron and coal trades, they consider they are unable to pay an interim dividend for the past half-year.

The yearly balance-sheet of Palmer's Shipbuilding and Iron Co., made up to June 30th last, shows a profit of £13,324, in addition to a sum of £7425 brought forward from the previous year's account. The directors propose to carry forward the whole amount to next year.

The Darlington Iron and Steelworks were closed on Saturday last owing to lack of orders. It is thought the stoppage will not be of long duration.

Messrs. John Knox and Co.'s shipyard at South Hylton, on the Wear, has been re-opened after a stoppage of several months. The firm has two vessels to complete, and will afford employment to a limited number of workmen.

On the 26th ult. an excursion was made by the members of the Cleveland Institution of Engineers to the works in progress connected with the new Hury reservoir. These are being carried on by Messrs. Walter Scott and Co., the well-known contractors of Newcastle-on-Tyne, under the guidance of Mr. Mansergh, C.E., and at the instance of the Stockton and Middlesbrough Corporations Water Board. The position of the reservoir is about three miles above the village of Cotherstone, and six or seven above the town of Barnard Castle. There the river Balder, a tributary of the Tees, and draining a large tract of moorland country, will be hemmed in by a dam extending across the valley through which it flows. The reservoir so formed will be between 150 and 200 acres in area, and will completely submerge certain farmsteads and woods situated in the valley. To form a dam of earthwork across a small watercourse would seem at first sight to be a very simple matter; but experience has again and again shown that nothing is more difficult if permanence and safety be desired. Consequently a trench about 7ft. wide and 60ft. deep is being cut, extending far into the sides of the valley and some 60ft. downwards, until a suitable water-resisting stratum is reached. The trench is filled with impervious concrete, made of crushed gravel and sand and cement in the proportion of 1 of the last to 5 of the first two ingredients. At the level of the present river bed the concrete wall is broadened out to form a shoe for the puddle clay core of the embankment or dam proper. This will extend 100ft. upwards. On either side of the core will be sloping embankments made of suitable clay-like soil compressed by steam rollers after each layer of 6in. thickness has been laid down. Through the embankment runs a culvert 15ft. in diameter, forming an outlet for the river during the construction of the dam, and intended to contain the pipes through which the water will be let off for subsequent disposal. For some time the Hury reservoir will be used only for compensating purposes; that is, to furnish for letting off into the Tees such quantities of water as may be pumped from it by the Water Board's engines at Broken Scar in excess of 60 million gallons weekly. Eventually, however, the water from the Hury reservoir will be taken by gravitation, through pipes, direct to the Water Board's other reservoirs near Darlington, and thence on to Stockton and Middlesbrough, without being allowed to flow into the Tees at all. Mr. Yourdie, acting on behalf of Mr. Mansergh and Mr. W. Scott, jun., received the Cleveland engineers and conducted them round the works. A dinner at Barnard Castle concluded the day's excursion, which was throughout of a most interesting and instructive character.

NOTES FROM SCOTLAND.

(From our own Correspondent.)

THE position of the iron market is rather more encouraging, inasmuch as the value of warrants has been on the increase, and some inquiry has been experienced by brokers for investing purposes. So far as appears on the face of the shipping returns, however, there does not appear to be much actual improvement in the consumptive demand, so far, at least, as the foreign department of the business is concerned. The past week's shipments were 8268 tons, compared with 8942 in the preceding week, and 9539 in the corresponding week of 1884. There are still rumours about an expected output of furnaces. Since last report one has been extinguished, and there are now 89 in blast, against 94 twelve months ago. The stock of pigs in Messrs. Connal and Co.'s stores continues on the increase, the addition for the past week being about 1400 tons.

Business was done in the warrant market on Friday at 41s. 6d. cash. Buyers were inclined to operate on Monday, when the cash prices were 41s. 6d. to 41s. 7½d. Tuesday's market was again firm at 41s. 6½d. up to 41s. 8d. and 41s. 8½d. cash. On Wednesday forenoon prices advanced to 41s. 11½d. cash, a slight reaction taking place in the afternoon. To-day—Thursday—the market was very strong, with business up to 42s. 5d. cash, closing at 42s. 4½d.

The current values of makers' pigs are—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 46s. 6d.; No. 3, 43s. 6d.; Coltness, 48s. 6d. and 45s.; Langloan, 47s. 6d. and 45s.; Summerlee, 46s. 6d. and 43s. 6d.; Calder, No. 3, 43s. 6d.; Carnbroe, 45s. and 43s. 6d.; Clyde, 46s. and 42s. 3d.; Monkland, 41s. 6d. and 39s. 6d.; Quarter, 41s. and 39s.; Govan, at Broomielaw, 41s. 6d. and 39s. 6d.; Shotts, at Leith, 47s. and 46s. 6d.; Carron, at Grangemouth, 41s. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 45s. 6d. and 41s. 6d.; Eglinton, 41s. 3d. and 38s. 3d.; Dalmellington, 42s. and 39s. 6d.

In the past week there was shipped from Glasgow £9200 worth of machinery, of which £5800 was sugar-crushing plant and marine engines for Manilla; £2713 sewing machines, £3800 steel goods, and £24,530 iron manufactures. The foundries and malleable works are fairly busy, but working at low prices. An order for 1000 tons of gas pipes for Adelaide has been placed with Messrs. Macfarlane, Strong, and Co., of the Lochburn Ironworks, Glasgow, and it is expected that some important contracts for water pipes will be arranged before long.

The coal market is active, there being large orders in course of being sent away for abroad. In the home department, however, there is a scarcity of business. Prices are without material alteration.

The miners are making great efforts to so organise themselves as to render their demand for an increase of wages effectual. In addition to meetings in the different districts a national conference has been held at Glasgow, and in some places hints are thrown out that a strike may possibly be resorted to.

The Mining Exhibition now being held at Burnbank, Glasgow, is regarded by all concerned as a capital representation of the present equipment of the mines. Nearly all the principal firms have sent contributions to the exhibition, which will be open to the public until near the end of the present month.

The above exhibition, together with the autumnal meetings of the Iron and Steel Institute, has attracted to Glasgow a very large gathering of gentlemen connected with the iron and coal trades, and the principal collieries and ironworks in the Glasgow district have been freely thrown open to their inspection. Much hospitality has also been extended to the visitors.

During the past month 19 vessels, of an aggregate of 17,650 tons, were launched from the Clyde shipyards, as compared with 25, of 26,981 tons, in the same month of 1884. The work of the eight months comprises 179 vessels and 129,608 tons, against 192 of 198,594 tons in the corresponding period of last year, and 197 of 262,210 tons in 1883. There are about 119,370 tons of shipping now in course of construction, compared with 150,000 tons at this date last year, and 292,000 tons in 1883.

Messrs. Russell and Co., shipbuilders, Greenock, have made a reduction in the wages of rivetters, which has been the occasion of a strike among the workmen, who allege that their pay is curtailed by 25 per cent.

On Tuesday the Clyde was visited by Lord George Hamilton, First Lord of the Admiralty, Lord Walter Kerr, Mr. Ashmead-Bartlett, M.P., Mr. Ritchie, M.P., Admiral Brandreth, along with Viscount Valletoot. The party came from Belfast to Greenock in the Enchantress, and there going on board the Clyde Trustees' steamer Clutha No. 6, they visited in succession the shipbuilding yards of Messrs. William Denny and Brothers at Dumbarton, Messrs. J. and G. Thomson at Clydebank, Messrs. Elder and Co. at Fairfield, and Messrs. Napier and Sons at Govan. They were attended by Mr. David Rowan, deputy chairman, Provost Browne, Mr. J. L. Mitchell, and Mr. A. M'Onie, members of the Trust, together with Mr. Deas, the engineer, and Captain White, harbour master. Their lordships were shown over the different yards by members of the respective firms, and appeared much interested in what they saw. Their inspection of the yards of Messrs. Thomson and Napier and Sons enabled them to see the progress being made with the Admiralty contracts now in course of execution. In the evening their lordships were entertained to dinner by the Clyde Trustees in the Queen's Hotel, and they afterwards left with the night mail for the south.

The Clyde has also been favoured this week with a visit from the Committee of Lloyd's, together with the chief inspectors, who likewise paid visits to the different shipyards.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE more gratifying accounts received as to the condition of the corn and cotton crops of the United States is certain to have a beneficial effect on English trade with American markets, and more particularly in respect of Sheffield. It was stated early in the year that the American harvest would be far below the average; but it is now reported that the yield will be abundant, even "more abundant than usual." This will give the men of the West more money to spend on hardware and cutlery, and do something to restore animation to the somewhat drooping business between Sheffield and the Transatlantic markets. Already several good orders have been received by one or two leading American houses, which have enabled the employers to put their men on an extra day per week, and it is hoped that the fall trade will be greatly improved, so as to afford something like constant work for the artisans, who have borne their adversity very bravely during the last eighteen months.

A Sheffield gentleman who has just returned from the United States tells me that the manufacturers in this country have really no conception of the extent to which the Americans are using mechanical appliances in the production of goods for which it has long been considered that hand labour was indispensable. This, he says, has been going on for a long time; and while the Sheffield firms, laudably eager to maintain the quality of their goods, were adhering to the old system of manual labour, the Americans were quietly and vigorously elbowing them out of the market by placing upon it machine-produced goods which were quite equal to the work required of them, and were far cheaper. When the mischief was well-nigh accomplished, the home maker realised the gravity of the situation, and set himself—by also having recourse to mechanical production—to win back the lost markets. In addition to other industries, the file, edge tool, and saw trades have been injuriously affected. My friend, who has been for many years associated with the principal engineers in the Sheffield district, says he found his firm's finest machines being used all over the States. They sent over workmen to erect these machines, and the workmen not only stayed there themselves but induced others to go over and join them. In this way the American had not only the benefit of the best Sheffield-made machinery, but the most skilful artisans. His opinion is that in the higher classes of cutlery, particularly spring cutlery, as well as in the finest crucible steel, Sheffield will continue to hold her own; but that in files, saws, edge tools, and similar goods, the American market has almost gone already, and in a year or two will go entirely. The Bessemer plant, he said, eclipsed anything he knew of in this country. There is no prospect of any change for the better in a demand for Bessemer or the lower grades of crucible, and in secondary qualities of table cutlery he thinks the Americans will be abundantly able to supply their own wants. It is chiefly in the finest of the old staple trades that Sheffield must seek to retain her supremacy, looking for new markets in India, China, and Japan to make up for the loss of the old.

A local firm of cutlers, I am told, have recently completed a unique order for the East in the form of splendidly jewelled daggers for the body guard of the Emperor of Japan. The jewels for the hilts were sent from Japan, and the ivory handles in which they were set were cut out of the solid tusk of the elephant. It is said that the work done on each dagger cost £25. Some very fine scissors for Persia have also been completed of late. The work required for that country is of an unusual kind, the scissors being suspended at the girdle, and used for purposes of defence as well as utility.

In the heavy industries several departments keep fairly well employed, though it cannot be said that there is any change towards animation in the iron trade as is reputed elsewhere. A more hopeful feeling, however, prevails in commercial circles, and there is a slight improvement again in the stock exchange values of local companies, following a steady drop in the quotations. Reduced dividends, with two exceptions, have been the order of the day during this year. Even Messrs. Vickers, Sons, and Co., who pay their dividend quarterly, have paid their last at the rate of 10 per cent. per annum, against a rate of 14 per cent. per year for 1884.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

THE coal trade remains in a sluggish condition, and exports last week again showed a decline, Cardiff sending only 118,000 tons in round numbers, as against 122,000 tons in the previous week, and Newport 32,000 tons as against 45,000 tons. Swansea, on the other hand, shows a small increase of 2000 tons.

I have not a solitary item to note in connection with the coal trade of a satisfactory character. The important sinking at Ynysybwl, to which I referred last week, remains unproven, and some of the mining engineers in the locality begin to shake their heads dubiously. Still, I have strong hopes yet. The history of nearly every important colliery has been the same. Ferndale, Coedcae, Merthyr Vale, Harris' Navigation, Mountain Ash, all have had their disastrous epochs.

One of Mr. Cory's collieries is, I hear, to be closed this week. The Naval Colliery Company remains as before, and the statement current is that no coal will be sent to bank for three months. About 600 men are idle. Mr. Cory will further increase the ironworkers by 300, and to this a large number may be added from other collieries. Two or three turns a week is the state of things at most collieries, and house and steam coal are alike in a bad state. Collieries hitherto of the most prosperous kind, and capable of turning out 1200 tons of coal daily, are sending up 600 or 700 tons.

This week Mr. W. T. Lewis and Sir George Elliott sailed for Halifax by the Allan line, on a professional visit to the coal-fields of Nova Scotia. It is Mr. Lewis' intention before returning to visit the iron and steel works of the United States. Last week he and Mr. Galloway conducted some interesting experiments in the Dowlais collieries with the Abel water cartridge and dynamite. The object was to test the question of the extension of explosions in coal mines by coal dust, and evidence of an important nature will soon be forthcoming.

House coal quotations are low, but they fail to get trade. Present prices are, for No. 2, 8s., and for No. 3, 8s. 6d. per ton. Small steam is advancing on account of the lesser quantity of large steam wanted, and 5s. 3d. for best samples is easily obtainable. If the present state of things should last I anticipate 5s. 6d. will soon be reached.

In the iron trade there is not much to report. I fancy a slightly firmer tone is noticeable, though make is small. Last week the entire shipments from Newport and Cardiff only amounted to 4000 tons, and of this the most important one was 1300 tons to Sundswall.

Grave doubts are afloat that a stoppage is meditated at Pentyrch. Notices are out, and as these include the colliers, there is a strong suspicion that a stoppage is intended, until probably an improvement takes place in the trade. Possibly this stoppage may not include Melingriffith.

A better condition is beginning to characterise the tin-plate trade. I am told that more orders than usual are being placed at Swansea, and that works in Monmouthshire, which have been in a dormant state, are about to be restarted. Rhiwderin men are going in at the old prices.

Makers are meeting buyers half-way, and are not quite so fixed in prices. Common cokes, for instance, instead of being firm at 15s., are quoted at 14s. 6d., and even at 14s. 3d., and at these figures a good deal of business is being done. Some kinds are being sold for as low as 14s. Siemens steel plates fetch 15s. to 15s. 3d.

Tynybedw Colliery is henceforth to be carried on by day-to-day contract.

LAUNCHES AND TRIAL TRIPS.

ON Tuesday, the 1st September, Messrs. Earle's Shipbuilding and Engineering Company launched from their yard, at Hull, a fine steel screw steamship, the Torpedo, built for the coasting trade to the order of Messrs. Thomas Wilson, Sons, and Co., of the same port. The dimensions of the vessel are as follows: 150ft. long, 25ft. beam, and 13ft. depth of hold. She is classed A1* in the Liverpool Registry, has a short poop aft, bridge over engines and boilers, and topgallant forecastle forward. She is provided with water-ballast forward and aft for trimming purposes, and is rigged as a schooner with two pole masts. The rudder is made of cast steel, by Messrs. W. Jessop and Sons, of Sheffield. There is accommodation in the poop for captain, and cabin under bridge amidships for the mates and engineers, the crew being berthed in the forecastle. As the vessel is intended primarily for cargo purposes, the arrangement of holds, hatches, &c., is such as will afford ample facilities for handy working. She will be fitted by the builders with their triple compound three-crank engines, having cylinders 14½in., 22in., and 36in. diameter by 24in. stroke, which will be supplied with steam from one single-ended steel boiler made for a working pressure of 150 lb. to the square inch.

MR. CHARLES JACOMB, who has been writing to the *Times* suggesting that the sewerage of Tottenham might be connected with the metropolitan outfall sewers, seems to hold curious notions as to relative capacities of sewers of different sizes. He proposes an inquiry, which he says "would show whether or not a 3ft. pipe drain, or two of 18in.—which would involve half the cost of excavating—one for day and one for night purposes, as required, from Tottenham to Spring-hill—which might be laid down in a month—would carry or not, all or the major part of Tottenham drainage."

A RAILWAY REMINISCENCE OF THE UNITED STATES.—It is fifty-three years since the first trial trip was taken on the Albany and Schenectady Railroad. The following amusing note of the occasion is from the American *Electrical Review*:—"The cars were coach bodies from an Albany livery stable, mounted on trucks. The trucks were coupled with chains, leaving 2ft. or 3ft. slack, so than when the train started the passengers were 'jerked from under their hats,' and in stopping they were sent flying from their seats. The locomotive fuel was pitch pine, and a dense volume of the blackest smoke floated toward the train. Those on top of the coaches had to raise their umbrellas, but in less than a mile the cloth was burned off, and the frames were thrown away. The passengers spent the rest of the time whipping each other's clothes to put out the fire, the sparks from which were as big as one's thumb nail. Everybody had heard of the trip, and came thronging to the track as though a presidential candidate was on exhibition. They drove as close as they could get to the railway, in order to secure a place to look at this new curiosity. The horses everywhere took fright, and the roads in the vicinity were strewn with wrecks of vehicles."

SIR JOHN FOWLER.—Mr. John Fowler, C.E., has been made a Knight Commander of St. Michael and St. George. Sir John Fowler, who is a past-president of the Institution of Civil Engineers, was born in 1817. He is the eldest son of Mr. John Fowler, of Wadley Hall, Sheffield; as pupil of Mr. J. F. Leather, the well-known hydraulic engineer, he obtained his first practical knowledge under that gentleman in the construction of the large reservoirs which supply the town of Sheffield with water. He afterwards surveyed the country for a line of railway between Stourbridge and Birmingham, passing through Dudley and Wolverhampton. This railroad was commenced twenty years later by Mr. Brunel, and completed by Mr. Fowler. He became acting-engineer in the construction of the Stockton and Hartlepool Railway, and was afterwards engineer and general manager of the Clarence, and of the Stockton and Hartlepool. At the age of twenty-seven he was selected as engineer for the Manchester, Sheffield, and Lincolnshire Railways. Removing to London, he was afterwards engaged in the laying out and construction of railways, docks, &c., in the United Kingdom and the Continent. His works included the Oxford, Worcester, and Wolverhampton Railway, the Severn Valley, Mid-Kent, London, Tilbury, and Southend, the Great Northern and Western of Ireland, the Victoria-station and Pimlico Railway, the Millwall Docks, and other undertakings connected with the reclamation of lands from the sea, and improvements of rivers. His best known work is the Metropolitan Inner Circle Railway. He was chief engineering member of the Royal Commission on Irish Railways, consulting engineer to the Great Northern Railway, to the Great Western, and other companies, as well as the Government of Egypt. Sir John Fowler is now the Conservative candidate for Hallamshire, which includes his birthplace.

GERMAN ENTERPRISE ABROAD.—M. Guyraud, who is in charge of the French Consulate-General at Hamburg, reports that the Central Society of Commercial Geography, Berlin, has come to an understanding with the German Export Bank for the organisation of an expedition intended to make German manufactures better known abroad than in the past. A commission furnished with samples selected with the greatest care will successively visit the various ports and great centres of trade in foreign countries, where its members will study the requirements of the place, and the conditions under which German products may be imported to such places, so as to compete with the merchandise of other nations. In order to assure for its work a continuous influence, the commission will inter into permanent relation with German firms already established in those centres on a solid basis, and who would thus become its correspondents. In places where no German subject has settled under conditions which would meet the requirements of the commission, the latter would leave one of its members there to carry on its work. These members comprise not only paid officials, but volunteers travelling at their own cost and on their own account. The commission will first visit the northern ports of Africa, and travel to the Levant, visiting also various ports in the South of Europe, such as Salonica, the Piræus, Naples, Barcelona, and wherever it would be assured of the immediate co-operation of German merchants. In order that foreign competitors may not be unduly set on the alert, the chief of the expedition has authority to vary his itinerary, according to circumstances. The undertaking is all the more worthy of notice from the fact that the attention of German houses has been directed to the Mediterranean basin only for a comparatively short number of years. In the Levant the small German colonies in Asia Minor and Smyrna have raised up a current of trade which German firms at home are somewhat anxious to strengthen and develope. With regard to North Africa, and Algeria in particular, Germany is now importing thence large quantities of wines, cereals, and other native produce, and is seeking to carry her own manufactures to the market in return. Her trade with Spain and Italy has greatly increased, as is shown by the official return.—*Liverpool Journal of Commerce.*

NEW COMPANIES.

THE following companies have just been registered:—

Electric Locomotive and Power Company, Limited.

Upon terms of an agreement of the 31st July unregistered) this company proposes to purchase the several interests of the Jarman Electrical Company, Limited, and C. P. Elieson, in patents for the production of electricity and for transmitting motive power from electric motors. It was incorporated on the 14th inst., with a capital of £50,000, in £5 shares, with the following as first subscribers:—

	Shares.
*George Hamilton, Highfields, Leytonstone	1
*P. T. Lironi, Walnut Tree House, Leytonstone	1
*T. Wickham, Cromwell House, Leytonstone, merchant	1
Watson Smith, Hainhault-road, Leytonstone, accountant	1
W. H. Protherew, Hainhault-road, Leytonstone, auctioneer	1
*C. P. Elieson, 7, Drayton-road, Leytonstone, electrician	1
F. Walker, 36, Spondon-road, Tottenham, engineer	1

The number of directors is not to exceed seven; qualification, 400 shares; the first are the subscribers denoted by an asterisk, and Mr. Richard Cory, of Cardiff; remuneration, £1000 per annum, and in any year in which the dividend is not less than 10 per cent. a further amount equal to 5 per cent. upon the dividend so paid. Mr. C. P. Elieson is appointed managing director.

Berry, Catherwood, and Berry, Limited.

This company was registered on the 25th ult., with a capital of £2000, in £1 shares, to carry on the business of engineers and commission merchants in all branches. The subscribers are:—

	Shares.
*Richard Berry, 1, St. Ann's-road, Stamford-hill, engineer	1
*S. Hardman Berry, 1, St. Ann's-road, Stamford-hill, engineer	1
*A. H. Catherwood, 38 and 39, High-street, Hampstead, engineer	1
*T. W. Catherwood, 81, Victoria Park-road, E., cashier	1
R. A. Schöner, 1, St. Ann's-road, Stamford-hill, bookkeeper	1
T. J. Potter, 5, Langham-road, West-green, N., secretary to a building society	1
T. J. Potter, jun., 5, Langham-road, West-green, clerk	1

The number of directors is not to be less than two, nor more than four; the first are the subscribers denoted by an asterisk. The three first subscribers are appointed managers, and are each to receive £2 per week. Mr. T. W. Catherwood is to receive £6 per annum and £5 per cent. upon all business introduced through him.

Samuda Brothers, Limited.

This company proposes to carry out an agreement to be made between the City of London Contract Corporation, Limited, of the first part, Bernard Moore, of the second part, and this company for the third part, for the sale to the company of the shipbuilding yards, works, plant, and other effects of the business of shipbuilders carried on by Messrs. Samuda Brothers, at Poplar. It was registered on the 25th ult., with a capital of £100,000, in £10 shares. The subscribers are:—

	Shares.
J. A. Eaton, C.E., 49, Starch-green-road	1
J. G. B. Elliott, 103, Forest-road, Dalston, accountant	1
A. Challenor, 1, South-square, Gray's-inn, secretary to a company	1
W. Best, 2, St. George's-terrace, N.W., secretary to a company	1
A. Davidson, 36, Porchester-square, merchant	1
F. J. Funell, Lawn House, Shepherd's-bush	1
T. Grover, 17, Devonshire-square, W., contractor	1

The number of directors is not to be less than three, nor more than seven; qualification, shares or stock of the nominal value of £200; the subscribers are to appoint the first, and act *ad interim*. Remuneration, £200 per annum to each director, with an additional £100 per annum to the chairman.

Lewis Hand Fire Extinguisher Company, Limited.

Upon terms of an agreement of 24th July this company proposes to purchase from an American company of the same title the British patent No. 3892 for improvements in hand fire extinguishers. It was registered on the 20th ult., with a capital of £30,000, in £1 shares. The purchase consideration is £20,000 in fully-paid shares. The subscribers are:—

	Shares.
G. H. Daw, 57, Threadneedle-street, gunmaker	625
C. Downes, 3, Gracechurch-street, land and estate agent	625
H. A. R. Moen, 38, Old Jewry	625
C. Rowan, Gracechurch-street, surveyor	625
C. N. Lavender, the Ferns, Gunnersbury, accountant	625
H. Bowen, Enfield	625
Mary Ann Burgett, 26, High View-road, Upper Norwood	625
R. W. Hunt, 9, St. George's-place, Canterbury, solicitor	625

The number of directors is not to be less than four; qualification, 20 shares; the subscribers are to appoint the first and act *ad interim*; remuneration, £1 1s. per director for each meeting.

General Compressed Air Power Company, Limited.

This company was registered on the 22nd ult., with a capital of £50,150, in 5000 shares of £10 each and 30 founders' shares of £5 each, to acquire and work the following letters patent:—No. 5363, A.D. 1882, for "Improvements in and appertaining to the treatment, distribution, and application of compressed air for motive power and other purposes, and in apparatus therefor," the invention of Messrs. Thomas Alfred English and John Sturgeon; No. 5232, A.D. 1883, for "Pipe systems for distribution and supply of compressed air," the invention of Messrs. John Sturgeon and C. J. T. Hanssen; No. 16,568, A.D. 1884, for "Improvements in meters for registering the supply of compressed air to users in systems for motive power distribution, and for other purposes," the invention of Mr. John Sturgeon; No. 964, A.D. 1885, for "Causing air and fluid meters distributed in various districts to transmit to a head office, or other central point, a record of their indications," the invention of Mr. John Sturgeon; No. 2839, A.D. 1885, for "Improvements in and appertaining to the laying of pipes and mains in streets for the supply of compressed air, or other purposes," the invention of Mr. John Sturgeon. The subscribers are:—

	£10 Shares.
R. T. Jenkins, C.E., 16, King William-street	1
J. J. V. Fitzgerald, 3, Philbeach-gardens, S.W.	1
G. F. Rogers, 5, Great Winchester-street, telegraph engineer	1
Samuel Canning, C.E., 3, Great Winchester-street	1
Robert Fowler, 6, Lombard-street, engineer	1
F. N. Newton, 9, Warrington-crescent, engineer	1
A. Kitt, C.E., Bessborough House, Lupus-street, S.W.	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first; qualification for subsequent directors, 50 shares; remuneration, a sum not exceeding £1000 per annum.

Domestic Inventions Association, Limited.

This company proposes to acquire and sell inventions whether patented or not; also articles and inventions protected under the Trade Mark and Designs Act; to take out patents at home and abroad, and to advance money to inventors and others for a like purpose. It was registered on the 25th ult., with a capital of £2600, in £10 shares, of which 60 are A or preference shares.

	Deferred Shares.
John Ward, Northfleet, Kent, merchant	1
E. Player, Elmsholme, Catford Bridge, accountant	1
J. Gowen, 120, Salisbury-square, Fleet-street, newspaper proprietor	1
W. Armitage, 4, George-yard, Lombard-street, stock and sharebroker	1
G. McConnal, 3, Clifford's-inn, solicitor	1
P. T. Bingley, 9, Chesterton-road, North Kensington, commission agent	1
W. M. Harding, 9, West-terrace, Fairland Park, Kingsland, surveyor	1

Most of the regulations of table A of the Companies' Act, 1862, are adopted.

Kit Hill Granite Company, Limited.

This company was registered on the 24th ult., with a capital of £30,000, in 21,000 preference and 9000 ordinary shares of £1 each, to acquire the quarries and business of the Tamar and Kit Hill Granite Company, Limited, of Gunnislake, Cornwall. The subscribers are:—

	Shares.
W. J. Chalk, C.E., Gunnislake	1
*J. Brunton, C.E., 13A, Great George-street, S.W.	1
F. H. Grove, 15A, South Audley-street	1
J. J. Brunton, C.E., 13A, Great George-street	1
*Major-General A. Light, 44, Emperor's-gate, S.W.	1
Lieut.-Colonel S. G. Woodard, 15, Nevern-square, S.W.	1
W. C. Vokes, 30, Limerston-street, S.W.	1

The number of directors is not to be less than three, nor more than six; qualification, 100 shares; the first are the subscribers denoted by an asterisk, who may add four to their number; the company in general meeting will determine remuneration.

SAND DUNES.

M. CAMBRELENT, Inspector of Public Works, has made a report to the Agricultural Society of France on the subject of the dunes in the lands of Gascony, of which the following is an interesting abstract from *Nature*. The subject is one which has important bearings on some harbour engineering questions. These sand-hills cover a surface of more than 85,000 hectares; they are more than 80 metres high and 5 to 6 kilometres wide. Before a method of arresting these was discovered they were constantly being pushed inland by the winds, invading and covering fields, villages, and even burying churches up to their towers. In 1780 Brémontier sought to render them immovable by planting them, after many experiments designed to develope a primary vegetation. His work has been continued with perseverance, and it is only recently that it has been completed, and these 85,000 hectares, which menaced all the country adjoining, have become covered with a rich forest vegetation which has fixed the dunes in one place. A great public danger has been converted into a large forest. But this work, which renders permanent dunes already existing, has not prevented the sea from throwing up on the coast new sand day by day, which forms dunes, which in their turn invade the permanent dunes. After having fixed the old sand-hills the problem was to prevent the formation of new ones. To solve this it was decided to construct a dune above high water, in which all the conditions of the movable dunes would be reversed. The form given to the latter by the wind is such that on the side of the sea they present a gentle slope, which the sand can mount easily as on an inclined plane, in order to fall down a steep decline. It is by the gentle slopes forming a series of inclined planes that the sand moves forward. The formation of the new dune was encouraged, but it was directed in such a manner that it had a steep slope on the side of the sea. To secure this a wooden palisade was erected about 120 metres away from the sea all along the shore. The sand first struck against this in its progress, and fell at its foot, a portion of it escaping through the interstices left between the planks. The latter was carried some distance by the force of the wind and fell, forming slight slopes, while the sand which fell at the foot of the palisade on the side near the sea formed a steep incline. Soon this reached the top of the palisade, and then the planks were drawn up by means of a special implement to the needed height, and the formation continued as before, the slope on the side of the sea growing steeper, while the other got more and more gentle. Ultimately the dune reaches such a height (generally 10 to 12 metres) that the sand can no longer get over it, and it is definitely arrested between the barrier and the sea. It falls back on the shore, unable to advance, until contrary winds come and blow it out to sea again. To fix the sand on the other side of the barrier, the *Arundo arenaria* is planted. The roots penetrate to a depth of 4 or 5 metres, and the plant always keeps its head above the increasing sand. The results obtained by this new dune—says M. Cambrelent—have been complete. The most violent storms have not been able to carry the sand over it; the latter has fallen back on the shore innocuous, and the advance of the inexhaustible sand coming from the sea has been absolutely arrested.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

25th August, 1885.

10,025. KNITTING MACHINE, W. Aiken, London.
10,026. CAR VENTILATORS, A. Bell, London.
10,027. ROLLER for COTTON WARP, &c., MACHINERY, J. Harland and S. Settle, Bradford.
10,028. INTERRUPTING the FLOW of FLUIDS in PIPES, D. Fulton —(*E. Laroche, France.*)
10,029. EXTINGUISHING LAMP BURNERS, O. Mason, Birmingham.
10,030. WRINGING WOVEN or FELTED CLOTH, S. Warburton, Leeds.
10,031. TELEPHONIC COMMUNICATIONS, H. Westman, Birmingham.
10 032. FILTERS, W. Thompson, Claughton.
10,033. TILE HEARTHS and FENDERS, S. B Sutcliffe, London.
10,034. CLIPS for MACHINES for STRETCHING, &c., WOVEN FABRICS, D. P. Smith, London.
10,035. GAS STOVES, C. Partington, London.
10,036. DOOR CHECKS, D. Doyen, London.
10,037. PORTABLE COVER or AWNING, E. H. Grey, London.
10,038. NAILS, W. A. Large, London.
10,039. SAFETY PADLOCKS, A. Vachette, Paris.
10,040. WARDROBES, &c., W. J. Roffe London.
10,041. DUPLEX TOBACCO POUCHES, T. F. Ward, London.
10,042. SEWING MACHINES, J. W. Ramsden and H. S. Ellis, London.
10,043. SATCHEL-BOTTOM PAPER BAGS, J. H. Johnson. —(*European Paper Bag Machine Company, U.S.*)
10,044. PREVENTING or RELIEVING SEA-SICKNESS, W. Dodshon, London.
10,045. TELESCOPE or MAGNIFYING GLASS, H. J. Haddan. —(*B. Rodi, Germany.*)
10,046. TREATING TEXTILE MATERIALS with LIQUIDS and GASES, H. J. Haddan.—(*Pelzer and Fils, Belgium.*)
10,047. BOTTLE STOPPERS, E. L. Lloyd and C. C. Joly, London.
10,048. SECURING SLIDING SASHES of WINDOWS, M. N. Shirlaw, Glasgow.
10,049. THERMOSTATS, W. E. Gedge.—(*H. F. Perry, United States.*)
10,050. BOTTLES and STOPPERS, D. J. Monk, London.
10,051. CLEANING the CYLINDERS of CARDING MACHINES, E. Edwards.—(*H. Honegger, Austria.*)
10,052. STAITHS, G. Taylor, London.
10,053. BOOTS and LEGGINGS, T. Stanfield, Liverpool.
10,054. BLOWER APPARATUS, J. F. Churchill, London.
10,055. BLAST FURNACE, R. Bonehill and L. Haguè-Halon, Liverpool.
10,056. BOBBINS, W. P. Thompson.—(*F. Lehner, Germany.*)
10,057. TRICYCLES, T. Humber, London.
10,058. VULCANISING RUBBER, F. W. Seabury, London.
10,059. SAUCE, F. Russell, London.
10,060. SHEAF-BINDING HARVESTERS, &c., J. Howard, E. T. Bousfield, and G. Gibbs, London.
10,061. PRINTING, &c., MACHINERY, W. Conquest.—(*R. Hoe and Co., United States.*)
10,062. LAMPS, A. Kitt, London.
10,063. WHEEL TIRES, W. H. Bates and H. Faulkner, London.
10,064. FIRMLY SECURING RAILS, MacG. Knowles, London.
10,065. THERMO-ELECTRIC BATTERIES, H. E. Newton.—(*H. W. Cook, Switzerland.*)
10,066. STOPPERING BOTTLES and JARS, J. W. Hall, London.
10,067. STEERING GEAR, J. D. Jack, London.
10,068. JET PROPULSION, T. Griffiths, London.
10,069. FLOATING BREAKWATERS, G. F. Redfern.—(*L. T. Froideville, France.*)
10,070. FOUNTAIN PENS or PENHOLDERS, F. S. Bartram, London.
10,071. BALL BEARINGS for VELOCIPEDES, F. Ellery, London.
10,072. BALL BEARINGS for VELOCIPEDES, F. Ellery, London.
10,073. HANSOM, &c., CABRIOLETS, C. A. Floyd, London.
10,074. TELEPHONE TOLL SYSTEM, J. Y. Johnson.—(*H. Edmunds, jun., and C. T. Howard, United States.*)
10,075. ELECTRICAL LAMP, V. Klan and F. Spurny, London.

26th August, 1885.

10,076. PERFORATING MACHINES, W. Rhodes, Wakefield.
10,077. VERTICAL BINS for STORING GRAIN, &c., W. B. and J. A. Johnson, Wigan.
10,078. HATS and CAPS, W. H. Blackwell, Hooley Hill.
10,079. HAULING GRIPS, W. S. Parkes, Walsall.
10,080. OBTAINING SULPHUR from SULPHURETTED HYDROGEN, E. W. Parnell and J. Simpson, Liverpool.
10,081. STRETCHING WOVEN FABRICS, H. Wallworth and W. Hargreaves, Halifax.
10,082. PREPARING MATERIALS for ROOFING PURPOSES, J. Storer, Glasgow.
10,083. CONSTRUCTING FURNACES, J. Storer, Glasgow.
10,084. CLIPS USED IN MACHINERY for FINISHING WOVEN FABRICS, J. Dalglish, Glasgow.
10,085. SMELTING COMPLEX ORES, C. B. Phillips and G. Bargate, Chester.
10,086. POWER GEAR, J. E. Rogers, Smethwick.
10,087. WINDOW SASH FASTENER, J, Johnson, Blyth.
10,088. BOOTS and SHOES, W. Barlow, London.
10,089. MULES for SPINNING, &c., W. Heaton and J. Catterall, London.
10,090. ROPES, &c., E. S. Savage, London.
10,091. SOCKETTED DRAIN, &c., PIPES, C. E. Newton, London.
10,092. COTTON and WOOLLEN DRYING FELTS, &c., J. Kenyon, London.
10,093. ADJUSTABLE CUFF HOLDER, C. Hawxwell, Birmingham.
10,094. CARRIAGES, J. Harrington, London.
10,095. HYDRANTS, W. Bell, London.
10,096. DRIVING SPINDLES, G. F. Dawson, L. Firth, and A. Ashworth, London.
10,097. RAILWAY BUFFERS, A. Jackson, London.
10,098. STOCKING KNITTING MACHINE, W. and C. W. Harrison, Chorlton-on-Medlock.
10,099. CARD CLOTHING for CARDING ENGINES, J. T. Fallows, Manchester.
10,100. FITTING WASHSTANDS and LAVATORIES, H. A. Whitaker, London.
10,101. TUBE FLY LATHE CARRIER, A. Millar, Glasgow.
10,102. RAIL FASTENINGS for RAILWAYS, J. Poyser, London.
10,103. HANGING RUDDERS, T. G. Tagg, London.
10,104. PORTABLE BLAST RIVET HEATING FURNACE STOVE, W. W. Arbuthnot, N. A. Mercer, and J. B. Guy, London.
10,105. CLEANING PIPES and CIGAR HOLDERS, A. W. Montgomery-Moore, Dublin.
10,106. SIGHTS for FIRE-ARMS, R. W. Studdy, London.
10,107. SPAR DIGGERS, J. R. Bell, London.
10,108. RIVETTING MACHINES, L. Delaloe, London.
10,109. CAGES, F. Ayckbourn, London.
10,110. MANUFACTURING SUGAR from AMYLACEOUS, &c., MATTERS, A. C. Henderson, London.—(*G. Durosad, France.*)
10,111. EMBROIDERING MACHINES, R. Blau, London.
10,112. PRODUCING a DRAUGHT in FURNACES, A. Reis, London.
10,113. SOLITAIRES, STUDS, SCARF RINGS, &c., G. Gotz, London.
10,114. RAILWAY CARRIAGES, &c., U. Scott, London.
10,115. COVERING ROOFS, &c., with SHEET METAL, A. Martin, London.
10,116. SEWING MACHINES, W. Beecroft, London.
10,117. HYDRAULIC ENGINES, W. Speight, London.
10,118. UMBRELLA and PARASOL STICKS, W. G. Attree, London.
10,119. REDUCING TIN STUFF, &c., S. H. Stephens and S. Rodda, London.
10,120. COAL CUTTING MACHINES, T. and R. W. Bower and J. Blackburn, London.
10,121. MANUFACTURING BUTTONS from HORN, &c., E. G. Brewer.—(*D. Robbiati, Italy.*)
10,122. CURRENT REGISTERING INSTRUMENT, F. F. Yeatman, London.
10,123. MIXING LIQUID DISINFECTANTS with WATER, W. J. Bishop, Brondesbury.
10,124. PRESERVING DRIED or COOKED MEATS, A. J. Boult.—(*L. M. Rousseau, France.*)
10,125, VALVES, H. Trott, London.
10,126. TELEPHONE TRANSMITTERS, R. Pryor.—(*Miles and Co., New Zealand.*)
10,127. TYPE WRITERS, J. Cox, London.
10,128. WIRE for USE in BOOT and SHOE NAILING MACHINES, H. H. Lake.—(*H. S. Bacon, United States.*) 17*th June*, 1885.
10,129. STEAM ROAD ROLLERS, J. and H. McLaren, London.
10,130. ANTISEPTIC, H. H. Lake.—(*C. Collin and Co., Belgium.*)
10,131. PROTECTING APPARATUS or INSTRUMENTS in ELECTRICAL CIRCUITS, H. H. Lake.—(*D. J. Cartwright, United States.*)
10,132. APPLYING ANTI-FRICTION CONE ROLLERS to the AXLES of WHEELS, &c., J. A. Thümling, London.
10,133. RAILWAY SIGNALLING APPARATUS, H. L. Davis, London.
10,134. CATCHING INSECTS such as BEETLES, &c., W. L. Wise.—(*J. V. Abbott, France.*)

27*th August*, 1885.

10,135. LANTERNS, H. J. Allison.—(*H. Gläser, Austria.*)
10,136. HOLDERS or TUBES for CUT FLOWERS, J. M. Gibbs and A. E. Ragg, Chester.
10,137. REMOVING SEWAGE from CESSPOOLS, &c., W. Spence.—(*F. Sanders, Russia.*)
10,138. MACHINERY for PRINTING SPOOLS, C. Watson and W. R. Landfear, London.
10,139. TREATING HYDROCARBON BODIES, J. K. Field, London.
10,140. ANIMAL TRACTION of CARTS, &c., J. Harkess, Glasgow.
10,141. STEERING ENGINES, D. Campbell, Glasgow.
10,142. VENT PEGS, H. Cockcroft, Shipley, and F. Spong, Leeds.
10,143. FILTER PRESSES, J. A. Drake and R. Muirhead, London.
10,144. WINDING of YARN, W. Norton, Oldham.
10,145. GUNS for THROWING LINES, &c., W. Burnett, Dundee.
10,146. RAILWAY COUPLING, J. and J. E. Lees, Oldham.
10,147. TREATING TANNIC EXTRACTS, J. C. Mewburn.—(*J. Marchal et L. Bories, France.*)
10,148. RETURN STEAM TRAPS, J. J. Royle, London.
10,149. FUR BLOWERS or PICKERS, T. and S. Buckley London.
10,150. METALLIC BEDSTEADS, F. R. Baker, Birminghaam.
10,151. SELF-ACTING TEMPLES for LOOMS, G. Harling, Halifax.
10,152. A PUSH-IN CONNECTING SOCKET, H. Hart and R. Flühs, London.
10,153. NECKTIES, &c., A. G. Speight, London.
10,154. EXTRACTING, WASHING, and DELIVERING GOLD, &c., W. H. Duncan, Shropshire.
10,155. APPARATUS for HOLDING ROLLED TOILET PAPER, O. H. Hicks, Paris.
10,156. DRIVING GEAR for BICYCLES, H. Pipe, London.
10,157. PREVENTION of FRAUDULENT APPLICATION of POSTAGE STAMPS, F. J. White, London.
10,158. WOOD BLOCK FLOORING, W. Duffy, London.
10,159. APPLICATION of TERRA-COTTA for ELECTRIC LIGHTING, J. T. Armstrong, London.
10,160. HANGING BRACKETS, A. Sinclair, London.
10,161. PRODUCING DECORATING FILLETS, E. A. Brinkmann, London.
10,162. PROTECTING HEELS of BOOTS, H. H. Leigh.—(*J. H. Peters, Germany.*)
10,163. COMBINATION SHOE-HORN and HANDLE, E. P. Hinkel, London.
10,164. SANDWICH BOARDS for ADVERTISING, E. H. S. Bruce, Oxford.
10,165. COMBINATION of TIME-PIECE, DATE-BOX, and POSTAL and RAILWAY INDICATOR and LETTER-BOX, J. M. Ferguson, London.
10,166. APPARATUS for HEATING, &c., J. Johnston, Manchester.
10,167. APRON, H. J. Haddan.—(*F. P. Teuffert, France.*)
10,168. VENT CASKS, F. A. Sharratt, London.
10,169. REMOVING CAKES from FILTER-PRESSER, B. H. Remmers and J. Williamson, Glasgow.
10,170. PUMP BUCKETS, D. McQueen, Glasgow.
10,171. TENSION DEVICES for TWINE FEEDERS of SHEAF BINDERS, T. Wardlaw and D. Thomson, Glasgow.
10,172. REFINED SUGAR, P. Jensen.—(*M. C. P. Barbe, Holland.*)
10,173. DELINEATING CONTOURS from ANIMATE FIGURES &c., J. Hunter, London.
10,174. METER with HYDRAULIC or other SPRINGS for WATER, &c., A. Bonna, London.
10,175. PENHOLDER, F. F. J. Mann, London.
10,176. LEVER for one or more PEDALS, W. B. Downey, Hendon.
10,177. VALVES, A. J. Boult.—(*W. W. St. John, United States.*)
10,178. ENEMA INJECTION and DOUCHE APPARATUS, J. Thompson, London.
10,179. HOLDERS for DRINKING GLASSES, C. W. Blackman, London.
10,180. ELECTRICAL GOVERNORS, P. W. Willans, London.
10,181. GALVANIC BATTERIES, S. Pitt.—(*S. Stepanoff, Russia.*)
10,182. CAR SEATS, M. N. Forney, London.
10,183. AUTOMATIC FIRE EXTINGUISHING APPARATUS, W. R. Lake.—(*W. Harkness, United States.*)
10,184. PORTABLE CRANES for UNLOADING WAGONS, W. H. Gittins, Liverpool.
10,185. MANUFACTURE of CUPELS, F. M. Lyte, London.
10,186. UMBRELLAS, E. Lindenberg, London.
10,187. ELECTRICAL MEASURING INSTRUMENTS, E. W. Lancaster, London.

28*th August*, 1885.

10,188. STEAM BOILER FURNACES, A. Anderson and H. C. Paterson, Glasgow.
10,189. RAILWAYS and TRAMWAYS, W. R. Kinipple, Glasgow.
10,190. GATHERING and ELEVATING CORN, C. H. Job, London.
10,191. FILLING MACHINES, J. P. Jackson and W. Bruce, Liverpool.
10,192. AUTOMATICALLY DETACHING HORSES from VEHICLES, T. Wilson, Ashton-under-Lyne.
10,193. ROLLER BLIND FURNITURE, W. Dobson, Manchester.
10,194. FASTENINGS ATTACHED to ELASTIC, L. Hogarty, Dublin.
10,195. CHAIR for RAILWAY RAILS, J. Moore, Rotherham.
10,196. DOG COLLARS, A. D. Melson, Birmingham.
10,197. REVOLVING SCREENS for SCREENING STONE, T. Robottom, Nuneaton.
10,198. EXTINCTION of FIRES, P. Jolin, Bristol.
10,199. SECURING HANDLES to SWEEPING BRUSHES, B. Baron and R. W. Kenyon, Halifax.
10,200. ELASTIC BANDS and BUTTONS for UMBRELLAS, A. Whittle, Pendlebury.
10,201. VENTILATING CASKS AUTOMATICALLY, J. W. Blakey, Leeds.
10,202. FIGURES USED by TAILORS, W. Stiff, London.
10,203. BICYCLE and TRICYCLE SPRING and SADDLE COMBINED, G. W. Pridmore, Birmingham.
10,204. BEER TAPS, &c., N. Ager, London.
10,205. INSTRUMENT for EXAMINING the INTERNAL ORGANS of the HUMAN BODY, E. de Pass.—(*B. du Rocher, France.*)
10,206. BRACES, F. Hewett, London.
10,207. PRINTING MACHINES, J. H. Johnson.—(*R. Hoe and Co., U.S.*)
10,208. PRINTING MACHINES, J. H. Johnson.—(*R. Hoe and Co., U S.*)

10,209. PRINTING MACHINES, J. H. Johnson.—(*R. Hoe and Co., U.S.*)
10,210. PRINTING MACHINES, J. H. Johnson.—(*R. Hoe and Co., U.S.*)
10,211. SPRINGLESS LOCKS and LATCHES, H. Glendining, Carlisle.
10,212. ANTISEPTIC, DEODORANT, and DISINFECTING COMPOUND, P. Ockenden.—(*H. Rocke and H. T. Tompsitt, Australia*)
10,213. SWING JOINT for PIPES, A. Feist, London.
10,214. ELECTRIC SIGNALLING APPARATUS, &c., C. E. Zimdars, London.
10,215. FINGER RINGS and THIMBLES, J. Creeth, London.
10,216. MATCH-BOX, A. Hodges, London.
10,217. COMPOUND EXPANSIVE STEAM ENGINE, &c., J. Matthews, London.
10,218. PLOUGHS, H. J. Haddan.—(*F. W. Unterilp, Germany.*)
10,219. METALLIC PACKING for STUFFING-BOXES, J. J. Defalque, Belgium.
10,220. HORSESHOES, J. P. Bryce, London.
10,221. LINOLEUM FLOOR-CLOTH, C. E. Lucas, London.
10,222. RECEIVING, &c., COINS, A. W. L. Reddie.—(*J. Roggy, Germany.*)
10,223. ENVELOPES, O. Wethered, London.
10,224. AUTOMATICALLY SHUTTING OFF the SUPPLY of WATER to CISTERNS, F. Baxter, London.
10,225. EXTRACTING OIL from MAIZE, W. R. Lake.—(*T. H. Jacobs and J. Y. Lockwood, U.S.*)
10,226. STOPPERING BOTTLES, T. Durrans, London.
10,227. MOTOR ENGINES, W. D. and J. Priestman, London.
10,228. BUNGS and FAUCETS, A. Lamart, London.
10,229. HEADS of BICYCLES, &c., W. Bown and E. Corr, London.
10,230. PENCIL-CASES, &c., E. H. Schmidt, London.
10,231. TELEPHONIC TRANSMITTER, C. D. Abel.—(*La Société Générale de Téléphones—Reseaux Téléphoniques et Constructions Electriques—France.*)

29th August, 1885.

10,232. ROLLER SKATES, W. Green, Harborne.
10,233. MICROPHONES, J. J. Walsh, London.
10,234. TISCHOLIN CANDLE, L. Chandor, London.
10,235. GULLEY GRIDS and SEWER TRAPS, G. Kyte and A. F. Williams, Cardiff.
10,236. GRINDING or REDUCING SOLID MATERIALS, F. B. Welch, Manchester.
10,237. SOLDERING ALUMINIUM, O. M. Thowless, Birmingham.
16,238. SECONDARY BATTERIES, W. Beatson, Rotherham.
10,239. MILL BASKETS, A. U. Ward, Bradford.
10,240. SIFTING DRUGS, &c., S. M. Pelly, Dublin.
10,241. MACHINERY for ROLLING of BARS, P. Kirk, Manchester.
10,242. RAIL FASTENING DEVICE, W. P. Thompson.—(*L. E. Whipple, United States.*)
10,243. CLOSING APPARATUS for BOTTLES, W. Milward, Liverpool.
10,244. APPARATUS for DELIVERING GAS on BOARD SHIPS, &c., E. Mansfield and W. Gadd, Manchester.
10,245. BRACES, J. W. Seddon, Manchester.
10,246. TIPPING MACHINES for EMPTYING WAGONS, W. Cook, jun., Glasgow.
10,247. TRACE FASTENERS, G. D. Sampson, London.
10,248. APPLIANCE for FACILITATING the EDUCATION of CHILDREN, W. B. Maxfield.—(*P. W. Peckham, United States.*)
10,249. WASTE WATER PREVENTING CISTERN, J. White, London.
10,250. PACKING and PRESERVING of FISH, C. M. Pielsticker, London.
10,251. SELF-ACTING CUT-OFF PRESSURE VALVES, E. Davies, London.
10,252. BOTTLES, J. Y. Johnson.—(*La Société Bruand and Berthier, France.*)
10,253. ELECTRIC AUTOGRAPHIC PRINTING PENS, R. and E George, London.
10,254. STOPPERS for BOTTLES, &c., B. Wood and D. Rylands, London.
10,255. SAUCEPANS and KETTLES, N. Fellows and H. Winkley, London.
10,256. BOTTLING MACHINE, S. Bunting, London.
10,257. APPARATUS for MEASURING ELECTRIC CURRENTS, A. G. Brookes.—(*J. L. Huber, Germany.*)
10,258. FASTENINGS for RETORT LIDS, A. Dempster, Yorkshire.
10,259. LAMP for BURNING MINERAL OILS, J. Ristelhueber, London.
10,260. DYNAMO-ELECTRIC MACHINES, J. S. Sellon, London.
10,261. APPARATUS for FEEDING SHEETS of PAPER to PRINTING MACHINES, J. Johnson and J. Stukley, London.
10,262. LAWN-TENNIS RACQUETS, H. J. Fitch, London.
10,263. LAYING WOOD PAVEMENT, G. Walker, London.
10,264. HOLDFASTS, R. C. Hope, London.
10,265. REMOVING VEGETABLE SUBSTANCES from WOOL, J. C. Mewburn.—(*F. Lorthiois, France.*)
10,266. PIPES for SMOKING, J. R. M. Mallet, London.
10,267. DRYING COFFEE BEANS, H. H. Lake.—(*Worth and Co., Holland.*)

31*st August*, 1885.

10,268. MEASURE ADJUSTER, J. Hicken, Landport.
10,269. PULLEYS for DRIVING MACHINERY, W. S. Dougall, Manchester.
10,270. PRESSURE and VACUUM GAUGES, A. Budenberg, Manchester.
10,271. BRUSH and BRUSH HEADS, &c., G. E. Chapman, Chapeltown.
10,272. GRINDING CARDS for CARDING FIBRES, C. Mills, Halifax.
10,273. BUTTONS, R. Rogers, Birmingham.
10,274. BREECH-LOADING GUNS, D. H. Willey, Southampton.
10,275. WARP SELVEDGE CARRIERS, R. H. Wiseman, Manchester.
10,276. FASTENING BOOTS, GLOVES, &c., A. Sugden and J. W. Haigh, Leeds.
10,277. OPERATING the HEALDS of LOOMS for WEAVING, J. and J. Ward, Halifax.
10,278. ROLLER BEAM CLEARERS, J. Edge, Halifax.
10,279. DAMPER MOVEMENT for GRAND PIANOFORTE ACTIONS, M. Weichsleder, London.
10,280. MANIFOLD MEMORANDUM or SALES BOOKS, J. L. O'Connor, London.
10,281. STAY CLASPS, R., H., and B. G. Simpson, London.
10,282. BLOWING, VENTILATING, EXHAUSTING, T. W. Beverley, London.
10,283. COMPRESSING and EXPELLING GAS and AIR in GAS MOTOR ENGINES, W. Muir and D. C. Smith, London.
10,284. LAMPS for BICYCLES and TRICYCLES, W. Thomas and J. Williams, Mansfield.
10,285. AUTOMATIC PERFORATING MACHINE, F. E. P. Ehrlich, London.
10,286. STRAINING WIRE, J. Reid, London.
10,287. COMBINED TANK and CARGO VESSELS, C. Armstrong and R. N. Tough, London.
10,288. FLUSH SASH LIFTS, W. J. May, Birmingham.
10,289. AUTOMATIC PENDULUM SYSTEM for SAVING OIL, R. C. S. Woods and G. J. Lampen, Kirkgate.
10,290. VALVES for WIND MUSICAL INSTRUMENTS, F. E. P. Ehrlich, London.
10,291. AUTOMATIC MUSICAL INSTRUMENT, F. E. P. Ehrlich, London.
10,292. FASTENING FIGURED or SPECIAL IRON, L. A Groth.—(*K. L. Gocht, Germany.*)
10,293. SHUTTLE with RENEWABLE TOP, L. A. Groth.—(*H. E. Kühn, Germany.*)
10,294. ADVERTISING, D. Falcke, London.
10,295. SHEARING SHEETS of CARDBOARD, &c., A. J. Boult.—(*W. Ames Canada.*)
10,296. OXIDES of TIN and TIN SALTS, W. P. Thompson.—(*R. Tamine and E. de Cuyper, Belgium.*)
10,297. OBTAINING MUSICAL SOUNDS on REED INSTRUMENTS, J. Beare.—(*E. Hamma, Germany.*)
10,298. ATTACHMENT to SEWING MACHINES, I. Nasch, London.
10,299. SPLITTING, &c., GRAIN, R. Howarth, London.
10,300. PREVENTING and TREATING CERTAIN DISEASES, J. G. Claud-Mantle, London.
10,301. LIQUID FUEL FURNACES, &c., J. H. Selwyn, London.
10,302. RAISING, &c., MUD, GRAIN, &c., D. D. Richards, London.
10,303. PERAMBULATORS, J. Wiseman, London.
10,304. POROUS PLATES and CELLS for GALVANIC BATTERIES, F. H. Varley, London.
10,305. PROTECTING PROPELLER SHAFTS, &c., from CORROSIVE ACTION, J. F. G. Common, London.
10,306. DRAWING METALS, ALLOYS, &c., V. J. Grandperrin, London.
10,307. PRESSES for BALING COTTON, &c., W. Gaskill, London.
10,308. WAR, &c., SHIPS and VESSELS, E. G. C. Bomford, London.
10,309. UMBRELLAS and PARASOLS, A. Hill, London.
10,310. REDUCING FRICTION, W. J. Brewer, London.
10,311. PRODUCING CARBON from REFUSE BARK, W. Wells, London.
10,312. PUMP VALVES, R. Marshall and G. H. A. Thunder, London.
10,313. TREATING VEGETABLE FIBRES for the MANUFACTURE of PAPER, G. H. Talbot.—(*J. D. Gay, U.S.*)
10,314. GRITTING MARBLE, E. J. Douglas, London.
10,315. ORDNANCE and GUN BARRELS, H. H. Lake.—(*W. H. Brown, United States.*)
10,316. ROASTING COFFEE, O. Imray.—(*V. L. de Pesloüan, Argentine Republic, and A. J. de P. Hargreaves, Brazil.*)
10,317. CASE PROJECTILES, O. Imray.—(*H. Bischoff, Bavaria, and A. Mieg, Saxony.*)
10,318. CASE PROJECTILES with GUIDING COLLARS, O. Imray.—(*H. Bischoff, Bavaria, and A. Mieg, Saxony.*)
10,319. RINGS and TRAVELLERS of SPINNING FRAMES, W. Clark.—(*J. J. Bourcart, Switzerland.*)
10,320. SCREW for PROPELLING SAILING VESSELS, W. Zealand, London.
10,321. VENTILATORS or BLOWING MACHINES, B. J. B. Mills.—(*G. Serramoglia, Italy.*)

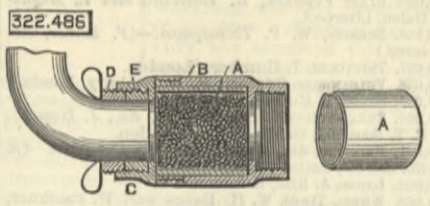
SELECTED AMERICAN PATENTS.

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

322,486. HYDRANT FILTER, *George W. Shawk, Cleveland, Ohio.—Filed December 29th*, 1884.

Claim.—The tubular part C, having its lower end externally screw-threaded and its upper part internally screw-threaded, in combination with case B, which engages with said lower external screw-threads, a cylindrical filter A, located within said case and part

322.486

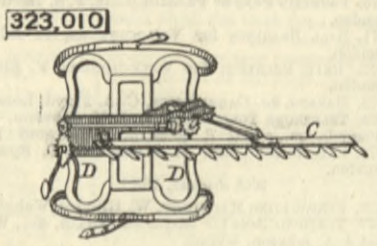


C, a tubular nut D, which engages with said upper screw threads, and an annular packing E, which is compressed by said nut to clamp part C to the pipe, substantially as set forth.

323,010. HEDGE-TRIMMER, *William Williams, jun., Sugartown, Pa.—Filed August 30th*, 1884.

Claim.—(1) The centrally-pivotted cutter-bar C, in combination with the supporting frame attached to the body of the operator, and mechanism, substantially as described, whereby it is adapted to be elevated

323,010

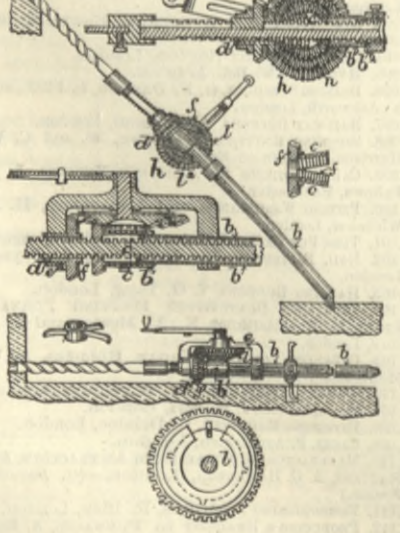


or depressed, and adjusted to cut horizontally or vertically, as set forth. (2) In a hedge-trimmer, a centrally-pivotted cutter-bar, in combination with the breast-plate D and intermediate cutter-bar supporting mechanism, as shown and described.

323,007. ROCK and COAL DRILL, *Thomas Willard, Woodville, Pa.—Filed November 20th*, 1884.

Claim.—(1) In combination with the drill and screw shaft and the enclosing tube, the partible nut hinged at its end to its support around the shaft and means for holding it in engagement with the shaft. (2) In combination with the drill and screw shaft, the partible nut *c* and the tube *b*, having the extension b^1 fitting around the nut, substantially as and for the purposes set forth. (3) In combination with the drill and screw-shaft, the support *b*, the sliding frame *e*,

323,007



having a collar fitting around said support and secured thereto by a set screw or equivalent device, partible nut *c*, engaging with the shaft within the frame, and the extension b^1 on said support fitting around said nut, substantially as and for the purposes set forth. (4) In combination with the drill and screw-shaft, the support *b*, having the extension b^1, the frame *e* adjustably secured to said support and carrying the pinion *l*, and the pinion *f* and partible nut *c*, hinged thereto and engaging with the screw-shaft within the frame, substantially as and for the purposes set forth. (5) The combination of the drill and screw-shaft, the support *b*, having the extension b^1, frame *e*, adjustably secured to the support, and carrying the pinion *d*, keyed to the screw-shaft, pinion *f*, carrying the partible nut *c*, engaging with the screw-shaft, combined power pinion *h*, mounted in the frame and formed of the pinion *l*, and ring pinion *n* around it, and means for connecting the two pinions, substantially as and for the purposes set forth. (6) In combination with the drill and screw-shaft, the pinion *d* keyed thereto, the pinion *f* carrying the nut engaging with the shaft, the combined pinion *h* having the ring pinion *n*, meshing with the pinion *d* and the pinion *l*, having two gear faces, l^1 l^2, to mesh with the pinion *f*, according to the feed desired, substantially as set forth.

323,038. ROTARY ENGINE, *Horace F. Hodges, Boston.—Filed December 10th*, 1883.

Claim.—(1) In combination with the cylinder A, shaft C, and piston B, the gates D, supported by arms or spokes D^1, shafts E, cranks F, and connecting-rod G G^1, substantially as and for the purpose described. (2) In combination, the cylinder A, shaft C, and piston B, gates D, supported by arms D^1, shafts E, cranks F, connecting-rod G G^1, and the nuts H^1 H^1,

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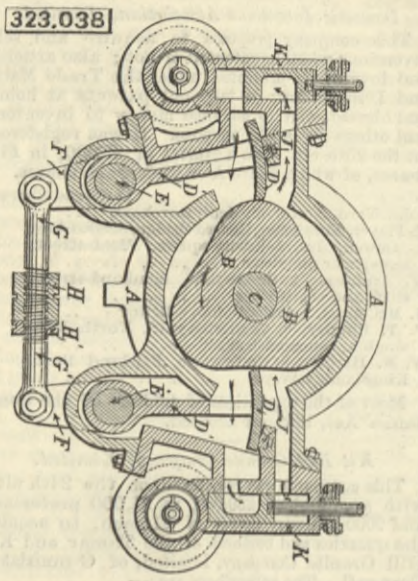
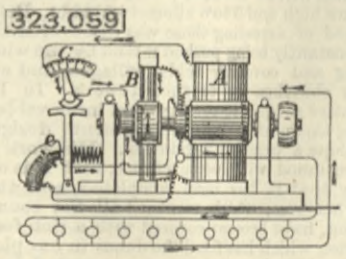


arranged and operating substantially as and for the purpose set forth. (3) The combination of the cylinder A, shaft C, piston B, gates D, fitted with packing pieces J, arms or spokes D^1, shafts E, cranks F, connecting-rod G G^1, and steam chest K, substantially as shown and described.

323,059. REGULATOR FOR DYNAMO OR MAGNETO-ELECTRIC MACHINES, *Richard R. Moffat, Brooklyn, N.Y.—Filed January 18th*, 1882.

Claim.—(1) The combination of a dynamo-electric machine A with a similar auxiliary machine B, the circuit from which energises the field of the machine A, the field of the machine B being energised entirely or in part by the machine A, through means of a derived circuit to its main or working circuit, substantially as set forth. (2) The combination, with a battery of dynamo-electric machines, of an auxiliary machine for supplying the field current thereto, said auxiliary machine having its field energised entirely or in part by means of a derived circuit to the main circuit of the battery of the machines, substantially as set forth. (3) The combination of one or more generators A with the auxiliary generator B, the former having its fields energised by the latter, and the latter having its fields energised entirely or in part by the dynamo or dynamos A through a circuit derived from the main circuit, and a variable resistance R, located in said derived circuit for controlling the current that energises the field of dynamo B, substantially as and

323,059



for the purpose specified. (4) The combination of one or more generators A with an auxiliary generator B, the dynamo or dynamos A having their fields energised by the dynamo B, the latter having its field energised by the generator or generators A through a circuit derived from the main circuit, and a variable resistance C, located in the circuit that energises the fields of the generator or generators A, for controlling their generating capacity, substantially as and for the purpose herein specified. (5) The combination of one or more dynamos A with an auxiliary dynamo B, the field of the latter being energised by the former through a derived circuit, and the field of the dynamos or dynamo A being energised by the dynamo B, and an automatically adjustable resistance C, located in the circuit that energises the machine or machines A, said resistance being operated by means of magnets *e* and e^1, located in and forming part of a circuit that is derived from the main circuit of the machine or machines A, substantially as and for the purpose herein specified.

323,146. SCISSORS SHARPENER, *James W. Hilton, Brooklyn, N.Y.—Filed June 28th*, 1884.

Claim.—As an improved article of manufacture, scissors sharpener, consisting of the longitudinally grooved block A, having bevelled ends, and provided

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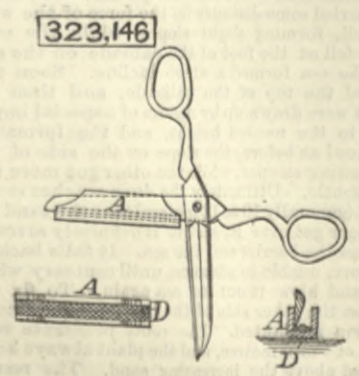
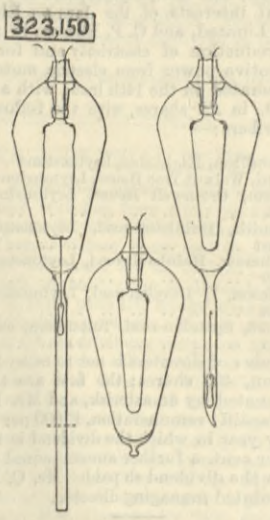


with the angular grooves C, and the triangular file D, having one wide and two narrow sides, and fitting in the grooves of the said block, as set forth.

323,150. METHOD OF MANUFACTURING INCANDESCENT ELECTRIC LAMPS, *William Holzer, Harrison, N.J.—Filed June 5th*, 1884.

Claim.—(1) The method of straightening a loop form incandescing conductor or of changing its shape, consisting in subjecting it to strain while raised to incandescence, substantially as set forth. (2) The method of maintaining straight a loop form incandescing conductor during the operation of exhausting the lamp and heating the conductor prior to sealing, consisting in maintaining such conductor under constant strain during such operation, substantially as set forth. (3)

323,150

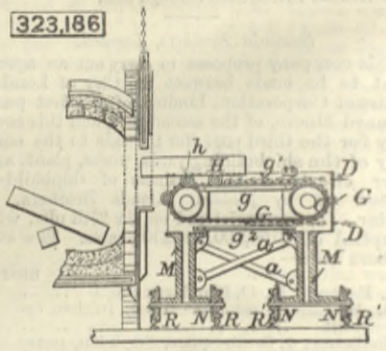


The method of exhausting and sealing incandescing electric lamps having loop form conductors, consisting in attaching weights to the loops, then exhausting such lamps and heating the conductors therein, then sealing off the tubes some distance from the lamps, then removing the weights from the conductors and dropping them into said tubes, and finally sealing off the lamps from the tubes above the weights, substantially as set forth.

323,186. CHARGING CARRIAGE for ROLLING MILL FURNACES, *James L. McDonald, Steelton, Pa.—Filed June 8th*, 1885.

Claim.—(1) In a charging carriage for mill furnaces, the combination, with laterally movable carriage on tracks in front of furnace mouth, of drums journalled in uprights on said carriage, and of an endless chain belt provided with mechanism for operating it back and forth, for the purpose substantially as set forth. (2) In a charging carriage for mill furnaces, the combination of rigid carriage frame mounted on wheels, and tracks adapted for moving carriage from furnace to furnace laterally, of drums journalled in said frame, of endless chain belt supported on said drums, of a trundle bed having its axles or transverse bars flexibly secured to said belt, and its rollers guided for relieving said belt of undue stress thereon, and of chains or means connecting said belt with a motor adapted to impart a reciprocatory movement thereto, substantially as and for the purposes set forth. (3) In a

323,186



charging carriage for mill furnaces, the combination of the pedestals M, braced rigidly together and movably mounted on tracks R R^1, the drums C, journalled in said pedestals, the chain belt G, supported on said drums, the trundle axles H, &c., attached to said belt, the trundle rollers *h*, &c., applied to flanges C^3 on said drums and to the rails *g* g^2 in line therewith, and the chains D D^1, applied to couple said belt and actuating mechanism, substantially as and for the purposes set forth. (4) In a charging carriage for mill furnaces, the combination of pedestals M, braces *a*, wheels N, drums C, chain belt G, trundle bed *h* H, &c., guide rails *g* g^1 g^2, and chains D ^{1}, all connected and adapted for operation as and for the purposes set forth.

323,239. MEANS FOR PREVENTING INTERFERENCE IN COMBINED TELEGRAPHIC and TELEPHONIC SYSTEMS, *Francois van Rhysselberghe, Schaerbeck, Belgium.—Filed January 24th*, 1884.

Claim.—(1) In a system for the simultaneous transmission of telegraphic and telephonic currents or messages, the combination, with telegraph instruments and devices for rendering gradual the emission and extinction of the telegraphic currents, of two telegraph line wires or conductors, and a telephone connected with said line wires, the latter forming a complete telephonic circuit, substantially as described.

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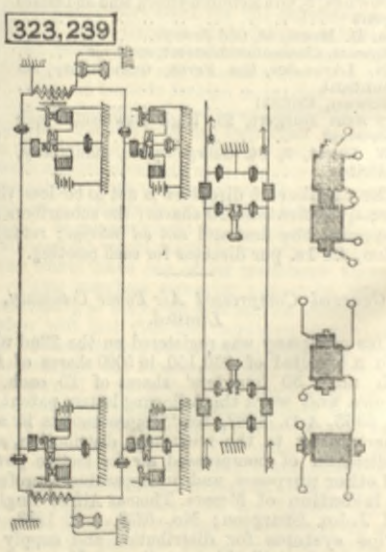

(2) In a system for the simultaneous transmission of telegraphic and telephonic currents or messages, the combination, with telegraph instruments, and devices for rendering gradual the emission and extinction of the telegraph currents, of an induction coil having its two primary circuits connected with two telegraph line wires and the earth, and the terminals of the secondary circuit in communication with a telephone and the earth, substantially as described.